

**BARRIERS TO SUPPLY CHAIN MODERNIZATION
AND FACTORY PRODUCTIVITY ENHANCEMENTS**

HEARING
BEFORE THE
JOINT ECONOMIC COMMITTEE
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FIRST SESSION

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BARRIERS TO SUPPLY CHAIN MODERNIZATION AND FACTORY PRODUCTIVITY ENHANCEMENTS

THURSDAY, JUNE 5, 2025

UNITED STATES CONGRESS,
JOINT ECONOMIC COMMITTEE,
Washington, DC.

The committee met, pursuant to call, at 10:00 a.m., in Room 210, Cannon House Office Building, Hon. David Schweikert [chairman of the committee] presiding.

Present: Representatives Schweikert, Estes, Spartz, Beyer, Casten, and Min. Senators Hassan, Klobuchar, Blackburn.

Staff Present: Ron Donado, Laura Epstein, Nic Aguelakakis, Cam Healy, Alexander Schunk, Matthew Cernicky, Jaxson Dealy, Garrett Wilbanks, Oliver Sibal, Colleen Healy, Jeremy Johnson, Sebi Devlin-Foltz, Hannah Ceja, and Tamara Fucile.

Chairman Schweikert. All right. Why don't we get ourselves—because we are right on time, which is a rarity around here. Just want to adjust that volume.

Okay. And my understanding is Senator Hassan is leaving the Senate and on her way over, and if not, Mr. Beyer can always just manage everything.

I appreciate this is one of those—yeah, we have a really weird echo. I am going to turn that off for right now, and we can survive without. This is a small enough room.

I first want to thank the staffs. My understanding, at least from my Republican staff, is that they were great with some of the Democrat staff, that because this is actually—for the way we tried to approach it, this is a technology hearing.

We tried to do something: Instead of trying to make everything partisan, can we actually understand the potential technologies here? For a couple of you, we have sent you some unusual articles of everything from automated rail to—I have a whole collection of binders of automated port structures around the world—to other things going on; what does the future look like?

Chairman Schweikert. And, with that, I am going to introduce the witnesses. When the Senator gets here, I am going to have her introduce the Democrat witness. If you also have parts of your testimony, articles, other things that you also attribute towards the research part of the record, please, even if you send it to us in a couple days, we would most appreciate that.

We have a couple people on the Joint Economic Committee, researchers, that have been trying to study this issue of, if we would

get some of the technology adoption policy correct, what would it be additive to long-run GDP growth, and what does that future look like?

And so often our debate around here is debating investments in previous structure technology models, and we are trying to push what it looks like in the future.

So our first witness is Dr. Patrick McLaughlin, a research fellow at the Hoover Institution who specializes in smart regulation with a focus on the railroad industry. His past research has analyzed how overzealous regulations have prevented—okay. You just turned me on. We will—and let me know if it starts to echo like crazy—regulation has prevent—yeah, that is still horrible—has prevented our supply chain from working more efficiently—and adding to the cost of domestic production.

Dr. Yossi—

Dr. Sheffi. Sheffi.

Chairman Schweikert. Sheffi. “Sheffi” I would have got.

Dr. Sheffi. Yossi is fine.

Chairman Schweikert. Yossi is fine?

—is an Elisha Gray II—wasn’t he the true inventor of the telegraph?

Dr. Sheffi. Who knows.

Chairman Schweikert. Okay—a professor of engineering systems at the Massachusetts Institute of Technology and director of the MIT Center for Transportation & Logistics. He has authored nine books, including “The Resilient Enterprise,” and he is an expert on supply chain labor force.

Dr. Jean-Paul Rodrigue is a professor of maritime business administration at Texas A&M University at Galveston. He has authored and co-authored a number of research publications on transportation, geography, logistics, and port management.

Before joining Texas A&M University at Galveston, he was a professor at Hofstra—

Dr. Rodrigue. Hofstra.

Chairman Schweikert [continuing]. Hofstra, which is Dutch, I think—University. And I am going to let the Senator, when she shows up, give you your introduction.

Doctor, have at it.

Dr. McLaughlin. Thank you, Chairman Schweikert, members of the committee. My name is—echo on my side too, I guess.

Chairman Schweikert. Yeah, and we will turn it on and off a couple times and see—do we have a—

Ms. Healy. Yes, the House Recording Studio staff is on their way to check all the wonderful mics.

Chairman Schweikert. All right. Well, let’s have it.

**STATEMENT OF DR. PATRICK McLAUGHLIN, RESEARCH
FELLOW, HOOVER INSTITUTION, PALO ALTO, CA**

Dr. McLaughlin. All right. I will speak loudly. As you said, I am a research fellow at Stanford University’s Hoover Institution. I am also a visiting research fellow at the Pacific Legal Foundation. My testimony today highlights four key points.

First, regulatory accumulation slows investments, innovation, and productivity growth; second, regulations can hinder emerging

technologies; third, permitting delays significantly hamper productivity growth; and, fourth, uniform Federal regulations are sometimes necessary to avoid a fragmented regulatory landscape.

But, first, let's discuss regulatory accumulation. Since 1970, regulatory restrictions—the words “shall,” “must,” and “may not”—occurring in the Code of Federal regulations have grown from about 400,000 on the books to about 1.1 million today.

A study that I published in 2020 showed that this accumulation of regulations slows economic growth by nearly 1 percentage point annually.

Specifically, and relevant to this hearing today, the study found that the build-up of Federal rules over time distorted business investment decisions. These investments include research and development expenditures, new machinery, new buildings and locations, and new business formation itself.

In the long run, such business investments are key drivers of innovation and therefore productivity growth. So regulation, by distorting, is sometimes deterring business investment, also slows productivity growth. And that slower growth in productivity means slower overall economic growth.

We found in that study that the slowdown was about 0.8 percentage points annually loss from annually GDP growth. That sounds like a small number, but over time, that adds up to quite a bit.

That slower growth, caused by regulatory accumulation, resulted in an economy that was about \$4 trillion smaller in 2012 than it could have been without regulatory accumulation.

Second, my second point is on regulations and emerging technologies. Regulations can sometimes block the adoption of new technologies. For instance, automated track inspection technologies in freight rail have been successfully piloted and shown to be at least as safe as manual inspections, while enhancing productivity.

Yet the Federal Railroad Administration, the FRA, denied Norfolk Southern's request for broader implementation, citing, quote, uncertainty and potential risks.

Ironically, this stance delays not just productivity enhancements but also actual safety improvements relative to manual inspections.

Third, the average time to complete an Environmental Impact Statement, required under the National Environmental Policy Act, NEPA, is about 4.5 years.

A large portion of major infrastructure projects also encounter significant NEPA-related challenges typically adding another 1 to 3 years to the process.

Such delays not only postpone but sometimes completely discourage investment in crucial infrastructure projects and the productivity gains that those projects would deliver.

Fourth, if there is going to be some form of regulation, then uniform regulatory standards can be crucial for network industries. This is particularly true in transportation networks. I will use another example from the FRA.

In 2024, the FRA issued a rule that mandated a minimum crew size of two. The FRA's final rule made the point, quote, “If the issue of crew size safety is left to be governed by a patchwork of State laws, logistically, it may become impossible for a railroad to

even consider operations with fewer than two crew members,” end quote.

At the time, at least 11 States required most freight trains to operate with at least two-person crews. The FRA’s final rule preempts these State laws in its at least attempts to offer a path for a railroad to demonstrate that a one-person crew can meet the same safety requirements as a two-person crew and seek approval of a one-person operation.

Now, the FRA’s crew-size rule remains imperfect as its requirement for a risk assessment that must identify and assess all possible hazards in a proposed operation is unnecessarily fraught with uncertainty and egregiously burdensome.

But the concept is a good one. Regulations should have a pathway for technological improvement built into them.

In the railroad industry, human error is the greatest source of risk in train operations, and if the goal is safety, the FRA should hope that railroads continue to invest in technologies that minimize the opportunities for human error, including more automation.

In conclusion, I have the following recommendations.

One, use AI to build a comprehensive database on permitting frictions and delays created by Federal regulations and regulatory guidance. This database could let us identify regulations that contribute to permitting delays.

In some cases, it may not be the requirement for a permit itself but other regulations that inadvertently limit how quickly a permit can be processed.

And, second, regulators ought to make regulations more accommodating to innovation and advances in technology. Regulations should outline a process that allows a business to demonstrate that a different approach than the one designated by a regulation can achieve the same or better outcomes without having to get a waiver.

Thank you for convening a hearing on such an important topic, and I look forward to your questions.

[The statement of Dr. McLaughlin appears in the Submissions for the Record.]

Chairman Schweikert. Thank you.

Doctor, we are going to do an experiment with you, and we won’t start the clock yet. Can you turn your mic on—and we have our recording engineer over here—and let’s say hi.

Dr. Sheffi. Hi, recording engineer.

Chairman Schweikert. Is it—we are back?

Voice. Should be good to go.

Chairman Schweikert. All right.

Dr. Sheffi. You think it is fine?

Chairman Schweikert. You are perfect.

STATEMENT OF DR. YOSSI SHEFFI, ELISHA GRAY II PROFESSOR OF ENGINEERING SYSTEMS, MIT, DIRECTOR, MIT CENTER FOR TRANSPORTATION AND LOGISTICS, CAMBRIDGE, MA

Dr. Sheffi. Okay. Thank you. Thank you, Chairman, and distinguished members. My name is Yossi Sheffi. I am a professor of en-

gineering system at MIT, director of the MIT Center for Transportation Logistics.

I was asked to inform the committee on two subject: the challenges to increase domestic manufacturing and specifically about the required workforce skill for efficient manufacturing.

The views here are mine and not MIT's.

So what can be done to support reshoring of manufacturing. First of all, investing in automation—robotics, AI, machine learning, whatever. You know, this reduce somewhat the reliance on manual labor, which we have a problem with. Most manufacturing plants cannot hire enough workers.

Invest; but, from supply chain point of view, it is not enough to talk about reshoring because you have to invest—we have to invest in domestic resources of material and intermediate processing.

Just moving the last stage of manufacturing assembly into the United States is meaningless because we don't change the reliance on the—from China and others. This is expensive, of course, but we have to decide if we want to depend on China and possibly relax some environmental regulations.

And I like, you know, clean air and clean water just like the next guy. I also don't like reliance on China. So it is a tradeoff.

We have to build this. We have to do some of it, but it seems that one side argue for green; another side argue—we cannot get the balance here.

We talk about, another point is targeted help, like part of the Defense Production Act, which are aimed directly at supporting domestic manufacturing—sorry to say, you guys always load it with unrelated ideas and unrelated things, which is kind of, I don't know, doesn't focus on the problem. I am trying—I am not political, really not, but some of it, just cannot avoid it.

Of course, investing in infrastructure, and, again, my colleague talk about regulation, which are hampering investment in high tech, investment in infrastructure.

Something on the short term right away that will help every company—again, try not to be political—but reduce tariff uncertainty. It is the uncertainty that is killing us, killing companies.

It is—supply chain executive can deal with any hand that is—that you throw at them. You tell them what the tariff is, 50 percent, whatever. But don't change it every other Friday, please.

I mean, because if people buy and create too much inventory and lose money, and they just freeze. They don't invest. They don't hire people. So it is an issue.

Now, the second related issue, very much related to this, is the skills of the U.S. workforce. One of the main challenges in reshoring is the lack of manpower. Who will exactly work in all these new plants? I can give you some examples later if we have time.

There are two contravening issues here. First of all, all the plants that they are going to come are going to be new plants. They are going to be high-tech plants. So they are not going to need as many workers, but we still don't have enough workers with the right qualification to run these plant.

The education, I don't have to tell you, this is all in the media. The U.S. is falling behind on K-12 education. Johnny cannot read

with the exception of special schools. So you see here; what can we do?

Religious, private, magnet school, in many States, parents do not have the funds. In my State, Massachusetts, you don't have the funds to go—if you want your kid to go to a special school, you can do it on your own, which means that we bifurcate the population.

The people who can afford it will send the kid to special school. The people who do not will send their kids to school controlled by union. Again, try not to be political, but just mentioning facts.

Universities. You were not here before when I had two people with—attacking me, about 20 minutes ago. They were escorted out. Ridiculous. They are disrupting studies in Harvard, in MIT, in Columbia, in all of these places.

So universities became obsessed with things other than merit and learning and coming up with the best research and the best student education. So it is not—it is K-12. It is also universities.

So what is missing the most? I am sorry I am running out of time. Give me one more minute, 60 seconds. So—give me one more minute.

So people always ask me, friends always ask me, “Where should I send my kid to school?” Sometimes I tell them, send them to Texas. Other times, I tell them, “Don't send them to university. Send them to trade school. Send them to people who will be plumber, electrician, or operator of numerical control machinery, operator of factory robots.”

So high-level trade schools, better trade school is what is desperately needed.

These, by the way, are the last positions that AI is going to replace. AI may replace people like us.

Chairman Schweikert. And, Doctor, we are going to go down this in our—

Dr. Sheffi. Of course, but it is not going to replace the plumber who comes to your home to fix the stuff. By the way, my plumber drives a Rolls-Royce. Just saying. It is absolutely true.

Today, last point, last point—talking about nonpolitical—changing immigration laws. Advanced countries are thinking about what they need. So the U.K. allow nurses to come in because they don't have enough nurses.

Tom Friedman wrote that, several years ago, a person gets a physics degree from MIT; we should staple a green card on their diploma because these are people that we need.

So what do we do? We educate them, and we send them to make China a big competitor. Anyway, let me stop here.

[The statement of Dr. Sheffi appears in the Submissions for the Record.]

Chairman Schweikert. Doctor, thank you for your endorsement of my talent based (inaudible) immigration bill.

Doctor Rodrigue.

STATEMENT OF DR. JEAN-PAUL RODRIGUE, PROFESSOR, DEPARTMENT OF MARITIME BUSINESS ADMINISTRATION, TEXAS A&M UNIVERSITY AT GALVESTON, GALVESTON, TX

Dr. Rodrigue. Okay. My turn. Can we reset the clock, please.

Okay. So I am going to hear—talk to you about, mostly a focus about ports and their relationship with logistics, and I will start with a blunt statement that United States is no longer a commercial maritime power.

Its power, or its capability to project trade, has been outsourced and offshored to the usual suspects. So that is one thing we have to bear this in mind. We have very limited level of control on our maritime trade. Our ports, it is a different story.

And we are going to talk about what I think about six major barriers to port logistics in the United States. The first one is pretty obvious. It is we are victims of our success in some ways.

