THE BROOKINGS INSTITUTION

MANUFACTURING U.S. PROSPERITY: A POLICY DISCUSSION

Washington, D.C.
Thursday, July 25, 2013

PARTICIPANTS:

Welcome:

AMY LIU
Senior Fellow and Co-Director, Metropolitan Policy Program
The Brookings Institution

Presentation:

GENE SPERLING
Director, National Economic Council
Assistant to the President for Economic Policy

Moderator:

MARK MURO
Senior Fellow and Policy Director, Metropolitan Policy Program
The Brookings Institution

Panelists:

JAMES MANYIKA
Director, McKinsey Global Institute
Nonresident Senior Fellow, The Brookings Institution

REBECCA BAGLEY
President and Chief Executive Officer
NorTech

MARTIN A. SCHMIDT
Associate Provost and Professor of Electrical Engineering
Massachusetts Institute of Technology

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P R O C E E D I N G S

MS. LIU: Good morning.

ALL: Good morning.

MS. LIU: Welcome to the Brookings Institution, and welcome to all of those who are joining us now, live, on the webcast. We are here today to talk about the state of U.S. manufacturing and U.S. manufacturing policy.

Now, this follows the President's economic address yesterday in which he asserted the importance of manufacturing in creating a strong middle class and in generating jobs in durable industries. And the President is, in fact, in Jacksonville, Florida, today, a major port region, to reinforce the case for making things in America and ensuring that the U.S. has a modern logistics and infrastructure network to get those American-made products to consumers around the world.

Now, I don't want to lose sight of how far this issue has come in four years. Where there was once debate about whether manufacturing even mattered anymore, there is now wide acceptance of its value to innovation, to exports, to good-paying jobs. Yet the issue now seems to have hit a new roadblock -- or perhaps just a speed bump. Is manufacturing's future itself durable, and how deep and wide is this "manufacturing renaissance"?

Now, to start, there is no doubt that manufacturing jobs led the economic recovery. To date, the U.S. has gained more than 500,000 manufacturing jobs since March 2010 and, further, some point to the resurgence in the automotive industry, including in Detroit. And major firms such as Caterpillar, G.E., and Ford have all announced plans to ship some production operations back to the United States. And to some experts, this re-shoring trend will continue as rising costs in China and cheap natural gas in the U.S. will tilt the economics in favor of America.

And there is increasing excitement about new technologies -- in robotics, in 3-D printing, in advanced materials -- that will accelerate U.S. leadership in design and production. And we at the Brookings Metro Program see all this forward momentum coming together in integrated efforts to boost advanced industries, skills, and exports in regions as diverse as northeast Ohio -- and we have NorTech here to join us on that; Louisville/Lexington, Kentucky; Charleston, South Carolina; Chattanooga, Tennessee; and Denver, Colorado. And we also see the interplay between manufacturing and services. Manufactured electronics, like phones and TVs, rely on cutting-edge services. And services firms, like the Caribou Coffee chain, must order manufactured products, like stools or mugs or equipment, to supply every new service franchise it opens either here or abroad.

Now, with this optimism and even bullishness about manufacturing's promise, shared, by the way, by some scholars here in the Institution, there's also some wariness also shared by other scholars in the Institution. Welcome to Brookings. (Laughter) The caution is in the thin job-creating potential of the manufacturing sector and its small size in a highly service-oriented economy that may not be sufficient enough to lift all boats. And the recent slowdown in manufacturing employment has given skeptics further fodder about the extent of the robustness of the manufacturing comeback.

So, to help us navigate this really important juncture for the manufacturing sector is Gene Sperling, Director of the National Economic Council. We are really pleased to be hosting his new statement on this issue, which will surely add insight to this evolving debate. He will be followed by a panel of national and local leaders who have been at the forefront of manufacturing innovation.

Now, Gene does not need an extensive introduction, as he has been a

fixture in this town having served eight years for President Clinton and now on route to do the same for President Obama. But what you may not know about Gene is that he once served as a research assistant here at Brookings. And then even prior to the Obama administration he served as a guest scholar here working on education issues in poor nations. And, I might add, when it comes to Big Ten– football, which is upon us soon, he is a huge Michigan fan.

So, please join me in welcoming Gene Sperling back to Brookings. Thank you.

MR. SPERLING: Yes, nothing to make you feel as old as realizing that not only were you a research assistance but it was 31 years ago (laughter) for Steve Hess, who's still here.

So, thank you very much for having us and hosting this discussion. I really want to thank Mark Muro, Bruce Katz, and of course Amy for hosting us. I've been working with Amy and Bruce for many, many years and am very happy to be part of their forum here. And I think, you know, with James and Marty and Rebecca you have just an all-star panel.

I obviously just want to start by thanking some other people in our administration -- Alan Krueger, Jim Stock, Mark Doms, Sue Helper, J.J. Rayner -- who were helpful in our work on this. And, most of all, I want to thank our real right-hand person, Jason Miller, who is really I think one of the stars in manufacturing policy in this country, and we're very privileged to have him at the National Economic Council with us.

So, as you've heard, the President is going to be delivering a series of economic addresses over the next several weeks, making the case that our North Star for economic policy is: Do we have a growing economy that strengthens as opposed to hollows out the middle class? And that will be very much the subject of the speeches he

gave. And as you saw yesterday in the framing speech, he starts by asking a question of: What do we need to do to make the United States a magnet for middle class jobs? What do we need to do to expand our new competitive edge for location for durable, strong jobs of the future? And as he is talking more over the next several weeks, there's no question that he will make the case for our manufacturing policy. And so I'm very happy that I could have the opportunity today to maybe go a little bit more in depth and make the case for the potential of a manufacturing renaissance.

You know, as Amy said, again there's little question that President has made this a key plank of that middle class and innovation and competitiveness agenda, and there's also little question -- nobody really doubts that a manufacturing has been a bright spot in the economy, that 500,000 jobs since 2010 is the most we've seen since the 1990s. But I think, as Amy mentioned, people do raise the issue of: Is a focus on manufacturing appropriate public policy? Is it really promising in light of globalization and technology trends? And is what we're seeing in the last couple of years just a normal cyclical recovery that doesn't represent any structural or competitive advantage for the United States?

And I guess I wanted to start by saying that I think that we do better in -- we view these issues through a more insightful lens if, I think, we kind of get the paradigm questions correct, and I think sometimes they are framed in a way that leads us in the wrong direction. So, let me mention three ways I would shift the paradigm in which we ask these questions.

First, we need to stop asking or thinking about the promise of advanced manufacturing from an industrial policy perspective -- in which we ask: Are we trying to pick winners and losers? -- to seeing the justification for this as more of an innovation spillover model where we are, as is appropriate in economic policy, asking: Does

manufacturing location in the United States lead to the kind of positive and innovation spillover benefits that benefit the economy and particular community as a whole beyond what any single private sector actor can capture?

The second paradigm shift is that I think we need to stop looking at the jobs question from the large factory paradigm -- which leads people to talk about whether they are large, silent factories -- to a manufacturing jobs perspective that looks at a supply chain paradigm, which recognizes that manufacturing and service jobs are impacted across integrated supply chains.

And, third, going to the issue of renaissance, I think we need to shift from having a static snapshot analysis of where we are to a dynamic analysis that asks the right question, which is: Is a manufacturing renaissance possible if we are implementing the right policies that put more wind at the back of positive economic trends.

So, having framed those three paradigms, let me go at them then.

The first is on seeing this from an innovation spillover model as opposed to industrial policy. Now, the absolute standard critique that you do get from some, though I won't say most or all, economists is just that manufacturing -- if you're stressing manufacturing, you must be engaged in some kind of misguided industrial policy in which you think the government is somehow better at picking winners than millions of investors in a competitive market and therefore you're, just by definition, going to lead to distortion and deadweight loss in the economy.

Now, if this was what we were doing, I would lead the charge against it, because I don't support that type of picking winners and losers, and anybody who looked at my -- you know, in my book, *The Pro-Growth Progressive*, I tell it fact and anecdote of how top government economists in 1992-93 predicted travel agents would be one of the top 10 growing jobs in the United States. And they were not wrong based on what they

were looking at in terms of demographics and more upper middle-class people in retirement. You know, they just missed that little Internet thing. (Laughter) But I think that is a humbling reminder for all of us.

But it has never been the purpose or motivation of the President, his economic team, or the economist CEOs and university presidents, some of who are part of our advanced manufacturing partnership -- it has never been their motivation or purpose to be engaged in that type of picking winners and losers. I think that the type of rationale -- I mean, first of all, nothing that we're doing is going out trying to pick one industry over another, that on a particular -- you know, this isn't *The Graduate* where we're whispering into Dustin Hoffman's ear, "Plastics!"

I dated myself there, yes. I told you it's been 31 years since I was a research assistant, so I had already dated myself.

But I think the paradigm, which is better to think about this, is research and development. I mean, we have a pretty wide bipartisan consensus that it makes sense for us to encourage research and development on our shores. The R&D tax credit requires you to basically be located here. And we do that, not because we're trying to pick a particular industry but because we do believe that research has spillover benefits to the economy as a whole, that if we do not have policy to encourage we will under-invest.

