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Promoting a High-Road Strategy

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In 1980, the Sharp Manufacturing Corporation opened a plant in Memphis to make televisions and microwave ovens. Due to the plant's success in achieving zero defects from its suppliers and full involvement from its workers, it remained open long after its competitor plants were driven out of business by low-wage competition. In 2002, however, Sharp moved all television production to Mexico, laying off 500 workers. Several months later, Sharp began producing solar panels in Memphis, believing that new energy legislation would lead to a big increase in demand. Today, half of the plant's 500 workers make solar panels. The skills of the International Brotherhood of Electrical Workers eased this transition.

This story illustrates many of the problems (low-wage competition) and opportunities (a skilled work force, increasing demand for environmentally sustainable products) facing U.S. manufacturing today. It shows how a "high road" production recipe, in which skilled workers, suppliers, and management work together to make innovative products, can lead to continued vitality in manufacturing—and that public policy plays a key role in reaching this outcome.[1]

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AGENDA FOR SHARED PROSPERITY

The Economic Policy Institute initiative for solutions that match the scale of the problems.

www.SharedProsperity.org

1. Introduction

Over the last decade, the United States lost manufacturing jobs at a stunning rate: 16% of its manufacturing jobs disappeared in just the three years between 2000 and 2003, with a further decline of almost 4% between then and now.[2] This had been some of the best-paying work in the country. The average manufacturing worker earns a weekly wage of $725, 20% higher than the national average.

This dramatic loss of high-paying manufacturing jobs is not inevitable. America can save many of these jobs with "high-road" policies that harness the knowledge of all of a firm's stakeholders to create a highly productive, high-wage economy. As the case of the Sharp plant above suggests, the nation can accomplish this turnaround in ways that also help meet critical national goals, such as environmental sustainability.

The loss of well-paid manufacturing jobs is part of a larger national problem: the U.S. economy is failing many of its citizens. The distribution of income has seriously worsened: 82% of the personal income gains between 1980 and 2005 went to the top 1% of the population. While productivity increased 71% over that period and the income of the top 1% increased 156%, median compensation rose only 19% in the last quarter-century (Levy and Temin 2007). Intergenerational mobility has also declined and is now less than in Western Europe, Canada, or Australia (D'Addio 2007).

The decline of manufacturing has hurt the U.S. economy in ways that go beyond the loss of high-paying jobs. The nation faces significant challenges in maintaining its status as a leading innovator, in fighting global warming, and in rebuilding its deteriorating infrastructure. The United States will not meet these challenges without major changes in the way the economy works—including a revitalization of high-productivity manufacturing.

To address these interdependent problems, the nation must both increase the size of the economic pie and distribute it more fairly. The program proposed in this paper consists of both demand-side and supply-side policies. On the demand side, it proposes policies to boost manufacturing capabilities to achieve critical national goals such as using energy sustainably, modernizing infrastructure, and maintaining a defense industrial base.

On the supply side, this paper proposes policies that promote a "high-road" production process. Through coordination with highly skilled workers and suppliers, firms achieve high rates of innovation, quality, and fast response to unexpected situations. The resulting high productivity allows firms to pay fair wages to workers and fair prices to suppliers while still earning fair profits.

This proposal does not provide special treatment for manufacturing as an end in itself. Instead, it recommends policies that remedy "market failures"—instances where markets do not provide incentives for efficient behavior. Therefore, this proposal does not include unconditional subsidies to firms in trouble. Instead, it aims to accomplish national goals by fostering a strong manufacturing base. Promoting manufacturing in this way can be a win-win solution for the economy as a whole, and especially for working people.[3]

There is no shortage of proposals to improve manufacturing. This proposal differs from others in two ways. First, it does not include policies that help manufacturers at the expense of other groups. In contrast, other proposals call for reducing protections for the environment, workers, and consumers (see for example, U.S. Department of Commerce 2004). These policies may benefit some manufacturing firms, but would hurt their employees and long-term national prosperity.

Second, this proposal calls for integrated changes within and between firms. Other proposals have pinned their hopes on improving individual inputs (such as worker education), which would improve the pie's ingredients without changing the way they are mixed together.[4] While certainly helpful, this strategy is not sufficient. Education alone will not allow firms to overcome the market failures that block adoption of efficient high-road practices. In addition, other nations also are increasing education, meaning that even college graduates in the United States now must compete with much lower wage workers abroad (Hira 2007). If the United States is to have stable high-wage employment, we need to make production "stickier." An efficient way to do that is to promote a high-interaction way of producing, such as the high-road recipe.

Similarly, increased spending on research and development is an important policy goal. However, by itself it is not sufficient to improve productive capabilities significantly. U.S firms have had a great deal of trouble moving from lab to production scale, in part because of difficulties in communicating across levels and functions in the value chain. Neither will increased research and development spending improve the income distribution, since the scientists who conduct research and development are already paid relatively well.

Some economists have argued that the best way to achieve a fairer distribution of income is by redistributing income through the tax system—that is, changing the way the pie is shared but not the way it is made (Okun 1975). But, in an era of globalization, redistribution is difficult; firms can too easily leave places that require them to share.[5]

In contrast, this program increases both equity and efficiency. Workers gain income and bargaining power because they are integrally involved in the design and improvement of their own tasks. Productive capability increases because firms are cultivating and drawing on the talents of all workers—not just those of a few stars in top management. The major challenges we face as a nation—to create a just society for all, to rebuild our infrastructure in a safe and environmentally sustainable way—are ones we must meet together.

The next section describes some of these challenges, and how our ability to meet them is hampered by the decline of manufacturing. It goes on to look at the health of firms that remain in the sector, showing that a core of highly productive firms remains.

Section 3 shows that manufacturing plays an important role in meeting national goals of energy sustainability and infrastructure renewal, and that meeting these goals both depends on, and contributes to, a high-road economy.

Section 4 argues that high-road strategies exist or could be created in most industries. As noted above, these strategies involve not just high-quality inputs of labor, capital, and technology taken separately, they also help firms mix these inputs together more effectively.[6]

Section 5 illustrates ways that public policies can promote the adoption of the high road. The centerpiece of this strategy is an expanded version of the Manufacturing Extension Program to help firms and workers make the complementary investments necessary for the high road to succeed. One important feature of the expansion would be to create industry and regional forums where stakeholders can evaluate the success of past programs and decide on new ones.

The section also shows how these policies can help firms compete with low-wage nations such as China, by improving productivity, product development, and logistics capabilities.

This section further discusses why many firms do not adopt high-road strategies, even though they are more efficient: The reason is that markets fail to provide firms with incentives to behave efficiently. Three such market failures are discussed: information problems (such as pervasive use of accounting systems that systematically understate the costs of offshoring), externalities (firms do not value benefits that accrue to other stakeholders, such as suppliers, workers, and communities), and complementaries (several high-road practices have to be adopted at the same time in order for any of them to be effective). Instead, many firms have adopted a low-road strategy, in which they attempt to keep costs low by paying workers low wages and keeping jobs simple enough to be done by a rotating crew of workers who are disposable (i.e., if some leave because of the poor working conditions, others can be found to take their place). These strategies leave the United States caught in the middle in foreign competition, paying higher wages than in developing countries, but with lower skills than in Western Europe.[7]

Section 6 briefly discusses other public policies that would create a favorable environment for high-road production. These polices are complementary in the sense that they are more effective if adopted together. These policies are wide-ranging, covering areas such as international trade and finance, workforce compensation and development, and corporate governance. Sensible policies in these areas can both "pave the high road" (reduce costs for firms that choose this path) and "block the low road" (make it more difficult to undercut socially responsible firms).

The last section of the paper summarizes this proposal and its costs and demonstrates that the return on these investments in manufacturing is likely to be substantial. The health of the U.S. manufacturing sector could be dramatically improved by replacing the tens of billions of dollars spent every year on "smoke-stack chasing" (subsidies to firms to locate in a particular region) with incentives provided only to firms who commit to undertaking high-road practices. In particular, an expanded Manufacturing Extension Program could easily pay for itself in increased tax revenue.

2. U.S. manufacturing: Why shrinkage is a problem—and is not inevitable

Why manufacturing matters

A stronger manufacturing sector could alleviate a number of problems plaguing the U.S. economy. These problems include:

1.Sagging infrastructure. The American Society of Civil Engineers (ASCE 2005) rates 27% of the nation's bridges as "structurally deficient," a danger exemplified by the recent collapse of the Interstate 35W bridge across the Mississippi River in Minneapolis on August.1, 2007. In addition, the ASCE reported large shortfalls on spending for clean water, cleanup of toxic waste sites, and wastewater treatment.

2. Failure to reduce emissions of greenhouse gases. According to the Nobel Peace Prize-winning Intergovernmental Panel on Climate Change (2007), the world faces potentially disastrous changes in climate. If temperatures rise by more than 2–3 degrees Celsius, we are likely to see catastrophic impacts, such as extinction of 20–30% of animal and plant species, widespread flooding of low-lying areas, increased spread of infectious diseases, and perhaps more frequent Katrina-like hurricanes. The United States is by far the largest per-capita emitter of greenhouse gases, and competes with China (a nation with nearly four times the population) for the dubious honor of greatest total emitter. These emissions continue to grow. If the world is to keep the temperature increase to less than 2.8 degrees Celsius by 2050, developed countries must reduce their emissions by 80%. Manufacturing can contribute to this reduction both by adopting energy-efficient production techniques and by making equipment to produce renewable energy.

3. *Declining rate of innovation compared to the rest of the world.* While patents for the invention of new technology granted to U.S. residents continue to increase, patent grants to non-residents now surpass those of residents (Sanyal and Jaffe 2005).[8]

In addition, a variety of market failures make firms reluctant to implement new technology or ways of working. For example, Americans are responsible for many of the inventions behind the revolution in information technology (IT)—but U.S. firms have not yet incorporated much of IT's promise into their day-to-day functioning. One reason is that the most effective adoption of IT requires firms to decentralize production and to increase the use of teams of employees.[9] To take another example, in Japan in the 1970s and in the United States in the 1990s, Toyota implemented a production system that dramatically reduces defects, inventory, and lead time. But many U.S. manufacturing firms still have not implemented this production philosophy, and only a handful of service providers are beginning to adopt it.

The need to innovate in both path-breaking and incremental ways will only increase in the future. Other countries will be doing so (Cerf and Miller 2005), so the United States must also do so in order to compete. A particularly important area for innovation is in the area of environmental sustainability. As the specter of global warming increases, the pressure to economize on carbon use while maintaining our standard of living will depend on our ability to create and use "green technology."

Manufacturing has long played a key role in the U.S. national system of innovation; as manufacturing becomes weaker, the capability to innovate is likely to become weaker, as well. Manufacturing was responsible for 60% of all U.S. research and development spending in 2003. Scientists and engineers make up 9% of the manufacturing labor force, a share that is nearly twice as large as in the rest of the economy (Scott 2008).

4. *An enormous trade deficit.* Manufactured goods account for more than two-thirds of the immense U.S. goods trade deficit of over $800 billion in 2007. The United States is caught in the middle in international competition: stuck between high-wage countries competing on the basis of new products and processes, and developing countries competing on the basis of low

wages. Too often the response of U.S. firms to this competition has been to make good jobs worse—cutting pay and benefits, increasing hours—rather than drawing on and developing the skills of workers.

In other cases, U.S. firms have simply exited the market. This is not always cause for alarm: U.S. consumers benefit from access to foreign ingenuity. But sometimes the United States is left with declining capabilities in key industries, hurting the nation's ability to innovate in the future (as in the case of the machine tool industry) and even, potentially, the nation's security.[10] Our health is vulnerable as well, as recent scares over children's toys and pet food illustrate. China, with its lax safety standards, provides 80% of toys in the United States. In 2007, a wide variety of toys imported from China were recalled, including 1.5 million Thomas the Tank Engine trains coated in lead paint, Barbie dolls with small magnets that came loose, and Playskool sippy cups whose spouts broke off, causing toddlers to choke (Felcher 2007; Labaton 2007). China also provides more than half of all apple juice, more than 80% of ascorbic acid (vitamin C), and many other chemicals that go into our food supply (Schwartz 2007).