That is we are a very strong generator of wealth and economic growth. And, therefore, each time we have wealth and growth, we have port traffic, growth TEUs. And, each year, we add about close to 1.6 million TEU, twenty foot equivalent unit. That is a lot of boxes.

And, each time you have traffic, you need infrastructure, and the ports are struggling to keep up with this. There are phases of growth and decline, but we have a limited problem.

So, let's say since 2010, we added three Canadas—or the equivalent of three Canadas or two Mexicos in terms of volume. So that is the first barrier. We have a difficult time to provide infrastructure to support port logistics.

And, of course, this infrastructure is subject to vulnerabilities. That is one of my greatest fears, is port infrastructure failure.

The latest one was when a ship hit a bridge in Baltimore, which completely messed up port, railroad, and car supply chain. So that is the first barrier.

The second one is the scale. The whole business is based upon the concept of economies of scale: The bigger the better—which makes a lot of sense.

However, the ships are getting so big these days that the great majority of them cannot enter ports on the East Coast, and the ports on the East Coast, since the expansion of the Panama Canal in 2016, are now trying to restructure themselves around a new standard.

And we have a little bit of a tough time because the shipping lines are privately owned. The ports are essentially public infrastructure. So we provide investment in public infrastructure to benefit, in some ways, private interests, which is okay.

However, it is a little bit of a catch-up game. It is excessively expensive. We have a problem with dredging as well. So this is another very important issue, the scale of the things in the United States.

Then the third barrier I see is the composition of the traffic. What comes in is completely different of what comes out in containers. What comes in? Retail goods, the usual Walmart, Target, all that stuff. It is the great majority of our imports.

Exports, commodities and cultural goods, even recycled goods. The leading exporter of American port is fresh air. That is empty boxes that comes out. So we have a very big problem between the composition of what comes in and the composition of what comes out.

It is only very strong seasonality to it, which creates what level of infrastructure need to provide according to the fluctuations—the retail cycle fluctuations. That is a little bit of the problem.

How do we address that? You cannot. That is the problem with ports. We are addressing issue which cannot—maybe reshoring is, I would say, a strategy behind this. But, still, we have a little bit of a problem.

The other problem we have also is the issue of imbalances. We have staggering imbalances in our trade. That is what comes in, in terms of container, is basically full container. What comes out are empty containers.

And the problem is the shipping lines want their container on the ocean. They don't want the containers to go inland. And, therefore, it has a detrimental effect on—sometimes to exporters that have difficulties finding boxes because the priority is to have port-centric logistics, bring the container in, empty them, and bring them back to the sea, across the Pacific to be reloaded. So that is also another challenge that we are facing.

And solution, there is none, unless the trade regime changes. That is another issue.

Fifth barrier is technology and labor. We have a very—two powerful, very powerful labor unions that control, I would say port; I would say labor. And that creates some problem because their stance have been continuously anti-innovation, anti-automation these days.

Their goal is quite logical, really easy to understand. They want to protect their constituent, but they are now in the rent extraction business. That is they are becoming as some kind of a struggle on trade; you know, the ports of the United States have a very difficult time to automate. There are restrictions to what automation, and we are running out of land. We cannot build new port infrastructure.

The only way you can increase the density—the productivity is through automation. It has to come up down the line. But obviously we are going to have serious issues and negotiation with labor to do something like that. And, again, very difficult time.

The last barrier is a matter of efficiency. Unfortunately, from a time ending perspective, American ports are among the not very, very productive. Actually, I have shocking evidence that the United States are 30 percent less efficient than the global average.

Most Chinese port are 100 percent more efficient than the global average in terms of time it takes to turn around a ship.

So, again, all of this is related to the trade imbalances, the lack of automation, logistical issues at ports. So we have some problem. So, in a sense, that is my assessment of the situation.

We need some kind of a better or coordinated national port infrastructure strategy. We have—part of the maritime academy. Our enrollment is declining while the demand—we cannot—the supply of labor compared to demand does not match. There is a huge demand, and we don't have enough labor.

[The statement of Dr. Rodrigue appears in the submissions for the Record.]

Chairman Schweikert. Thank you, Doctor.
Madam Senator.

Ranking Member Hassan. Well, thank you very much, and good morning to everybody. I am pleased to introduce Dr. Sujai Shivakumar, director of Renewing American Innovation at the Center for Strategic and International Studies, where he also serves as a senior fellow.

Dr. Shivakumar is an expert in U.S. competitiveness and innovation. Prior to his current role, he directed the Innovation Policy Forum at the National Academies of Sciences, Engineering, and Medicine, and led major studies of U.S. policies on advanced manufacturing, small business growth, workforce development, and entrepreneurship.

Welcome, Dr. Shivakumar, and I look forward to your testimony, and you are now recognized for your opening statement.

STATEMENT OF DR. SUJAI SHIVAKUMAR, SENIOR FELLOW AND DIRECTOR, RENEWING AMERICAN INNOVATION, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES, WASHINGTON, D.C.

Dr. Shivakumar. Thank you for that kind introduction, Chairman Schweikert, Ranking Member Hassan, and distinguished members of the committee.

CSIS, as you mentioned, is a bipartisan nonprofit policy research organization dedicated to advancing practical ideas to address the world's challenges. Our mission is to define the future of national security.

The Program on Renewing American Innovation attaches the idea of innovation to national security, with the goal of revitalizing our Nation's innovation system to enhance our Nation's economic competitiveness and strengthen our security in the new world order.

CSIS itself does not take any policy positions. So the views represented here are my own.

So let me, again, start by thanking the committee for holding this important hearing. In my remarks, I just want to emphasize why centering manufacturing is really important for our Nation's ecosystem.

Our Nation's innovation system for the past seven, eight decades has been focused on an R&D strategy. I have been arguing that we need to move manufacturing and the infrastructure that supports manufacturing back into the center of our strategy.

So let me just highlight three main points in my quick remarks to you today. First, rebuilding U.S. capacity to innovate and manufacture advanced technology is critical for our economic competitiveness and our national security.

Again, for decades, our economic orthodoxy prioritized short-term benefits of offshoring manufacturing, but now we find that this strategy has hollowed out our manufacturing sector, not only devastating many of our communities but also weakening the link between research and production.

So this broken transmission means that U.S. firms are increasingly unable to convert new ideas into competitive products or rapidly scale up and develop weapons and other efforts to enhance our national security advantage.

Our urgent task then is to build up and scale up the manufacturing infrastructure within our ecosystem.

Recent Federal legislation have begun to actually address this challenge. As you know, the bipartisan CHIPS Act was spurred by a pandemic-era realization that our semiconductor manufacturing had become alarmingly concentrated in Asia, which posed major risks to our Nation's security and economic well-being.

Roughly 95 percent of the CHIPS Act's incentives supports semiconductor fabrication. And, in turn, the construction of semiconductor fabs, now under way, has exposed the fact that we need to regain our footing in manufacturing.

We also need to rapidly and urgently upgrade our workforce, our infrastructure, and our regulatory framework.

My second point is that Federal, State, and local governments must partner to develop the ecosystem where innovation and manufacturing can actually reinforce each other and thrive.

We need to support, as my colleague mentioned, high skill and technical skill—a high-skilled technical workforce. We are now digging out from decades of underinvestment and neglect in our vocational education programs and apprenticeship systems.

For example, the lack of alignment between firm needs, community colleges, and State governments, for example, has created a fragmentation between industry needs and the available talent in our population.

We also need to urgently upgrade our infrastructure. Advanced manufacturing, including semiconductors, relies on highly—on reliable, high-capacity power, water, and transportation infrastructure.

The United States needs to make infrastructure investments into utilities and supply chains, and the Inflation Reduction Act and the Bipartisan Infrastructure Law are proactive instruments to support innovation and manufacturing in this regard.

We also need to modernize our regulations, a point already touched in this panel. As you already heard, permitting delays can stretch for years. We heard that NEPA can add 4 to 5 years additional time for the build-out of the fabs that are now going under way in various parts of our country.

So streamlining regulatory frameworks to ensure clarity, speed, and predictability while still safeguarding environmental and community protections are really essential for building and manufacturing at scale and speed.

My final point is that a tariff-only strategy that does not address the workforce development and infrastructure build-out regulatory relief—and regulatory relief for renewing U.S. manufacturing will not be effective.

I understand that the threat of high tariffs is now being used as a negotiating tool in trade talks, and in making the case for tariffs, the administration has argued that higher import costs will stimulate domestic production.

While there is unquestionably a need to address unfair trade practices and nonmarket behavior by other countries, relying on tariffs alone in today's era of globalized innovation and manufacturing is not sufficient to convince firms to rebuild industrial capacity in the United States.

In fact, higher volatile tariffs can introduce uncertainty that discourages private investment and may even risk the development of alternate supply chains that basically bypass the United States.

So, in summary, we face a national security imperative to place manufacturing back in the center of our Nation's innovation strategy, and that strategy must rest on a solid ground, supported by skilled workers, reliable infrastructure, and modern regulatory systems.

So let me pause here and look forward to your questions. Thank you very much.

[The statement of Dr. Shivakumar appears in the submissions for the Record.]

Ranking Member Hassan. Thank you.

Chairman Schweikert. I appreciate that. As is an idiosyncrasy, I am going to—I should go last because I like to sort of wrap up everything and figure out what everyone said.

I am going to have, Ms. Spartz, why don't you go first, and then—or do you want to do your opening statement now?

Ranking Member Hassan. Why don't I—

Chairman Schweikert. Okay, let's do that, because you may have to abandon us.

Ranking Member Hassan. I will try not to, and I thank the committee for their patience as we are juggling a number of hearings this morning on the other side of campus.

I want to begin by thanking Chairman Schweikert for calling today's hearing on such an important topic and by thanking your staff as well for the work we have done together on this hearing.

And, for our four witnesses, thank you so much for giving us your time this morning and sharing your expertise. It is greatly appreciated.

I join Chairman Schweikert in recognizing how important it is that we modernize our supply chains and strengthen manufacturing here in the United States, especially as we work to out-compete China.

As is often the case, the chairman and I are in full agreement on the problem and probably agree on about 80 percent of the solution, and I think that is a pretty good start, you know.

And, to Dr. Sheffi's comments, this is group decisionmaking in a democracy, but when we can find out that we really agree on a lot, we can make some progress.

In the last several years, we have seen increased investment in critical technology manufacturing across the country, including new funding for projects in my home State of New Hampshire.

These new investments have been spurred in part by legislation like the bipartisan CHIPS and Science Act, which is helping us to strengthen our supply chains and out-compete countries like China by investing in American research and manufacturing.

In addition, energy tax cuts in the Inflation Reduction Act and funding in the Bipartisan Infrastructure Law are driving investment in the energy production and infrastructure that will support modern supply chains.

To capitalize on these investments, deliver for the American people, and support private sector growth, we also need to streamline

regulations. Doing so is essential to advancing American innovation and manufacturing.

Lastly, I just want to raise my concerns that a couple of our witnesses have also raised, that President Trump's actions have threatened the progress that we have started to see in recent years.

His erratic tariffs are slowing manufacturing investment, and his moves to slash funds for cutting-edge research will make it harder for the United States to develop and produce our own technology.

If the United States gives up on scientific research, China will fill the gap.

I hope that conversations like the one we are having this morning will help us move forward with bipartisan efforts to strengthen U.S. manufacturing, our supply chains, and advanced technologies so all of our people can thrive and so that we can continue to lead the world.

Thank you, Mr. Chair.

[The statement of Ranking Member Hassan appears in the Submission for the Record:]

Chairman Schweikert. Thank you, Senator.

Representative Spartz. Thank you, Mr. Chairman, and I appreciate for this hearing.

Actually, Dr. Sheffi, I enjoyed your testimony. It was very common sense, not political, but really that is a conversation we need to have. I completely agree with you that we can—we talk about a lot of irrelevant things and not really dealing with issues that are relevant and try to find at least common ground.

So what I wanted to just kind of have a discussion, you mentioned a few big issues that we need to deal with. We do need to have automation, and definitely we don't want government to spending money and investment—that is the worst entity to make decisions—but what do you believe, you know, the biggest barriers for businesses, or maybe some incentives that maybe we need to re-shuffle, which I agree with you, which can make changes several times a year and sometimes retroactively—that is really bad for businesses—but, you know, what are the odd things with EPA or other regulations or some other things that you believe would be, you know, something that incentivize more automations or maybe barriers that we need to do?

And I think the second thing you deal with really skills and shortages of proper skills? Because I agree with you; we don't want to have, you know, the logistics and putting together some of this phones which cost not that much, you know, here, which is not really stops our dependencies in China. We want to have advanced type of manufacturing done in the country. So, if you can elaborate a little bit more on that, I would appreciate that.

Yes, Dr. Sheffi.

Dr. Sheffi. Thank you very much for your questions. Let me change the whole U.S. policy. No. You know, you talk about something that I mentioned before, the uncertainty, the uncertainty is killing businesses. This cannot—look, I was in a big conference of supply chain—chief supply chain officers when President Trump announced the new tariff regimes.

The response was—you would be surprised—was just another day at the office because, at that point, we thought, “This is it; okay, we can do something. We can deal with anything.” But what we cannot deal is the unknown, the question that is changing.

My colleague here talked about regulation. He is an expert on this. Maybe he can add, you know, specific ideas, but, look, I visited ports in—that is to go on another point—I visited ports in, you know, Dubai, in Singapore, in Shanghai, in Rotterdam, and if you want to get depressed, do the same tour that I did and visit the Port of L.A., or any other port in the United States. You just get depressed.

I teach in schools all over the world. MIT has good students, Stanford, good students. You know, elite universities have, by and large, good students, even though, let me be the first to say, the level of teaching is going down, because the students who are coming are not that well prepared, and for a whole lot of ideological reasons.

So the administration—let me go a step back again, can’t avoid politics—the administration, I understand why all the tariffs are happening. It is true that the imbalance with China is unsustainable, that China is eating our lunch, and not in a fair way.

Representative Spartz. All right. But I just wanted to—you know, there is a lot of negotiation. A lot of things are going to happen, and everyone understand we need to have predictable framework, and we are working on that.

But we are also—for businesses to be attracted, we have some weaknesses. You know, we have some weakness in education and skills preparedness, and those some things—or regulatory environment where really it is so much and so long to take it.

Several companies going to look, we say, “Yeah, we really want to bring jobs home, but the businesses, it is not cost-effective; it is time-consuming; and we don’t have skilled labor.”

What do you think we should prioritize maybe looking at some, as you said, maybe preparedness, more with technical skills. Maybe we should start doing more in K-12 and post-secondary education, and maybe we have too many perverse incentives to everyone going to college with worthless diploma that the people cannot get jobs.

