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## **Catalyzing Manufacturing Competitiveness with Targeted Responses to Key Market Failures**

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Good morning Chairman Bucshon and Members of the Subcommittee. I very much appreciate the opportunity to appear before you today to talk about a subject of great importance to the nation: the renewed importance of manufacturing to U.S. economic competitiveness.

I also appreciate the chance to say a few words about the best sorts of actions that the federal government can take in order to help sustain the sector. In doing that I'll provide a few comments on H.R. 1421.

As you know it is an opportune time for this hearing inasmuch as the manufacturing sector has been forcing us all to take note of late. With over 500,000 jobs added since the beginning of 2010, the sector has stood out as one of the economy's genuine bright spots. In fact, since then, the sector has grown no less than about twice as fast as overall economy, and in doing so manufacturing industries have significantly out-performed the range of a normal cyclical rebound. Something good is happening.

And yet, for all that, skeptical questions continue to be raised.

Some wonder why all the fuss and ask whether it really matters if the country has a strong manufacturing base.

Others grant that manufacturing matters but doubt whether manufacturing is an appropriate object for public policy.

And finally, views differ on which policy approaches will do the most good.

In view of all this, I want to insist that manufacturing matters, argue that it requires policy interest, and suggest some priorities for that interest. After that, I'll say a few things about the strengths and weaknesses of the bill before you in view of those priorities.

### **Why manufacturing matters and why policy should support it**

Let's first consider why manufacturing matters and why public policy should support it.

To see the importance of manufacturing one only needs to recall one of the central takeaways from the Great Recession: that the U.S. needs to rebalance growth away from consumption and imports financed by foreign borrowing and back toward making things and exporting them.

In this regard, the crisis reminded the nation of the perils of letting the economy tilt too far away from maintaining a healthy presence in the economy of such basics as innovative activities, production, and exports—the true sources of competitiveness and wealth generation. As one consequence of that drift the nation has run a trade deficit in every year since 1976, with the deficit exceeding 2.7 percent of GDP in every year since 1999 and clocking in at \$45 billion in May 2013.<sup>1</sup>

So why precisely does manufacturing matter so much? It matters for lots of reasons—including the decent pay and diverse but often accessible jobs it tends to offer. But here I want to stress the sector's importance for reducing the trade deficit and driving commercial innovation—two linchpins of nations' economic well-being.

On the trade side, it is important to recognize that manufactured goods account for about 89 percent of the merchandise exports from the U.S. and about 60 percent of all goods and services exports combined.<sup>2</sup> To be sure, service exports are rising, and should help with the task of improving the trade balance. But even so the fact remains that while it is theoretically possible for the nation to eliminate its trade deficit by increasing the export and reducing the import of services, agricultural products, and natural resources, the job will be much easier if manufacturing exports grow.<sup>3</sup> The bottom line: Stepping up our manufacturing exports is going to be essential if we want to reduce the trade deficit.

As to the matter of innovation, the simple fact is that manufacturing matters because of its huge role in product and process enhancement. Economists, in this connection, have for decades been very clear that innovation—the creation of new products, processes,

technologies, and business models—hugely influences nations’ productivity, competitiveness, and living standards.<sup>4</sup> And yet until recently fewer investigators had looked at the strong links between manufacturing and innovation. However, that has changed in the last few years or so thanks to work by researchers at Brookings, the Information Technology and Innovation Foundation, the Massachusetts Institute of Technology, and Harvard Business School.<sup>5</sup>

Last year, for example, my group at Brookings looked into this carefully and reiterated the basic story: Although manufacturing accounts for only 11 percent or so of U.S. output it is responsible for no less than 68 percent of domestic R&D spending by U.S. companies.<sup>6</sup> Likewise, the sector employs some 35 percent of the nation’s engineers and 60 percent of all U.S. R&D workers (despite employing only 9 percent of all workers) and is a major source of U.S. patenting.<sup>7</sup> The crucial point here: Manufacturing is a key site—arguably *the* key site—of the U.S. innovation machine that has in the last 15 years churned out such life-changing inventions as personal GPS devices, the iPhone, and so-called 3-D printing. Lose manufacturing and we may lose much more than just 12 million plant jobs.