Also troubling is the shift in the U.S. trade balance in advanced technology products from a surplus to a deficit in 2001 (and this deficit has been growing steadily since then). The information and communications products sector has large, escalating deficits. The deficits for life sciences and optoelectronics are smaller, but have also been growing (Yudken 2007).

U.S. manufacturing: A snapshot

The nation retains—at least for now—a core of highly productive manufacturing firms. Manufacturing employs 14 million people in the United States out of a labor force of 146 million (U.S. Department of Labor 2007b). These workers make everything from semiconductors to silverware, from socks to supersonic jets. The nature of their jobs varies as well, ranging from janitorial to engineering. Manufacturing employs significant numbers of white-collar workers: one in five manufacturing employees is an engineer or manager.

But manufacturing employment has shrunk dramatically, shedding 3.3 million jobs over the last decade. Although manufacturing still pays more than average, wages have fallen relative to the rest of the economy, especially for non-college workers. The problems of manufacturing hit certain areas of the nation, particularly the Midwest, especially hard (Scott 2008). What, if anything, should we do about this state of affairs?

Two groups of policy analysts argue that nothing should be done—but for opposite reasons. One group, exemplified by the Cato Institute, argues that the employment decline is a sign of soaring productivity, and that manufacturing is actually "thriving" (Ikenson 2007). Another view, exemplified by *New York Times* columnist Thomas Friedman (2005), says it is simply impossible to compete with countries whose wages are so much lower than ours. It is inevitable, he argues, that manufacturing will go the way of agriculture, employing a tiny fraction of the workforce.

This paper argues that manufacturing in the U.S. is not thriving—but with appropriate policies, it could be. First, there are problems with Cato Institute's statistical analysis. Second, a significant number of firms are holding their own, and more could do so with appropriate policies.

1. Statistical problems. The Cato Institute says that "U.S. manufacturing output reached an all-time high in 2006" (Ikenson 2007)—but they fail to subtract the value of imported inputs. When one looks at manufacturing value added, even Cato's data show that output has fallen since 2000. And these data, drawn from U.S. government sources, paint far too rosy a picture, for U.S. statistical agencies do not track what happens to goods outside U.S. borders.

The result of this limitation (and of some complex statistical interactions)[11] means that official statistics could be substantially underestimating growth in manufacturing output. For example, an analysis by *Business Week* finds that a significant chunk of the reported growth in manufacturing output could really be "phantom GDP"—a quirk in the statistics produced by rapid offshoring, rather than actual increases in U.S. production (Mandel 2007). If growth in output is lower than reported, then productivity growth numbers will also be affected. Instead of near-record growth rates, true productivity growth is much more likely to have continued at the stagnant rates of the 1980s.

2. Some firms are holding their own. Much public policy analysis of manufacturing performance is done at the level of the industry and asks whether a given industry (say steel or biotech) is performing well. However, industry averages mask important differences in performance across sectors and firms: 20% of the firms in the five lowest-productivity sectors[12] are performing better than the average of the five highest-productivity sectors (Luria and Rogers 2007).

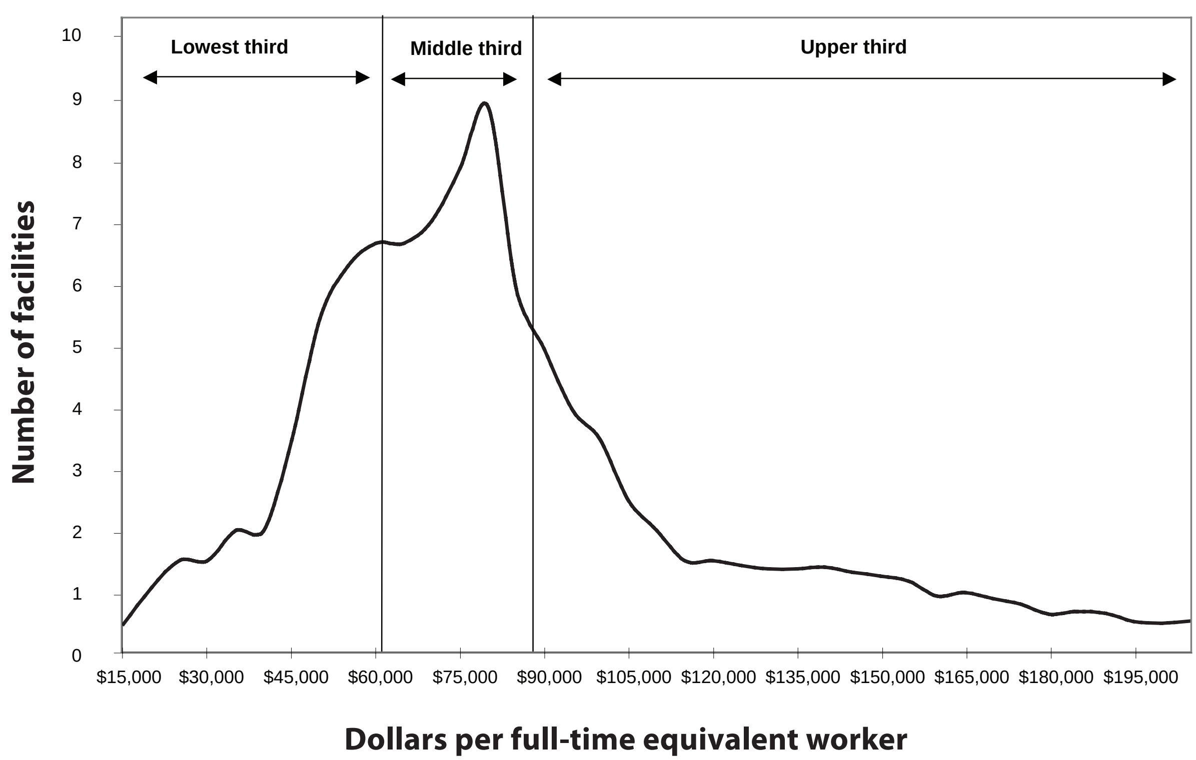
Moreover, the variation in production recipes for similar products is often quite striking.[13] For example, **Figure A** plots data collected by the Performance Benchmarking Service (PBS) of the Michigan Manufacturing Technology Center. Since 1992, PBS has collected data nationwide on small and medium-sized (250 employees or fewer) plants in a variety of manufacturing industries (see Helper and Stanley 2006 for details). PBS consistently finds that even the worst shop in the top 10%, on value-added per full-time equivalent worker, is still more than one and a half times as productive as the median plant.

For example, in metal stamping the median firm has a value-added per worker of about $74,000 per year. This is barely enough to pay the typical compensation for a worker in this industry of about $40,000, and still have money left for equipment and profit. In contrast, a firm at the 90th percentile has a value-added per worker of $125,000—a large enough pie to both pay workers more and to invest in modern equipment and training, as well as to earn a fair profit. **Table 1** shows that high-productivity firms also have high quality ("good first time") and low employee turnover. These data are consistent with the view that firms achieve high productivity in part because long-tenure employees are able to avoid wasteful re-work.

One thing these sectors all have in common is that they are shrinking—fast. "In nearly every major (3-digit NAICS) manufacturing sector, the number of establishments

FIGURE A

Productivity: Value added per full-time equivalent worker, 2006*



* Based on 2006 data gathered from 72 facilities in NAICS code 332116 (metal stamping).
SOURCE: Performance Benchmarking Service, Michigan Manufacturing Technology Center.

TABLE 1

Sectoral variation: auto suppliers

		Percentile cutpoint				
Sector	Metric	25th	Median	75th	90th	90th vs. median
Stamping	VA/FTE*	$54,687	$74,249	$89,316	$125,177	1.7
	Good 1st time	97.00%	98.85%	99.64%	99.97%	47.3
	Employee turnover	31.6%	17.1%	8.3%	0%	infinite
Molding	VA/FTE	$36,199	$53,331	$72,492	$112,053	2.1
	Good 1st time	93.19%	96.66%	99.10%	99.46%	6.2
	Employee turnover	37.4%	31.9%	10.4%	5.5%	5.8
Machined parts	VA/FTE	$54,034	$64,012	$84,529	$112,439	1.8
	Good 1st time	94.19%	97.00%	98.80%	99.85%	20.0
	Employee turnover	46.3%	23.3%	11.7%	0.0%	infinite
Dies, molds, prototypes	VA/FTE	$59,235	$67,625	$82,117	$105,566	1.6
	Good 1st time	90.00%	95.50%	98.50%	99.40%	7.5
	Employee turnover	27.0%	17.9%	9.7%	0.0%	infinite
Machine tools	VA/FTE	$66,621	$90,271	$141,286	$226,168	2.5
	Good 1st time	88.57%	96.17%	98.80%	99.90%	38.3
	Employee turnover	37.3%	16.3%	9.1%	5.3%	3.1
Electricals/ electronics	VA/FTE	$30,567	$43,007	$69,929	$91,577	2.1
	Good 1st time	92.25%	95.41%	98.08%	99.44%	8.2
	Employee turnover	47.1%	28.3%	11.7%	5.6%	5.1

Note: Variance within sector swamps variance between sectors.
* VA/FTE= Value-added/ full-time eqivalent

SOURCE: Performance Benchmarking Service, Michigan Manufacturing Technology Center.

and employment declined in recent years in every establishment size category. Medium-sized and large establishments shed especially large numbers of jobs in every sector. The largest losers included computer and electronic products, transportation equipment, machinery, primary metals and fabricated metal products, and apparel" (Yudken 2007).

Despite arguments like Thomas Friedman's, this decline is not inevitable, as the success of the high-productivity firms in Figure A indicates. As argued below, better public and corporate policies toward manufacturing would improve the functioning of these sectors and improve national welfare in crucial ways.[14]

3. Manufacturing capabilities: Critical to a sustainable economy

There are many precedents for setting (and reaching) national goals in U.S. history. The United States has undertaken programs for such purposes as connecting the nation (building canals, the transcontinental railway, the interstate highway system, and the Internet), military preparedness (investing in such industries as aerospace, computers, and semiconductors), and exploration (putting people on the moon) (Kuttner 1999). In setting such goals, the nation aims to provide goods that are underprovided by the market—it is not trying to pick winners in the marketplace.[15]

Achieving environmental sustainability is the challenge of our time. Maintaining the earth as a hospitable place to live will require efforts to develop renewable sources of energy, to dramatically increase energy efficiency, and to reconstruct the nation's physical infrastructure in a sustainable way. A number of respected authorities, such as the Stern Report, the UN Framework Convention on Climate Change (UNFCCC), several European countries, the State of California, and USCAP (a business-environmental partnership)[16] recommend that the United States set a goal of reducing its emissions of greenhouse gases by 80% by 2050 (Step It Up 2007).[17]

As an example of how policy can be used to meet national goals while strengthening manufacturing, below are some principles that could efficiently strengthen the manufacturing sector by overcoming the market failures in energy production and use that have contributed to the build-up of greenhouse gas emissions.

Manufacturing can play a key role in the transformation to a sustainable-energy society in two ways. First, manufacturers can make the equipment necessary for producing energy from renewable sources such as wind, solar, and biomass. Second, they can provide equipment and expertise to increase the efficiency with which we produce and consume manufactured goods.

Renewable energy

A program that created enough renewable capacity to meet 10% of U.S. electricity demand would not only reduce dependence on foreign oil and cut carbon emissions—it would also employ about 340,000 people for a year in each of five years (calculated from Scott and Siu 2006). It would cost about $35 billion per year for each of those five years. Creating these jobs would raise average wages (these occupations currently pay 12.5% more than the economy-wide average), and would probably reduce unemployment as well.

Renewable energy has the potential to be both affordable and an engine of growth in good jobs because the basic input (sun or wind) is free (Sterzinger 2008). In contrast, most of the cost of oil is in rents paid to the owners of this scarce input; only about $2/barrel of Saudi oil (now selling for over $90/barrel) is the cost of extraction. Thus, we can pay a great deal in wages to workers to turn the sun or wind into usable power, and still keep the end-user price at levels comparable to those of coal or oil.