I mean, what are you thinking? You kind of point out—I taught a little bit of college myself, and I have seen the decline of kids in ability to learn. And, in this fast-paced environment, it is even more important because it is changing a lot.

What do you think we should really start prioritizing, that we look at the relevant things that we can control?

Dr. Sheffi. Very quickly, the things that control. A, I don’t know if it is a Federal issue or State—allow parents to choose schools. This will increase significantly the use of Catholic school. I am Jew. I know so many of my Jewish friends send their kids to Catholic school just because they are better—I mean, it is nothing to do with religion—or to magnet schools and all of this.

We have somehow to release the hold that the union has on schools. We have to—President Trump already started changing the university.

Now, everything that he is doing has the right intention. Just the way it is being done is not ideal. We cannot lose Harvard. I am from MIT. And they—Harvard has some part, but each university is not a monolithic structure.

There are pockets that are outstanding and help U.S. competitiveness and help—MIT, we do a lot of defense work. There are pockets that should be spun off. That is the best way that I can—so just understanding the structure of something that you are dealing with.

Representative Spartz. Thank you. Thank you very much.

Chairman Schweikert. Thank you, Doctor.

Senator.

Dr. Sheffi. But maybe you should move and sit here. You have all the answers.

Ranking Member Hassan. Thank you very much. And my questions are mostly directed to Dr. Shivakumar, and I am greatly appreciative that you are here and that all the witnesses are here.

Dr. Shivakumar, as you highlighted in your testimony, the bipartisan CHIPS and Science Act has started to drive significant private sector manufacturing investments in the United States.

While this and other measures, like the Bipartisan Infrastructure Law and energy tax cuts in the Inflation Reduction Act, create new opportunities to invest in the U.S., projects can be held up by overly complicated reviews or unnecessary requirements that can slow down construction and raise costs.

Doctor, could you discuss ways to eliminate barriers so that we can get things done faster?

Dr. Shivakumar. Thank you for the opportunity. You know, there are three things that we have basically underinvested in, in this country for the past three decades or more.

When we started offshoring to China, we got the China price at least for a time being, but we also got off the hook in terms of modernizing and investing in our infrastructure.

We also got off the hook in terms of educating and training our skilled technical workforce, getting our vocational schools aligned with the needs of industry.

We also started—we haven't also kept our regulatory environment in, you know, in fighting form.

Yes, there is a need for regulation for standards to make sure that our environment is protected, but there are ways of doing that, that sustain our environment and make regulation speedy and efficient.

I think we heard about the, you know, 4- to 5-year delay in getting some of these fabs up and built in Arizona and Texas, other States around the country.

You know, every year that you delay—you create a delay, it is another billion dollars for the semiconductor companies.

So, if the CHIPS Act provides, you know, incentives to companies off that amount basically to build the fab, basically one hand gives; the other hand takes away, just because of the formalities of having to comply with these environmental regulations.

There are already a number of State and local regulations that the semiconductor companies have already factored into their plans. Because, you know, CHIPS is a Federal program, suddenly

these 1970s-era—and EPA, NEPA came into play, and this is something that, suddenly, you know, this is a 1970s-era law. We are now how many decades—

Ranking Member Hassan. Yeah.

Dr. Shivakumar [continuing]. Beyond that. It is clearly not, you know, structured to deal with today's world and today's needs and the need and the competitive cadence in which our economy competes against other powers in the world.

So this is a very urgent issue that we need to solve this. Thank you.

Ranking Member Hassan. Well, thank you.

Doctor, as you have recognized, Federal funding for science and research plays a key role in driving innovation and ensuring that we can out-compete countries like China.

Instead of supporting American innovation, the current administration is attacking universities, slashing research funding, and blocking some of the most talented students from around the world from coming to America to learn.

Short-sighted attacks on innovation will destroy part of what makes America great and will crush innovation.

Doctor, could you discuss how these actions undercut U.S. competitiveness, create additional barriers to future innovation, and block supply chain modernization?

Dr. Shivakumar. Thank you, Senator. If I can just provide a little bit of context—

Ranking Member Hassan. Yeah.

Dr. Shivakumar [continuing]. And historical context. So, after the Second World War, our manufacturing base was intact. What we found—that we didn't have the research base. So what we wanted to do at that time was actually build out the research infrastructure.

So, if you think about NSF, NIH—expanding NIH, the National Labs from DOD and DOE, our research—our universities' research infrastructure—all of these were implemented at that time.

We were also very, if you think about the Manhattan Project or the subsequent, we were very proactive in bringing the best and the brightest around the world to our shores to make sure that our research engine, which was then still connected to our manufacturing engine, was in fit form.

And so we have, over the past many years, have the world's leading research infrastructure in the United States. It is a huge advantage for us, both commercially as well as in terms of our national security.

What we find today is that that gear in our innovation system is not well connected to the manufacturing gear in our innovation system.

Other countries like China, Japan, Europe, put manufacturing at the center of their innovation system, but we need to preserve our advantage in research but connect it to the other aspects.

Ranking Member Hassan. Right. And I think we are seeing some alignment in our community colleges and our high schools. We have to do more obviously. But, at the State level and the local level, we are seeing a lot of alignment there.

I am out of time. I am going to just say that, if I were able to stay, I would also want to talk about the role that the CHIPS and Science Act is playing in places like New Hampshire, as we are putting together a biofabrication technical cluster that will make it possible, if you need a new kidney someday, Mr. Chair, to manufacture a new kidney out of human tissue and avoid a huge amount of healthcare costs and improve the quality of lives for millions of Americans.

So I was going to ask a question about that. I will invite you to come to New Hampshire to see it.

Chairman Schweikert. Senator, I will make you a deal. I have a fascination with synthetic biology and now the 3D-printing—

Ranking Member Hassan. Yeah.

Chairman Schweikert [continuing]. Of cells—

Ranking Member Hassan. We are 3D-printing human organs, yeah.

Chairman Schweikert. Yeah. Well, and synthetic DNA, I actually have one of my staff actually doing a research project on synthetic DNA. You just started another hearing idea.

Ranking Member Hassan. Well, and just so people, what the CHIPS and Science Act did was allow us to connect businesses, universities, research, all together in one, at the site of the old textile mills in Manchester, New Hampshire.

So, instead of creating 50 miles an hour of textiles, which we did in the late 19th century, we are now creating human organs in those same mills. So I look forward to that. Thank you for the indulgence.

Chairman Schweikert. Thank you.

Mr. Estes.

Representative Estes. Well, thank you, Mr. Chairman, thank you for holding this hearing, and thank you for all of our witnesses for being here today.

You talk about so much that is so important, whether it is talking about trade policy or regulations or how do we prepare for the future with investments and education, and it is so important as we look forward.

You know, one of the things, I think, that came out of the election last year was, how do we focus on putting America first and focusing on our future, and what do we do moving forward?

I think Americans are tired of seeing factories shut down and production move overseas and loss of jobs just because maybe production costs or production time is faster.

And regulations, as has been mentioned, has been somewhat entrenched in some of our public policy that is kind of a part of the problem that is causing this and driving this.

I think we all agree that, if we don't look at how do we continue to grow, make America first in terms of production and opportunities, we won't have an economy that will produce what we need, and we will be dependent upon foreign countries—in some cases, adversaries like China—to produce some of the goods we need.

And we can't allow things like semiconductors to be an area where we are depending upon somebody else.

So we need to make sure that we focus on good public policy to address some of these production issues, as well as technological

developments in the future and make sure that we stay competitive.

Supply chain modernization and factory productivity improvements are certainly important. In my home district, the Fourth District in Kansas, aerospace production is critical for our economy, and I have toured a lot of plants and manufacturing facilities and looking at, how do we develop and produce parts not just for today but for the future, and some of the major companies there—Spirit and Textron and Bombardier and so many others—are constantly looking to improve and produce aircraft that help power our Nation and help move us forward.

Dr. McLaughlin, in your testimony, you touched on the importance of research and development for long-term economic growth, and providing immediate expensing for research and development costs has been one of the priorities in Congress and always had bipartisan support.

In Kansas, R&D expensing helps make new jobs and helps grow the economy.

Can you tell us a little bit more about burdensome regulation and how inadequate tax policies may affect decisions businesses make especially related to R&D expenditures?

Dr. McLaughlin. Thank you for your question. So, in the study I referenced, right, looked at how regulation, the build-up of rules over time, directly affects business investments of various types, and tax policy is held constant there.

So, while I appreciate the nuance of what you are asking, my study didn't directly examine the interaction between regulations and tax policy.

That said, an obvious path forward for improving investment and research and development is to consider all ways in which regulation could interact with tax policy. I don't think I have empirical evidence on that right now, though.

Representative Estes. Yeah. Well, you noted something pretty interesting in your comments around the roughly—your study showed 0.8 percent reduction in GDP just based on regulatory burden, and that has kind of played out with some of those studies that we have seen from our bipartisan Joint Committee on Taxation and Congressional Budget Office, that said, if we get a 0.8 percent increase in GDP growth, we would actually, over 10 years, collect \$3 trillion more in tax revenue, which would help with our deficit.

And I don't know if your study included anything talking about the deficit and how do we—the benefit that we get out of good regulatory policy to help with that.

Dr. McLaughlin. I think that is a great point. The growth effect obviously will increase the tax base, and that should go into the budget conversation.

And, obviously, the growth effect from this study is corroborated by other studies. I did a study of British Columbia as an example. They cut regulations by about 40 percent between 2001 and 2004.

As a result, GDP growth went up by 1.2 percent. Again, a larger tax base.

Representative Estes. Yep. So, excellent, thank you.

Dr. Sheffi, you talked about supply chains and the workforce and new technologies. I mean, how can we use new technologies in the United States, like AI, to help promote more domestic manufacturing?

Dr. Sheffi. Well, first of all, using AI is a general term, but using—

Voice. Hit your mic.

Dr. Sheffi. I was trying to see if you can read lips. That is all.

Representative Estes. Thank you.

Dr. Sheffi. Obviously, you can't.

So what we were talking about?

Representative Estes. Talking about using technology to help make more—promote the best—

Dr. Sheffi. Use AI technology.

First of all, AI allow you to look at much more data, I mean, significantly more, and analyze more data, so you know more. Your decisions are based on fact, first of all.

Second, most companies work in silos as a—you know, these days, you know, procurement, they hardly talk to each other in most companies. And it is not even Congress. It is just in companies.

So the idea that information flows seamlessly across a company immediately make them more efficient because, again, they know more data.

Then there is the ability—most decisions have to do with the future. You have to forecast, what is life going to be? With machine learning and generative AI, we can focus better.

Now, when I say “focus better,” you have to realize, it is not, you know, a hundred percent better, but it is enough better to make a real difference, because then your decisions, your aiming like Gretzky said: “You want to skate to where the puck is going to be.”

So, here, you want to make decisions to what the world is going to look like in the future, in 3 years, in 5 years, in 10 years. Using modern AI allow you to focus better, to take a lot—because the large dataset, you can take a lot more factors into account and focus better. So this is just the tip of the iceberg on this.

Representative Estes. Great. Thank you very much. I am out of time.

I yield back, Chairman.

Chairman Schweikert. Mr. Beyer.

Representative Beyer. Thank you, Chairman Schweikert, Vice Chairman Hassan, for doing this. Thank you all. I found all of your testimony was fascinating, and I greatly appreciate it.

Because Dr. Sheffi and Dr. Shivakumar both mentioned tariffs, I serve on Ways and Means Committee, along with Mr. Schweikert and Mr. Estes, and I am consumed by concern over what the tariffs are doing to uncertainty in our economy.

Just this morning, I learned that our imports fell \$66 billion in April, the largest drop in American history. I just discovered an hour ago that the retail hiring was the lowest in April it had been in 25 years and that our net average tariff rate today is the highest it has been since 1938.

And, if the 50 percent steel tariffs go through, it is going to jump up to the highest since 1903, which is before all of us were born.

Let me move quickly because, in different ways, you have all talked about regulation. Every Democrat I know is reading Derek Thompson and Ezra Klein's new book on "Abundance."

So, Dr. Shivakumar, you specifically said that we need to modernize the regulatory framework. So Barack Obama appointed Dr. Cass Sunstein to go through all the regulations and eliminate "X" thousands of them.

Every Governor I know always promises in his inauguration speech he is going to set aside somebody to review all these regulations, but we still get all this accumulation. So how do we modernize the regulatory framework in a systematic constructive way—other than DOGE?

Dr. Shivakumar. Well, it will be—we have an expert on regulation so I will leave it to him to perhaps give you some more details, but we have, you know, basically regulation—a framework for regulation which is designed to keep our economy—which assumes that our economy is in a steady state.

Today our economy is in a very dynamic environment, and, you know, we were just talking about the role of AI in our, you know, strategic future; how do we bring in AI? If we don't use artificial intelligence to basically leapfrog the Chinese in terms of our technological abilities, we need to be, you know—and we can do that.

There are, you know, for example, we have what is called self-driving labs. These are robots that are connected with AI capabilities that do and speed up a lot of the lab research that goes on in pharmaceuticals and other areas.

We need to—and, by the way, the U.S. invests one-tenth of what Canada invests in this technology. So this is another topic that we should perhaps get into.

We need to be thinking more dynamically about how do we—rather than trying to create regulations that—around a static object; we need to be thinking dynamically, how do we then, you know, take the existing assets that we have, look at the world strategically—you know, where are the Chinese, where are we, what do we need to do to leapfrog them technologically—and make that bound?

Representative Beyer. You set up my next question really nicely. I want to thank Dr. McLaughlin for the idea of using AI to look at all the regulations. Although, I am a huge AI fan, but I do worry about some aspects—like, I don't trust the citations, among other things.

But, Dr. Shivakumar, one of the challenges I have with my Republican friends is most House Republicans did not vote for CHIPS and Science, which is really, we understand it was our first major commitment to industrial policy in America in the last 70 years.

And yet China, which has now grown to be larger than we are and is beating us in so many different ways in terms of manufacturing, is based on industrial policy.

How do you respond to my Republican friends' critique that governments shouldn't be picking winners when we clearly never had a semiconductor industry, et cetera?

Dr. Shivakumar. So I appreciate the question. Well, we know we have—again, looking internationally and strategically though—we have the situation where U.S. firms are working on the basis

of a market-based approach. You know, they create innovations. They sell them. We get some profits. Part of that is then plowed back into the innovation process, and that is how our system makes sure that it is at the lead.