And our case for manufacturing is really in that R&D innovation spillover benefit. We think that there is a general case that having particularly more advanced manufacturing located in the United States has a broader innovation spillover benefit that goes beyond the private actors involved and that justifies a public policy orientation promoting that.

So, let me just give a few of the arguments for the innovation spillover

model.

One, manufacturing does punch above its weight. Yes it is only 12 percent of GDP, but it represents 70 percent of private sector R&D. So, if we think -- it represents 60 percent of all U.S. R&D employees, 90 percent of patents issued, and the majority of U.S. exports. So, manufacturing punches above its weight in areas that we usually agree have larger benefits for the economy.

Second, a lot of research, and some done by people who have traveled through here, has shown that manufacturing generates spillover benefits to the location and to the country in which the activity occurs.

A 2010 study by Mr. Greenstone, who many of you know, and Hornbeck and Maretti showed that as a result of a manufacturing plant moving into the community, the productivity of the surrounding plants improved 12 percent. Now, remember, the model in just a market share mode might be that the competitor or someone else gets worse off. But they show when you come in that there are what they call agglomeration spillovers that end up making the surrounding firms 12 percent more productive.

Wolfgang Keller examined R&D in 14 countries over 25 years and found that the spillover benefits from that activity decline with distance by more than 50 percent when they are 700 miles away. So, location and proximity matter to the spillover effects.

Lee Branstetter, who many of you know, investigated the benefits of manufacturing in the U.S. and Japan and found that the knowledge and productivity spillovers tend to be intra-national or captured in the country where the activity occurs, making location critical to capturing those benefits.

All of that justifies, from a public policy point of view, an orientation to increase this type of activity that has such significant innovation spillovers.

Third: the proximity of production and design. I think there is a growing

body of literature that examines the importance of proximity between the actual manufacturing activity and the design activity. That's because for many technologies, the capabilities gained in production are intertwined with the new learning and the knowledge activities of research and development and design. And Marty's from MIT, and they have done in their Pi Program a lot of work, and one of the quotes from their report is: "Learning takes place as engineers and technicians on the factory floor come back with their problems to the design engineers and struggle with them to find better resolutions; learning takes places as users come back with problems." This iterative innovation process connecting manufacturing and design is how a wide range of so-called breakthrough technologies came to pass. In advanced materials, it took years of lab and shop iteration for DuPont to develop the science and the incremental process improvements to produce a true breakthrough product like Kevlar.

It is the reason while Bell Labs -- you know, the source of so much innovation in the 20th century -- talked specifically at housing "thinkers and doers under one roof." It's the reason why Boeing moved its engineer to the production floor and why many credit Intel's decision to locate its chip manufacturing near its design facilities in the U.S. with their current technology lead.

It is also this understanding that underpins the President's flagship initiative to create a national network of manufacturing institutes, connecting businesses, universities, and federal agencies to co-invest in world leading capabilities. These institutions rely on the complementary activities between production and design to encourage manufacturing location in the area or a particular region, and it is why former MIT president Susan Hockfield noted that the loss of manufacturing "not only destroys manufacturing jobs, but also saps our inventive advantage."

Next element of these innovation spillovers is what I think some have

called the industrial commons or the strength of the supply chain ecosystem. That ecosystem that develops around the intersection of innovation production does tend to be complex. Manufacturers established an emerging depend-on dense network of suppliers, high-skill talent capabilities. These often take years to develop, and when they are lost, it is a much more significant loss to the community and that potential for future competitiveness than can be sought by looking at any particular actor.

Harvard professors Pisano and Shih have observed that existing manufacturing capabilities provide what they call the “industrial commons,” or the R&D and manufacturing infrastructure know-how, process development, and engineering in firms, universities, and other organizations that provide the foundation for growth and innovation in a wide range of industries.

When we allow our manufacturing base to erode, we lose those capabilities and we create a vicious cycle that risks of our manufacturing sector and the services that depend on it today.

Now, again, justifying the public policy rationale, from the perspective of a single firm, the decision to move production elsewhere can make economic sense.. But the result of several individual firms doing that can have a cascading effect on customers and suppliers within this dense network within which manufacturing operates. And so for the next firm, the economics are then a little more favorable to moving and a little less favorable to expanding here. As a result of this dynamic, these cascading decisions can create a vicious cycle, making the U.S. less attractive as a location for manufacturing, and we lose the capacity to compete for the next industries. When we’re doing things like the manufacturing innovation hubs, we are making it more attractive to come and less attractive to leave.

Now, what Pisano and Shih highlight is the case of consumer

electronics, and they're both producing prosperity, and they kind of say: Well, you know, it might have made sense to seem like electronics capacity relocated largely to Asia, that it may not have seen that it would have detrimental impacts in the future. But their point is that it led to the loss of production capabilities when we started moving to the more advanced technologies like advanced batteries, LED lighting, fiber optics, and flat panel displays. And as MIT reports stated as a result of this loss of production and its impact across the industrial commons: "Across the entire industrial landscape there are now gaping holes and missing pieces."

So, it's not just what happens in that static moment. It's what it does to our capacity to compete for the next round of innovation, which we as a country should care about. And it is something that in the defense industry they are very aware of, that you can't just -- when a particular weapons system becomes obsolete, if you simply allow all that lost capacity, you can say that's okay because that weapon's obsolete. But if you lose that completely, you lose the ability to have the skill component, the supply side component, to conquer the next element that we may need for our military readiness.

Now, we're rebuilding and strengthening this ecosystem is a critical part of the strength of existing industries and the formation of new ones. You've seen this in a recent study in Delgado, Porter & Stern that talks about how the shared expertise not only led to faster employment growth in those industries but faster growth of new industries, 45 percent faster. But I guess if consumer electronics is the case of where we let the supply chain erode and lost our ability to compete as well as we might have, then the auto industry provides the counter-example.

At the time the President took office, GM and Chrysler were obviously on the brink of failure, and the thing that's most interesting and was a teaching moment was that this was never just about GM and Chrysler. It was about the positive or negative

impact it would have throughout the supply base. Like many industries, automakers have shared supply chains, and these suppliers not only make up the majority of the value-added vehicle, but they are critical to new innovation and competitiveness. The loss of the supply base triggered by the failures of GM and Chrysler could not only have cost hundreds of thousands of jobs in the middle of the deep recession but it could have led us to seed our claim to be competing for the advanced vehicles, advanced batteries of the future.

And, you know, if there was one quote I would focus on that I think is so telling, it is the comment of Ford CEO Alan Mulally concerning the federal efforts to rescue his main competitors. Now, if we were -- probably many of you, if you were teaching an intro business or economics class you might say if you have three big competitors and two of them are going to go down, that's going to be good for the third competitor. They're going to be able to seize more market share. But, Mulally actually ends up supporting the rescue of his two competitors precisely because they so understand this industrial commons supply chain competitiveness. And Mulally, when he testifies as to why Ford supported the rescue, says: We believed that "if GM and Chrysler would've gone into free-fall they could've taken the entire supply base into free-fall also, and taken the industry from a recession into a depression." That is a fairly insightful moment in thinking about a different paradigm for manufacturing.

So, the second thing I said was that shifting from the large factory perspective to the supply side perspective leads nicely into that. I hear that a lot. You know, when you go to a big factory it seems awfully quiet. Perhaps this suggests this is not the avenue for job creation.

I also hear that, well, manufacturing jobs are just in inevitable decline. And I want to take on both of those.

I'll do the first quickly, the myth of an inevitable decline on jobs. Just so we know, of course in every advanced country manufacturing has less jobs as a percentage of GDP and is a less share of GDP than it was decades ago. That's true for any advanced country. But it is not the case that in absolute numbers there's been a steady decline. That's just not the case. In 1965 the manufacturing sector employed 17½ million Americans. When I left the Clinton administration in 2000, the manufacturing sector employed 17½ million workers. It went up and down. It was not in inevitable decline. It was just last decade where we saw a dramatic loss, particularly before the great recession, even more so than during the great recession. From '65 to 2000 we steadily grew manufacturing production at 4 percent annum. It was only from 2010 where production underperformed the economy.

I will leave to another day analyzing what might have gone wrong in trade enforcement and focus on manufacturing in the last decade. But I do want to just note that this inevitable decline is stated often without actually looking at the numbers. And it is also the case that other advanced countries, while they have shrunk, they would not necessarily have lost -- we would not necessarily have lost as many jobs as we did. If the U.S. rate of decline followed the rate of the German decline over this period, there would be 5 million more jobs. And William Nordhaus, as you know, has done research that Brookings then extended into 2009 that showed that there was not a connection between increased productivity and loss of jobs in the manufacturing industry from '48 to 2003, and Brookings scholars checked that and extended it to 2009.

So, when we're looking for jobs, we need to look not at the large factory focus but at the supply chain focus. The McKinsey Global Institute -- and I'm sure this is James Manyika's work, who you will talk to -- estimated that there are another 5.7 million jobs in integrated manufacturing supply chains that are often not counted. Decades ago,

they would have been in-house and counted, but today when a company uses an outsourced transportation fleet or software design firm, they end up not being counted. Enrico Maretti suggested that, on average, a manufacturing job supports 1.6 jobs outside of manufacturing and when it's advanced manufacturing nearly 5 jobs across the broader economy.