Energy efficiency

Conservation is the least-polluting energy source, and manufacturing offers many opportunities to increase efficiency, in both the production and the use of goods.[18] A 2007 McKinsey study found huge potential for conservation in manufacturing; U.S. manufacturers could cut their projected energy demand for the year 2020 by 16% while making a *profit* of at least 10% on their investment (McKinsey 2007).[19]

For some manufacturers, increased energy efficiency will be crucial. Energy price increases will have a big impact on sectors such as steel, paper, and some chemicals (Yudken 2008). Policies that promote energy efficiency can mitigate these effects, offsetting a rise in the cost per unit of energy with a reduction in the number of units consumed. At the same time, however, energy is a small part of total costs in most manufacturing. For example, only 3.7% of the cost of making a car and its components is energy cost, so a 50% increase in energy prices would increase the cost of a car by less than 2% (McKinsey 2007). Thus, job losses due to energy price increases will not be large in most sectors, particularly if carbon taxes are adjusted for imports as described below.

Consumers' use of manufactured goods such as cars and computers also generates significant emissions. Conservation efforts can be quite productive (for example, refrigerators used 75% less energy in 2001 than they did in 1974), and need not induce hardship (refrigerator prices have steadily fallen in real terms). Due to strict regulation, California has doubled its gross state product since 1970 but has not increased its per capita energy use at all (Rosenfeld 2005).

There are important market failures in developing green technology, including the expense of educating producers and consumers about the benefits of the new technology and the need to overcome advantages of established competitors with conventional technology. Energy costs at manufacturing plants are often fragmented across different budgets, and plants rarely have access to energy experts who can show how to redesign operations to conserve energy (Goodstein 2007; McKinsey 2007). Many green technologies have upfront costs and pay for themselves only over time, raising issues of liquidity constraints (people may not have access to the capital they need to make a large purchase) and of capturing residual value (e.g., a person who spends a lot of money insulating a house, then sells it a few years later, may not be able to capture the full value of the on-going reduced energy costs in the sale price of the house). To overcome these problems, government could require labels that disclose the average energy use of a product (such as is now done with refrigerators), mandate energy efficiency standards (as is now done with cars' gas mileage), provide technical assistance directly to plants, and require utilities to achieve production "increases" through conservation (thus giving them an incentive to market entrepreneurial energy-saving products).

Energy sustainability thus offers the promise of creating new "green jobs." However, the move to reduce greenhouse gas emissions could be very damaging for working families. Without the right policies in place, these families could see large increases in energy costs not offset by reduced costs elsewhere, and may well find many "green jobs" are located offshore. For example, the move to energy-efficient lighting has led to job losses for U.S. workers as General Electric closes conventional lighting plants in the U.S. and opens factories to make compact fluorescent bulbs in China (*New York Times* 2007). But with the right policies, there does not have to be a tradeoff between environmental protection and jobs at fair wages.

Below are some principles for how energy legislation can efficiently and fairly fight climate change while promoting good jobs in manufacturing.[20]

1. Stop subsidizing fossil fuels. As discussed above, use of fossil fuels imposes large social and environmental costs. Yet, the federal government provides $3.6 billion per year in subsidies to the oil and gas industry (Clayton 2007).[21] Eliminating these subsidies would have only a small effect on fuel prices; they might rise about 4% (Nordhaus 2007; Carbon Tax Center 2007). However, this money could fund a significant increase in subsidies for the development of renewable fuels and conservation measures, activities that together currently receive only $14 billion (Koplow 2006).

2. Raise prices of greenhouse gas emissions. Currently, we treat the atmosphere as a free carbon dump. There is no price attached to fouling the air. This practice imposes large "negative externalities" (costs on innocent bystanders). It is only fair that people should pay the social cost of the carbon they emit. Moreover, such price increases are beneficial because they encourage consumers to economize on greenhouse gas emissions. They also provide signals that encourage private investment in conservation and in implementing and developing new energy technologies.[22]

3. Reserve revenue from these increased energy prices for social purposes; it should not become a windfall for private interests. Two important uses of the money are a.) overcoming market failures in green technology (discussed below), and b.) offering relief to poor and middle-class citizens from high energy prices. While a rise in energy prices has a good incentive effect (it encourages people to conserve), it has a bad wealth effect (it hits poor and middle-class people hard). We can reduce the bad effects by using some revenue to reduce taxes that hit the working poor hard, such as the payroll tax. For example, if a middle-class household's energy expenditure were to rise by $400, we could cut the payroll tax by $400, leaving that family's expenses unchanged. A family that used less energy than average would be better off than before. We could also use the revenue to subsidize weatherization of houses, which would both reduce energy expenditures and create jobs directly. (Most of these jobs would be in construction, but some manufacturing jobs would be created in making insulation, etc.) Importantly, policies that increase energy efficiency offset the impact of increases in per-unit prices.

The magnitude of the money raised could be quite large (though not large compared to spending on the Iraq war of $130 billion per year for each of the last five years (Dilianian 2007). In the model analyzed by Professor William Nordhaus at Yale, emissions reductions sufficient to restrict the temperature increase to less than 2 degrees Celsius could be had for a tax (or emissions permit price) of $10/ton carbon dioxide now, rising to $20 by 2020 and to $60 by 2050, if the whole world participated. A tax of $10/ton of carbon dioxide equivalent (approximately 10 cents per gallon of gasoline) would raise $55 billion a year in revenue in the United States (Carbon Tax Center 2007).[23] If the nation spent $31 billion of that on payroll tax reductions, plus ended oil and gas subsidies of $3.6 billion per year, more than $20 billion would be left for funding renewable energy (including conservation).

4. Fund new initiatives in energy efficiency and renewable energy. Raising prices is necessary—but not sufficient—to reduce carbon use. To meet the goal of having a sustainable energy policy, the United States needs to both a.) come up with radical new innovations in and dramatically increase the scale of renewable energy industries, and b.) build up capabilities in traditional industries as well, so that they can become more efficient and provide the equipment necessary to generate renewable energy.

The government should adopt a combination of energy efficiency standards and tax credits for retooling to make energy-efficient products (See "Energy and Autos: A Case Study" on p. 13). As the refrigerator example shows, standards for home appliances can be particularly effective in reducing carbon emissions, because appliances and heating consume considerable energy (households account for 17% of carbon emissions (EPA 2006)) and because appliance buyers (whether homebuilders or consumers) often focus more on upfront costs than on operating costs in making their purchasing decisions. Also, a tax credit for tooling for plants in the United States increases the likelihood that energy-efficient products would continue to be made in the United States (in contrast to the compact fluorescent light bulb example mentioned above). (Section 7 discusses additional safeguards to ensure that energy-efficient products are made in safe conditions by fairly paid workers.)

5. Enact legislation to prevent the creation of greenhouse gas havens in other parts of the world. Firms that import products made in countries that have not passed equally stringent greenhouse gas legislation should be required to pay carbon taxes or purchase permits whose value is equivalent to what would have been required had the factory been located in the United States. Otherwise, strict legislation in the United States will not reduce worldwide carbon emissions and will not slow global warming; it will merely shift emission to countries where regulation is less strict. About 6% of China's emissions come from producing products that are consumed in the United States. This is roughly the same as the total emissions produced by Australia or France.[24]

6. In the long term, enact legislation to address ways of reducing emissions in developing countries, where it is cheaper to do so. Because of lower production costs, it takes two to three times as much carbon to produce $1 of output in China and Russia as in the United States (Nordhaus 2007). Thus, the same amount of money spent on emissions reduction would have a much greater effect in developing countries. Some of the U.S. expenditures could go to reducing greenhouse gas emissions in other countries (and some legislation before Congress devotes some revenue from selling emissions permits toward preserving the Amazon rainforest, which is a major absorber of carbon). However, realizing such offsets on a large scale is fraught with difficulties, such as accurately construing what emissions would have been in the absence of the intervention. We need to get started on carbon reduction now, but ultimately we need a global solution to the problem.

Conservation initiatives can benefit U.S. manufacturers by changing the terms of competition away from production worker wages and toward inventiveness in saving energy. But to take advantage of the energy efficiency initiatives described in this section, firms need to have a base level of capability to introduce new products and to be able to ramp up production to efficient levels. However, several sectors critical for renewable energy production are in deep trouble. The tooling sector in particular is struggling (Dziczek et al. 2006). Other second-tier suppliers suffer from weak product development capabilities and lack the ability to learn about ways for reducing energy use in production. There is also a shortage of skilled workers. A National Association of Manufacturers' study finds that 90% of manufacturers report a moderate-to-severe shortage of skilled production employees, and 65% report a moderate-to-severe shortage of scientists and engineers (The Manufacturing Institute et al. 2005).

As shown in the next section, investments in high-road production methods can alleviate these constraints and therefore will benefit firms' efforts to reduce greenhouse gases in several ways: by increasing their speed of ramp-up to produce equipment necessary for renewable "manufactured" energy; by increasing their ability to design and produce new energy efficient products; and by increasing the fuel-efficiency of their production processes.

ENERGY AND AUTOS: A CASE STUDY

The auto industry contributes 25% of U.S. manufacturing output and 4% of GDP; the use of automobiles accounts for 17% of greenhouse gas emissions (EPA 2006).

An energy price increase may not increase auto fuel efficiency significantly unless the increase is quite large. Studies suggest that even a 10% increase in gasoline prices (almost three times what is envisaged in the proposals above) would reduce fuel usage only 2.1% (Greene 1990).[25] Thus, Corporate Average Fuel Economy (CAFE) standards, like the increase passed in late 2007, are crucial for reducing fuel usage because they mandate more-efficient cars.

Such an increase hurts Detroit's three major automakers, which currently specialize in the least fuel-efficient vehicles. To offset this disadvantage, this report proposes the enactment of the "tooling tax credit" studied by the University of Michigan Transportation Research Institute (UMTRI). Under this proposal, any manufacturer could claim a tax credit to offset two-thirds of the cost of the tooling and equipment investment required to convert existing U.S. facilities to the production of hybrid and advanced diesel vehicles and components. This tax credit would reduce total costs of such car production by about 15%. Suppose demand for hybrids and advanced diesels rose from less than 1% in 2003 to 11% by 2009, or about 1.8 million vehicles. If it did, a 67% investment tax credit that was 50% effective at switching projected imports to U.S. production would cost a total of $1.1 billion over four years, but would save almost 18,000 U.S. jobs and increase federal tax collections over a future 10-year period by almost $2.6 billion. If this credit also made it more likely that cars with hybrid engines were assembled in the United States, the public benefits would be even greater (Hammett et al. 2004).

To further improve the UMTRI proposal, it could be pro-rated according to the fuel efficiency of the resulting vehicle. For example, for every additional mile per gallon compared to the previous vehicle made at that facility, automakers might be given a tax credit of 5% of their tooling cost. This incentive would increase the likelihood that automakers would use hybrid engines to boost fuel economy, instead of continuing to boost acceleration. In contrast, advances in technology between 1987 and 2007 (when CAFE standards did not increase appreciably) were used not to increase fuel economy, but to augment other attributes such as acceleration. If automakers had maintained car weight and acceleration constant at 1981 levels, average miles per gallon would have increased by 2005 from 28.5 to 38—more than enough to meet the recently passed 35 mpg standard that takes effect in 2020 (Greene and German 2007; German 2006; and German 2007).

4. The high road in manufacturing

How do high-road strategies improve performance?

Section 2 showed that firms at the top of the productivity distribution have a value-added per worker of $125,000—producing a large enough pie to pay workers more, to invest in modern equipment and training, and to earn a fair profit.

Most of these firms achieved this productivity by adopting a "high-road" production recipe in which firms, their employees, and suppliers work together to generate high productivity. In manufacturing, this recipe can be summarized as "Full Utilization Learning Lean" (Luria, Vidal, and Wial et al. 2006).

In the "Learning Lean" part of the method, workers and managers work together to reduce waste and continuously improve the production process. This approach improves productivity because:

- Involving workers and managers in continuous innovation allows plants to handle more variety and smaller orders;
- Self-management reduces costly supervisory overhead; and
- Continuous improvement efficiently empowers workers to employ the knowledge that only they have.