The Chinese don't have a market system. Their high-tech technology companies benefit from the deep pockets of the state. So they are able to innovate at a much higher rate, and they are able to then put those products into the market, cutting into the bottom line of U.S. firms, and then reducing their ability to use those profits then to continue to compete.

So it is fine to talk about, you know, the market if China was also working on market principles, but we are now in a—again, in a strategic situation where a market-based economy is competing with a non-market-based economy, and where that non-market-based economy is using innovation and technology as a way to dominate, you know, technology, the world, you know, national security, markets around the world. So that is point one.

Point two is that I think a lot of people, when they say “innovation policy,” they think of top-down [inaudible] of systems, when what we are actually recommending, you know, and talking about, in a sense, is a, you know, innovation policy which is looking at the various connections points between technology, the workforce, capital markets, and so all of these systems within our innovation systems each has to work well, and each has to coordinate well with the others.

And so, when we talk about an innovation policy, we are talking a lot about, you know, American federalism in its truest form, which is both bottom-up as well as top-down.

The Federal Government can provide scale. It can provide focus, but especially in issues like workforce development, this is very much a State and local issue. You know, can firms work with State governments to get the community colleges to address their workforce needs, for example?

Representative Beyer. Thank you very much.

Chairman Schweikert. Thank you.

Senator Blackburn.

Senator Blackburn. Thank you so much, Mr. Chairman.

And thank you all for being with us today.

The logistics issue and supply chain issue is something that, on the Senate side and at Senate Commerce Committee, we have paid a good bit of attention to because it is essential, if we have the goal, which we do, of repatriating and bringing back a lot of manufacturing in this Nation, a consistent and ready supply chain is going to be necessary.

And one of the things in Tennessee that I represent is very important to us is logistics. It is an entire sector of our State's economy. And we look at Memphis as being the real anchor in this.

Memphis, Tennessee, has all five Class I railroads. We have an enormous intermodal because we have the port on the Mississippi River, and we also have FedEx.

In addition to this and because of this infrastructure that is there on the river and at the airport and in the rail yard, we have an enormous trucking industry that is thriving. So we do look at

it as air and river and rails and roads and the importance of that for our supply chain.

Dr. Sheffi, I do want to come to you on this, since part of your expertise is in logistics, and talk about the importance of establishing these intermodal hubs like we have done in Memphis.

Dr. Sheffi. Thank you very much. Let me suggest a book written by a young good-looking professor called “Logistics Clusters.” I wrote it about 6, 7 years ago. You can find it on Amazon. Just saying.

It is exactly this. It talks about—it also helps Ms. Hassan’s idea of putting—because it is correct for almost any industry. When you put together—people think it is counterintuitive. Why would you put competing companies together next to each other?

Well, look at the success of Silicon Valley. Look at the success of Hollywood. Look at the success of Wall Street. These are companies of the same ilk right next to each other because there is a flow of knowledge in coffee shop, in transmitting between people that elevates the entire cluster. The same thing.

And I spent a lot of time in Memphis. Fred Smith is a personal friend. So Memphis is looming large in my book because it is a classic example of a very successful logistic cluster.

And, as I said, it is all modes of transportation, but it is not only this. Because it has a good cluster, manufacturing has moved in. Because, if you want—today, if you want to fix your laptop, you can send it—you think it is Asus or Lenovo, you call them and you say, “My laptop is not working.” They say, “Put it in a FedEx envelope, send it to us.”

You are actually talking to another company; a third party that fixes the stuff. You send it Monday night, and Wednesday, at 10:30 in the morning, you get it fixed on your desk because the company moved in.

Medtronics. Now, if you need spine surgery, you know, the doctor needs a few tools, but he doesn’t know which ones until he opens you up. Not a good thought, but it is the truth. So they call Medtronics. Medtronics sends a kit up.

Senator Blackburn. Well, let me jump in here.

Dr. Sheffi. Anyway.

Senator Blackburn. I love the fact that you are talking about our industries there.

Dr. Rodrigue, I wanted to see if you had anything you wanted to add on the importance of these intermodal hubs as we look at expansion.

And Senator Cantwell and I have legislation, the Promoting Resilient Supply Chains Act, over on the Senate side, which would try to foster some of this. So I would like to get you to weigh in on this.

Dr. Rodrigue. Okay, perfect. Thank you. Indeed, to segue on I would say the authority on this issue, the concept of co-location and accessibility provided by transportation is a very important factor. It creates multiplying effects, and it creates, as we mentioned, these clusters. And, once these clusters are created, what we found out is they cannot be easily dismantled. It takes a lot of time.

And that is a segue to what China has done. China has created a massive amount of manufacturing and logistic clusters in all segments of manufacturing—

Senator Blackburn. My time has expired, but I appreciate that and note that we are doing that without a government overriding impact. We are doing it via the private sector without an industrial policy.

Chairman Schweikert. Mr. Casten.

Representative Casten. Thank you very much.

It has been a fascinating hearing. I want to try to come in with as much humility as a Member of Congress is capable of mustering. I am getting flashbacks to my first boss when I got out of grad school, who came into my office one day and said, “I need you to do some work to prove my preexisting theories.”

And, with that in mind, I have a preexisting theory and, Dr. Shivakumar, let me share with you the theory and just see if you share it.

I was 20 years in the energy industry before I came to Congress, both as a manufacturer and as a utility operator, did a lot of work with manufacturers. We were taking over their operations. And, over that 20 years, both for our company and for the companies we served, you had the globalization trends, the financialization of our economy trends, the, you know, everybody learning just-in-time manufacturing, the rise of shareholder capitalism.

Everybody skinnied up their inventories because, you know, the financial markets were saying, “You can’t have that much working capital anymore.”

And, on the manufacturing side, any CEO who wanted to keep their job had to look out and say, “I got three factories running 70 percent capacity factor. Shut at least one of them down. Get everything up to 90 percent.” And that created a ton of shareholder wealth but also essentially made the system more brittle.

And I would like to ask unanimous consent to enter some data into the record from the St. Louis Fed on the inventory-to-sales ratio over the last 30 years. And it is down about 20 percent over that period.

And, when we have had volatile points in our economy, like the 2008 financial crisis, like the COVID crisis, you see this huge spike where 100 percent of U.S. economic activity is explained by inventory shifts, right?

And so I guess my first question, Dr. Shivakumar, is, do you buy my theory? Have I got that basically right as far as like a sectoral trend and what has made our supply chains more brittle?

Dr. Shivakumar. Yes, your narrative is accurate. I mean, we have been—you know, our strategy has been assuming that there will be basically a strategically calm, relatively calm world where we can outsource parts of our productive activities without harming our own domestic innovation system and our manufacturing system. That has not proved to be the case because of events that we see now.

In the meantime, we have underinvested, as I mentioned, heavily in our workforce, our infrastructure. And so the reckoning is now here.

Representative Casten. But I guess—and I am sorry to be quick, but I am just watching the clock—if we agree that those sort of broader trends have created a set of supply chains that is more exposed to exogenous volatility—

Dr. Shivakumar. Correct.

Representative Casten [continuing]. Then the followup question is, is there anything currently going on in private markets that is going to fix that, absent government intervention?

Because, like, I have a hard time seeing banks all of a sudden saying, “I am going to give you more generous working capital terms,” or shareholders saying, “Sit on a dividend for a while because I would like you to have some spare capacity.”

Dr. Shivakumar. Well, there are some aspects of it that are clearly a collective aspect, and those should need to be addressed at the Federal level or the State level. There are also some of those activities that need to be—involve firms and the private sector as well.

So, in terms of the public infrastructure, highways, ports and so forth, these are very large public resources, and these have traditionally been the purview of the Federal Government and so forth because—for the scale and the public goods that they provide.

There are other issues regarding, for example, skilled worker training, where there has to be much more involvement on the part of the private sector.

Representative Casten. Yeah, but I think that is the tail of the dog because, to some degree, like, if you are not building the factories, you don’t need the workers, right?

So I guess, with the time left, the question I have got is, if our economy is more exposed to that volatility, then either we are going to put that risk on consumers, you know, or we are going to have—you know, in the form of higher inflation, in the form of supply shocks, what have you, or government has to step in to play that role.

And so what I am curious is, number one, these are global trends. Are there other countries that have managed that better that we could learn from?

And then, number two, we spent a lot of time not just in the CHIPS Act but in the Inflation Reduction Act, in the IIJA, around thinking about—because, you know, building electric transmission is also an investment in supply chain robustness.

Is there data to suggest that we did a good job of building those assets that the private sector was not going to get, or what could we have done better, and how do we think about making sure that—if the government has to play a role, how do we make sure that we are building the stuff that the private sector isn’t going to do, given the dynamics right now? And what international—which of our peers are doing a good job of that?

Dr. Shivakumar. Yeah, so the—you know, there is—let’s just take, for example, the building of these FABs. When you are trying to build a FAB, suddenly these semiconductor companies realize that they need large quantities of extremely high-quality power. So where is that going to come from, for example?

So we don't have the infrastructure in place now. It is a great opportunity to basically modernize our grid using new technologies, new resilience, new capacities.

If we are trying to become leaders in new artificial intelligence technologies, we need the power to then house and create the warehouses of data, so to speak.

So a lot of this—we have to play catchup in a lot of these technologies.

Representative Casten. I am over time, but I will just close by noting that, as a guy who built about 80 power plants, we do a really bad job of building existing technologies. The problem isn't the lack of technology that will meet those needs. It is how do we go out and develop capacity.

Thank you. I yield back.

Chairman Schweikert. Senator Klobuchar.

Senator Klobuchar. Thank you very much, Mr. Chair.

And thank you for holding this hearing.

I am somewhat obsessed with supply chains—yeah, there you go—and saw the breakdown during the pandemic. And I was actually thinking, my first thought was just—and I guess I will ask you this, Dr. Rodrigue: At that time, we had a huge problem with the ocean carriers that were basically charging huge amounts of money and refusing to take American exports overseas because they want to come back right away and get some other things, and it was a real problem.

So Senator Thune and I and Congressmen Dusty Johnson and Garamendi joined together and did this bill, Ocean Shipping Reform Act of 2022 signed into law in February 2022, which I think helped because it put some more power on Maritime Commission to be able to put in some rules, and even before they did those rules, I think they realized that they had to behave.

And I just wondered what is the role of intermodal transportation here in addition to all the bigger things we have been talking about.

Dr. Rodrigue. Thank you. Yes, this event, you could call it the great entanglement. That is where everything got clogged at the same time.

And, actually, what we found out afterwards, in hindsight, is the very high shipping rates were reflecting the lack of velocity. Things were not moving.

And people could not find I would say slots in container ships at any price, because there was not—because things got blocked because of the surge in demand, which was an outcome I would say of providing liquidity into the system, a lot of inciting people to—and then creating a surge at the shipping line they don't anticipate because everybody was betting the other way, that things were going down, and then suddenly things caught up, and people got caught up by surprise.

And it took a while for this—and that is why it became a public issue. Because it was entangled, we say, is there anything we can do? But, actually, there was not that much because it was actually a capacity problem.

It essentially start up at the ports. The ports were not capable of handling containers because their yards were full. The chassis

were not—no chassis were available and everything. That created a domino effect, and everything propagated, and then the rates went up.

Senator Klobuchar. It was just such a disaster that we don't want to repeat again.

Dr. Rodrigue. In my opinion, unlikely.

Senator Klobuchar. Yeah. Okay. So, coming out of that, we now look at—so things got better on the shipping front, and things were going. And now we have these tariffs, which I am very opposed to. I don't mind targeted tariffs here and there. But I just was in Canada with the new Prime Minister, as we hope we can negotiate those tariffs with the administration. Senator Cramer and I and others were there. So it was a bipartisan trip.

Dr. Shivakumar, could you just go over again just the risks that these higher input costs pose to business investment. That is what I am very worried about.

I am worried about the immediate, small businesses are roadkill because they can't—they are unable to have any kind of reserves that help them if the prices go way up. But I am worried about the investment decisions that are going to hurt us going forward.

Dr. Shivakumar. So small businesses are—especially small businesses thrive on a certain level of continuity in terms of the economy, as well as they are also very sensitive to prices. So the high tariffs affect prices of inputs, and volatility creates uncertainty, which, you know, increases business risk. And so, in that environment, it just makes it that much harder for our private sector to thrive.

It also affects our high technology industry. If you look at the aluminum tariffs, which have recently moved from 25 to 50 percent; they are very negatively impacting many of our semiconductor—the companies that make the tools that make the semiconductors. And so, you know, their costs are rising.

In today's world, there are competing manufacturers of these tools, and so we need to be mindful of our high technology advantage as well vis-à-vis the impacts of volatile tariffs.

Senator Klobuchar. Very good. And could you also comment—was it you that said we haven't kept our regulatory environment in fighting form? Was that you, or was it you? It was you, right, earlier in your testimony. I just thought that was a nice euphemism for the problem.

Just what do you think would have the biggest impact in terms of doing something quicker, whether it is energy projects, whether it is housing projects, whether it is many things, to make our country more competitive?

Dr. Shivakumar. So, again, you know, if you look at the FABs that they are now constructing, the regulations from NEPA and so forth are adding 4 to 5 years to the clearance process. And so, you know, within—if you think about Moore's Law, which is sort of, you know, clicking along every 2 years, 4 years, you are already two cycles past. And you are creating a FAB, you know, waiting for the regulatory, you know, pegs to fall into the circles, and you are already—you know, technology has basically bypassed you.

And you are—you have to—regulation has to be at the speed of technology. And so that is really something that we need to be

aware of. It is no longer a steady-state economy or an economy that is technologically moving at a very predictable rate.

You know, if you think about, again, Moore's Law, the efficiencies that we gained, say, from the mid-1960s when we first invented, you know, practical semiconductors to today, that doubles in 2 years, and that doubles in 2 years.

So, for a while, we were moving on, you know, this part of the curve. We have moved past the point of inflection, and we are now on the ashen—

Senator Klobuchar. Uh-huh—

Dr. Shivakumar. So, if we don't catch up, if we don't—if we don't innovate and manufacture and, you know, be productive in that context, other countries—and if you fall behind, it is very difficult to make up the distance. It is a train that has already accelerated, gone off the train station. We will not be able to catch up. We will certainly—then we will become a follower of technology, not a leader of technology. So getting our regulatory systems in fighting form for the new, you know, technology-based innovation competition that we have is absolutely imperative.

Senator Klobuchar. Thank you very much.

Chairman Schweikert. Thank you.

Mr. Min.

Representative Min. Thank you, Chair Schweikert.

I really appreciate you convening today's hearing on this very important topic. And, obviously, as has been stated, the COVID-19 pandemic provided a clear wake-up call to us all on how reliant our Nation is on imported goods, particularly from China, and also how vulnerable our Nation's supply chain is to a sudden shock.