Third, even the silent factory fails to envision the connection between high-wage services and high-wage manufacturing. Jobs developing software, services, and apps using sophisticated electronics in areas like the Boeing 787 Dreamline, now embedded in products from cars to microwaves, and even in Michigan today, the fastest growing technical jobs are software system and application developers growing three to four times as technical occupations largely because of demand for programmers who can build new software applications for automobiles.

So, again, when we look from the supply chain perspective instead of the big factory perspective, the case for manufacturing jobs again becomes stronger when you have the appropriate, broader vision through the supply chain and the jobs that support or interconnect with manufacturing whether they are technically counted in the manufacturing sector or not.

And then the final perspective was on this renaissance issue. Now, I think that, you know, just to do the brief history over the last several months, I think probably myself and others use the phrase "renaissance" and I think a couple of very reputable and very talented economists at Goldman Sachs and Morgan Stanley put out reports that were reported as questioning whether a renaissance in fact had taken place.

And I think I want to take this on in two levels. One, mostly what I want to say is that from a public policy question, a snapshot perspective is not the right perspective. I mean, if you're -- what you want to know is if we do the right policies in the

dynamic process, can we have a renaissance? Is this possible? Is the wind blowing at our back in a way that it makes sense that if we laid the right foundation we could achieve a lasting renaissance in manufacturing? That is really the only relevant public policy question. Taking a snapshot at this moment and saying, looking at facts at this second, are we there or not there? It's an interesting question. But it is not the determinative or most important question from a public policy perspective.

Now, the first thing I want to say a little bit is that I don't even necessarily think that the snapshot view they took was particularly correct, or at least in the way it was interpreted. Let me make a couple of comments about that.

One, that was read by some as saying everything we're seeing right now is just kind of cyclical, has no policy connection. Well, that's kind of wrong on its face. I mean, that ignores completely the role of the auto rescue. Remember the Bush CA projected they were going to lose one million jobs if GM and Chrysler were to fail? The auto industry has added 325,000 jobs instead of losing a million since GM and Chrysler emerged from bankruptcy.

So, first of all, any thought that the strength of manufacturing is somehow cyclical, non-connected to public policy, is wrong on its face once you recognize the role of auto jobs and the auto policies.

Secondly, the Goldman Sachs and Morgan Stanley pieces were just not as negative as they were reported. I mean, they expressed skepticism of whether if you took a snapshot now you could prove a renaissance, but Morgan Stanley acknowledges, and I quote, "There is clear evidence that the draining of U.S. manufacturing capacity into China/EM has stopped." Similarly, Goldman stated that, quote, "The outlook for the manufacturing sector is reasonably bright. Over the next few years we expect U.S. manufacturing to grow a bit faster than the economy as a whole." Well if Goldman's

predicting that manufacturing would grow a bit faster as a whole if you added three years to what we have there, that would be the longest period of manufacturing outperformance of the economy in a half century. So, one, I don't think they were quite as negative.

But also right now the U.S. is increasing share of global exports. Bridgewater noted that the U.S. has gained global share at a faster pace than all major countries except China. And even as we've had the slowdown, that has remained true.

Alan Krueger, our Council of Economic Advisors, and Jim Stock have done analysis and find significant amount of the job gains is structural, and they do that by adjusting and looking at previous recoveries as well.

So, I think, one, I challenge that their snapshot is not a little fuzzy, but I also think it's the wrong perspective. The right question is: Are there trends that suggest a potential for a manufacturing renaissance if we adopt the right policies? And I think the answer there is clearly yes.

When the President did his in-sourcing forum in the beginning of 2012, a CFO of a very major technology company said to the President: You know, Mr. President, it is true that in the last several years we are now considering U.S. location much more than we were. He said: But you have to understand, it's still a close -- that doesn't mean we come to the U.S.; that means it's a close call now. What you do on R&D policy, on infrastructure, on manufacturing, how manufacturing is treated in the tax code -- all of those could make the difference at the margin. How easy do you make it or how hard do you make it to invest here?

So, policy matters. And I think that we have a reason to believe that policy would matter now more than maybe even in the last decade, because I believe at this point we do have more of the wind at our back. And that analysis did not start with the Obama administration or any political person. It really started with the major business

consulting groups like McKinsey, like the Boston Consulting Group, who started telling clients that when you look at not the last 10 years but the future 10 years, location in the U.S., particularly for manufacturing, is more competitive now. They did that by looking at the impact on wages and productivity. They do that by looking at what's happened in terms of abundant low-cost energy and U.S. natural gas prices and the potential competitive advantage that you have there. And I think there's been a greater recognition of the hidden cost of long supply chains, including logistic uncertainty and even natural disaster uncertainty. All of these have, I think, put us on a more competitive edge.

Of manufacturing executives surveyed by Morgan Stanley, more than 50 percent listed supply chain shortening as a top reason why they chose to bring new production back to the United States.

A survey by the Boston Consulting Group last year found that nearly 50 percent of companies -- 50 percent of companies -- with more than 10 billion in sales were actively considering relocating production from China to the U.S.

Morgan Stanley's recent survey suggests that re-shoring outlook is even more possible for the medium term with more than 70 percent of respondents predicting expansion in the U.S. over the next five years.

So, I will stop briefly as opposed to going through all of our policies, you know, to recap: I think that when you look at the proper paradigm of innovation spillover, when you look at the supply chain jobs, and when you look at a dynamic analysis as opposed to a static analysis, there is every reason to believe it makes good sense to have a public policy perspective that pushes us to be more competitive in manufacturing and advanced manufacturing.

And our agenda is broad in that area. It goes from making the U.S. more

competitive by reforming the tax code, and, you know, in our plan we would have the tax rate for manufacturing as low as 25 percent. Modernizing our infrastructure is absolutely a competitiveness and location issue, as the President of the United States is talking about today. Harnessing our natural gas and energy resources -- all of these support the first plank of cost competitiveness.

Second. Spurring innovation through next-generation technologies, encouraging the dynamic advantage of location here, the President's proposal on manufacturing innovation institutes, his constant support for research in advanced manufacturing and advanced batteries in key technologies.

Third, a real agenda about skills in community supply chains. We have proposals, significant skills proposals, community college to career fund proposals, manufacturing extension partnerships. We have a focus for $6 million on community tax credits and a new proposal in the State of the Union on investing in manufacturing communities, partnerships to use to have all the agencies working together to help with strategic partnerships.

Four, we do have to take trade enforcement seriously, and I think it was a serious mistake of the previous administration not to use the § 421 with China in manufacturing. I think it sent a very important signal when the President came into office right away and did that in the tires case and was willing to take on the auto and auto parts zones in 2012 and make sure we have a level playing field.

And then, finally, you know, we need a pillar where we are more active as a country in encouraging investment here. That's why we have the new Select USA initiative. That's why we'll have the new Select USA summit. That's why we are making clear, through our policies and our action and our words, that we want you to locate jobs in the United States.

So, I really appreciate the chance to come and be part of what's been a very good discussion and make the case for manufacturing renaissance. So, thank you very much.

MS. LIU: Thank you so much, Gene, that was a very, just robust linear case for manufacturing's promise matched by, I think, a similarly linear agenda to support the manufacturing moment, I hope we can credit some of your Brookings' research assistant skills in that.

We do, Gene has about five, seven minutes, maybe, for us to take some questions, I think what I'll do is call on two questions at a time, if there's a lot of interest. I do want to make sure, given our limited time, that we keep the questions focused on his remarks, no questions about the royal baby. So, let's start here, because your hand was up first, in the back.

MR. WESSNER: Thank you. I'm Chuck Wessner from the National Academy of Sciences, very appreciative of your remarks, it's inspiring. In fact, so inspiring, I have two questions, perhaps. Can you make more of an effort than is being made, you know, the National Manufacturing Initiative is very impressive, but can you put more resources? I realize you're running in the headwind, there, but still. Some of the existing programs, you want to move MAP up 25 million, you know, there's a country to the north, not exactly east Asian, where a conservative government has doubled the IRAP program to 228 million. We're at 123. They're ten times smaller in population and economy.

That's what I'm talking about, the Fraunhofer's, or others where we're really outgunned. So my question is, can you yes, you're in the right direction, can you really gear this up to make a difference and can you do it quickly before the time runs out?

MS. LIU: Ma'am?

QUESTIONER: Yes. As someone who works extensively in rural parts of the country, we're pretty excited about the opportunities in the bio economy.

MR. SPERLING: Yeah.

QUESTIONER: In fact, I would say, if the graduate were updated, the word that ought to be whispered to Dustin Hoffman is, bio plastics (laughter), so could you maybe address that issue a little bit in the opportunities? Thanks.

MR. SPERLING: Yeah. So, let me, I'll start with yours, and actually, your, I'm glad you mentioned it, because one of the interesting things is, at the NEC, we run manufacturing policy, we actually have also an office of kind of manufacturing that we co chair with commerce, but a critical player in our manufacturing process is Tom Vilsack and the Department of Agriculture. And we, and it was in my written text, but not, I didn't mention it, but we are absolutely where you are, and you have a Secretary of Agriculture who has made this point very well.