In the "Full Utilization" part of the method, firms achieve high-capacity utilization, leading to reduced fixed costs per unit. In part, these firms are busy because of the actions described above, but a key element is also that they actively seek new business, both by developing new products and by aggressive sales and marketing efforts. Such efforts are key to the success of this method, since the "lean" effort usually yields double-digit increases in capacity. If sales do not increase, then either the firm does not achieve cost savings or it reduces capacity through layoffs, leading workers to feel betrayed.[26]

Successful adoption of these policies requires that everyone in the value chain be willing and able to share knowledge. Below are several examples of how distributing knowledge across the value chain enhances productivity.

1. Involve workers. Low-level workers have much to contribute because they are close to the process: they interact with a machine all day, or they observe directly what frustrates consumers. For example, a careful study of steel finishing lines found that those with high-road practices have 6.7 percentage points more uptime (generating $2 million annually in net profit for a small plant) than do lines without them. The increase in uptime is due to communication and knowledge overlap. In a firm not using high road, all communication may go through one person. In contrast, in high-road facilities (such as the one run by members of the United Steelworkers at Mittal Steel in Cleveland) workers solve problems more quickly because they communicate with each other directly in a structured way.[27]

2. Involve suppliers. A small supplier to Honda had a problem with some plastic parts. On an irregular basis, parts would emerge from the molding machines with "splay" (white spots along the edge of the product) or "short-shots" (a mold not completely filled in). This problem had long plagued the company, but was not solved until Honda organized problem-solving groups that pooled the diverse capacities and experiences of people in the supplier's plant. They quickly solved the problem: molding machine operators noticed condensation dripping into the resin container from an exhaust fan in the ceiling, quality control technicians then saw that the condensation was creating cold particles in the resin, and skilled tradespeople designed a solution (MacDuffie and Helper 1997).

Why is Honda providing technical assistance for free to its suppliers? Honda management believes that the benefits of having more capable suppliers far outweigh the additional costs. Most manufacturers, Honda included, are no longer vertically integrated. Well over half of costs at most manufacturers are components purchased from outside suppliers, meaning that these suppliers have a large impact on the ultimate quality and price of the lead firm's products. This impact of suppliers is far greater than the impact of direct labor, which is well under 20% at most manufacturers—yet managing supplier costs receives far less attention than does managing labor costs (MacDuffie and Helper 2005).

3. Use information technology (IT). According to a variety of pundits, IT will be the savior of the U.S. economy, and indeed, U.S. firms have invested heavily in both hardware and software. However, until recently, "you can see computers everywhere except in the productivity statistics," according to Nobel laureate Robert Solow. It turns out that computers do not increase productivity unless they are accompanied by a decentralization of production—a key element of high-road production (Bresnahan, Brynjolfsson, and Hitt 2002).

A study of valve producers found that more-efficient firms adopted advanced, IT-enhanced equipment while also changing their product strategy (to produce more customized valves), their operations strategy (using their new IT capability to reduce setup times, run times, and inspection times), and human resource policies (employing workers with more problem-solving skills, and using more teamwork). The success of the changes in one area depended on success in other areas. For example, customizing products would not have been profitable without the reduced time required to change over to making a new product, a reduction made possible both by the improved information from the IT and the improved use of the information by the more-empowered workers. Conversely, the investments in IT and in training were less likely to pay off in firms that did not adopt the more complex product strategy (Bartel, Ichniowski, and Shaw 2000).

A key reason that the high road's linked information flow is so powerful is that real production rarely takes place exactly according to plan. A manufacturing worker may be stereotyped as someone who pushes a button—the same button every 20 seconds, day after day, year after year. But, even in mature industries, this situation rarely occurs: for example, temperatures change, sending machines out of adjustment; customers change their orders; a supplier delivers defective parts; new product is introduced. All of these contingencies mean that the perfect separation of brain work and hand work envisioned by efficiency guru Frederick Taylor does not occur, and doing even the simplest job involves some tacit knowledge.

In mass production, following Taylor, managers have tried to minimize these contingencies, and in particular, workers' discretion to deal with them. In contrast, the Toyota production system recognizes that the very local information that workers have is crucial to running and improving the process, and sets up methods for the sustained and organized exploration of that information. These methods require substantial overlap of knowledge and expertise, a practice that may seem redundant but yields substantial benefits (MacDuffie and Helper 2005; Takeishi 2002).

For example, at Denso (a Japanese-owned supplier in Battle Creek, Michigan), someone approved a suggestion that a supplier be able to deliver parts in standard-size boxes, thus saving money. These boxes were two inches deeper than the previous boxes—a seemingly minor change. Denso's practice (following just-in-time philosophy) was that a worker would deliver the boxes from the delivery truck directly to a rack above the line, thus meaning that the worker who assembled these parts had to reach up and over and down into the box an extra two inches 2,000 times per shift, which proved quite painful. The situation was corrected quickly, due to an overlap of knowledge. Denso had a policy that managers worked on the line once per quarter and the purchasing manager had done that job in the past. Thus, the worker knew whom to contact about the problem (since she had worked next to him for a day), and the purchasing manager understood immediately why the extra two inches was a problem. He called the supplier and asked them to go back to the previous containers. In a world of perfect information, Denso's rotation policy would be a waste of managerial talent; but in a world where much knowledge is tacit and things change quickly, the knowledge overlap allowed quick problem identification and resolution.[28]

This high-road model of production provides an alternative to the current "winner take all" model, in which corporate executive "stars" at the top are supported by workers that are held to be disposable at the bottom (Robert Frank 1995). Note that in this view, there are no jobs that are inherently "low-skill", or "dead-end."

5. Facilitating the high road through public policy

As we have seen, the high road works only if a company adopts several practices at the same time: it must improve communication skills at all levels, while creating mechanisms for communicating new ideas across a supply chain's levels and functions, along with incentives to use them. Thus, a key aspect of high-road policies is that they improve the way that a company mixes the ingredients together. That is, these policies attempt to change firms' production functions. For these reasons, merely "getting the prices right" (adding taxes or subsidies to correct for the presence of externalities) is not sufficient to build capabilities. Thus, it makes sense to provide technical assistance services to firms directly.

Expand the Manufacturing Extension Partnership

One example of such a program is the Manufacturing Extension Partnership (MEP), which was set up in 1989 and is part of the National Institute of Standards and Technology (NIST). The MEP program was loosely modeled on the agricultural extension program, although the rate of subsidy was much lower (Shapira 2001). Jarmin (1999) describes the activities of the centers:

> Manufacturing extension centers provide technical and business assistance to small and medium-sized manufacturers, much as agricultural extension agents do for farmers. This assistance often consists of providing "off-the-shelf" solutions to technical problems. Examples might include helping a plant install a CAD/CAM system or switching to newer, lower cost, higher performance materials. Manufacturing extension

centers can also channel more recent innovations generated in government and university laboratories to SMEs that lack access to such information. Besides helping plants adopt modern manufacturing technologies, most centers also offer business, marketing, and other "softer" types of assistance.

How well have MEPs done in improving firm productivity? Jarmin conducted a careful study of the early years of the MEP program. Using the Census Bureau's Longitudinal Research Database, he estimated that productivity at MEP client firms rose in the range of 3.4%–16% more between 1987 and 1992 compared to productivity at non-client firms (1999).[29] Using data in Jarmin (1999), we can show that MEP programs pay for themselves in terms of increased tax revenue collected.[30] Oldsman and Russell (1999) found similar results using different data and methods. They looked at similar firms that did and did not receive services from the Pennsylvania Industrial Resource Center (an MEP affiliate), and found that $1 of state spending on the program yielded $21 in additional gross state product, and $1.24 in additional tax revenue.

Despite such positive results, federal support for manufacturing extension activities has shrunk from $138.4 million in 1995 to $106.6 million in recent years to only $90 million in FY 2008—well under $7 annually per manufacturing worker (Helper and Stanley 2004). Federal support to individual centers must be at least matched by state and local sources.

And despite the effectiveness of the programs, Helper and Stanley (2006) found only 6% of small manufacturing firms reported receiving assistance from a publicly supported manufacturing extension center during the previous three years. Since these centers are targeted at small manufacturing firms, this is somewhat surprising. Why do small firms make so little use of this resource? A part of the answer is that MEPs are not easy to work with in their current form. Knowing that their clients have little money, they often teach courses piecemeal, without offering an overall improvement plan to a firm. Even if they do offer such a plan, liquidity constraints and lack of organizational slack make it difficult for small firms to undertake a sustained program of improvement (Helper and Stanley 2006; Helper and Kiehl 2004).

The Manufacturing Extension Program has had significant success in its current, limited form. The following changes to the program could increase these benefits:

- Restore the ability of the MEP to provide subsidized training, allowing the program to reach out with an integrated program to small firms that lack the capability to plan a coherent change effort. Such a program would enable MEPs to teach skills necessary for the high-road model, such as brainstorming and problem-solving, to a wider audience.
- Organize training by value chain in addition to focusing on individual firms. An example of this sort of training is the consortial model of supply chain modernization used by the Wisconsin MEP. It set up the Wisconsin Manufacturers' Development Consortium (WMDC), which trains supplier firms in general (rather than customer-firm specific) competencies, and promotes mutual learning by harmonizing supplier certification and encouraging cross-supplier communication. This framework meets diverse supplier needs through multiple institutional supports. For example, major improvements at formerly struggling suppliers resulted from a mix of WMDC training, OEM-led projects, and internal initiatives at suppliers (Whitford and Zeitlin 2004).
- Include training on manufacturing services, since a key part of what high-productivity manufacturing firms offer is not production itself, but pre-production (learning what customers want, designing the products) and post production (delivering just-in-time, handling warranty issues efficiently). These activities are often more tied than production is to the location of consumers, who (at least for now) are usually in the United States. These activities also benefit especially from close linkages both within and between plants—e.g., skilled production workers and tradespeople can ramp up the production of high-quality products more quickly, can produce more variety on the same lines, and reduce lead time for customized products, reduce defects, etc. Two key types of services are:

1. *Developing new products and finding new markets.* These skills help high-road firms avoid competing with low-wage commodity producers. They also enable firms to make use of the additional capacity freed up by "lean" initiatives. MAGNET (the MEP center in Northern Ohio) has had significant success in this area. It employs a staff of 15 (plus four subcontractors) that can take a small company from initial stages through prototyping to a manufacturable product. The MAGNET staff is able to draw on ideas from several industries and technologies, to develop products as diverse as a light fixture than can easily be removed from the ceiling to enable bulb-changing without a ladder, and a HUMVEE engine that can be replaced in one hour rather than the previous two days.

2. *Quick response to customer needs.* Firms that are able to master just-in-time production techniques and deliver with very short lead times have a significant source of competitive advantage, particularly when competing with suppliers offshore.

- Help firms learn to save energy (not a big source of savings now, but it will become such if energy prices increase significantly), and reduce pollution while saving money.
- Create a national standard for evaluating total cost of acquisition for components, and then teach firms to use it, so they can measure costs beyond piece prices.

Create discussion forums

The above production techniques have been codified and shown to work. But this process of codification takes a long time. How will the next generation of programs be developed? In addition, the exact ingredients of the high-road recipe vary by industry, and over time.[31] Thus, it is necessary to have forums for discussion so that industry participants can make coordinated investments, both subsidized and on their own. The forums elicit the detailed industry-specific information necessary to design good policies, thus avoiding government failure (Rodrik 2004; Sabel 1993). However, in order to avoid having the forums be captured by firms for their benefit alone, there needs to be capable representation from various stakeholder groups, such as government, union, and community groups (Safford 2004).

Federal and state governments could establish competitive grant programs in which industries could compete for funding to establish such forums. They should encourage unions and community groups to use such funding for capability development. Merely subsidizing private consultants is not enough. Private consultants can and do help with knowledge diffusion, but they will tend to emphasize short-term cash generation rather than long-term capability development (Helper and Kiehl 2004).

The MEP should encourage cities and regions to apply to create such forums. A large literature, including case studies and statistical work, finds that firms that are geographically close to other firms (including customers, suppliers, rivals, and even firms in unrelated industries) are more productive. The sources of the advantage include the ability to pool trained workers and the ease of sharing new ideas; these advantages of proximity can be magnified if institutions are created that organize these exchanges, facilitating the communication and development of trust (Rosenthal and Strange 2004; Harrison 1997; and Helper and Stanley 2006).