So I have the privilege of representing the 47th Congressional District in California, home to cities like Irvine and Newport Beach, Huntington Beach, a vibrant economy, very dependent on a lot of trade but also just down the coast from the busiest port in America, the Port of Long Beach.

And, during the COVID-19 pandemic, we saw a backlog of container ships, which, of course, impacted the ability of Americans to get vital goods quickly and affordably. And that is one I think of many instances that underscored the importance of this topic of why we in the Federal Government need to do more to shore up our supply chains and why we need to invest in our critical infrastructure.

But I am a bit puzzled by the emphasis on the policies of Joe Biden and the complete absence of any inquiry or oversight into the current President, Donald J. Trump, because, when I talk to my constituents, talk to businesses large and small that I represent, I have to say none of them talk about the negative effects of Biden's policies on the supply chain. Quite a few of them, of course, are very concerned about the policies of Trump.

Quite the contrary, in fact. I would say that many businesses have lauded policies from the Biden administration, the Inflation Reduction Act, the CHIPS Act, the Bipartisan Infrastructure Act, as important policies that are helping to bring back massive investments in important manufacturing segments to the United States, including, as has been mentioned, in semiconductors, clean energy, and energy infrastructure.

Just as a few examples, the Port of Long Beach, just up the road from my district, joined the Alliance for Renewable Clean Hydrogen Energy Systems, a private-public partnership that will leverage IRA investments to create more than 220,000 good-paying jobs in southern California, almost \$3 billion in economic investments.

Kia, which has its U.S. headquarters in my district, Hyundai, which is based just down the road in Fountain Valley, have both significantly expanded their U.S. manufacturing of clean cars based on the clean energy tax rebates offered from the IRA. Hanwha Qcells, also based in my district, opened two new massive solar manufacturing plants in Georgia based entirely on those same tax credits. We are talking about thousands and thousands of good-paying jobs, billions of dollars in economic impact in critical economic areas.

Of course, as has been discussed, the CHIPS Act has driven I think \$280 billion in manufacturing commitments in key infrastructure, key critical economic area to the United States.

And, at the same time, all of the complaints I have heard about weaknesses in our supply chain, concerns around our supply chain, have all come from the current policies, including the illegal impoundment of funds around IRA, other funds that businesses were relying on to make manufacturing investments in the United States penciled out, as well as, of course, the tariffs that my colleague in the Senate just pointed out, that have created real stresses on our supply chain, including a lot of the manufacturing that is based here in America.

Just as one example, I have a small electronics manufacturing business that I talked with recently in my district. And they pointed out that a lot of their inputs, even the ones that they import from other places, they get improved upon in the United States. Then they may go across border again to Canada or Asia to get improved, come back to the United States.

And levying a tariff each time these parts or inputs cross a border has made their business essentially nonviable. They are actually thinking about now moving their entire manufacturing offshore because that is actually cheaper than manufacturing in the United States, based on these tariffs.

So I guess my—that is the macro point I want to make. I think we are focused on a lot of the past policies and not on the current policies, which I think it is clear are having a huge negative impact on the supply chain, the strength of our supply chain.

But I guess my question—and I will ask it to you all—is, when we think about industries and inputs in the supply chain, are there ones that we should be emphasizing?

Because I can't imagine that we want to bring everything back to the United States. There are certain types of minerals that are hard to produce here. There are certain things that we may not want to emphasize in our economic policy.

But what are the three or four critical areas akin to semiconductors that we think we should be trying to bring into the United States for national security or other reasons? And I will start with you, Dr. Shivakumar.

Dr. Shivakumar. I think the point that you made about, you know the impacts of high tariffs and the fact that the way in which

manufacturing is structured in the world is through networks of activity.

So very often there are subcomponents which are produced in country A and move to country B for further assembly, that then becomes a part of some other equipment, that then produces a chip in a third country, which then is packaged in a fourth country, which then gets into a product in the fifth country, and then finally perhaps makes its way back to the United States.

When you create these tariffs—often, these products are moving in and out of the United States. Every time you are creating extra costs in the production process, what will ultimately happen is, if the tariffs are too high or too volatile, this network will start building itself around the United States.

So what we are really concerned about is, you know, unless we have manufacturing front and center as our strategic objective—

Representative Min. And I apologize. I am out of time. But are there—

Dr. Shivakumar [continuing]. We are going to lose out.

Representative Min [continuing]. A few areas that you would recommend that we consider in thinking about strategically what we want to bring back to the United States? Dr. McLaughlin.

Dr. McLaughlin. Well, within my area, which is regulation, I will talk about that. I think we could target certain industries for streamlining of regulations first that are more vital to the supply chain. Transportation—

Representative Min. And I am way over time, so Dr. Sheffi.

Dr. Sheffi. Anything that has to do with high technology.

Representative Min. Dr. Rodrigue.

Dr. Rodrigue. We have to move away from a trade regime which is trade by convenience to a trade regime which is trade by necessity.

Representative Min. Thank you. Food for thought.

I yield back.

Chairman Schweikert. I appreciate.

And one of the joys of getting the chair is you get to put yourself at the end, and we have this term sort of I don't get the clock. So our next meeting is a couple hours. So let's have at it. Okay.

Like a couple of you, you have spoken about—it is sort of amusing. Being someone from the desert, I have had a fascination with visiting ports. This time last year, I was in the Port of Singapore visiting some of the new construction, watching the automation. I have been to a number of them. I have also visited the Port of L.A. and Long Beach, and I saw the same thing.

And so, look, the vision for this hearing was, what can we make the future look like? Politically, we always have the habit of we got to get in our shots at each other because that is what makes a good YouTube video for when we want to put up our 20 seconds, so let me do my 20 seconds.

But we actually have occasions like this where in the Inflation Reduction Act, we have language functionally making automation illegal. Well, it turns out my own President actually put out a statement that he wasn't thrilled with the idea of automation of ports. I border on being a techno utopian.

So let's actually play a game here. You are all freaky smart. If I came to you today and said, whether it be from a regulation, from a technology, from even domestic repatriation of certain activities to incentive models that you have written about, if we could start from—and except this is not real but starting from a clean slate, how efficient could I make our supply chain infrastructure? You know, so we will deal with the products and the desire and style and those things.

But, Dr. McLaughlin, you already know my fascination with the automated skids for rail. They are electric. They are environmentally safer. Like in the Port of Long Beach, you immediately put it on the skid, and it goes to the warehouse it is supposed to go, the distribution center, to the things I have seen of, you know, the laser-measured automated lifts at the ports to the ability, some of the technology where the container ship is able to moor within minutes compared to hours.

Dr. McLaughlin, if I came to you right now and said, "You get to be a techno utopian and design a new port, that everything from the rail to the rules to the regs to the automation," give me your vision.

Dr. McLaughlin. I would try to remove myself as much as possible from picking the pass and let people innovate in ways that are maximally profitable to them.

Chairman Schweikert. What are you—

Dr. McLaughlin. This is a punt, but I mean the point from my perspective is to set up the infrastructure, if you will. And, by that, I mean the regulatory infrastructure, the legal infrastructure that permits innovation.

And so, by that, we need things that are streamlined. We need things that are flexible, things that accommodate new technologies when they do come about, because we can't predict all the ones that would come about.

Chairman Schweikert. Doctor.

Dr. Sheffi. There are some examples. If you want to go and look at Dubai that started basically from nothing and became a leading logistics hub of—you know, they have one of the best airlines. They have one of the best ports. They have lots of infrastructure that started from nothing.

Now, the truth is that autocracy, benevolent autocracy is the best form of government. They don't stay benevolent for long; that is the problem. So you have, you know, Dubai with money and total control. Yeah, they do good things, like China. President Trump was there singing their praises on building everything.

But, if we look at—there are examples of—if we look at the Dutch port of road—Chinese highways, I mean, they are amazing, actually. I go through China quite a bit. European trains.

You know what kills me, when I go to Spain. I can deal with German high-speed train, with French high-speed train, but you go to Spain, and they have high-speed train? That is ridiculous. And we still don't have it. To build a train from, what is it, in California, The New York Times reported that it takes nine times per mile the cost of building in—

Chairman Schweikert. It may be even worse than that if you actually—

Dr. Sheffi. As compared to France. Not as compared—as compared to France. So talk about regulations. But it is not only regulation. It is corruption, to be fair. There are a lot of things that are into it that we must clean out in order to get the European-level port, European-level trains, Chinese-level highways, Dutch-level ports, all of these things to be clean.

Dr. Rodrigue. Okay, thank you. Most of the container terminals in the world are operated, somewhat controlled by terminal operators. They are very large conglomerates. The HPH, Port of Singapore Authority. And they know their business. They know how to make things very, very efficient.

And the problem is, like anybody else, they don't like uncertainty. And right now we are in a phase of readjustment of the trade regime, which creates uncertainty. We are in a disruption phase of the resilience curve you could say, and it is going to reach an equilibrium.

But my point is there are already corporations, which many of them are branches of shipping lines, that are experts at making supply chain efficient. But, when their strategy or their investment hit the road and they encounter the regulatory system, the delay in investment, I saw quite a few port projects in America being canceled because of regulation. And I say, "Here goes 1 million TEU; here goes 2 million TEU," because we cannot build infrastructure. It is not we don't have the capability to operate it, but we don't have the capability to create an investment framework which is stable enough for that capital, which is already there, that expertise, that technology which is already there.

There are companies, they are now having drone-making companies that are part of a port terminal operator. They are implementing these—they all have these strategies. But it is very difficult to implement in the United States, as you mentioned before, because automation has become illegal in some ways. We are becoming the Luddites of this world. It is an overstatement, of course, but there is a little bit of truth.

Chairman Schweikert. You may have just won an award. I think you are the first one this year in the Congressional Record to say "Luddite."

Doctor.

Dr. Shivakumar. Thank you. Since my colleagues have been talking about physical supply chain infrastructure, let me talk maybe just also a little bit about the workforce supply infrastructure.

So this has traditionally been a local and State responsibility, but we have basically broken things between students and workers and their ability to find the jobs that firms and industries are supplying.

But there is a—and firms, similarly, are having difficulty finding the characteristics and the talents and the skills that they need for their operations. But we have the technology available to actually circle this square.

So we have, for example, we all use Google Maps or Waze to find our way to a destination that we don't know. It tells you to turn right, avoid a traffic jam here, you know, turn left here, take that bridge and so forth, turn-by-turn directions.

There is similarly a possibility to do software to tell workers to, you know, take this course in the community college, top it up with this credential, take this university credit, and work your way to what the industry is asking for. That is something that is missing, and that is—actually, the technology to do that is off the shelf.

On the other side, industry is looking for workers with specific types of skills. So let me give you a quick anecdote. There was this lady who was working at a Dunkin' Donuts shop. She had the skills to manage her shop, manage the inventory, which is perishable, manage customers, you know, manage the payroll.

Those skills were what the semiconductor company that was setting up a FAB was looking for. And, by looking at it, say, from a perspective of a dating app, which we are all familiar with, perhaps, to some degree or the other, they were able to look at the characteristics.

And then they found this lady, and they were able to train her, you know, the final stretch. And she is now working in a semiconductor fabrication plant. So—

Chairman Schweikert. Doctor, in some ways, you are making the argument for time for a revolution in accreditation.

Dr. Shivakumar. That is also part of that, yeah.

Chairman Schweikert. And the barriers that—

Dr. Shivakumar. There are existing solutions. There is a non-profit called NIICA, which actually has the software to do this. And it is just a matter of, you know—and they are looking at—this kind of combines like, you know, turn-by-turn aggregate data, user data, to put these—you know, to help solve the workforce problem and to get that workforce fixed. So that is—

Chairman Schweikert. So you have human input. You have regulation. You have technology adoption. You have, you know, what is world trade.

So, if I came to you—let's first do a reference. And it is, probably 3 years ago, in one of my binders I actually have a—it is actually someone's doctoral thesis, but the premise in there is, what would happen tomorrow if you threw a switch and every vehicle on American highways was automated? You know, so Waymo of the truck, Waymo this. And they were trying to calculate its additive effect to GDP. And it was remarkable, the value of time, the value of the fact I can sit in the back seat and do my work. I can do this.

And, for the last couple years, I have been thinking over and over and over, one of the things that rarely comes up when we talk about labor force is the fact that the number of 18-year-olds that will turn 18 this year as a percentage of the population I think is the smallest in U.S. history. Yet our number of those 65 and up in the last 20 years has doubled. We have a demographic issue, and it is all over the industrialized world. We have a shortage of young people.

And, if we want to deal with the reality of, how do you have productivity? How do you move goods and services in a way where you could have that productivity so we can maintain societal growth, lifestyle, those things in functionally a flatter, shrinking population with those ratios upside-down? We are going to need a revolution in what is regulation.

And, look, 7 years ago, I did a silly little YouTube video. I actually had an artist draw a cartoon. And it was the concept of crowdsourcing air quality, you know. You would attach a \$99 thing to this, put a couple thousand in your community. And you need someone to get an air quality permit to do the motorcycle paint shop, because we all know putting paperwork in file cabinets makes the air quality cleaner. It is documentation for the next lawsuit.

But the fact of the matter is, if I had crowdsource, the moment that person's filters aren't working in the paint booth, you catch him immediately. And you also catch the clowns that are painting cars in their backyard that were never going to be part of the air quality regulatory regime.

Crowdsource the environmental data. Well, it turns out you can do that in water, in markets, in all sorts of things. And, in this brilliant place, I proposed that bill now what, 7-plus years.

And it will never get a hearing because it turns out the current regulatory regime actually has the incumbency effect. The folks that make their money off of being the one that shows up to be your engineer who signs off on your filters to the bureaucracy that sticks the paper in the file cabinet.

And that was one of the reasons for doing this hearing is there is a way to do, from the port automation to my fascination with the automated skids to data that you and I—and methods we actually don't know to actually having an education system that values your skill sets and your talents, not where you fit into a regulatory education regime, which all these are—we just, by those last couple sentences, just enraged all our constituencies because those barriers to entry, those regulations, those business models are how they make a living.

And so what I am begging from all of you is, give us an idea. Okay. So regulation is a huge barrier. Is there a way where my vision of using AI, using crowdsourcing revolutionizes it? The value of push, push, push, push, adopt the next generation of technology, you know, those of us that have a fascination in generative AI, but I don't know what it is actually going to do. I am not as bright as I think I am. I couldn't get into your university, but they sent a lovely rejection letter.