Which bring us to the question of policy: Is manufacturing an appropriate priority for public policy action? On this important issue, I would commend to you two well-argued speeches given last year and this summer by Gene Sperling, director of the National Economic Council, which mount some of the right arguments.<sup>8</sup> But for my part, I want to say, right off, that manufacturing absolutely *is* an appropriate focus for policy support. Not only does manufacturing matter but there are sound economic reasons for fostering it.

To be sure, many economists—and perhaps many of you—start from the premise that any type of preferential treatment of any single type of investment is off-base because it is “distortionary.” However, it is essential to remember that standard economic theory also justifies government action where there is a “market failure”—meaning, in situations where the societal benefits of an activity exceed the private return—making it unlikely that a private business will invest sufficiently unless government plays a role.

At Brookings we believe U.S. manufacturing is challenged by a number of market failures many of which have to do with the extent to which manufacturing activity generates positive “spillover effects” that the individual firm cannot monetize and that thereby creates a risk of the nation under-investing in areas of societal benefit.<sup>9</sup>

In this regard, many of the market problems result from the very power of the beneficial “co-location synergies” that economist Greg Tasey suggests result when manufacturing firms cluster together in a region. But at any rate, we see a number of serious market problems relevant to this morning’s discussion that merit government attention. Specifically:

- Manufacturers underinvest in collaborative public-private roadmapping exercises because the collaborations are hard to organize and because collaborators can rarely reap the full value of the association in their profits. Here we know that when an

economic activity has positive “spillover” effects that an individual firm can’t capture we as a society and economy may well under-provide it

- Manufacturers—especially small ones—underinvest in R&D because they cannot reap the full value of technical advances in their profits. This is the classic example of the problem of positive spillovers
- Manufacturers—especially small ones—often lag in adopting or identifying and developing the latest training and education models and practices. Here again the inability of firms to capture all of the benefits of their own investments means they will produce much less productivity-enhancing activity than is optimal for society

In addition we would note that:

- The economic and innovation benefits of regional manufacturing clusters are underappreciated as well as underprovided. Again, clustering generates positive externalities that benefit the overall economy but that can’t always be captured by the participating firms<sup>10</sup>

In each of these instances, then, the implication is clear. Fundamental market issues ensure that the nation will under-invest in key aspects of the nation’s manufacturing commons if it simply leaves well enough alone. And if we do the nation’s manufacturing competitiveness will be further compromised. In sum, policy attention is not just permissible but necessary.

### **Key components of sound manufacturing policy**

But how, then, should policy support be configured? What sorts of policy actions make sense if public policy support for manufacturing is warranted?

To begin with, it’s important to note that manufacturing policy would not “pick winners and losers.” In fact, a smart pro-manufacturing stance on the part of the public sector would lean away from special treatment of single firms. Instead, well-considered manufacturing policy would undertake two main activities: It would seek to improve the “macro” environment in which all manufacturers operate while at the same time intervening in limited, strategic ways to address specific, demonstrable market failures that affects *groups* of firms. In both cases the thrust of policy would in general move toward improving the lot of large groups of firms or whole industries or sectors.

In this regard, I will pass rapidly over the most general suite of economy-wide policy stances before focusing on some responses to crucial market problems. Aimed at ensuring that the U.S. is one of the world’s most attractive locations for high-value production, the basics of general policy encompass such “macro” topics as technology, taxes, trade, talent, infrastructure, and energy and have been well articulated by Rob Atkinson and Stephen Ezell of the Information

Technology and Innovation Foundation as well as my Brookings colleagues Bruce Katz, Amy Liu, Rob Puentes, Brad McDearman, and Scott Andres who have worked intensively on global exchange and infrastructure issues and advanced industries topics. In brief, it is important that federal policy:

- Increase public investment in R&D and technology development
- Improve the nation's tax competitiveness for high-value industrial investment by reducing its high effective corporate rates, including by increasing the generosity of the R&D tax credit and reducing the effective rate on capital equipment investments
- Foster trade by ensuring that manufacturing firms are well-connected to global markets and capital flows. Export and foreign direct investment promotion are critical but so must the rights of manufacturing firms be protected in international markets even as trade policy emphasizes expanded access to new markets
- Invest in the nation's STEM workforce, particularly to ensure the availability of applied technology engineers and an abundant "middle skills" worker pool
- Modernize the nation's declining highway, rail, and port infrastructure to facilitate exports and speed time to market
- Safeguard the nation's providential energy windfall of unconventional natural gas, ensuring its abundance at low prices for domestic industrial use

Along these lines, much consensus exists about the more general macro policy agenda the nation needs to maintain and expand a competitive manufacturing sector.