Several prototypes of these "discussion forums" already exist. Some examples of discussion forums from a variety of stages of the value chain occur in innovation (Sematech), upstream supply (Program for Automotive Renaissance in Tooling (PART) in Michigan), component supply (WMDC), and integrated skills training (Wisconsin Regional Training Partnership, the Manufacturing Skills Standards Council (MSSC)) (AFL-CIO 2004).[32]

The Program for Automotive Renaissance in Tooling (PART) includes communities, large automakers and first-tier suppliers, and small tool and die shops. Thus, its membership reflects the current organization of much manufacturing, in which large firms outsource much work to smaller suppliers, who remain geographically concentrated. The program, funded by the Mott Foundation, coordinates joint research among members, and provides benchmarking and leadership development for small firms. It helps organize "coalitions" of several small tooling firms that agree to joint marketing efforts and development of standardized processes; these coalitions are eligible for significant tax breaks offered by the state of Michigan if they are located in a "Tooling Recovery Zone" (Center for Automotive Research 2006).

Costs

How much would it cost to implement these recommendations? Currently the MEP is a decentralized program, with federal money plus some state funds. This structure has the advantage of decentralization, allowing MEPs to focus on the skills the companies in their regions need. A disadvantage, however, is that MEPs vary significantly in quality and energy. Some do not even spend their full current annual federal subsidy.

Therefore, an expansion of funds should be done on a nationally competitive basis. Here are some ideas:

1. *Competition for money to aid high-road firms.* The MEP program in recent years received about $115 million in federal funding annually. This funding supports a one-third federal subsidy for programs that annually reach 2–3% of the 115,000 U.S. manufacturing plants with 20–499 employees. A standard engagement to teach firms to do lean production (as offered by the Michigan Manufacturing Technology Center) costs about $30,000 per firm. To reach 10,000 more plants each year with this package would cost $300 million. If the federal government paid half of the cost (up from one-third now), they would need to increase MEP funding by about $150 million (Luria, personal communication). This extra money should be allocated to companies that are (or commit to being) in the top half of firms in their industry on wages, and in the top third on productivity since such firms generate significant positive externalities. Total federal cost per year: $150 million.

2. *National supply-chain program.* Few states have both major customers and small suppliers clustered tightly together; more often, important pieces of the supply chain are spread across several states. Thus, to be most useful to both suppliers and customers, a supply chain program should have national guidelines. One-time cost: $50 million.

3. *Product development.* A bill introduced by Sen. Sherrod Brown establishes a $50 million low-interest revolving loan program for small firms to develop vague ideas for new products into prototypes and production-ready drawings. Firms would present early-stage ideas to a panel of experts, who recommend funding (usually through an MEP) for the best ideas. The program is modeled after a similar program funded by Cuyahoga County in Ohio. Cost: $50 million per year.

4. *Discussion forums.* A pilot program should make a few generous awards (to stimulate groups to write good proposals), perhaps five awards at $10 million each. Cost: $50 million per year.

5. *Evaluation.* All programs should be rigorously evaluated, with random assignment to treatment and control groups if possible. MEP should spend 0.5% of funds on this, or $1.5 million per year.

In total, these programs would cost approximately an additional $300 million. If just half the firms increase their productivity by 20% as a result, and can therefore compete with China, the United States will have saved 100 employees per firm multiplied by 5,000 additional firms equaling 50,000 jobs at $6,000 per job. This would pay for itself in increased tax revenue.

This $300 million is a tiny amount of money. State and local governments currently spend $20–30 billion (more than 70 times as much) on tax abatements to lure firms to their jurisdiction (Bartik 2003). That spending generally does not improve productivity, though it allows firms to benefit from bidding wars to attract them. Moreover, it is much cheaper to act now to preserve the manufacturing capacity we have than to try to reconstruct it once it is gone. The falling value of the dollar helps increase export demand, but it will not reduce prices enough to induce replacement of capability once held by firms that have already gone out of business.

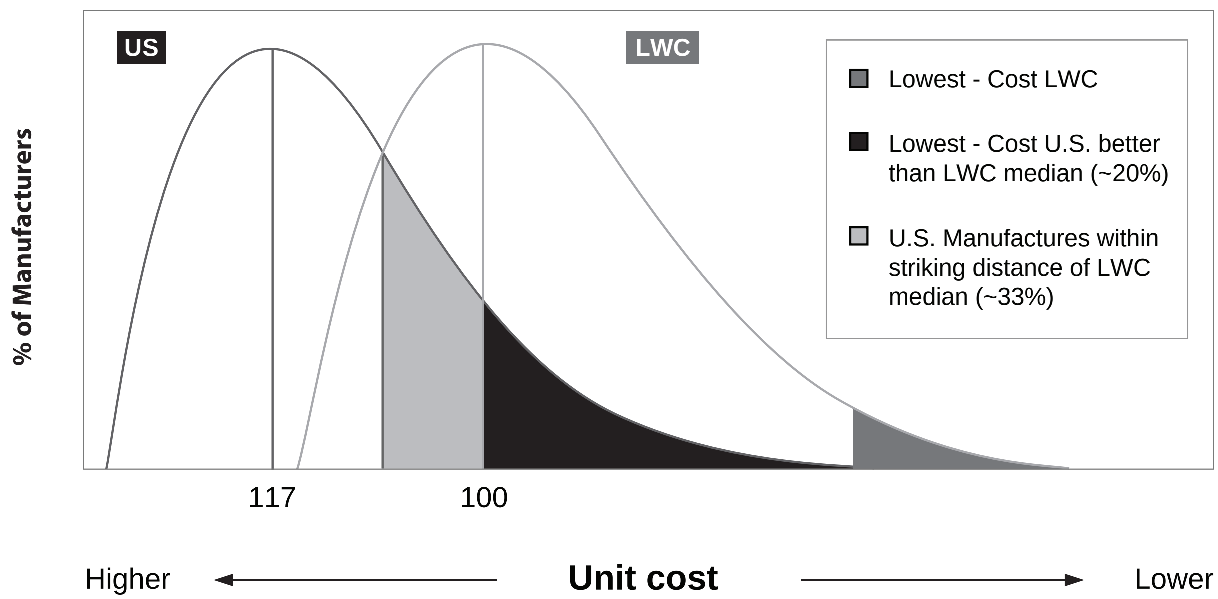
This expenditure of $300 million can also be compared with that for agricultural extension—$430 million

BETTER MANUFACTURERS ARE NOT DOOMED BY LOW-WAGE COUNTRIES

U.S. firms can and do compete with China and other low-wage countries, in part because direct labor costs are only 5–15% of total costs in most manufacturing. As **Figure B** below shows, many U.S. firms have costs not so different from those of China. Therefore, it is not naïve to think that manufacturing can and should play an important role in the U.S. economy of the next several decades. This box discusses a mix of policies that could help U.S. manufacturers compete with low wage nations.

FIGURE B

Better U.S. manufacturers not doomed by low-wage countries (LWC) manufacturers low *average* land cost



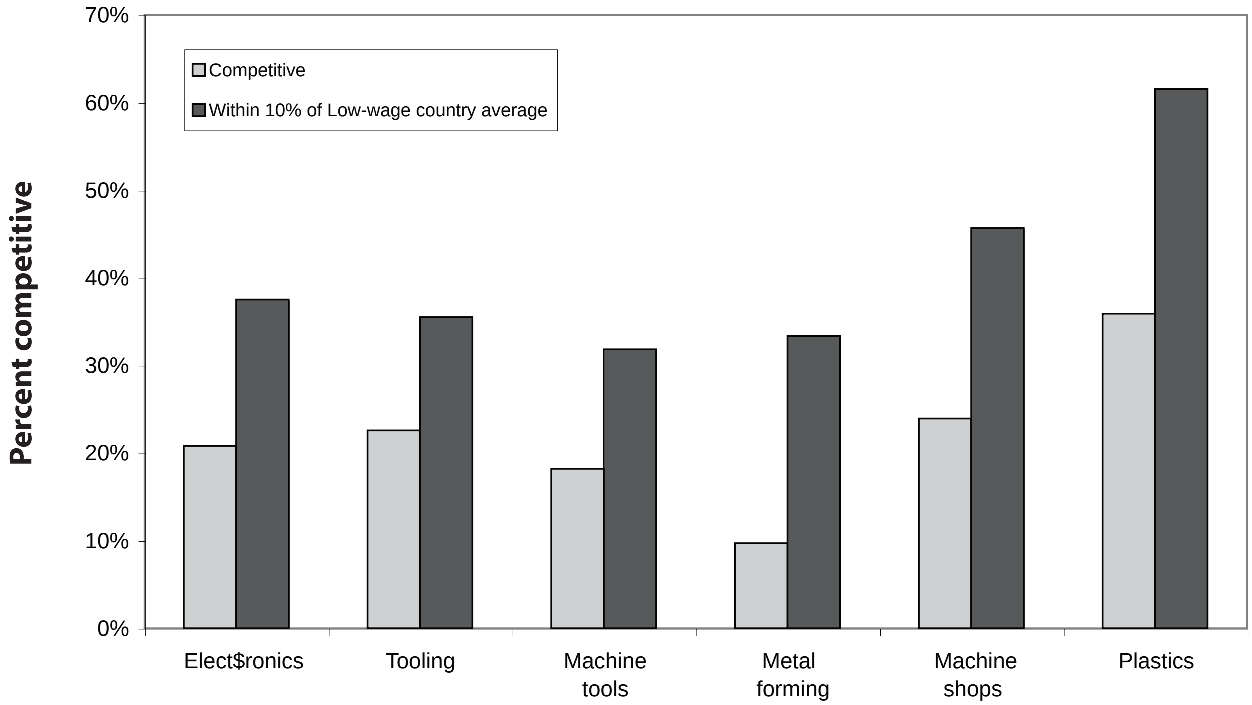
SOURCE: Performance Benchmarking Service, Michigan Manufacturing Technology Center.

The data in **Figure C** suggest that almost all U.S. firms in plastics (PL) are competitive with Chinese firms or could become so.[33] Similarly, a McKinsey study found that in many segments of the automotive parts industry, the "China price" is only 20–30% lower than the U.S. price for a similar component (McKinsey 2004). Note that neither this study nor the PBS study takes into account most of the hidden costs discussed below. That is, "low-wage" countries are not necessarily "low-cost" countries. U.S. companies can continue to pay higher wages for direct labor and offset the added cost with greater capabilities, capabilities that lead to outcomes such as higher productivity, fewer quality problems, and fewer logistical problems.

Unfortunately, firms are handicapped in deciding where they should locate production, because they do not take into account the hidden costs of off-shoring. Most firms—even large multinationals—use standard accounting spreadsheets to make sourcing decisions (MacDuffie, Fixson, and Veloso 2005; Suri 2004). These techniques focus on accounting for direct labor costs, even though these are a small percentage of total cost (again, typically 5–15% in

FIGURE C

Cost competitiveness varies by sector: Global cost index, fiscal year 2006



SOURCE: Performance Benchmarking Service, Michigan Manufacturing Technology Center.

manufacturing), and ignore many other important costs. Some "hidden costs" of having suppliers far away include:

- Distraction of top management. Setting up a supply chain in China and learning to communicate with suppliers requires many long trips and much time, time that could have been spent on introducing new products or processes at home.
- Increased risk from a long supply chain, especially with just-in-time inventory policies.
- Increased coordination and "handoff costs" between U.S. and foreign operations. More difficult communication among product design, engineering, and production hinders serendipitous discovery of new products and processes. Quality problems may be harder to solve due to geographic and cultural distance. Time-to-market may increase.[34]

These costs can be substantial; one study found that they added 24% to estimated costs of offshoring. (Schneider 2007).[35] In addition, several factors could shrink the U.S.-China price differential substantially in the near-term, such as exchange rate fluctuations and increased transportation costs due to increased oil prices. If the differential shrinks after many U.S. firms have gone out of business, it may be difficult to re-establish the lost capabilities. Thus, extensive off-shoring could, in the long run, be devastating for firms in many industries.

Even in the medium-term, the challenges of dealing with a far-flung supply base make it difficult for firms to innovate in ways that require linked design and production processes. For example, one Ohio firm had based its competitive advantage on its ability to quickly add features to its products (cup-holders in riding mowers, to take a non-automotive example). But when they sourced to China, last-minute changes wreaked havoc with suppliers, and the firm was forced to freeze its designs much earlier in the product development process.