So, I mean, am I just rambling? Because I have had stunning amounts of coffee already. I mean, is there a vision here we can sell? Let's go to Dr. McLaughlin.

Dr. McLaughlin. One of the problems you touched on is the existing regulatory system and how slow it can be. I am sure that many regulators inside the EPA, for example, would love to crowdsource some monitoring of air quality, but the path going from here to there where regulation allows that is too fraught with obstacles and takes too long.

So your vision of using, say, AI and crowdsourcing, those would be tremendous upgrades to accommodate new technology. Right now, what we have to do to accommodate new technology is often use soft law, have agencies issue guidance on how regulations might look if you were to invent an autonomous car, for example.

But, if, instead, we are able to update regulations more quickly using AI, for example, or crowdsourcing, we wouldn't run into this

problem nearly as often, “this problem” being called the pacing problem. Technology outpaces regulations.

So I think we can upgrade the pace, but it does require Congress to do this. The procedure is defined by Congress, the Administrative Procedure Act.

Chairman Schweikert. And, Doctor, remember our word of the day is “Luddite.”

Dr. Sheffi. Okay, great one. So first of all—

Chairman Schweikert. Is your mic on?

Dr. Sheffi. I am on? Okay. Sorry.

We have to find a way to overcome the short-term resistance in order to get long-term benefits. You mentioned autonomous vehicles. I deal with autonomous trucks. Amazing productivity. But the top job in 23 States in the United States is truck driver. So there will be people sitting on both sides who will fight tooth and nails against it.

Chairman Schweikert. But yet you and I see the demographics of—

Dr. Sheffi. I couldn’t agree more.

Chairman Schweikert [continuing]. The age of my average truck driver.

Dr. Sheffi. I live in a university.

Chairman Schweikert. In a decade, we have massive shortages.

Dr. Sheffi. Well, it is not quite that simple because it is tied to an immigration policy.

Chairman Schweikert. Yes.

Dr. Sheffi. So it is—you know, Angela Merkel didn’t allow a million Syrians to come in because of her good heart. She allowed them because Germany were losing workers in factories, so—and she understood it early. So we need—I mentioned before we need to create some kind of point system like advanced state.

Chairman Schweikert. Take a look at my talent-based immigration bill I introduced a couple weeks ago. And I thought I would get my head kicked in. Shockingly, I had both folks on the left and the right go, “Yeah, makes sense.”

Dr. Sheffi. Okay. One last point. You mentioned the stickiness of regulation. I actually wrote a few papers on the stickiness of tariffs. If the tariffs are going to stay, they will be constituents developed to keep them forever, because there are companies and people that benefit from these, not only the people who will manage this but companies who can raise their price because the competitor now has high prices. So—

Chairman Schweikert. Your colleague to your left actually mentioned rent seeking in that environment.

Dr. Sheffi. Absolutely. And let it not be said that I belong to left or right. I am just trying to stay—

Chairman Schweikert. But that is the nature—remember, and you and I have had this conversation dozens of times. Washington, D.C., is mostly about one thing: money, whether it be barriers to entry, whether it be direct subsidies, whether it be—and it breaks my heart because, you know, bleeding markets actually are innovation, and in many ways, we have abandoned that concept.

So, tell me, is my utopian vision of—okay, we have a demographic issue that is going to continue to grow. It hits us very hard shockingly soon. Is it, okay, open up the border? Is it the adoption of technology? If I am going to maintain productivity and, therefore, GDP, therefore, you know, lifestyle, you know, innovation growth and how American people live?

Dr. Rodrigue. That is quite—

Chairman Schweikert. It is a universal theory.

Dr. Rodrigue. It is quite a tall order. In some ways, all roads lead to automation down the road. The problem will be or the issue will be how this is going to be deployed, and is it going to be a synchronous deployment, or is it going to be an asynchronous deployment?

If it is synchronous, you can manage things. But, if it is by industrial sector, it is going to create disruptions and lack of synchronization between things.

So that is a very, very difficult question to answer. But, on the other hand, I have looked at international trade for quite a long time, and it is imbalanced. In my opinion, it is unsustainable. It has created I would say commercial structures, which, from a distance and transportation space perspective, do not make sense that much.

They exist because the transportation cost is very low, very cheap, and it has created these global supply chains, many of which should be more regional focused. And I suspect automation is going to incite us to look at regionalization of things, the regionalization of our manufacturing, the regionalization—

Chairman Schweikert. With respect to sort of the hub, specialty hub concepts.

Dr. Rodrigue. Of course, we are going to still trade long distance. There is going to be a lot of it. But it will make a bit more sense, because I don't think it makes sense to make a toy at the other side of the world to move it here. We do that because it is convenient, because there is a cost structure behind it.

But, on the long term, I am skeptical, I would say, although I am a very big proponent of free trade and things like that. But it went in very strange ways over the last 30 or 40 years. We have seen supply chains have been created that are bizarre. But, when you look at them, they make sense from a low-cost perspective.

Chairman Schweikert. Doctor, can you give me a vision that is not as—let's say you and I actually synchronize on labor inputs. What is acceptable in automation and the use of 3D, the printing, all the other types of technology? Does that stabilize wage, help us produce wage growth and other things?

If I am trying to deal with a supply chain that is very fragile—we have already seen certain inputs, and I get a cascade effect. What would you do technologywise?

Dr. Shivakumar. Well, just to put this in a little perspective, the strategic environment in which we operate in the world is radically different.

And I think, in many ways, the election of President Trump, the electorate sent a message that, you know, the way in which we do things has been disrupted. And I think that is an important message that all of you in Congress also are very attuned to.

We need to be thinking in terms of, how do we leapfrog China in technologies because that is the only way we are going to be a leader? But, you know, in terms of whether it is workforce or whether it is, you know, by modernizing our supply chains, these are investments that have to be rethought, given the fact that we have new technologies. Artificial intelligence, robotics, you know, all of this has—the existing models, as you say, have been gamed and to the point that they are immobile almost.

We cannot compete globally with the existing structures that we have, whether it is physical infrastructure or the regulatory infrastructure. So it is just—it is—this is actually something that is across the board. It is not one party or individual who is—

Chairman Schweikert. And maybe that is my vanity of trying to believe, could we ever sell the concept of a much more unified theory?

And, look, I just need to throw this out because it is one of those I need: I am constantly worried about parts of the CHIPS Act. Love the investment in research and development, but there are a couple great academic papers that now you see actually doing a much broader error correction on a quantum chip. But, as soon as that error correction, even if I have to slow it down to, you know, a series of a server farm that takes care of my errors on a quantum, I have hundreds of billions of dollars in FABs that almost become stranded assets the next day.

And there is sometimes the arrogance of what we do in Congress saying, “We are going to invest in an industry we like,” instead of allowing the technology and the disruption to drive it.

You know, for the young people in here, you have no idea what I am about to say, but there used to be this thing called Blockbuster Video. And, if they had hired enough lobbyists, we would have slowed down the internet for them.

So, you know, and I would like to give you an example. Maybe as much as 2 years ago, we did a hearing here, and one of the discussions was pharmaceutical manufacturing.

And I think we may have done it in the Ways and Means Committee. And we had one witness sort of make a point saying, okay, United States, why do we import so many of these generic drugs?

And it turns out he had a couple charts that showed some of the precursors that go into like this generic small molecule drug, or create—for every pound I got of the precursor that goes into the pharmaceutical, it created hundreds of pounds of really nasty, fairly highly toxic byproducts.

And his point was, “Tell me how I get that permitted to make that input in the United States. Do you have high-temperature incineration?” And there was a reason it was being made in India and China, those inputs.

So we will have brain trusts, you know, these types, these electives will say, “We want to repatriate pharmaceutical manufacturing.” Okay. But the regulatory and also infrastructure of, “Okay, what is my mitigation of toxic waste products and those sorts of things?”

And everyone wanted to talk about the repatriation of pharmaceuticals, but no one wanted to have the conversation of the infrastructure of, how do you actually deal with these inputs and their

sometimes nasty byproducts? And that is actually part of my fixation of we talk supply chain and how we modernize it.

And, yes, okay, fascination with port infrastructure, electric skids and, you know, the next generation of AI training and those things and automation that you and I may have no idea. What does the future world trade regime look like?

USMCA, did we actually truly build a North American supply chain that actually is much more efficient? And our barriers are we have—the Joint Economic staff was kind enough to provide me sheet after sheet of regulatory barriers.

So we do Inflation Reduction Act, and then we add dozens of rules that make it so, okay, we have businesses willing to take the checks, but the innovation we just crush by our own reg sets.

Please help us. Help us come up with ideas where our arrogance of thinking we can design what the future economy looks like. I worry that the populism needs planned economy, industrial policy. And, over and over, we can show you what we move resources to, within a decade, it is a stranded investment.

Help us plan for the future and the reality of what our demographics are. And it is a very different vision, but I see supply chain making it much less fragile, much more robust, and much more innovative is an absolute necessity if we are going to actually start to maintain any type of reasonable type of GDP growth.

Any last comments as before I throw the gavel and go heat up my coffee?

Thank you. This was one of the most interesting and actually learned panels I have ever had in my time on the Joint Economic Committee. I appreciate all of you. Thank you all.

With that, we are done.

[Whereupon, at 11:52 a.m., the committee was adjourned.]

OPENING STATEMENT - Ranking Member Maggie Hassan

June 5, 2025

I want to begin by thanking Chairman Schweikert for calling today's hearing on such an important topic, and by thanking your staff for their work on the hearing.

I also want to thank the four witnesses for testifying before the committee and sharing your expertise on this topic.

I join Chairman Schweikert in recognizing how important it is that we modernize our supply chains and strengthen manufacturing here in the United States, especially as we work to outcompete China.

As is often the case, the Chairman and I are in full agreement on the problem, and probably agree on 80 percent of the solution. I think that's a pretty good start.

In the last several years, we have seen increased investment in critical technology manufacturing across the country, including new funding for projects in my home state of New Hampshire.

These new investments have been spurred in part by legislation like the bipartisan CHIPS and Science Act, which is helping us to strengthen our supply chains and outcompete countries like China, by investing in American research and manufacturing.

In addition, energy tax cuts in the Inflation Reduction Act and funding in the bipartisan infrastructure law are driving investment in the energy production and infrastructure that will support modern supply chains.

To capitalize on these investments, deliver for the American people, and support private sector growth, we also need to streamline regulations.

Doing so is essential to advancing American innovation and manufacturing.

Lastly, I want to raise my concerns that President Trump's actions have threatened the progress that we've started to see in recent years:

His erratic tariffs are slowing manufacturing investment.

And his moves to slash funds for cutting-edge research will make it harder for the United States to develop and produce our own technology.

If the U.S. gives up on scientific research, China will fill the gap.

I hope that conversations like the one we are having this morning will help us move forward with bipartisan efforts to strengthen U.S. manufacturing, supply chains, and advanced technologies.

Thank you again to Chairman Schweikert and to our witnesses for agreeing to testify today. I look forward to today's discussion.

The Relationship Between Regulation and Productivity

Dr. Patrick A. McLaughlin
Research Fellow, Hoover Institution, Stanford University
Visiting Research Fellow, Pacific Legal Foundation

Testimony Before the Joint Economic Committee
June 5, 2025

Chairman Schweikert, Ranking Member Hassan, and Members of the Committee:

Thank you for the opportunity to testify today regarding how regulations impact supply chain modernization and factor productivity enhancement. I am a Research Fellow with Stanford University's Hoover Institution and a Visiting Research Fellow with the Pacific Legal Foundation. I am also an associate editor of the *Journal of Regulatory Economics*. The views expressed here are strictly my own and do not necessarily reflect those of the Hoover Institution, Stanford University, Pacific Legal Foundation, or any other entity with whom I am affiliated. The bulk of my research is on the regulatory process and its economic effects, and it is mostly based on this research that I have four main points to make today:

1. As regulations accumulate, they increasingly distort and deter investments into the activities that are primary drivers of long-run economic growth: research and development, new machinery, new locations and buildings, and new business formation.
2. Emerging technologies—also vital drivers of productivity growth—are sometimes limited by regulations, by accident or by design. To remove the regulatory barriers to new technology, we should actively identify, and then modify or eliminate, those regulations that inhibit the adoption of emerging technologies, especially when those technologies could improve productivity at no cost to safety or other goals of regulation.
3. Regulations cause major infrastructure projects to be delayed by years, and it is unclear whether we gain anything substantial as a result of these delays.
4. In some unique circumstances, such as in network industries that span multiple states, federal regulation is necessary to preempt state-level regulations that would create a patchwork of mismatched obligations that can also limit productivity growth.

Each of these issues is increasingly solvable as AI becomes more and more advanced, but at some point, a long-term solution will require Congressional action. I will discuss some possibilities throughout my testimony.

1. Regulatory Accumulation Hinders Productivity Growth

Regulations, of course, play a vital role in modern society, and with good design and management, regulations can deliver important desired outcomes. Conversely, poorly crafted or conceived regulations can lead to rules that create only costs and little to no benefits. More importantly, the accumulation of regulations over time stifles innovation and productivity growth, and as a result, slows economic growth overall. A unique but, in my opinion, very feasible challenge for policymakers today is to find a way to trim unnecessary regulations while preserving necessary public protections.

Over the past several decades, the stock of federal regulations on the books has more than doubled. The quantity of regulatory restrictions in the *Code of Federal Regulations*, or phrases within regulatory text that create obligations or prohibitions, such as the word, “shall,” or the phrase, “may not,” has grown from about 400,000 in 1970 to over 1.1 million today.¹

Regulatory accumulation refers to the steady buildup of regulations over time. Without a systematic approach to reviewing and removing outdated, redundant, or otherwise undesirable regulations, the steady buildup of government rules eventually shows up in economic outcomes ranging from business activities such as investment decisions, startup rates, and productivity growth to household outcomes such as household income and consumer expenditure.

A study that I co-authored with Bentley Coffey and Pietro Peretto, published in the *Review of Economic Dynamics* in 2020, showed that regulatory accumulation slows economic growth by nearly one percentage point annually.² Specifically, the study found that the buildup of more and more federal regulations over time distorted business investment decisions. These business investments are broadly defined, including research and development expenditures, new machinery, new locations and buildings, and new business formation itself. In the long run, such business investments are key drivers of innovation and productivity growth. As a consequence of the slower productivity growth that it causes, the buildup of federal regulations creates a considerable drag on overall economic growth, amounting to a 0.8 percentage point average reduction in annual GDP growth. This seemingly small annual reduction has large implications. The slower economic growth caused by regulatory accumulation resulted in an economy that was \$4 trillion smaller in 2012 than it could have been without such regulatory accumulation. That amount equaled about a quarter of the US economy in 2012, and if it were a

¹ These figures come from the RegData project, hosted at QuantGov.org. For methodology, see: Al-Ubaydli, Omar and Patrick A. McLaughlin, “RegData: A Numerical Database on Industry-specific Regulations for All US Industries and Federal Regulations, 1997 – 2012,” *Regulation & Governance* 11 (2017): 109–123; and McLaughlin, Patrick A. and Oliver Sherouse “RegData 2.2: A Panel Dataset on US Federal Regulations.” *Public Choice*. 180 (2019): 43–55.