And it may not be, maybe in the past, the Secretary of Agriculture wasn't part of the manufacturing policy process, but I will tell you, in ours, he is, he's absolutely integral. So we're very aware of that, and we are also looking for policy, and how to expand that policy, and he's very personally committed to that. And I'm going to give him the plastics line, but I'm going to credit it to me (laughter).

So, on the resources, well, let me make a couple points. I mean, I think that we operate, we try to operate, I think, in a parallel process with our priorities, which is we have a very robust legislative agenda, but then we also say to ourselves, if we can't get something passed through Congress, we can't just call it a day, we have to look for what we can do. I think, if you look at our legislative agenda, it is quite robust in the resources, I think that there's a very strong research budget in manufacturing, clean energy manufacturing, very strong that we're fighting for constantly. It not that it's not in our budget, it's about getting it passed.

We, our manufacturing initiative was a billion dollars to do 15 manufacturing initiatives, we also have deployment community initiative that has some bipartisan support that would, that's a couple of billion dollars. So I think that, if you add it up, the dollars in the initiatives, we have a decent amount. I think the problem that we have is that we just have not had a bipartisan willingness to

look at something that should be at uncontroversial as how to have a stronger advanced manufacturing base.

I will say there is some bipartisan hope I've seen in the Senate, and I do think, when you look at the businesses in the communities, there is support, but this is a challenge. And, obviously, right now, a perfect example is another reflection of the complete idiocy of the sequester. I don't find that there's a big difference between Democrats and Republicans in wanting to have a strong manufacturing base in their state, et cetera, and yet you've got this meat axe approach that is cutting at a time, as you say, where our competitors are investing more, and we're just disarming when we allow that to happen.

So that is very, so that is a case we will be making, the President is, again, going to do a series of speeches where he's going to try to get out of some of that manufacturing budget crisis and wars, so that we can actually have these type of conversations about what is actually the end goal of our public policy, what do we need to make us a magnet for middle class and manufacturing jobs. Now, that said, the manufacturing innovation hubs is a good example of how you try to make progress even if you can't get new legislation. The President asked us if he thought we could get legislation in 2012, when we said no, he said, can't we at least do a pilot project.

Jason Miller and I went around passing the hat from agency to agency, and came up with 40, 45 million, which allowed just one pilot. But that one pilot, when it's tangible in Youngstown, with Carnegie Mellon, Case Western, has just created enormous amount of interest, not just in academic and manufacturing circles, but in the Congress now. And now we came back and we're doing three more with existing resources before a total of 200 million and our phone is ringing with people asking what could they do to compete for one.

So I guess what I would say is, we need those resources, we will make that case, we need more bipartisan support for doing that, but in the absence of that, we're going to look for every way we can make progress. So the investing in manufacturing partnership needs resources, but if it doesn't get the resources, we're still going to create that coordinated government approach that allows communities to have a supply chain strategy. We're going to try to get the billion for manufacturing innovation hubs, if we can't, we're going to keep expanding with existing resources, and as people see more success, we believe we will create more demand.

MS. LIU: Okay. I think we have, let's see the hands up, let's see how many we have. I think we have time for just three questions before I know that Gene needs to leave, so we'll go with Antoine, here, in the front row, and this person on the side. Go ahead, Antoine.

QUESTIONER: As you mentioned, we have, in manufacturing, a skills gap, we're trying to do things about it, there's community colleges, et cetera. The question I have, and the economy seems to be divided on this is, why don't you see wages go up for trained operators in a way that would stimulate us?

MR. SPERLING: Yeah okay.

MR. LUDWIG: Helmuth Ludwig from Siemens. You mentioned the factors for manufacturing resurgence, manufacturing renaissance, traditional ones like energy cost, closing productivity cost gap with Asian countries. And we strongly believe, we actually believe that there's a very strong stream of software driven manufacturing renaissance, and we just actually gave a grant, a software grant to Youngstown State University of

MR. SPERLING: Yes.

MR. LUDWIG: $40 million U.S., because we strongly believe that there is this incredible opportunity. Still, I get asked more and more, Helmut, you talk so much about manufacturing renaissance, when is it really picking up? The question to you, what's holding us still back?

MR. KATZ: Hi, I'm Brandon Katz, I'm an intern with the Brookings Institute and also a senior at the University of Michigan (laughter). So, as I'm ending my undergraduate career, this is the fourth year that tuition has continued to raise, and I continue to ask myself how middle class and lower class families are

able to attend these four year universities and get a desk job in the future with an unsecure desk job career.

So my real question is, how do we tackle education reform and dealing with, like, STEM job encouragement and focusing on the manufacturing sector supply chain to encourage that innovation and spark that renaissance if we're just focusing on an elitist-based institution with making college so unaccessible to so many Americans?

MR. SPERLING: I'll start in reverse order. He really wanted to ask me what his senior year in the post-Denard Robinson era would be out of Michigan (laughter). But he feels pretty good about Gardner, so he decided he'd ask something that would not get him embarrassed in front of his fellow research assistants.

You are a man of the President's heart because he is focused like this, like a laser beam. We just reached, we just passed the student loan interest compromise yesterday, which will keep the Stafford unsubsidized subsidized at 3.84 for this year, it will be very good. But the President made very clear as he talked to members that this, to him, was a temporary measure and that you, and that we need to be taking a broader look, that you can't just be looking at the financial aid component.

It's an important component, we fight for it, we prioritize it, but if you're not looking at the general college cost issue, you're only getting part of the picture. So I think this is a very serious issue, and I think we are looking at what we can do to, first of all, empower students with more information. He's talking about a college score card, more informed consumers who make choices based on price and quality will enforce competition. There's room for more innovation. Since I'm in an economic environment, here, I'll say I don't think the Baumol's disease for education, you know, makes as much sense in a world of technology mooks, all the new forms of competition, and I think it's a bit of a cop out for people to suggest that there's not ways of delivering more value at a lower cost, with all of the technology revolution that we're going at.

And a lot more discussion about are you paying for performance when we're going our financial aid. So I think this is a really important issue, I think it's one the President is very focused on, and I think it's one you'll hear him talk more about in the next couple of months.

So, first of all, on the point from the gentleman from Siemens, first of all, I think your point is very well taken. I tried to actually try to do the connection on the software, but making the point more on the competitiveness, I think that's important and a good note, a good add for us. I think that, first of all, thank you for your support at Youngstown, the software donation, it was noted and greatly

appreciated, and obviously, I think some of the federal money that we have spent, you've been partners with on some of the community colleges on and have been well used.

In terms of is there, on the renaissance happening yet, you know, again, I still believe that, as you look right now, there's good evidence. I mean, there was, the amount of cases of people moving production back to the United States, expanding production in the United States, the fact that even with you know, you can look at the export slow down in one or two ways; you could say, well, the job growth hasn't been as good in the last 12 months. But I guess what I would say is, we haven't created 500,000 jobs like this since the '90s, we were growing at a very fast pace there.

So now we have, we're coming out of the worst financial crisis, our main export partners are growing slow, and we're still up 500,000 jobs, which we have not been in probably close to 20, or at least 15 years. So I think, you know, that the share of exports, all the things we're talking about, makes me believe that, even from a snapshot perspective, things are going well. But I do believe that policy matters, and that's why, you know, when somebody says are you having, is there a renaissance by just looking at things right now, it just is the wrong question. The wrong question is can we. Can we, is it possible? And I'll say that, you know,

when my book came out, ProGrowth Progressive, in '05, '06, that was probably the toughest time.

You're going out, you're making a lot of these arguments, you're going places that, just the overwhelming trend is shifting location to India, China a bit, so you felt like you were making good arguments, but the wind was in your face. Eight years later, I feel like the wind is at your back, and like a lot of things in life, good things happen when you seize opportunity, when you have a trend going your way and you seize and you expand on it, and I think that is the real question for us.

On the skills gap issue, I think it's been a real frustration for us that everybody, that CEOs come in and talk to us about this, this seems like such a bipartisan, nonpolitical issue, and yet you go through the normal budget cycles here again, and people, in and this is why the President is lifting up and talking about the big policy issues, because everything becomes like a number, an arcane budget issue instead of us actually having a conversation about the fact that there is a broad consensus in the United States right now that we should be doing more on the skills side, we should be doing more, obviously, in the education side, getting more disadvantaged young people who are talented to go to the best schools that they're eligible for, increasing the pool, making, creating more opportunities for people who want education or redesigned high school

experiences that are more tailored to a particular industry, having a system with community colleges that work in really close coordination with intermediaries, the private sector, to make sure they're filling local skill needs.

I think there's a lot of agreement on this, I think we have examples, I think the Siemens North Carolina Community College is a good example of something working like that. But, and we're putting a big focus on this now, but we proposed $8 billion career to community college initiative that goes right at this, everybody seems to like it, it doesn't even get a hearing. So, again, this is an area where we're just, we are going to be looking for what we can do with our existing resources, even if we have to kind of pilot and just show best case successes to try to create more demand.