But what about public policy agendas that speak more directly to the several market problems I identified earlier?

In this connection, I have argued that in certain situations where the benefits of specific desired activities cannot be contained within or fully monetized by the participating firms, policy intervention is warranted to ensure that relevant good is adequately provided. So what are the kinds of policy responses that would help make up for some of the market problems we are discussing here today: the underproduction of such socially beneficial goods as collaboration to identify long-term industry technology needs; innovative activity among SMEs; and the production and use of top quality manufacturing education?

Here are some thoughts:

Collaborative roadmapping and multi-actor coordinated work to develop shared technology platforms and infrastructure may well be best induced through competitions that call into being multi-actor consortia that must collaborate—and invest on a matching basis—to secure

funding. This strategy—which my group suggested in work that informed the design of the Department of Energy’s Energy Innovation Hubs program—is currently being employed in numerous Department of Commerce challenge grants and most prominently in the department’s National Network for Manufacturing Institutes (NNMI) initiative.<sup>11</sup> My group likes these challenges because they combine the funding needed to “buy” the under-provided social good with criteria that require and structure the most beneficial sort of collaboration and governance, since collective action problems inevitably accompany the spillover problems associated with technology collaboration.

Turning to mechanisms for increasing innovative activities among SMEs, governments can choose among various tools to incite smaller-firm R&D. They can employ direct grants or competitive contracts again to simply “buy” R&D activity or they can employ indirect fiscal incentives such as R&D tax credits.<sup>12</sup> More recently some states have begun to experiment with the establishment of “innovation vouchers” structured to allow individual firms to “buy” R&D from third-party providers.<sup>13</sup> In thinking about which tool is more appropriate it is worth noting that each tool addresses slightly different market problems. Whereas a direct grant can be directed toward specific types of projects that government deems important, a voucher or tax credit provides a general incentive to all kinds of R&D across the economy and leaves the topic to the firm.

Otherwise, the strategies policymakers might employ for addressing manufacturing education and training problems resemble those they might employ to catalyze collaborative technology roadmapping. Fundamentally a collective action problem suffused with positive externalities for participating firms, education challenges are probably best attacked through a competitive grant strategy that aims to call forth new collaborations between firms and, in this case, community colleges—our leading front-line training organizations. Critical here will be insisting that private sector actors aren’t just participants but active leaders of the education initiatives.

In short, for each of these market failures a targeted, bounded, but potentially effective policy response can be designed that will help realign the incentives of firms and institutions to deliver more of the specified socially beneficial activity than the market does now.

### **Comments on H.R. 1421**

So how does H.R. 1421 comport with the elements of good manufacturing policy I have laid out here? I would say it lines up pretty well and addresses several areas of recognized market weakness with reasonable, focused responses.

The advanced manufacturing technology consortia item (Sec. 2) should help overcome the coordination problems that currently limit pooled work on shared technology issues. In doing so, the section will provide a welcome mechanism for better aligning public, private, and university long-term industrial research. By way of advice, I would just suggest that to make the greatest economic impact the consortia should be focused on an accepted list of top “cross-cutting technologies” such as that identified by PCAST in its second report on capturing

advantage in advanced manufacturing.<sup>14</sup> Ranging from advanced materials and sensing to additive manufacturing and robotics these technologies will be pivotal in enabling U.S. competitiveness and are prime candidates for roadmapping.

The Small Manufacturer Innovation Program (Sec. 3) is also welcome as it specifically addresses innovation needs (and besetting market problems) affecting SMEs at a time when most SME policy lags behind modern economic reality. Large original equipment manufacturers are pushing technology needs upstream to their disperse network of SME suppliers so targeted assistance to support SME innovation is needed. Unfortunately, most SME policies currently support basic business development and some skills training with little emphasis on R&D. So, again, the new focus on innovation is extremely welcome, although I would only wonder if a “retail” grants program is the best way to reach thousands of “head down” SMEs with often lower capacity. One thought would be that the pilot ought perhaps to be focused on somewhat larger “middle sized” firms that are more likely “ready to innovate.”