² Bentley Coffey, Patrick A. McLaughlin, and Pietro Peretto, “The Cumulative Cost of Regulations,” *Review of Economic Dynamics* 38 (2020): 1–21.

nation's GDP, it would have been the fourth largest in the world at that time.³ This translates to a loss in real income of approximately \$13,000 in year 2012 dollars (or about \$18,000 in current dollars) for every American.⁴ Another study estimated the effect to be even larger, finding that regulatory accumulation slowed US economic growth by as much as two percentage points annually.⁵

This line of research is focused on the totality of regulations and their cumulative effect, rather than the direct compliance and paperwork costs that are typically included in regulatory impact analyses produced by regulatory agencies. This is not to dismiss those direct compliance and paperwork costs—they often are large and noteworthy. But when we consider the opportunity cost of regulations—and how they distort business investments and the productivity gains that comes from them—the total cost of regulations is substantially greater than the sum of the projected compliance costs when each regulation is analyzed on its own. Indeed, forgone innovation eventually makes compliance and paperwork costs seem relatively trivial in comparison.

Research also shows that regulatory accumulation disproportionately burdens small businesses—including the startups that are often the sources of innovation—and that this burden grows at an increasing rate as regulation accumulates (i.e., the negative effect of each new regulation grows larger as the stock of regulation grows larger).⁶ And where there are fewer new businesses entering an industry, there is less competition, less investment in new technologies, and slower productivity growth.

2. Regulations Can Limit the Adoption of Emerging Technologies

Ideally, regulations would facilitate, or at least not hinder, technological advancements, especially when emerging technologies can enhance safety or other regulatory goals while simultaneously increasing productivity. An excellent but frustrating example comes from the transportation world, where challenges include maintaining safety while keeping costs down and supply chains running smoothly. In the freight rail industry, investments in R&D have led to the development of automated and autonomous track inspection technology. Autonomous Track Geometry Measurement Systems, which these days can be mounted on working locomotives,

³ Patrick A. McLaughlin, "What If the US Regulatory Burden Were Its Own Country?" (Mercatus Data Visualization, Mercatus Center at George Mason University, April 26, 2016).

⁴ Coffey et al., "The Cumulative Cost of Regulations."

⁵ John Dawson and John Seater, "Federal Regulation and Aggregate Economic Growth." *Journal of Economic Growth* 18 (2013): 131–177.

⁶ Dustin Chambers, Patrick A. McLaughlin, and Tyler Richards, "Regulation, Entrepreneurship, and Firm Size," *Journal of Regulatory Economics* 61 (2022): 108–134.

continuously collect real-time data on rail conditions. Compared to periodic, visual track inspections performed by humans, these systems can detect problems earlier and pinpoint where preventive maintenance is needed. In other words, these technologies offer significant safety improvements over manual inspections performed by humans. And they increase productivity in multiple dimensions: less down time because real-time and more frequent track quality data permits timely preventive maintenance; less human error; and when these systems are mounted on a locomotive, as opposed to on a repurposed car, there is more capacity on the train for freight.

Despite successful pilot projects by Norfolk Southern and other railroads, under a waiver granted by the Federal Railroad Administration in 2020, regulatory inertia remains a barrier. Norfolk Southern's application for an expanded waiver was denied by the FRA in 2022—in the name of preventing uncertainty and potential risk. The reality is that automated and autonomous inspections of railroad tracks represent an improvement to safety, not a new risk. This regulatory inertia inhibits both productivity gains and safety improvements.

3. Infrastructure Permitting Delays Are Productivity Delays

According to Taiyo.ai—an AI startup with perhaps the largest infrastructure database in the world—the average time to complete an Environmental Impact Statement required under National Environmental Policy Act (NEPA) is about 4.5 years, and the median time is around 3.5 years. A large portion of major infrastructure projects encounter significant NEPA-related legal challenges, typically adding another one to three years to the process.

NEPA-related delays, of course, are not the only delays caused by federal rules and processes related to permits. It should be obvious that delays to new or upgraded infrastructure also delay the increases in productivity they would create. Or, even worse, that the threat of delays can deter the investments altogether. While the details of NEPA and permitting in general are beyond the scope of my testimony today, I would like to leave this committee with a few thoughts on permitting:

1. With as much data as NEPA has created over the decades of its existence, we should be able to establish what, exactly, we are getting in exchange for the delays. There are clear costs in terms of delay and paperwork alone. What are the benefits, and are they worth it?
2. Part of the problem is that there can be dozens of different permits required for a given project, and separate approval processes run across a multitude of agencies. The state of Virginia has shown, with its permitting transparency project, that some transparency and a sense of competition across regulatory agencies can lead to much more rapid permitting. Virginia's Permit Transparency Initiative portal allows permit applicants to track the status of their permits from submission through approval—making easy to see

which agency is reviewing the application, how long it has been there, and where it will go next. Virginia reports that permitting review time by its Department of Environmental Quality was reduced by about 70 percent following the launch of this initiative as a pilot program.⁷

3. Recent executive orders and actions are already attempting to deal with some of these issues.⁸ Congress, meanwhile, can begin addressing the set of laws that are at the root of the issue. For example, are there laws in place that inhibit agency usage of software that could speed up the permitting process?

4. Federal Preemption is Sometimes Necessary

If there is going to be some form of regulation, then uniform regulatory standards can be crucial for network industries. This is particularly true in transportation networks that require physical connections of roads or railways across multiple state lines to properly function. While in some industries, businesses could avoid a state-level regulation by simply ceasing to operate in the state, the same option is often not possible in transportation. For example, a train traveling from the state of Maine to the state of Massachusetts has no realistic option but to cross the state of New Hampshire.⁹

In cases such as this, there is sometimes little choice but to create a federal regulation that preempts state-level regulations. I have previously written about proposed rulemakings from the Federal Railroad Administration (FRA) related to the minimum size of train crews, arguing that 1. The FRA has not presented evidence that one-person crews have a worse safety record than larger crews, and 2. Establishing a minimum crew size of even one person would deter investments in safety-enhancing technologies and innovations that could potentially lead to even safer operations. I maintain those positions and would be happy to submit my previous writings on those related rulemakings for the record.

However, as the FRA pointed out in its 2024 Final Rule, which mandated a minimum crew size of two, “if the issue of crew size safety is left to be governed by a patchwork of State laws, logistically it may become impossible for a railroad to even consider operations with fewer than two crewmembers.” At the time, at least eleven states required most freight trains to operate with at least two-person crews. The FRA’s Final Rule, flawed though it is, at least attempts to offer a path for a railroad to demonstrate that a one-person crew can meet the same safety requirements as a two-person crew and to seek approval of one-person operations.

The FRA’s crew size rule remains imperfect, as its requirement for a risk assessment that must identify and assess all possible hazards in a proposed operation is unnecessarily fraught with

⁷ <https://www.governor.virginia.gov/newsroom/news-releases/2024/october/name-1035453-en.html>

⁸ See, for example, “Updating Permitting Technology for the 21st Century.”

<https://www.whitehouse.gov/presidential-actions/2025/04/updated-permitting-technology-for-the-21st-century/>

⁹ Circumventing New Hampshire by way of Canada is not a realistic option.

uncertainty and egregiously burdensome.¹⁰ But the concept is a good one: regulations should have a pathway for technological improvement built into them. In the railroad industry, human error is the greatest source of risk in train operations. If the goal is safety, the FRA should hope that railroads continue to invest in technologies that minimize the opportunities for human error to create safety hazards, including more automation. Regulations, in turn, should accommodate such innovation.

5. Conclusion

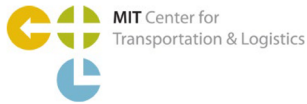
The thicket of regulations built up over the decades challenges traditional approaches to optimizing them, such as benefit-cost analysis. Prioritizing flexible, innovation-friendly regulatory frameworks will enhance economic potential, improve safety, and strengthen national competitiveness. I leave you with the following modest recommendations:

1. Use AI to build a comprehensive database on permitting frictions and delays created by federal regulations and regulatory guidance.
 - a. Follow Virginia's lead and use transparency to establish a culture of competition across agencies for speedier permitting.
 - b. Use the database to analyze the total costs and benefits of permitting delays—NEPA in particular, but all permitting should be fair game.
2. Regulators across the board ought to make regulations more accommodating to innovation and advances in technology. Regulations should outline a process that allows a business to demonstrate that a different approach than the one designated by a regulation can achieve the same or better outcomes. If agencies do not know where to start, use AI to help identify rules that contain engineering or design standards, or that limit how far automation can go. Develop alternative performance standards as an option for these rules.¹¹

Thank you. I welcome any questions.

¹⁰ Instead, FRA should consider a straightforward and clear process by which a railroad can seek to operate a one-person, or eventually, a zero-person operation.

¹¹ For a deeper dive on performance vs. design standards, see: Laura Montgomery et al., "Performance Standards vs. Design Standards: Facilitating a Shift toward Best Practices," *SSRN Electronic Journal*, 2019, <https://doi.org/10.2139/ssrn.3420320>.



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June 5, 2025

Distinguished chairman and members of Congress.

My name is Yossi Sheffi, and I am a professor of engineering systems at MIT and director of the MIT Center for Transportation and Logistics.

I was asked to inform the committee on two subjects: the challenges for increased domestic manufacturing, and specifically about the required workforce skills for efficient manufacturing and supply chain operations. The views in this statement represent my own and not MIT's.

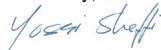
First: What can be done to support reshoring manufacturing?

- Investing in automation (Robotics, AI, ML, etc.). These reduce reliance on manual labor (but require higher-skilled labor). This may involve a reform of regulations and tax regimes. We must regulate less and do more (we have to examine the trade-offs). Also: most companies still use point technological solutions and legacy systems rather than newer systems that avoid silos and inform entire processes.
- Investing in domestic sources of materials and intermediate processing. Example: rare earth materials. The main problem is not that China has them (the US has huge reserves), it is that China has developed a processing method and controls 80-90% of the processing capacity. This is dirty and expensive, but we have to decide if we want to depend on China and possibly relax some environmental regulations and permitting, or keep being at China's mercy.
- Targeted help, like parts of the Defence Production Act, which are aimed directly at supporting domestic manufacturing. But staying on message and not including unrelated issues.
- Improve infrastructure. Roads, bridges, ports, passenger railways, and airports. They are far behind advanced world standards. The Infrastructure Investment and Jobs Act was a good step in this direction, but what is required are consistent investments, faster paths to implementation, and not clouding the path with unrelated current political priorities.
- Short term: reduce Tariff uncertainty. Supply chain executives can deal with any hand that you throw at them, they just need to know the rules. When rules are changing seemingly haphazardly, it is impossible to plan, and the result is higher costs due to inventory accumulation and even bare store shelves.

An issue of utmost importance: the skills of the US workforce. This is the second related issue.

- One of the main challenges with re-shoring manufacturing is the lack of manpower – not enough of the “right” labor. Even today, US manufacturing cannot hire what it needs.
- Two countervailing issues: the new plant will be high-tech and will not create many jobs, and we still do not have enough workers.
- Education issues:
 - The US has fallen behind on K-12 education. “Johnny cannot read.” With the exception of special schools (religious, private, magnet), in many states, parents do not have the funds (directed at public schools) to send their kids to better schools. Maybe there is a Federal solution, even though this is a local control.
 - Universities have become obsessed with things other than education: DEI, antisemitism, etc., and their weak leadership is not successful in righting the ship. The administration must change this without killing this asset.
- However, new technologies can disconnect learners from the old paradigm of a teacher in front of the blackboard.
 - Example: MIT CTL MicroMaster: a series of five courses and a final exam in supply chain management. 1.2 million learners from every country except North Korea.
 - Online courses allow for continuous learning and upgrading of skills. Call it just-in-time education.
- What is missing most: technology-savvy trade people: plumbers, electricians, operators of numerical control machinery, factory robot operators.
 - When friends and neighbors ask me where to send their kids to college, I try to direct them to trade school. If there is one thing the government should do, it is to fund a significant increase in the number (and quality) of trade schools.
 - These are the last positions that AI can replace. AI is already replacing white collar office workers, including artists, programmers, writers, lawyers, etc. Nobody is replacing plumbers or factory machine operators.
- An action with immediate impact will be to change immigration laws to be consistent with the country’s needs, not the lottery or those who cross illegally.
 - Today’s need: nurses, tradesmen, but also high-level scientists and engineers.
 - Allow STEM PhDs to stay in the country and contribute (right now, we teach them and send them home)
 - Other countries have a “point system” based on the current needs of the economy and businesses. Maybe the US should adopt one.
 - Increase the number of postdocs and visitors to universities from places with leading STEM researchers.

Sincerely,



Yossi Sheffi

In a Tight Spot: American Ports in Global Supply Chains

Presented to the Joint Economic Committee, Congress of the United States, June 5, 2025

“BARRIERS TO SUPPLY CHAIN MODERNIZATION AND FACTOR PRODUCTIVITY ENHANCEMENTS”

Jean-Paul Rodrigue, Professor, Department of Maritime Business Administration, Texas A&M University at Galveston.

Disclaimer: The views presented here are personal and do not in any way reflect those of Texas A&M University, the State of Texas, or any stakeholders mentioned herein.

A Maritime Future at Stake

I can begin by making a bold statement. The United States is no longer a commercial maritime power. Most of our commercial maritime capabilities have been outsourced and offshored. By the size of its market, the United States remains the world’s leading trade power, which creates some paradoxes between the capabilities of the American economy to generate wealth and the ability to support its commercial interests on the world’s maritime trade lanes.

I will discuss here how this scenario unfolds for American ports, particularly container ports, which are the anchor of our national logistics system. Six core barriers contributing to national and global supply chain inefficiencies can be proposed.

Barrier 1. A matter of volume

Since the 1990s, the volume of containers handled by American ports has continuously grown. Between 2010 and 2024, 19.8 million Twenty-Foot Equivalent Units (TEUs) have been added to the cargo handled by ports, which has reached 60.4 million TEUs (Figure 1). This absolute growth is the equivalent of the cargo generated annually by three Canadas or two Mexicos. Each year, American ports need to handle an additional 1.6 million TEU of cargo at a growth rate of around 2.3%.