On the skills gap issue, you raise an interesting issue, and I don't have a great answer to it, which is that virtually everywhere you go, you hear people having difficulty hiring welders, hiring certain high skilled jobs that make it clear that there are some areas where we are having skill gaps, and we need to address them, but it is the point that a lot of our top labor economists look and say why aren't the wages going up more for those. And that does seem to be a puzzle from what you hear and see in some of the data, and I don't know if things are just a little out of date and those will match up, but it is an interesting question that

Larry Katz and others have raised with me, so it's a good question for this Institution to look at.

MS. LIU: Well, again, let's thank Gene for his remarks and his time (applause). Please stay put, we're going to swiftly move on to the next part of the program which will be a panel discussion led by Mark Muro, who is a Senior Fellow at our Brookings Metropolitan Policy Program and the Director of our Policy Program. Thank you.

MR. MURO: Thanks. Excellent. Good morning, everybody, and with Gene on his way, I'd like to convene what I think is an excellent panel today of who will be our first responders, immediately jump into view of what we just heard. I think we heard pretty cogently and quite linearly, which is a very high word of great praise around the Metro program at Brookings, but these guys are going to provide some initial readouts, I think, and then move into some broader reflections.

But I think, first, we wanted to respond immediately and do some initial reactions to what we heard. Eventually, I will open the floor up and we'll get a good 10 or 15 minutes of incoming questions for you. I'm Mark Muro, Senior Fellow here at Brookings and the Policy Director at the Metropolitan Policy Program, where I lead our advanced industry and next economy work. Without tipping my hat, my hand too much, I'll just say we've focused very intently over the last five years on the need for the U.S., in large part through its cities and

metropolitan areas, to construct a more innovative, productive and opportunity-rich economy. Hence, our interest in these issues, so we're vitally interested in the country and its places getting things right on manufacturing.

So as to our panel, I think we have three people who really are uniquely well positioned to provide, I think, diverse initial readouts on what Gene said this morning, and then more broad reflection, but let me just call them out, here. We're delighted to have Marty Schmidt from the Massachusetts Institute of Technology next to me, here. Marty is an Associate Provost at MIT and a Professor of electrical engineering, and while his research and teaching are in the realm of micro and nano-technology, he also serves as a key player in MIT's production in the innovation economy project, a multiyear interdisciplinary inquiry that seeks to understand how innovation is linked to manufacturing and production activities. I should note, he also is a senior officer responsible for MIT's industrial engagements with private sector companies, so I think we have a grounded sense of the pulse of these economies.

Second, it's a privilege to have James Manyika here this morning, in the middle. James is a Director at McKinsey & Company, and Director also of McKinsey Global Institute, so he works in Silicon Valley, and he also reflects globally on that work. He is an extremely insightful on many of these issues, and just in the last year, he's helped author several touch stone reports, one including

the future of manufacturing last year; just last week, he released a report of Game changers: *Five Opportunities for U.S. growth and renewal*; and in May, he was the lead author on *Disruptive technologies: Advances that will transform life, business and the global economy.* He's change-oriented and dynamic, and I'll add that he's a non-resident senior fellow here because we like his work so much.

And then, finally, we have here Rebecca Bagley, also no slouch (laughter). Currently, Rebecca's President and CEO of NorTech, a technology oriented economic development organization working to revitalize Northeast Ohio by accelerating the growth of regional industry clusters there, advanced industry, flexible electronics, even water technologies. Before joining NorTech, Bagley served as deputy secretary for Technology, the Technology Investment Office at the Pennsylvania Department of Community and Economic Development, where she had a huge investment portfolio.

So let's just plunge right in, and what I'd like to do is offer each of you, first, just an initial chance to provide your initial reaction. What are your first reactions, what was interesting to you in what Gene Sperling said? I mean, as a technologist engaged with industry, I think you may have a particular feel for some of them, so I'm interested in your first top line views.

MR. SCHMIDT: Thanks for having me. It's a pleasure to be here.

MR. MURO: Absolutely.

MR. SCHMIDT: I think, from the perspective of an individual who's been involved in transferring technologies to industries, both startups and large industries, and thinking about the MIT engagements, and the focus we've had at MIT and thinking about how we move innovative ideas into products, and the role that the production ecosystem plays. I really think there's a strong resonance for me on the, I'm thinking about all these issues from the lens of our innovation capability. I mean, the sound bite is, I think it's about the innovation, stupid.

I think if we keep that focus, I think that's where we have our impact. I mean, it's clear to us in our experiences at MIT that we can't innovate in new products that are based on disruptive new technologies without a vision for how we're going to make it. And that vision is derived by playing in an ecosystem where product development occurs where you have access to ideas, people, important capabilities, sophisticated capital. And so I think our ability to transition ideas out of MIT is intimately gated by this sort of production ecosystem. And proximity matters, we have an awful lot of examples of that where companies vote with their feet. My favorite example is, because I'm a Homer, is Gillette in south Boston.

Grooming is an $8 billion business for Proctor & Gamble, and it's interesting to note that, on 30 acres of waterfront property in downtown Boston,

Gillette manufactures disposable razors. Why do they do that? Because that's where they do the product development, and that's where they interface with the customer to think about new products, and once they get it right in south Boston, they roll it out around the world. And where pennies make a difference in a disposable product, that linkage of customer experience to product design and manufacturing is vital.

We've all heard the stories of GE's Appliances experiences in bringing their capabilities back to Kentucky and how that interplay between production and design works out. And there's a recent study by Liz Reynolds at MIT looking at a particular area, bio manufacturing, an interesting note is that 80 percent of the production facilities in a particular aspect of bio manufacturing are within 100 miles of the R&D facility. So you can't transfer those things far, particularly in these disruptive.

And the last point I would make is, there's this really critical feedback to our campus, and Suzanne Berger highlights in her preview of our pie work, where some of our faculty are working on advanced solar technologies really rely on that ecosystem to develop some of the tools that enable the campus research that then drive it out. So it's a very virtuous cycle, and I think the linkage and the focus on innovation when we think about manufacturing is important, and I

don't think it's about picking winners in industry, I think the winner we're picking is the American innovator.

MR. MURO: Yes, certainly, he placed innovation front and center. James, you bring a real feel for complexity and diversity in manufacturing, say, over and over that we don't have a single manufacturing sector, and you have a great sense of, I think, big trends, looking forward. So I'm curious, what, in your view, what do you find really resonates in what Gene suggested, with your experience, and are the things that we ought to be thinking about beyond that, and are you as bullish in some ways as Gene is?

MR. MANYIKA: Thank you, Mark, and thank you all of you for being here. I think a lot of what Gene described actually resonated quite strongly. I won't repeat the resonance of the innovation observations, Martin, that you made, but I also think what he said about how we need to rethink questions of how we think about employment, supply chains, the complexity of manufacturing, and also taking a longer term view as opposed to a snapshot really resonated.

Let me comment on a couple of those. I think, as we think about manufacturing, even our own work is pointing to the fact that the jobs in manufacturing are actually quite different now. Even if you look at the, we typically think of the roughly 11, 12 million jobs in manufacturing. Well, of those, close to a third of those are not really assembly line jobs anymore, they're actually quite

different, they look a lot like services jobs. And then you look outside of manufacturing, outside of the 11, 12 million, you also have a lot of jobs that are very connected to manufacturing, engineering, design services, et cetera, that typically are not counted in manufacturing, so the question of how we think about jobs is quite different.

But the other thing that I also wanted to reinforce is, one of the things that came through very clearly in our own work, looking at just micro and macro analysis, but also seeing what companies do, which is something that I spent a fair bit of time doing, is manufacturing is actually not monolithic, fully, and I think we tend to think of it as one big lump. It's really not. And we did some work thinking through, not so much in terms of is it automotive is it metals, but to think about what are the inputs and dynamics that drive manufacturing; so labor intensity, R&D, knowledge intensity, energy intensity. And you take all those inputs and you suddenly realize that you have something like four or five big groups that are going through very different dynamics. I won't take you through that, but if you look at the renaissance, or at least what's happened in the recovery, it follows that pattern quite consistently. So, for example, if you want to look at output growth that we've had since 2010, if you want to look at jobs growth that we've had since 2010, if you want to look at even the inflows of FDI, Foreign Direct Investment,

that's going towards green field investments in plants and manufacturing facilities, or if you want to look at exports.

That's been led largely by three or four parts of this, primarily; it's been automotive, machinery, fabricated metals. If you look at those three part of manufacturing, they've driven most of what we, so if you look at the 500,000 jobs that Gene talked about, that's certainly true, but something like close to 80 percent of those are in these three places; automotive, machinery, and fabricated metals. If you look at the output growth in GDP output, again, you come back to these three sectors. If you look at what's happened in inbound green field FDI into the United States, something like $135 billion have come in since 2010, close to $100 billion of that has gone to manufacturing.

Most of that has gone, again, to these three segments, so you start to see that, as we look at the dynamics of what's going on, it really depends on which part of manufacturing you're looking at. And the ones that have come back, the ones that I just mentioned, they're the ones where the demand has been strong, it has a lot to do with proximity to the markets, it has had a lot to do with companies and other investors looking to make locational decisions mostly informed by where demand is, where the supply chains are, where the knowledge and innovation happens to be. So you look at that, and I think you start to explain what we've seen.