Some observers argue that U.S. firms can remain competitive by off-shoring labor-intensive parts of the production process (such as assembly) and retaining high-skill parts of the process (such as tooling and design) in the United States (Schultz 2004). These observers argue that off-shoring can be considered successful "triage" (in the sense that off-shoring low value-added work allows the high value-added work to remain). But off-shoring may actually promote "hollowing out" (in which off-shoring some tasks pulls other tasks to follow). It turns out that "triage" effects are likely in some industries and "hollowing out" effects are likely in others. For example, in semiconductor design, Brown and Linden (2005) argue that off-shoring did protect high-skill U.S. jobs; but there are some signs that the "hollowing out" effect may predominate in "integral" industries such as autos. What accounts for the difference? To the extent that there is a high return to high interaction between tasks (as in autos), U.S. firms may not remain competitive with a far-flung production network, and offshore locations may increasingly add more complex tasks (Lara and Carrillo 2003). A similar pattern has occurred in notebook computers, where production has "pulled" design work to China as well (Dedrick and Kraemer 2006). The reason is that firms find themselves hiring engineers that work near the production plants so that problems can be solved quickly there. The problem-solving generates ideas for new products and processes, leading to the hiring of more engineers and gradually moving more de-bugging and design capability to the offshore location.

in 2006 for an industry that employs 1.9% of the workforce and produces 0.7% of GDP. In contrast, manufacturing is 10% of the workforce and 14% of GDP (USDA 2006; U.S. Department of Commerce 2004).

Barriers to adoption of high-road strategies

If high-road production is so great, why don't more firms adopt it? This section briefly discusses two main reasons why firms might not adopt it even though it is efficient to do so: externalities and complementarities (see appendix for more details).[36]

Externalities. An externality is a benefit or cost of an action that accrues to someone other than the people who decide to undertake that action.

The above hidden costs (of incorrect accounting methods) are largely costs that are borne by private firms. To the extent that these costs are present, off-shoring is not a profit-maximizing strategy. In addition, profit-maximizing firms fail to account for many other costs of off-shoring, so workers and citizens bear these costs, including:

- Community disruption and job loss. Jobs that pay high wages are replaced with lower wages and lower GDP, and tax revenues are reduced.
- Less dense supplier cluster reduces innovation in all firms that lose local partners.
- Potential abuses of environmental and labor rights in the host country.

A second type of externality is that profit-maximizing owners do not value benefits that accrue to others. Thus, they will under-invest in policies that make the high road possible. A particular problem is training. If workers are mobile, profit-maximizing firms will provide less than the socially optimal amount of general training because they fear that they will not get the full benefit of their training expenditure since the trained employees might be hired away by other firms (Becker 1975).

Complementarities. Changing to a new production paradigm is particularly expensive and difficult if changes are complementary, that is, if two modifications made together yield greater performance gains than the sum of the two modifications made separately. For example, firms that adopt Toyota-inspired "lean production techniques" gain higher quality and lower inventory—but only if they couple inventory reduction and quality control (MacDuffie et al. 1995). Each of these initiatives is complex, but firms that do inventory reduction without quality control are likely to be plagued by supply shortages. Firms that improve quality without reducing inventory may not see sufficient savings to justify the costs of the program.

Adopting a high-road production system is not just a matter of sending some blue-collar workers to be trained. Managers must be willing and able to learn new skills as well, and to make use of the skills their subordinates have obtained. Supervisors must be retrained from being disciplinarians to being coaches.

6. Complementary policies

A number of observers have noted the fragility of high-road production in the United States. Cooperation, especially between labor and management, may flourish for a while, but then collapse. Or cooperation may not really get going because management does not want to be too open with the union, because it wants to keep its options open regarding the future of the facility. Low-road options (either in non-union areas of the United States or in low-wage nations overseas) remain attractive to firms, even if they impose costs on society. After a few failures, unions often become reluctant to trust again. Similar problems plague customer-supplier relations. (For examples of breakdown of cooperation, see Sheahan 1996; Parker and Slaughter 1994; Whitford and Zeitlin 2004; MacDuffie and Helper 2006.) Therefore, broader economic policies affect the stability of the high road in manufacturing and in other sectors.

This section draws on other papers in the Economic Policy Institute's *Agenda for Shared Prosperity* (and other sources as well) to briefly discuss policies that help create a favorable environment for high-road production. These policies can be divided into those that "pave the high road" (reduce costs for firms that choose this path), and those that "block the low road" (increase costs for firms that choose the low road, thus reducing their ability to undercut more socially responsible competitors).

Pave the high road

Some key additional policies would improve the supply of high-quality inputs, by subsidizing such activities as training, research and development, and capital. For example:

- *Workforce development.* Policies to improve our schools would lower the expenditures that firms must make to allow their workers to become full partners in providing ideas for and adapting to new production processes. Skilled tradespeople are retiring, and not being replaced. So there is a big opportunity to train people for high-skill, high-wage jobs.[37]

- *A new social contract.* The nation should adopt policies that increase worker bargaining power, so that those who work can support themselves and their families above the poverty line. These policies also benefit high-road employers. As Michael Siegel, CEO of Olympic Steel in Cleveland put it, "I need workers who can focus on their jobs, on delivering quality to the customer—workers who come to work unencumbered by fear about whether their families have health care, or whether they can hold on to their houses." Such policies include promoting full employment, family leave, reducing intimidation of workers who want to form unions, and strengthening the safety net for workers who become unemployed (Bernstein 2007; Cauthen 2007; Hartmann et al. 2008; Kochan and Shulman 2007).

- *Universal health care.* Currently, responsible employers who provide health care for their workers are disadvantaged by the system (Hacker 2007).

- *Adjustment assistance.* People who are laid off from their jobs—whether due to international trade, technological change, increased energy prices, etc.—should receive wage replacement and generous retraining (Bernstein 2007).

- *Infrastructure provision.* Firms as well as individual citizens draw on infrastructure to produce their goods and services. Society's economic functioning relies crucially on well-maintained roads, electricity distribution, and transportation networks. Currently there is a movement to privatize this infrastructure, saying that services can be provided more efficiently and governments can free up much-needed cash by selling off public assets such as roads and de-regulating electricity. But experiences such as the California energy crisis have shown that the theory is often far from the reality. In fact, because of the inelasticity of demand for such services (i.e., if prices rise a lot demand will fall only a little) there is much room for gaming of the system, and companies (such as Enron) will have a great incentive to do so, making the theoretical savings illusory in practice (Krugman 2007).

- *Government procurement policies should take spillover benefits into account.* Give a small preference in obtaining government contracts to firms that employ people in the United States (either directly or through their suppliers), and pay above-median wages. A model for this might be the "Patriot Corporations" bill (Schakowsky 2006).

- *Require firms to consider the welfare of workers and communities as well as stockholders.* Tax breaks could be restored or increased for firms that are likely to be less footloose than firms owned by absentee shareholders, such as employee-owned firms (with a requirement for actual participation by employees), co-ops, etc. The Community Reinvestment Act could be strengthened to require more lending to local businesses.

- *Innovation policies.* There has been no shortage of proposals for improvements to the patent system and other ways of generating inventions and new technology (see, for example, Jaffe and Lerner 2006). Wial and Atkinson (2007) have a comprehensive proposal for a National Innovation Foundation.

Block the low road

Ways to prevent firms from undercutting socially responsible firms by taking the low road include:

- *Redesign international trade.* Include labor and environmental rights in trade treaties (Faux 2007). One approach is to condition trade agreements on a country's record of having wages and benefits increase with national productivity. The United States might consider going to a form of "most-favored nation treatment" in which tariff reductions would go to those countries with proven records in this area. It would not be necessary to specify the exact means countries use to get there, but some effective policies measures include: minimum wage increases tied to national productivity, support for free trade unions, and a socially oriented domestic tax policy (Bluestone 2004). These proposals (especially those that subsidize high-road production in the United States) may require revision of existing trade agreements (though the provisions of these proposals should apply equally to all firms that do business in the United States, regardless of ownership).

- *Push China to revalue its currency.* China has kept its currency artificially low, which makes its exports cheaper and its imports more expensive. This greatly aids China's export market, but holds the Chinese standard of living down, keeping many Chinese in poverty.

- *Reduce inter-state poaching.* The United States should adopt the rules used in the European Union, with the modification suggested by Bartik (2003). That is, national and regional governments may offer firm-specific assistance for economic development only in a few limited instances: to promote high-tech industry, to help small and medium-sized businesses, to assist distressed regions, and (a suggestion by Bartik) to help revitalize brownfields (land with actual or perceived environmental problems impeding their development).

- *Strengthen regulation of unsafe products and workplaces.* One cause of the debacle with contaminated Chinese toys was the severe cuts to the Consumer Product Safety Commission. The commission's budget is just $62 million, even though the agency regulates an industry that sells $1.4 trillion annually. The Food and Drug Administration, with a $2 billion budget, spends nearly twice as much monitoring the safety of animal feed and drugs as the Consumer Product Safety Commission spends to ensure the safety of products as diverse as toys, tools, and televisions. In the 1970s, the safety commission had nearly 1,000 employees; it had only about 500 employees in 1998; and it now has only 420. The impact of these cuts can be seen in the rising product-related death toll, from

22,000 in 1998 to 27,000 in 2006 (Felcher 2007; Lipton 2007; *New York Times* 2007).

- *Don't subsidize "bad" competitors (those that exploit workers or communities).* One way to promote responsible behavior by firms would be to require a company to meet (or make progress toward meeting) criteria such as the following in order to receive public money (Luria 2007):
    - The value-added / full-time equivalent employee rate is above average for its industry
    - The average hourly wage is in the top one-third of its industry (and value-added/sales is at least 30%, to reduce the return for setting up shell corporations)
    - Health care is provided to at least 85% of its workers, where the employer-paid premium is at least $3,000 per covered worker
    - Annual turnover rate is less than 20%
    - Demonstrated competency in lean techniques
    - No violations of labor, environmental, or consumer protection laws

These rules take away the unfair advantage gained by firms who make profits by squeezing their workers.

7. Conclusion: An excellent return on public investment

Coordinated public effort to develop productive capabilities in the United States is an effective way of confronting the twin problems of shrinking manufacturing and stagnant income for most Americans. With the right policies, the United States can have a revitalized manufacturing sector that brings with it good jobs, rapid innovation, and the capacity to pursue national goals.

This paper proposes "demand-side" polices that would increase capacity utilization in manufacturing while serving national goals such as promoting energy sustainability and fixing infrastructure. We also propose "supply-side" policies to help plants increase their productivity to match the level of the best plants in their industry. The centerpiece of this policy is an expanded Manufacturing Extension Program (MEP). This program will:

- Help firms learn high-road production methods that empower workers while creating innovative and sustainable goods and services.
- Sponsor discussion forums to promote regional clusters of firms in related industries that can share institutions for innovation and training.

It also proposes complementary policies that improve worker skills and bargaining power. These policies interact in positive ways: the high-road policies improve firms' efficiency, while the national goals provide additional demand to fill their capacity; the complementary policies make it more difficult for irresponsible firms to undercut more broad-minded firms.

This plan is fiscally quite modest. The plan provides a revenue stream to fund each proposed project. It includes proposals to:

- Generate 20% of U.S. electricity demand from renewable sources, costing $35 billion per year for 10 years, and generating about 350,000 jobs. It would be funded from a portion of revenue generated by taxing carbon emissions (or by auctioning off permits to emit carbon).
- Develop and implement ways to encourage energy efficiency could be funded by cancelling oil and gas subsidies of $3.6 billion per year. This proposal would save at least 18,000 jobs in the auto industry alone by facilitating re-tooling to make hybrids and other advanced vehicles.
- Expand the Manufacturing Extension Program by approximately $300 million, which would save a (crudely estimated) 50,000 jobs.
- Use the spending on economic stimulus to fix aging infrastructure, creating thousands of jobs while preparing the nation for an era

of environmental sustainability and softening the coming recession.

In sum, the plan would probably create about 420,000 new jobs in manufacturing and preserve about 70,000 others that are in danger of being lost. This number pales beside the 3 million manufacturing jobs lost between 2000 and 2003. Far more needs to be done to establish and maintain infrastructure compatible with environmental sustainability. But this plan places the nation's manufacturing capability on a far firmer footing than in the past.