At the same time, I applaud the proposed experiment with innovation vouchers in Sec. 4. I like its simplicity and potential speed. I like that it provides a small-dollar tool for spurring innovation in SMEs while providing a mechanism that will give universities and labs an incentive to be more responsive to industry needs and particular companies. In that sense, vouchers strike me as a nimble way to get SMEs “into the game” while engaging universities and research institutions by fomenting more exchange.

Meanwhile, the advanced manufacturing education grants to community colleges hits a particularly relevant issue—the importance of sub-baccalaureate STEM workers. Research from one of my Brookings colleagues has found that half the STEM jobs in the United States require less than a bachelor’s degree, with many of these positions in manufacturing.<sup>15</sup> And yet I think the production of relevant workers through collaborations of community colleges and industry is a classic collective action problem, plagued with positive externalities that ensure neither firms nor colleges engage intensely enough. Given that, I think the proposed competitive grants make sense. I would only counsel that the scale of the problem here is enormous and that the criteria for grant awards should stipulate very substantial participation on the part of large and smaller firms in proposals. A serious problem here is that many community colleges remains seriously divorced from industry needs so the grants should require bridging that gap.

Otherwise, I want to make one general comment about what I am somewhat surprised is missing here, which is some reference to the *regional* locus of manufacturing innovation and workforce recruitment. As the policy director of the Metropolitan Policy Program at Brookings I am biased here but I want to stress that geography matters in manufacturing.

Innovation, and its deployment, does not happen just anywhere. It happens in places and most notably, within metropolitan regions where firms and workers tend to cluster in close geographic proximity, whether to tap local supplier networks, draw on a pool of skilled workers, or profit from formal or informal knowledge transfer. If properly channeled, these “co-location

synergies” as Greg Tassef has called them augment the vitality of regional—and therefore national—manufacturing clusters. Nor is this only a “soft” benefit. Such local synergies—accumulated region by region—represent a crucial source of national manufacturing capacity and productivity. Given all this, I would love to see some references in the bill to “regional manufacturing networks” and the participation of “regional industry associations” and so on as I think the best proposals will reflect strong regional involvement in regions that retain what Willy Shih and Gary Pisano call a strong “manufacturing commons” of shared access to webs of technical know-how, operational capabilities, and specialized skills that are embedded in the region’s firms, workforce, suppliers, educational institutions, industry associations, and the like.<sup>16</sup> I realize some of these features are reflected in Investing in the Manufacturing Communities Partnership initiative as well as the NNMI but it would be good to prioritize proposals that reflect thought about the local industrial commons.

## **Conclusion**

In conclusion, I will say simply that manufacturing very much matters, that policy interventions are needed, and that competitive grant programs can target key market failures and help to ensure sufficient production of key societal good. HR 1421 addresses several of the relevant problems and so represents a step toward addressing several fundamental challenges the nation faces as it seems to rebuild its regional manufacturing commons.

*The views expressed in this testimony are those of the author alone and do not necessarily represent those of the staff, officers, or trustees of The Brookings Institution.*

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<sup>1</sup> U.S. Department of Commerce, Bureau of Economic Analysis, August, 2013.

<sup>2</sup> U.S. Department of Commerce, TradeStats Express Data Home, 2013.

<sup>3</sup> See, for example, Susan Helper, Timothy Kreuger, and Howard Wial, “Why Does Manufacturing Matter? Which Manufacturing Matters: A Policy Framework” (Washington: Brookings Institution, 2012)..



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<sup>4</sup> Innovation refers to the production greater output with the same level or fewer inputs. Economies can grow for a short time by simply adding more (or better-skilled) workers and machinery to the production process, but eventually all inputs, save innovation, reaches diminishing returns. Robert Solow first showed that only innovation was responsible for long-run growth in his seminal work, “A Contribution to the Theory of Economic Growth” in 1954 and since there has been no shortage of economic literature that shows innovation drives long-run growth. For example, Princeton professors Robert Hall and Charles Jones find in a study of 127 nations that “relatively little of the difference between high- and low-performing countries owed to physical and human capital” but instead depended on how countries invested in new technologies to increase productivity explained their success. See Robert Solow, “A Contribution to the Theory of Economic Growth,” *The Quarterly Journal of Economics*, 70 (1) 1956.