I think, to your question, Mark, about am I as bullish about the renaissance, I think it's important to keep a historical perspective, I think to the extent that we've seen job growth start to flatten since, basically, I think it's reached its peak in about February 2013 in manufacturing, we saw the same thing happen after the recession of '81, in 1991, it's what you'd expect to happen. But the question if I take Jean's counsel, which I agree with, is not to have a snapshot, but look forward. There's so much more that's still promising to come beyond what's already happened, we have hardly even tapped into the benefits from manufacturing that are going to come from shale energy and shale gas, for example.

Our own work already estimates that just the impact of shale energy in this economy by 2020 will probably lead to something like 1.7, 1.8 million jobs, and of those jobs, yes, some of them are going to be in oil and gas production itself, but almost an equal number are going to be in manufacturing. That has hardly even kicked in yet. You look at some of the innovations we're talk about, whether it's the software example that was given or 3D printing, and all those things, they've hardly yet kicked in, so there's enough that's forward looking that's promising.

But will that magically solve the jobs challenge that the U.S. economy has? It won't be enough, there's a lot more that's required to solve the jobs question.

MR. MURO: And if you want to return, I think we'll want to dwell on the job nexus and the relevance to the middle class shortly. So, Rebecca, you have a strong regional and sub national perspective, I think, on all of this, and I think we heard a fairly strong discussion about the centrality of place at different scales, even less than 100 miles, less than 10 miles. So I'm curious to show, someone on the front lines in a region, what did you hear in this conversation this morning?

MS. BAGLEY: I think, obviously, when Gene talked about the spillover effects in every example that he gave, and the sub places of that really built on the idea that regions are critical when you think about manufacturing. And when you think about how to build up that manufacturing base within the U.S., or continue to build on what we have, one of the interesting things as I was listening was the discussion of the industrial commons.

And, for me, that word has been floating about quite a bit lately, and the way that he defined it around multiple, not only supply chain, but research and development, OEM, sort of that complexity, in my mind, it also worked back into the clusters area. And so when you think about, because when people would

say manufacturing clusters, I'm like, well, that's not really accurate, because it's not an industry vertical, right, it's a crosscutting. So I started to see an interesting lattice work when you're doing work in a region of the industrial commons being sort of an overlay, an overlaying industry in cluster work, like we just did a road map in water technologies.

So, in everything that we do in Northeast Ohio is really based on the manufacturing economy, so when you think about the industrial lines and clusters, and overlay that with the idea of industrial commons, so much of what we then do as an intervention, as the things that the markets are not doing are pretty much the same, right. So you're thinking about interconnection of that ecosystem for product development, you're thinking about interconnection of the ecosystem for stickiness to manufacture here. And so all of those same concepts, and, certainly, there's some unique ones, but all of those same concepts, then, overlay.

So I was fascinated, because I've been having trouble in my own mind, and many of you might think that we have the speech days in advance, but instead, we were puzzling out sort of doing the speech around sort of how that's so. So those were the things that were going through my mind is bringing those things together, because I think, on the ground, in Northeast Ohio, working with our MAP center, that's pretty much the thing, what we're doing is, here we have all these market opportunities that are coming up, and we have this manufacturing

base largely based on the three industries you talked about, that's where our growth has come from over the last two years. How do we bring those things together in a way that then leads to U.S. competitiveness, Northeast Ohio competitiveness.

So that was one thing. The other thing that I'm still puzzling about is the supply chain piece, because I think that there's so much more to the interaction between these SMEs, small to medium sized manufacturers and the larger fortune 500 companies, so we can get into this maybe a little bit more later, but that anchor partner, relationship, we're seeing it play out over and over in Northeast Ohio where we have smaller companies that are working with the Rockwells and the Avery Dennisons and the Eatons, and it's not necessarily always in a supplier relationship, so I think there's some complexity there, too, that would be interesting to explore a little bit.

MR. MURO: Excellent. Returning to Marty, and I do want to pick up, first, on the innovation theme that was so strong, here, and I think because it was suggested that innovation plays to our strengths as a country. I want to push just a little bit, though, on how well we're really doing on that front in certain ways. Talk to us about what you and your colleagues have been concluding about the state of the U.S. innovation system?

Because, in some ways, we heard the quote about significant gaps, as well, and a lot has happened, a lot has been lost. Are we well positioned for an innovation decade in manufacturing in the U.S.?

MR. SCHMIDT: I think we need help. I think, I can think of specific anecdotes of technologies that we've transferred, or things we've learned through our pie study and companies we've talked to, this notion that the ecosystem is hollowed out, that the industrial common says has cleared out. We really see that quite tangibly in specific examples and in talking to companies, I think, and it's kind of clear in hindsight that where the capital markets have pushed the large vertically integrated firms to be more capital efficient and shed capacity, which is not perceived to be a core competence, and going to sort of distributed supply chains and more lean manufacturing.

That slows down the innovation process because you don't have all the knobs to turn to develop that next generation product, and that key supplier that's going to enable to next innovation isn't across the street or even under your same roof, but he's on the other side of the continent or on the other side of the world, and that slows things down. And I think it's really critical. We did a lot, we looked at startups out of MIT, we've talked to large firms, when you ask companies in general, how long does it take to take a disruptive new idea that

requires a new process, a new technology, and generate revenue and a product based on that, it's north of ten years.

I have a company that I started 12 years ago, they're just getting the product in the market, and that's not uncommon, large manufacturing firms talk about the same thing. And so it takes a long time, and we think, our view at MIT is that it's a rich opportunity to think about how you compress that time. And what's the R&D agenda, and what's the policy agenda that strengthens the ecosystem and compresses that time and plays to our competitive strength.

MR. MURO: Building on that, James, I mean, you have written a lot on the array of disruptive technology, many of which seem incredibly exciting, and I'm wondering to what extent you view the technology explosion of the next decade as beneficial for the U.S. positioning. And, again, looking at that segmentation of industry, what does that mean for this country? Should we be optimistic about how this will play our for the U.S. in this sector?

MR. MANYIKA: I think we should be, but I want to go back and maybe add something to the previous question and discussion.

MR. MURO: Yeah.

MR. MANYIKA: One of the things that's interesting, particularly as we work with many companies on this question of innovation and supply chains is that I think you're starting to see a significant shift, I think. We used to do, for

decades, lots of work on lean manufacturing, lean supply chain, getting things incredibly efficient, I think you're starting to see a change where there's a lot more excitement about how do you make supply chains more resilient and more agile and more responsive, almost above and beyond just simply being lean and efficient. And I think that's starting to change, and I think that shift, I think, plays well to the trends and the capabilities and potential, particularly of the U.S. economy, and I think we're seeing a lot more of that.

You're also seeing the requirement for that agility and that flexibility and resilience to be very closely linked to where the markets and the demand happens to be. It's still the case, though, that the U.S. is still the world's largest market, despite what you might think, right, it's still the largest market globally. So I think all of that bodes very well. I think, when you look at the raft of new technologies that we're starting to see, we did some work where we were looking at these technologies mostly from the point of view of, not so much what's cool and exciting, but more, which of these things are going to be some economic consequence, because they touch big chunks of the economy or big supply chains or big profit pools.

And there's roughly a list of 10 or 12 of these things, but what you see across those technologies is that, you're starting to see new supply chains are going to emerge from, to support that. So I think, take 3D printing, I think when we

talk about 3D printing a lot, we talk a lot about the person, the garage making prototypes, I think that's very exciting, but we don't talk enough about the underlying supply chain that's going to need to be in place to actually help bring those products at scale into fruition. We don't talk enough about that.

So, as you look underneath the covers of a lot of these technologies, there's a lot of scale change and scale innovations that are going to have to come into play. The good news, and you look at that list of the roughly 12 that we had, is that most of those innovations are actually mostly originating here, most of the breakthroughs have come from the United States. So the question is can we scale up the infrastructure capabilities of supply chains, the skills and the talent to fully capitalize on that, I think that's where real work is required for all talent, challenges and infrastructure challenges that we all like to talk about.

MS. BAGLEY: And that's where we have fallen down quite a bit in the past, right

MR. MANYIKA: Absolutely.

MS. BAGLEY: and where some of that overlay, I think, in the clusters work that I was talking about. I was thinking about, also, during James' speech and some of your comments, I don't think it's going to be seen as individual firms, like Avery Dennison moving something back and having their manufacturing

closer to their productivity, and just that on the ground thing. I actually think, also, at least we're seeing in Northeast Ohio. That it's going to be firm to firm.

So whether it's supply chain innovation, that's what made me think about it again, or in the flexible electronic space in Northeast Ohio, we're seeing firms locate relatively close to each other, within a few miles, and then cross-pollinating employees and different things because, while they have the same base, I mean, it's almost like Semitech, in a sense, teeny tiny. They have the same base issues, but they're not competing for the same markets, and so they're able to cross-pollinate a lot of the different technology issues, so you're seeing that play out really dynamically across firms, not necessarily just in a single firm and its supply chain. So I think that's another piece.