This plan is a far better alternative than current economic development strategy. The United States spends tens of billions of dollars every year on financial transfers from other groups toward manufacturers and their executives, such as corporate tax reductions, property tax abatements, and tax write-offs for stock options given to executives (Bartik 2003). Despite their strong backing by groups such as the National Association of Manufacturers, these policies typically do not influence plant location, let alone increase national welfare. The reason that tax breaks have little impact on firm location is two-fold: first, taxes are a small part of firms' costs and, second, when taxes fall, so do public services that firms depend on, such as roads, police protection, education, etc. (See the review by Lynch 2004).

Why not let all the manufacturing jobs disappear, and have an economy of just Ebays and Googles? There are (at least) two problems with this strategy. First, it would be unfair, at least in the short term, requiring the difficult transition of 14 million people out of manufacturing jobs. Second, it would be inefficient. The United States can compete in many areas of manufacturing, especially if we enact policies to resolve market failures in adopting high-road production. Moreover, a large nation needs to have expertise in most technologies as a preparation against future shocks that might present us with huge technical challenges to the habits of daily living (e.g., global warming), leave us unable to buy from abroad (e.g., military exigenices), and/or with nothing to sell that others want. In most industries, to have effective design and innovation, it is necessary to have at least some production.

Rather than abandon manufacturing, the sector could become a showcase that leads the way toward higher productivity in the economy as a whole. The rationale for high-road policies is applicable to most industries in the United States. The policies outlined here could ensure that all parts of our economy remain strong and that all Americans participate in a productive way and reap the rewards of their efforts.

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Appendix: Barriers to adoption of high-road practices

In this appendix, we discuss in more detail the reasons why firms do not adopt high-road practices, even though it is efficient to do so. We discuss two principal reasons: externalities and complementarities.

1. Externalities. An externality is a benefit or cost of an action that accrues to someone other than the people who decide to undertake that action.

The hidden costs of offshoring discussed in the text are largely costs that are borne by private firms. To the extent that these costs are present, off-shoring is not a profit-maximizing strategy. In addition, profit-maximizing firms fail to account for many other costs of off-shoring, so workers and citizens bear these costs, including:

- Community disruption and job loss. Jobs that pay high wages are replaced with lower wages and lower GDP, and tax revenues are reduced.
- Less-dense supplier cluster reduces innovation in all firms that lose local partners.

There are also negative externalities for the countries hosting off-shoring jobs. International trade offers the possibility of raising the standard of living for both Americans and their trading partners, as firms in each country specialize in what they do best. However, the low prices charged by Chinese firms often come at the expense of Chinese workers. The AFL-CIO estimates that violations of labor rights cut Chinese costs 47-86%; even if this estimate is high, the savings to Chinese firms are substantial. Although workers' wages have been rising, their buying power remains low due to the lack of democracy and independent unions. Factory workers have little ability to capture a fair share of their productivity, since many are internal migrants with few legal rights (for example, they cannot leave one urban job to accept a higher-paying job elsewhere). China also has weak environmental laws, so firms save money on pollution abatement. But again, citizens pay the cost: air and water pollution levels in China are among the worst in the world. In short, the main beneficiaries of these conditions are U.S. multinationals, not Chinese workers. Multinationals account for two-thirds of trade between the United States and China (AFL-CIO 2006; Faux 2007).

Externalities and high-road production. Profit-maximizing owners do not value benefits that accrue to others, and will thus under-invest in policies that make the high road possible. A particular problem is training. If workers are mobile, profit-maximizing firms will provide less than the socially optimal amount of general training because they fear that they will not get the full benefit of their training expenditure since the trained employees might be hired away by other firms (Becker 1975).

A production process that relies on coordination among several parties also has implications for bargaining power. To the extent that parties involved in the coordination are hard to replace quickly, employers or lead firms must share more of the profits with these partners than in arm's-length markets with interchangeable workers or suppliers. Sometimes the pie is made sufficiently larger by collaboration so that powerful firms' profits actually rise with collaboration. But other times, firms find it not privately profitable to invest in collaboration even though it is socially efficient (Stanley and Helper 2006).[38]

Moreover, there is evidence that firms *design* production processes to minimize interdependence with suppliers and workers. This may be profit-maximizing for the firm, but not for society. For example, U.S. automakers de-skilled the job of being an auto supplier in the 1950s, moving such complex tasks as design and sub-assembly in-house, and having each supplier produce only a small component (e.g., one bracket rather than a head-rest assembly). This strategy increased the bargaining power of the automakers, because they could easily switch among a large number of competing suppliers who needed to know only how to read a blueprint (not how to design parts themselves). But this extreme and adversarial division of labor produced inefficiency and poor quality, since a supplier could not design components to fit its own production process. When Japanese automakers entered the U.S. market using a more collaborative strategy, the U.S. firms had trouble dismantling the old adversarial structures and adopting a time horizon long enough to overcome suppliers' distrust (Helper 1991; Helper and Levine 1992).

Why did U.S. firms adopt these strategies, rather than the more collective strategies favored in Western Europe or Japan? Several explanations have been put forward; they may all be true. First, the explanation for suppliers above focuses on the fast growth experienced by the first firms to figure out mass production in the United States, growth which gave these firms the cash to invest in in-house design and sub-assembly. Second, with respect to labor, Chiaki Moriguchi (2003) argues that both U.S. and Japanese firms embarked on "welfare capitalism" in the 1920s, in which firms asked workers for their knowledge and loyalty in exchange for an implicit promise of a long-term job. In Japan, firms largely kept these promises. But the extreme depth of the Great Depression in the United States made it profit-maximizing for firms to renege on this commitment. As a result, a self-reinforcing adversarial culture and institutions arose in much of the U.S. economy.

Third, in the past, the United States had market power. Thus, firms could compete using these inefficient strategies that reduced their dependence on the knowledge of suppliers and workers. In the 1950s, a truce was reached between management and labor that Levy and Temin (2007) call "the Treaty of Detroit" in which unions agreed to not take a role in management, and management agreed to share the fruits of productivity gained from their unfettered ability to change production. This "treaty" made the distribution of income somewhat more equal. However, Levy and Temin argue that income inequality has increased in recent years because institutions that promote re-distribution (such as unions and governments) have become weaker.

This paper discusses a reason that institutions for distribution become weaker. The separation of production and distribution of income is no longer sustainable in the face of international competition. Management can gain access to workers who are not protected by the agreement about sharing fruits of productivity, first in the U.S. south and now throughout the world.

The above argument gives a new perspective on the large economics literature on "skill-biased technical change" (Berman and Machin 2000). Economists have argued that increasing inequality is due to lack of education, which has become a particular problem because technological change for some unknown reason has been biased toward increasing skill. However, if the problem is that institutions that promote re-distribution have become weaker, then increasing education by itself will not resolve inequality. Krugman (2007) points out that most of the growth in income inequality is due to large gains by the top 1% of the population. The median college-educated man has seen his income rise only 17% since 1973, suggesting that education alone is not the key to avoiding income stagnation

A key part of the solution is to adopt high-road institutions that give most workers (not just a few top managers) an integral role in production—making them indispensable, not disposable. But, changing to the high road requires complementary investments. This brings us to another source of market failure.

2. Complementarities. Changing to a new production paradigm is particularly expensive and difficult if changes are complementary, that is, if two modifications made together yield greater performance gains than the sum of the two modifications made separately. For example, firms that adopt Toyota-inspired "lean production techniques" gain higher quality and lower inventory—but only if they couple inventory reduction and quality control (MacDuffie et al. 1995). Each of these initiatives is complex, but firms that do inventory reduction without quality control are likely to be plagued by supply shortages. Firms that improve quality without reducing inventory may not see sufficient savings to justify the costs of the program.

Adopting a high-road production system is not just a matter of sending some blue-collar workers to be trained. Managers must be willing and able to learn new skills as well, and to make use of the skills their subordinates have obtained. Supervisors must be retrained from being disciplinarians to being coaches.

Consider all the interrelated changes necessary to adopt a successful suggestion program (Helper, Levine, Bendoly 2000). Workers often react quite positively to being asked for their opinion.[39] But then someone must direct the resulting flood of suggestions to individuals who can evaluate them, which may be difficult because no one remembers all the reasons why a particular process was originally designed the way it was. Someone needs to collect data to make it possible to evaluate the suggestions in an objective manner. Engineers need to evaluate the suggestions in a timely way, taking time away from their own projects to look at ideas from people they have typically considered not particularly bright. Someone needs to get back to the suggestor, explaining, if necessary, why the suggestion was not adopted or had to be modified. The right level of incentives for good suggestions needs to be established; if too low, workers feel cheated; if too high, gaming will be encouraged.

Coordination problems occur between firms as well as within them. If customers can rely on suppliers to provide timely delivery and high-quality products, they can adopt more efficient production processes. For example, they do not need to inspect the suppliers' shipments, and they can eliminate expediters. But if not all of the suppliers invest in these activities, customers cannot achieve all of the synergies of running low-inventory production processes.

Many of these investments require relatively long pay-back periods (total-quality management can require a two-year payback), and create intangible assets that are hard for financial markets to value. Thus, another problem is liquidity constraints. Adopting the production processes that lead to high wages and high value-added requires capital and product development capability. These upgrading activities require fairly large upfront expenditures. Since many of these expenditures do not result in a tangible asset, banks are often not willing to lend money to help finance them (Levine 2007).

This brief tour through the U.S. economy shows that the real economy is different in crucial ways from the model of competitive markets that has dominated recent political discussion. To overcome market failures, *strengthening* these departures from the competitive-market model is key to a productive, fair economy. First, the competitive market model's emphasis on instantaneous, costless reallocations of resources is misplaced. Involving suppliers and workers in designing and improving their production process creates stickiness; this stickiness gives firms and workers incentives to invest, promotes the exchange of tacit information, and gives workers more bargaining power.[40]

A second departure from competitive market thinking lies in the values we believe an economy should promote. U.S. economic policy should aim to create opportunities for increased standard of living and fulfilling work. Policy should thus provide incentives to firms to produce in the United States using a production recipe that is innovative, high-wage, and environmentally sustainable.

How public policies can help

The pervasiveness of externalities and complementarities, plus the importance of avoiding vast disparities of wealth, suggests that markets may fail to maximize social welfare. Thus, it is possible that government intervention could improve welfare—that is, that $1 of spending (either in paying taxes or complying with regulations) yields more than $1 of public benefit.

But there are risks to government intervention. Governments and legislators may fail to maximize welfare, as well. They may try to "pick winners" without providing any justification as to why bureaucrats can make better choices than market forces. They may use public money to reward their friends rather than to promote economic development. They may provide subsidized assistance to some competitors that disadvantages more responsible competitors who develop capabilities on their own. To overcome these problems, it is important to design good policy. Such policy would:

Focus on solving market failures. As Dani Rodrik (2004) argues, governments should not favor particular industries. It is indeed true that officials (especially in a developed country that cannot rely on following a path blazed by other, more-advanced nations) typically do not have better information about the likelihood of success of particular industries. Instead, officials should design policies to remedy market failures. In particular, Rodrik states that:

> industrial policy needs to focus not on the policy *outcomes*—which are inherently unknowable ex ante—but on getting the policy process right. We need to worry about how we design a setting in which private and public actors come together to solve problems in the productive sphere, each side learning about the opportunities and constraints faced by the other.

Based on the discussion in the previous section, public policy would be likely to improve welfare if it promoted the development and use of production recipes that boost:

a. Training and use of skilled workers (which the market under-provides due to training and coordination externalities)

b. Linkages among tasks (which the market under-provides due to firms' desire to retain bargaining power)

Set up mechanisms for continuous improvement. All funds provided should be listed on the Internet. There should be rigorous evaluation programs (Levine 2007); one task of the discussion forums described above should be to design these.

Endnotes

1. Sources: Charlier 2005; Troester and Stanfer; n.d. Bob Roberts, IBEW (personal communication, 2008).

2. See ftp.bls.gov/pub/suppl/empsit.ceseeb1.txt. For August 2007, see http://www.bls.gov/news.release/empsit.nr0.htm. The number is slightly smaller if we adjust for rising use of temporary labor in manufacturing (Dey, Houseman, and Polivka 2006).