<sup>5</sup> See, among many others, Helper, Kreuger, and Wial, “Why Does Manufacturing Matter?” as well as Stephen Ezell and Robert Atkinson, “The Case for a National Manufacturing Strategy” (Washington: Information Technology & Innovation Foundation, 2011); Gary Pisano and Willy Shih, *Producing Prosperity: Why American Needs a Manufacturing Renaissance*. (Boston: Harvard Business Review Press, 2012); and Richard Locke and Rachel Wellhausen, “Report of the MIT Taskforce on Innovation and Production” (Cambridge: MIT Press, 2013).

<sup>6</sup> Helper, Kreuger, and Wial, “Why Does Manufacturing Matter?”

<sup>7</sup> Ibid.

<sup>8</sup> See Gene Sperling, “The Case for a Manufacturing Renaissance.” Speech at Manufacturing U.S. Prosperity: A Policy Discussion. Washington, DC: Brookings Institution. July 25, 2013 as well as “Remarks at the Conference on the Renaissance of American Manufacturing.” Speech at the Second Annual Conference on the Renaissance of American Manufacturing – Jobs, Trade and the Presidential Election. Washington, DC: The National Press Club. March 27, 2012.

<sup>9</sup> Studies have found in general terms that the rate of return to society from corporate R&D is at least twice the estimated rate of return to the company. In addition to spillovers from R&D performed to create new products, there are also significant spillovers from process R&D, which is the R&D conducted to help organizations produce output more efficiently. However, the inability of firms to capture all the benefits of their own investments in R&D and new capital equipment means that, left on their own, they will produce much less innovation than is optimal for society. See: Michael Gort and Steven Klepper, “Time Paths in the Diffusion of Product Innovations” *Economic Journal* 92 (376): 630-653; Charles Jones and John Williams, “Measuring the Social Return to R&D,” *Quarterly Journal of Economics* 113 (4): 1119-1135; and Edwin Mansfield, “Social Returns from R&D: Findings, Methods, and Limitations,” *Research Technology Management* 34, no. 6 (1991): 24-27. Turning to the manufacturing sector Robert Atkinson and his colleagues at the Information Technology and Innovation Foundation laid on many of the market problems that embroil the manufacturing sector. See, for example, Robert D. Atkinson, “Effective Corporate Tax Reform in the Global Innovation Economy” (Washington: Information Technology and Innovation Foundation, 2009); Stephen Ezell and Robert Atkinson, “The Case for a National Manufacturing Strategy” (Washington: Information Technology & Innovation Foundation, 2011); and Scott Andes, Stephen Ezell, and Jesus Leal, “Benchmarking Manufacturing Extension Services in Latin America and Caribbean Countries (Washington: Information Technology & Innovation Foundation, forthcoming).

<sup>10</sup> See Lee Branstetter, “Are Knowledge Spillovers International or Intranational in Scope? Microeconomic Evidence from the Japan and the United States,” NBER Working Paper 5800 (1996) and Wolfgang Keller, “Geographic Localization Of International Technology Diffusion,” *American Economic Review* 92 (1,Mar):120-142

<sup>11</sup> For background on the use of competitive grants to call forth applied research “consortia” in the energy industry see Jim Duderstadt and others, “Energy Discovery-Innovation Institutes: A Step towards America’s Energy Sustainability” (Washington: Brookings Institution, 2009). For background on the National Network for Manufacturing Innovation see Advanced Manufacturing National Program Office, “National Network for Manufacturing Innovation: A Preliminary Design” (Washington: National Science and Technology Council: 2013).

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<sup>12</sup> OECD, “R&D Tax Credits: Rationale, Design, Development.” (Paris: 2010)

<sup>13</sup> For background on innovation vouchers see Stephen Ezell, “Lessons from Foreign Countries on how U.S. States Can Spur Manufacturing.” Innovation Files blog.

<sup>14</sup> Advanced Manufacturing Partnership, “Capturing Domestic Competitive Advantage in Advanced Manufacturing” (Washington: President’s Council of Advisors on Science and Technology, 2012).

<sup>15</sup> Jonathan Rothwell, “The Hidden STEM Economy,” (Washington: Brookings Institution, 2013).

<sup>16</sup> Pisano and Shih, *Producing Prosperity*.