And I can't miss the opportunity to talk about the additive manufacturing center because Youngstown is within our region, and we've been working on a tech-belt collaboration for many, many years, about eight to ten years, that this is sort of, our big win was the additive manufacturing center. And I think it affords a great opportunity to be able to really focus, not only in Northeast Ohio, but nationally, how do you build out that supply chain? And that, obviously, is one of the big focuses, and then to obviously break down some of the technology barriers, there. So we see that as a huge opportunity in Northeast Ohio to be able to, and for the nation, to be able to build out that supply chain

aspect in both places, but has, hopefully, some concentration, from our perspective, in that tech belt region from Pittsburgh down into West Virginia and into Ohio.

MR. MURO: I mean, let's stay here, and I want to ask both James and you about, let's code this into the top like metric that the country's obsessed about, which is certainly job creation. So let's widen the aperture to talk about the supply chain, let's talk about the extent to which this does or can't contribute significantly to the construction, as the President said, an economy that grows from the middle out.

On the one hand, you've suggested some caution, here, meanwhile, you're on the front lines in a region that has seen some job growth associated with all this. Do you want to each give us, what's the appropriate way of thinking about this, the implications for middle class job growth?

MR. MANYIKA: Well, certainly, from my point of view, I think it's a moderately optimistic view in terms of if you're thinking about jobs within the manufacturing sector. I think we'll see bigger gains in terms of either output or productivity or GDP, and I think jobs will grow, but I think we'll have to moderate our expectations if we're trying to imagine that manufacturing will go back to where it was at its peak in the '40s and '50s where it was the highest, 30 percent of employment, I don't think that's realistic in a very large services economy.

And that's just because, and we're talking shares of employment, so while I think manufacturing probably itself will grow, as a share of the economy, the services part of the economy is just too big and grown too quickly, so I think we have to moderate our expectations.

Having said that, though, I think, already, we've seen a big record growth in job, absolute jobs in manufacturing. I think it's hard to deny that, and I think, and the fact that we still have more things ahead of us than behind us that are going to lead to job growth, shale energy, innovations, that's very, very optimistic. I also think it's quite important, I think the gentleman from Siemens made an important point, which is also linked to some of what we see, I think we have to change our mindset as to how we think about what constitutes a manufacturing job. So I think if we're thinking of manufacturing jobs as assembly line jobs, I think that's a very narrow view. I mean, we're starting to see a whole raft of different kinds of jobs, software coding, maybe software coding is a factory job of the next decade.

We see a whole set of service related jobs, we see a whole set of cascade sort of jobs in the supply chain, and I think it's a little bit of an artifact of the way we code this data that we don't even include, for example, engineering services or design services part of manufacturing. Doesn't make sense to me. But I think we have to have a much larger aperture. And many of those jobs, by the

way, that we were just talking about pay a lot, actually, those are descent jobs, pay very well, they're very attractive, very competitive.

Part of the challenge, we don't often have the right skills, so you're here, and I spend a lot of time with companies, the difficulties of finding talent, and I think we, that's a big area for us to work on. And it's not just the stem degrees. Yes, of course, stem degrees are very, very important, I mean, I think it's quite, it's not great that the U.S., if you look at people that graduate with stem degrees, it's something like 15 percent of graduating classes have stem degrees, that's behind Mexico and China. China is graduating 42 percent of stem degrees, so we have to solve that.

But put that aside, you also have the more vocational and technical skills that are also in short supply, and these are not stem degrees at elite schools, right, these are very practical, needed technical vocational skills that we don't have the, we're not doing, we're not creating at the size and scale and pace that we need to.

MR. MURO: Yes

MR. SCHMIDT: I'd like to add, just on this one point, in the MIT study, we looked at, we took a database of manufacturing firms in the U.S., separated out those that had doubled the revenue in a four year period from 2004 to 2008, and also grew their employment base, and there are about four attributes

to those companies, so those so called champion manufacturers. One of them was, a lot of their growth was derived by figuring out how to bundle important services with their manufactured products, and I think that job component is really critical.

MR. MURO: Absolutely. So, again, getting to the question of what is a manufacturing enterprise? It's frequently this hybrid of manufacturing, software, digital activities, and so on.

MR. SCHMIDT: Actually, just to add one other point. I'm actually quite impressed with one of your former colleagues, Rodney Brooks and what he's done with Baxter, for example. The reason why the Baxter robot, to me, is quite interesting is, I love robotics, but not just because it's robotics, but for the first time, it changes how we think about the human machine interface and the kind of skills that are required to be able to train and to work with very complex equipment as in Baxter.

So that also has an impact on how we think whether jobs, the skills required to operate quite complex machinery, as well, which will help.

MR. MURO: Yes. So, in Northeast Ohio, give us a quick read on what you're seeing in the employment front, and then, turning to this critical training issue, are you feeling significant choke points there in the occupations being served?

MS. BAGLEY: Right. I think, obviously, we hit on a lot of the same challenges nationally. It becomes a microcosm in a region of those challenges. Our unemployment rate is slightly higher than slightly lower than the national average, so from a sort of national perspective, that's okay. I think this middle class issue and having so relied on manufacturing through the decades, and then needing, really, to continue to make sure that that happens in the future, I think that is very sort of evident in all the policies and the work that Northeast Ohio does.

And even, like I was talking about earlier, in the clusters work, these are just market opportunities that cut across manufacturing companies. I mean, that's sort of how it ends up, so the product opportunities and things build those teams, and then the manufacturing, hopefully, then also well, not hopefully, but we have very specific ways in which we connect that back in. I think, one of the things I wanted to bring up here, because I think it connects to some of Gene's comments, too, is the administration and the work that they've done with across agency solicitations, like the Jobs Accelerator, SBA has a clusters award that we've won, and we're able to then partner on multiple, so with our MAP center, with our community college on the skills gap.

And one of the things I think is a challenge is sort of the projection of where you need the jobs, right, so the timelines don't match up. Community

college needs to build a program, or university needs to build capacity in a certain place to be able to train and put out a certain type of worker, yet companies are not able to say in three to five or ten years where they're at. So what we're doing with our Jobs Accelerator is, the community college is really working in more of the cluster concept. So if one of the companies bails, there's other jobs in that vein that will be available in three to five years when the community college is actually putting out graduates that have that trained expertise.

So that's just one example of the things that we've been able to start to pilot or test on the ground as we're trying to figure out how to solve for that. Because I think there is, I mean, that hollowing out of the middle class, as Gene put it, I think is a real issue in the industrial Midwest, and how we make sure that we continue. Because our economy is not going to shift well, Pittsburgh is an interesting example, shifting into some of the software, the health care. I don't think we'll see as major of a shift in that, I think we still are going to have a very industrial and manufacturing based economy, and obviously, if that's declining, then we're in significant trouble over the years.

So we need to transform that, we need to be thinking about how we base it on innovation and technology and new market opportunity.

MR. MURO: Let's turn to policy. We've heard some shorthand about it from Gene, I'm curious, Marty, from your work both through this systematic

pie project at MIT, but also your work directly with companies. What is the short list, what are the top interventions that we need at the federal level, since we're here in Washington, but I think then also what are the regional responsibilities?

MR. SCHMIDT: I think there's about four things I would mention. I mean, we really believe in the concept of the manufacturing innovation institutes, I think it fills an important gap. And I think, having participated in the AMP activity, we were just delighted that, at least one of the first data points in the experiment was that the commitment to creating innovation in institute unlocked a lot of investment from state governments and from the industries who needed to get that risk pooling in order to advance that technology. So we think that's a great concept.

I think the small and medium enterprises are really struggling, and I think particularly at the regional level, there's a lot of things that state and local governments, as well as the federal government can do to help them be successful, fostering these public/private partnerships around employment, job training. I think there's lots of great examples out there, and I think figuring out how to share best practices and promulgate that, I think, is really critical. I think on the education front, I think that's a really critical area. The community college level education, I think, is really critical, but there are probably new delivery models that I think could be more effective in that space.

And the last

MR. MURO: Thinking of online solutions or

MR. MANYIKA: Exactly.

MR. SCHMIDT: And the last one I mentioned is, one thing that I don't think we've really seen a good solution for, but it's a significant problem is access to capital. It's an issue for small and mediums, state governments are working with them on that, but one of our studies at MIT of startups, when it takes 10 to 12 years to go through, to get first revenue, we're past the point of the publicly traded power point, so that period of pre revenue IPOs is gone. And so, and the venture capital industry chokes on that last round of investment that takes the scale up.

And, interesting enough, in our experience, we studied MIT licenses 20 startups a year, we studied 200 of those start ups from '97 to 2006, interesting enough, 75 percent of them were companies that make a product that, if you drop on your foot, it hurts, as opposed to a software service. And when you look at what happened with those, 60 percent of them are still alive, but what's interesting is they've reached this inflection point, and Liz Reynolds at MIT studied this carefully, where they need another, say, they raised the first 60 million, no problem, sort of, but that last 60 to go into production, a lot of those investments

are coming from foreign investments, Rush Nano, Singapore government/Chinese government.

And those carry a commitment to do something in that

MR. MURO: Because U.S. sources are just not there?