3. In recent decades, much has been made of the argument that government intervention in the "free market" will only reduce public welfare (Friedman, 2002). This argument is flawed. As any economics text explains, in the real world unfettered markets often fail to align public and private incentives. For example, if government does not charge firms to pollute, then firms can make profits by contaminating air and water—in which case shareholders benefit, but the public suffers. The policies this paper proposes for manufacturing all aim to resolve "market failures" such as these.

4. See, for example, http://www.brookings.edu/projects/blueprint.aspx

5. As Ralph Gomory, former IBM executive and head of the Sloan Foundation, put it, "In this new era of globalization the interests of companies and countries have diverged. In contrast with the past, what is good for America's global corporations is no longer necessarily good for the American people" (Gomory 2007).

6. Other papers in the Agenda for Shared Prosperity series have looked at ways to improve the quality of individual inputs, as described later in this paper.

7. There are many examples of high-road policies in Europe. See, for example, Herrigel (2004); Streeck and Thelen (2005). Westergaard-Nielsen (2008).

8. Several studies describe problems with invention and propose solutions. See, for example, Wial and Atkinson (2007); Kalil and Irons (2007); and Altman et al. (2006). This paper focuses on the problems of *implementing* new technology, an issue that has received much less attention.

9. See, for example, Bresnahan et al. (2002); Bartel et al. (2007).

10. See, for example, McManus (2003).

11. The following example illustrates some of the problem. When we think of labor productivity increasing by 10%, we usually think, for example, that Joe Machinist figured out how to make 110 parts in an hour instead of 100. Instead, what happened is that Joe's boss outsourced some production to China and fired Joe. So he is now getting 100 parts with 10 workers rather than 11, but only because of imports. Moreover, attempts to account for the value of offshoring fall short. As it turns out, no part of the government's immense statistical machinery actually tries to measure the price differential between a product produced in the United States and the same product made in China or elsewhere. As a result, the real value of off-shored goods and services is underestimated (Houseman 2007; Mandel 2007). An additional problem is that the increasing use in manufacturing of workers from temporary help agencies inflates manufacturing labor productivity measures. This is because the staffing agency workers utilized in manufacturing are classified in the services sector, not the manufacturing sector, and the output measure used to compute manufacturing labor productivity does not net out purchased services (Dey, Houseman, and Polivka 2006).

12. As measured by three-digit NAICS code.

13. Similar results have been obtained with other industries. See, for example, for the case of automobile assembly in MacDuffie (1995).

14. In this endeavor we can indeed learn from agricultural policy; agricultural extension services played an important role in transforming U.S. agriculture from subsistence farming into a highly productive endeavor. The industry did shrink—but continues to export in part because of farmers' new capabilities (Shapira 2001).

15. There are other pressing national needs to which manufacturing skills are critical.

    Public works infrastructure: Mishel et al. (2008) propose a $140 billion economic stimulus package that would create about 75,000 manufacturing jobs (plus many more construction jobs) by funding infrastructure projects. Public infrastructure (roads, bridges, sewers, etc.) is crucial for private firm productivity. The type of infrastructure that is most effective will change as the nation takes seriously the costs of environmental degradation (carbon emissions, air and water pollution, etc.); fewer highway expansion projects and more mass transit will be needed, for example. The United States could reduce electricity use by upgrading to a "smart grid" that minimized power losses in transmission, and allowed consumers to plan consumption to reduce peak demand (Lordan 2004). Planning for future infrastructure should assume much higher energy prices.

    Military needs. Reducing dependence on foreign sources of energy (plus adopting a less aggressive posture) will reduce the need for a large military. However, it is problematic that the United States has lost capability to make key components needed for national defense. In some cases, the military does not know of these shortages, because it lacks detailed information about the lower tiers of the military supply chain (Yudken 2007). The military should consider a.) requiring contractors and subcontractors to disclose to the Department of Defense the name and location of suppliers, and b.) require a U.S. location for a certain percentage of supply.

16. Stern Report: http://www.hm-ctreasury.gov.uk/independent_reviews/stern_review_economics_climate_change/sternreview_index.cfm; UNFCC: http://unfccc.int/; State of California Press Release: http://gov.ca.gov/index.php?/press-release/4111/ ; USCAP: http://www.us-cap.org/.

17. The potential for catastrophic events rises significantly for temperature increases in the range of 2–3 degrees Celsius. If we are able to stabilize the concentration of these gases in the atmosphere at 450 parts per million carbon dioxide-equivalent, we would have about a 50% chance of keeping the global average temperature from rising more than 2° Celsius, or 3.6 degrees Fahrenheit, above pre-industrial levels, and a 67% chance of rising less than 3° Celsius.

    To meet this target, worldwide cumulative emissions must be limited to 1,700 gigatons (Gt) carbon dioxide-equivalent for the 2000–50 period—of which approximately 330 Gt carbon dioxide-equivalent has already been emitted. To allow developing countries room to raise their standards of living, they should get 60% of the remaining emissions budget (they are 85% of the population). Allocating the rest of the allowances among the developed countries yields a reduction target of 80% in cumulative emissions by 2050, or an amount equal to an annual reduction of 2% (0.16 Gt carbon dioxide-equivalent) of the United States' current emissions for the next 40 years.

18. An EPA (2007) study (which allocated electricity emissions to end users) found that "industry" (a category that includes non-commercial service industry as well) accounts for 28% of emissions in the United States.

19. An additional reason for optimism is that careful studies have shown that firms have vastly overestimated the costs of complying with environmental initiatives in the past (Goodstein 2008).

20. See http://www.americanprogress.org/issues/2007/11/energy_chapter.html for a general plan on how to reduce carbon emissions by one-third by 2050.

21. This number, calculated by the Congressional Research Service, includes only tax breaks that go exclusively to oil and gas producers; it does not include items such as transportation subsidies that largely benefit these producers, or the $19 billion annual cost of defending Persian Gulf shipping lanes.

22. Energy price increases in the past have led to significant increases in research and development spending for energy efficiency (Chow et al. 2003).

23. There are good arguments in favor of both a carbon tax (it is simple to administer, would give companies a known price) and a cap and trade system that a.) auctioned most of its permits with the revenue going to the public treasury, and b.) had a safety valve (ability to purchase emissions permits at a given (albeit relatively high price). The safety valve is very important because it prevents firms from hoarding permits and then auctioning them off at a very high price (similar to what happened in the California deregulation/energy crisis).

24. A provision in the current version of the Climate Security Act links responsibility to carbon consumption, not production. This idea derives from a joint proposal by the American Electric Power Company and the International Brotherhood of Electrical Workers. The provision requires that importers of goods from countries without carbon caps obtain permits for the emissions resulting from the goods' production (Chevalier 2007).

25. Greene (1990) cited in Goodstein (2007).

26. Thus, an additional benefit of pursuing the national goals described in section 3 is that it helps firms increase their capacity utilization.

27. See, for example, Ichniowski et al. (1997) and Gant (2002). The $2 million figure is derived as follows: the authors estimate that 1 percentage point of uptime for a small plant is worth $28,000 per month (net of the additional costs of the employee involvement program); $28,000/month multiplied by 12 months/year multiplied by 6.7 percentage points of uptime for "system 1" HRM = $2.25 million (in 1997 dollars). The Mittal steel example comes from Helper and Kiehl (2004).

28. Much attention has been paid recently to the idea of "modular design," which has as its explicit purpose to eliminate the need for knowledge overlap between designers of components. If there is a standard interface, designers do not need to interact with designers on the other side of the interface (Baldwin and Clark 2000; Sturgeon 2002). Such modularity allows for multiple experiments to take place independently, often speeding up the process of invention (Fallick, Fleischman, and Rebitzer 2006). This kind of activity is facilitated by many policies in the United States, such as subsidies for learning general skills in universities.

    However, modularity is not a panacea. In practice, problems are identified that were not considered when the standard was developed. Or, someone comes up with an innovation that requires re-drawing module boundaries. Thus, some overlapping expertise between adjacent modules, or between design and production, has a big payoff in reduced lead time, defects, etc. (Sabel and Zeitlin 2004; MacDuffie and Helper1997; Clark and Fujimoto 1991; Ernst and Kim 2002; Lester et al. 1998). As noted in the text, high-road production processes suffer from many externalities that lead to underinvestment in these techniques. It is unlikely that the modest programs discussed here would lead to high-interaction problem-solving being used where it is inefficient.

29. Jarmin's study takes a novel approach to the problem that participation in the program is not random. Firms who are either more productive than average (and therefore more aggressive) may be more likely to seek out the program, or firms who are less productive than average (and therefore more desperate for help) may be more likely to use the program. In either case, the estimates of the effect of the MEP "treatment" will be biased. Jarmin corrected for this bias by observing that firms that are closer to an MEP are more likely to use it. His statistical method thus compares the productivity of two firms that are identical except that one is close to an MEP center and one is not

30. The average program studied by Jarmin cost $191,000, of which two-thirds was paid by state or federal government. We assume that treated firms have only 3.4% higher value added after five years than do untreated firms (Jarmin's low estimate) they linearly approach this level over the first five years after the treatment, and then fall back (linearly) to that of untreated firms after five years. For the average-sized firm the additional value added sums up to $750,000 using a 10% discount rate. If the firm subtracts its payment for the project and then it or its workers pay taxes on the remainder at 20%, the present value of taxes paid on the additional value added would be $137,000—more than the $128,000 public cost of the project.

31. Two examples: 1.) the participants in the WMDC decided to focus on cycle-time reduction as the key skill that suppliers needed. In contrast, for steel production, a key issue is increasing uptime. 2.) In apparel, the most useful form of worker interaction seems to occur in on-line teams that react to problems as they occur. In contrast, in steel, off-line teams that analyze problems in detail are more useful (Appelbaum et al. 1994 and 2000). This difference may explain why studies that look for positive productivity impacts of a common set of employee involvement practices across all industries tend not to find significant effects (e.g., Freeman and Kleiner 1999), while those studies that look at a single industry tend to find highly positive effects of employee involvement practices tailored to that industry (Helper and Kleiner 2007).

32. AFL-CIO (2004) has more examples of such "cluster intermediaries" (p.28). See also Bernhardt et al. (2001).

33. The low-wage-country costs are what the U.S. companies' costs would be if they had the low-wage-country's factor costs, productivity, and quality, and had to serve the U.S. market from offshore. The industry averages are calculated from the Performance Benchmarking Service data (see appendix for description). The core assumptions about low-wage country (LWC) costs are derived from extensive interviews. They are:
    - LWC shop floor worker wages = 10% * U.S.
    - LWC non-shop pay = 33% * U.S.
    - LWC labor productivity = 25% * U.S.
    - LWC purchased services cost = 70% * U.S. (because this includes subcontractor wages)
    - LWC waste rate (scrap, rework, rejects) = 5 * U.S. waste rate
    - LWC material, energy costs = 90% * U.S. material, energy
    - LWC must add 12% to cover extra freight, duty, and logistics (Dziczek et al. 2006).

34. Note that most of the "hidden costs" are incurred in the United States. Thus, it is not a contradiction to argue both that government statistics overstate the piece price of imports (as in section 2), and that firms understate the "total cost of ownership" of an off-shored part.

35. The sponsor of the study was Fanuc Robotics a (Japanese) company promoting automation as an alternative to off-shoring. Hence, it is not unbiased, but does give an order of magnitude of the hidden costs. www.saveyourfactory.com.

36. See also Levine (1995) and Freeman and Lazear (1994).

37. For more on training, refer to the Manufacturing Skill Standards Consortium or National Association of Manufacturers.

38. While productivity almost always increases when high-road practices are adopted, profits may not. For example, the PBS data shows that firms that design their own products are more productive. But, all of the extra productivity is captured by increased salaries to engineers and workers—profits do not rise at all.

39. This enthusiasm is markedly reduced after workers have experienced employee involvement that are poorly organized and/or characterized by employer reneging on commitments (Sheahan et al. 1996). Thus, new rules (described in Section 6) as well as new training will be required to make high-road production viable.

40. This statement does not mean that all forms of stickiness are socially beneficial; only those that promote investment have this property.

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