MR. SCHMIDT: Well, they're interesting enough. They're actually somewhat attractive to the investors, the original investors because, typically, they're non dilutive investments.

MR. MURO: Let's do one more reflection from you, and then I want to open it up to the audience.

MS. BAGLEY: Okay, that sounds good. I just wanted to build on that a little bit, because I think one of the critical things that people have talked about is products into market, right, and shortening those timelines, and that's really what a lot of our work has focused on, is bringing together consortiums to commercialize products faster. So what's that speed to market, and what are the market opportunities? But one critical piece of that is, we call it industry specific funding, and so it is, a lot of times, non dilutive capital, but it's also going to sometimes not just one company. So the venture capital market is not necessarily, you know, so the supplier needs to retool a line, the company, I suppose OEM, is the best term for it, but the product sort of innovator has more of a venture capital need.

And so I think that industry specific funding piece, that's where the federal government, you know, I think, has a role with their existing funding, and plays that role, but we're trying to get better and better at our regional level at taking advantage of what is offered in the federal government as grants and SBIRs and different things that, the timing issues sometimes impede, but I think have a major impact. So, from a funding perspective, that's certainly a great role that the government can continue to play.

MR. MURO: And, clearly, there's that important regional role in much of this.

MS. BAGLEY: Right, exactly.

MR. MURO: One thought, and then I want to open to the audience.

MR. MANYIKA: I think, from a policy standpoint, I'm suddenly in the role of making policy proscriptive recommendations, but I think I've certainly aimed the policy fire power probably at two or three areas in terms of formulating policy. One thing is, we do know, for example, while the U.S., I think, has done better in the last three years than has done in a long time, in terms of attracting foreign direct investment, there's a lot more that could be done. Because we do know that when you have, whether they're U.S. companies or international

companies, the world's most productive innovative companies investing in your economy, it drives performance and growth.

And we do know from a supply chain cluster standpoint that most of these large companies, they purchase close to 80, 90 percent of their intermediate inputs from smaller firms that are local in their environment. So the more you can do to get large corporations, quite frankly, who have a lot of money on their balance sheets, and so forth, to open that up and invest, that's going to make a big difference, however you do that, whether it's thinking about we forming the tax code or R&D tax incentives, that's a big area to think about.

The other area to think about is also infrastructure. We know that, from working with a lot of companies, that among other things, infrastructure and the quality of it is one of the big area that actually influence some of the choices that companies make, particularly in this sector about, given all the things you said about supply chains and so forth. So to the extent that the U.S. reach is lagging in terms of the rate at which it invests in its infrastructure by any study that's out there, that's an area, I think, where firepower, the policy of firepower could make a big difference.

The third and last area is this whole area of talent and education and training. What's striking to me about that is, I think, while all of us can think of lots of examples of community colleges that are great, the problem is none of

those are operating at a scale to meet the challenge, right. So the jobs training skills challenge we're talking about is denominated in the millions, right, and yet we often talk about a small scale micro solution, so there's got to be something to bring these questions, to have them be addressed at national scale in some meaningful way. So, I am at those three areas.

MR. MURO: So I think you've given us themes for the next two Brookings convenings, certainly infrastructure, my colleague Rob will pile on to. Well, let's spend a few minutes here, why don't we go out and here, we'll take a state who you are and who you're with, and we'll take three or four or five questions.

QUESTIONER: Hi, my name is Tracy, and I'm actually an intern with SelectUSA that Mr. Sperling had mentioned, so my question is, we do a lot of work with FDI investments from foreign countries, so I'm curious as to the dynamic between trying to retain American manufacturing and trying to attract foreign manufacturing, especially if some of those foreign firms maybe have their R&D or product design in overseas countries.

MR. MURO: You want to take a shot?

MR. MANYIKA: Sure. My response, I think it's a, all too often we think about those questions at zero sum times, right, in the sense that I think any company, any large multinational which invests in the U.S., whether it's a U.S.

company or an international company, is almost empirically going to buy a lot of its intermediate products from local companies, and that benefits small and medium sized businesses. So, on that basis alone, I think is to the good that any company is investing here. We also know that some of the most competitive companies historically in some sectors, take the automotive sector, I think it's terrific that it's come back and the U.S. is doing very well, but for decades, the most productive, the most innovative automotive companies were not American companies.

So to the extent that you have innovative companies invest, you have the spillover effect of benefitting, so I think, I wouldn't think of it in zero sum terms in that form, I think any investment in this economy is a very good thing.

MR. MURO: More questions. About how right here, yeah.

QUESTIONER: Hi, my name is Nagi Sharam, I have two titles, actually, I work with the Stiefel Family Foundation, an age old investment group out of Silicon Valley, and then also with, I cofounded a public/private partnership called Made in America, which is focused on U.S. competitiveness in manufacturing issues, it's a challenge accelerator platform. But a question that I was kind of hoping you guys could expound on, Gene Sperling kind of talked a little bit about it and touched on it, Dana ultra property framework and issues around that, because I'm guessing NorTech and all that, it's and that used to be my bread and butter ten years ago.

I quit that field, but I'd like to get your perspective a little bit about what you guys have done in that space of trying to making a frictionless situation and I mean, I had my experiences from L.A. when I was helping on some stuff there, but if you could enlighten the crowd on what works and what hasn't worked so far, especially between SMEs and industrial partners.

MS. BAGLEY: Yeah, go ahead.

MR. MURO: Marty then or Rebecca then Marty?

MS. BAGLEY: Actually, you're probably

MR. SCHMIDT: You've done it, yeah. I think you're talking about SMEs to large, we have less experience

QUESTIONER: (Inaudible) university industry partner.

MS. BAGLEY: Yeah.

MR. SCHMIDT: Well, I think so, I would say that the first order intellectual property licensing operations with the universities are working reasonably well, people always would like to get a better deal or I think where we run into challenges, particularly in this sector, when you're talking about manufacture goods, that long time cycle makes it difficult, because you're negotiating IP terms with a lot of uncertainty in terms of where you're headed, and I think where I see challenge is in that regard.

The other thing, you know, is a challenge for us right now, I think, with respect to intellectual property and working particularly with large manufacturing firms is their desire, again, because of this long time to market, to get some certainty around royalty rates, as they start cumulatively investing in this technology. And through some unfortunate interpretations of the IRS around how tax exempt bonds funded building at universities are treated, there's restrictions that the universities have in terms of what they can do, and I think that particular issue was actually highlighted in the AMP report, that's one of our challenges.

MS. BAGLEY: I guess, just to build a little bit. I mean, you hit on a hugely challenging issue, and I'm not sure that there's sort of a silver bullet answer. I mean, a lot of it in the cluster work we're able to skirt the issue because we'll sort of go to a certain point in a group, and then two companies will break off and they'll negotiate their own agreement and then come back into the group, and that sets sort of the tone for things. One of the actually more interesting models for sort of industry collaborative university, is actually in Philadelphia with the Nano Technology Institute, they have, I want to say, ten institutions with anything that's commercialized in the nano-technology is done under the same agreement, so it's a shared format. So if you're interested in that, I mean, that's one of the better models I've seen for sort of industrial, sort of a multi-tiered industrial collaboration with institutions.

MR. MURO: Good. Let's take one more question, maybe, how about over here.

MR. MALLOY: Thank you. Pat Mulloy, I'm a trade lawyer, but I was on the U.S./China Commission for ten years. And here's the question I have; Gene had talked about the need for public policy changes including taxes. Fred Bookstein, who runs the Peterson Institute across the street, made a major speech recently about the deleterious impact that exchange rate under pricing by Asian countries has had on the U.S. economy. In other words, when you underpriced your currency, it makes it more difficult for us to spend export into that market and give those goods coming from those countries like China an export subsidy coming here.

Both houses of Congress, unfortunately on different years, have passed legislation to put a countervailing duty to counteract that export subsidy that they get from the underpriced currency. Do you think dealing with that is part of a public policy initiative that we need to encourage manufacturing in this country?

MR. MURO: How about Marty and James each take a whack at that.

MR. SCHMIDT: I'll defer to you.

MR. MANYIKA: I think certainly the question of how we think about currency and the value of currency plays, in a big way, for this sector for manufacturing in particular. So I think it's an important topic to address for sure. But let me point to a related issue that goes with that, one thing that's quite striking, by the way, on when we look at the trade balances is that, if you look at most advanced economies have had a trade surplus in the value of knowledge intensive manufacturing goods except for the U.S. in the last decade or so, except for the U.S.

Now, some of that is explained by currency valuations, so that's a big part of that, but the other part of it just also has to do with just, we have not been as competitive in some of the sectors where knowledge intensity is actually pretty important for tradable manufacturing goods. And I think that's an opportunity. Now, we've seen that start to turn in the last three years, actually, I think there's been some very smart policymaking that's helped with that. But I think that still doesn't address the currency valuation question you're raising, so I think that's an important topic. Unfortunately, I don't have a prescriptive answer for you.

MR. MURO: I think we are out of time, so I want to thank everybody, this has been extremely interesting. I'd like to thank both Gene in

absentia, but also our panelists and for the great questions here, and thank you very much, we will see you soon (applause).

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Expires: November 30, 2016