This growth is derived from the dynamism of the American economy, which is a positive thing, but also from the outsourcing and offshoring of American production, which is more controversial.

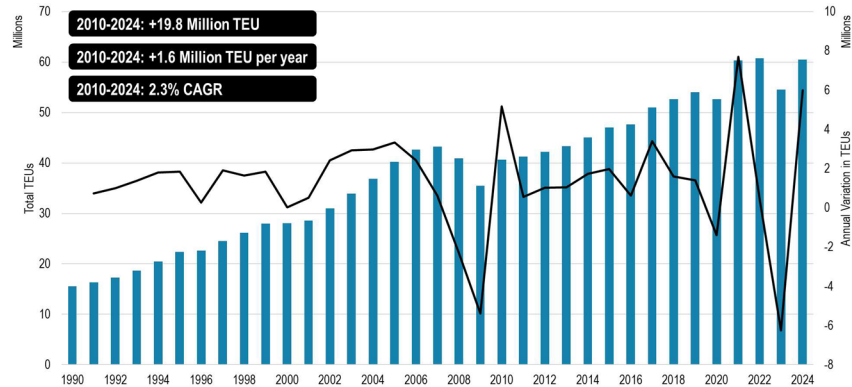


Figure 1 Container Traffic at American Ports, 1990-2024 (in Twenty Foot Equivalent Units, TEUs). Source: Own compilation based on reports from port authorities.

The ongoing growth of the containers handled by American ports requires a constant commitment to maintain, upgrade, and expand our port infrastructure, including constructing new terminal facilities. Further, port infrastructure is subject to vulnerabilities and occasional failures, such as the 2024 bridge collapse in Baltimore after a containership collided.

Barrier 2. A matter of scale

The maritime industry pushes for scale economies in ports worldwide. The American port system, particularly on the East and Gulf coasts, was designed around the Panamax standard, the largest ship that could fit in the Panama Canal when it was initially designed. In the late 1990s, ships beyond the Panamax standard were introduced, opening Pandora's box (Figure 2). When the Panama Canal was expanded in 2016, a new standard called New-Panamax was set. It was also accompanied by a wave of port infrastructure investments on the East and Gulf Coasts to ensure that major ports would be able to accommodate this new ship class. However, it also resulted in a skewed distribution of the costs and the benefits. Maritime shipping lines assumed the benefits of economies of scale, but public port authorities mainly assume the infrastructure costs.

There are significant variations in the capability of American ports to handle larger container ships (Figure 3). While West Coast ports tend to have deep drafts, many East and Gulf Coast ports are challenged to keep up with costly dredging and harbor improvement programs.

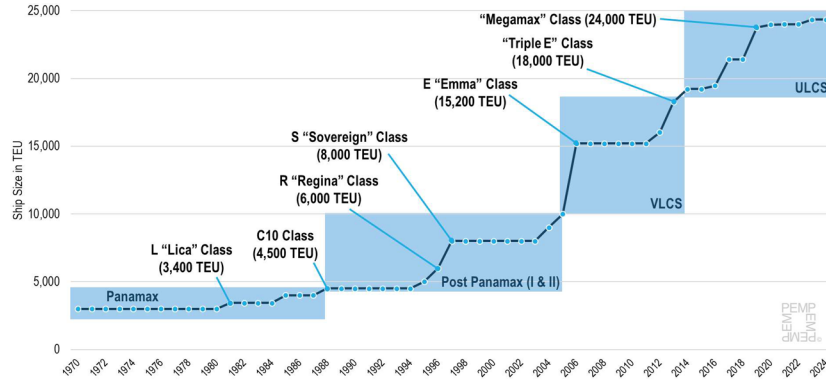


Figure 2 The Largest Available Containership, 1970-2024. Source: Own compilation¹.

¹ <https://porteconomicmanagement.org/pemp/contents/part6/ports-and-container-shipment/largest-available-containership-teus/>

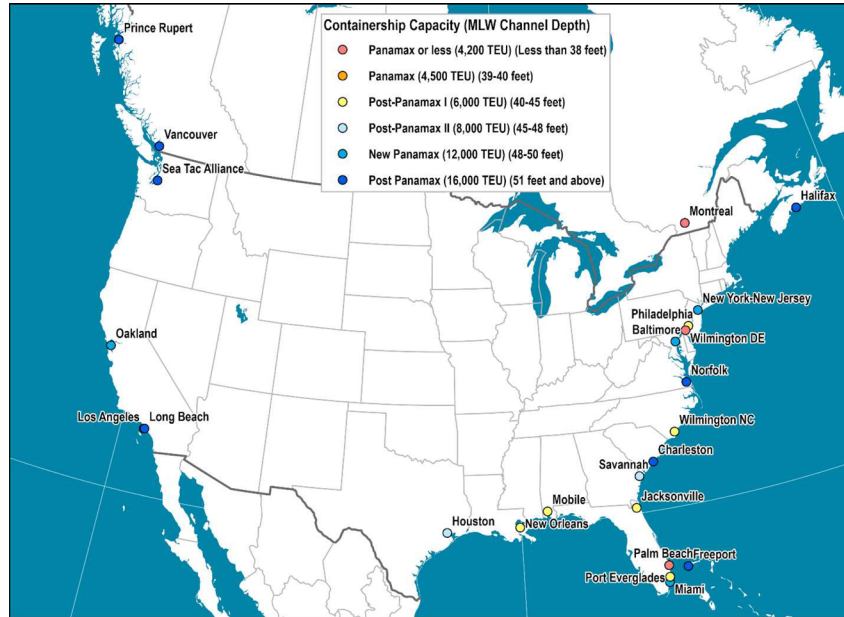


Figure 3 Channel Depth at Major North American Container Ports. Source: Own compilation based on port authorities and terminal operators².

The above calls for consideration of whether there should be ship size limits calling at American ports and if New Panamax should be the frame of reference. An analogy would be the restrictions on truck size and weight on the Interstate because of the related infrastructure, maintenance, and safety costs.

For competitiveness and resilience, ports should be able to engage more effectively in infrastructure programs, particularly dredging. These programs are usually affected by delays and cost overruns. The turnaround time between the design, approval, and construction of an infrastructure project should be shortened, as uncertainties and delays are substantial barriers to private investments.

² <https://transportgeography.org/contents/chapter6/port-terminals/channel-depth-ports-north-america/>

Barrier 3. A matter of composition and seasonality

The differences in the composition of imports and exports handled by ports are substantial, which is associated with logistical complexity. While the majority of American containerized imports are linked with the retail sector, exporters are entirely different (Figure 4). They mainly involve resource-based and agribusiness sectors, recycled goods, plastics, resins, and chemicals. The composition of this trade is also associated with seasonality, with a peak level of activity between July and October and low activity in January and February (Figure 5). Like most transportation infrastructure, this creates a capacity planning problem.

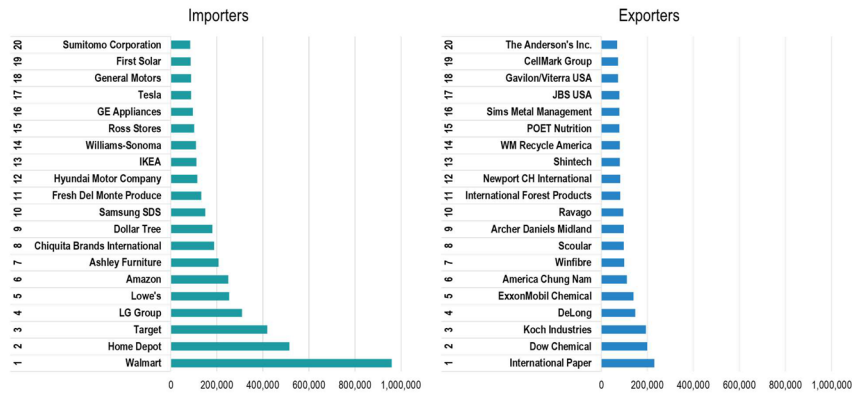


Figure 4 American Foreign Trade by Maritime Containers, 2024 (in TEUs). Source: Journal of Commerce³.

³ <https://porteconomicsmanagement.org/pemp/contents/part1/maritime-shipping-and-international-trade/american-foreign-trade-maritime-containers/>

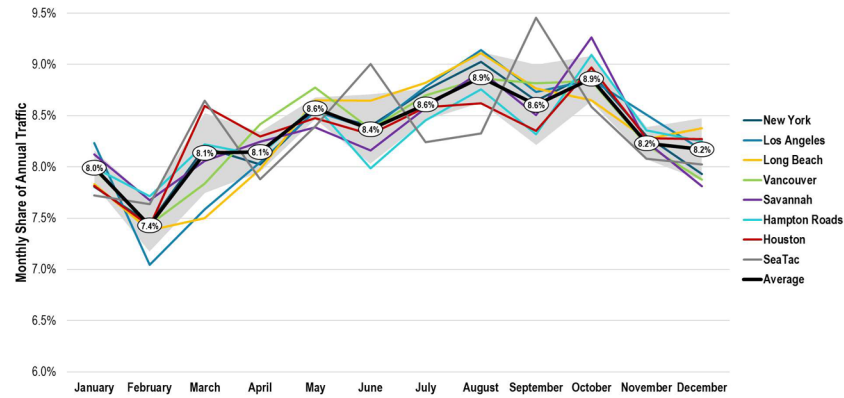


Figure 5 Average Monthly Container Traffic Share, Selected North American Ports, 2005-2023. Note: The grey area represents one standard deviation. Source: Port Authorities.

The composition of imports and exports and their seasonality cannot be effectively abated, as ports are not the drivers of the composition of the traffic they handle. A switch from a trade by convenience to a trade by necessity regime may provide some mitigation, but it is outside port policy considerations.

Barrier 4. A matter of imbalances

The systemic negative trade balance the United States maintains with several trade partners is well known. It has profound implications for container flows, as there are substantially more inbound full containers than outbound full containers (Figure 6, which was also evident in Figure 4). We have strong import-based supply chains and prioritization of the infrastructure and processes supporting these flows. The leading export of American container ports is fresh air, as around 70% of all outbound containers are empty. When container shipping faces a capacity shortage, the availability of export containers inland can be curtailed, as the priority of shipping lines is for importers. This imbalance has incited import-based logistics clusters to be in proximity to ports, contributing to regional congestion.

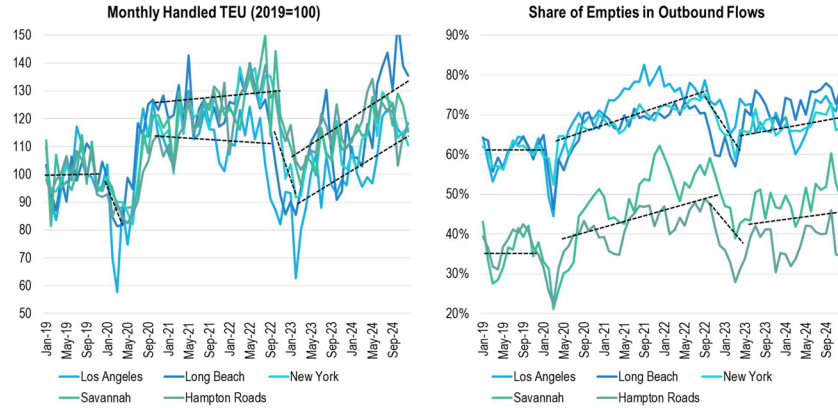


Figure 6 Container Flows, Selected American Container Ports, 2019-2024. Source: Port Authorities.

There are no apparent mitigations to the acute imbalances in containerized trade flows handled by American ports, outside substantial changes in the trade regime.

Barrier 5. A matter of labor and technology

Most of the port workforce is under the jurisdiction of two powerful labor unions. On the West Coast, the International Longshore and Warehouse Union (ILWU) and on the East and Gulf Coast, the International Longshoremen's Association (ILA). Although the workforce is highly qualified, its essential role within supply chains is often used for rent extraction purposes. Union leaders have also opposed automation, a process that can be traced back to the introduction of the container in the 1960s. This opposition was apparent during the ILA 3-day strike in October 2024, where automation remained the core contention.

Automation and related technologies are essential to the future of port operations and logistics. There are strong barriers to its implementation in the United States, and only six container terminals have a level of automation: three on the West Coast and three on the East Coast (Figure 7). There are also restrictions on the level of automation, with East Coast terminals having a partial level of automation.

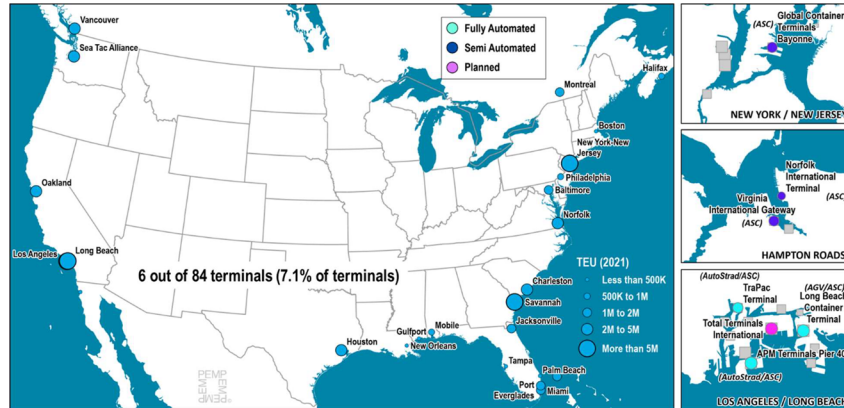


Figure 7 Automated Terminals in the United States. Source: Own compilation⁴.

Impediments to automation remain a barrier to the improvement of American supply chains. As container volumes continue to grow, more container terminals will need to be automated, which will be a logistical challenge on their own. This will need to be associated with a labor transition strategy and coordination with the inland logistics infrastructure.

Barrier 6. A matter of efficiency

According to the Container Port Productivity Index (CPPI) released by the World Bank⁵, no American port figures among the top 50 in terms of their time performance. Using a national average, American container ports are about 30% less time-efficient than the global average (Figure 8). These productivity figures are of concern and related to the barriers discussed above, including the strong import-orientation of logistics flows.

⁴ <https://porteconomicmanagement.org/pemp/contents/part6/terminal-automation/automated-terminals-united-states/>

⁵ <https://openknowledge.worldbank.org/entities/publication/87d77e6d-6b7b-4bbe-b292-ae0f3b4827e8>

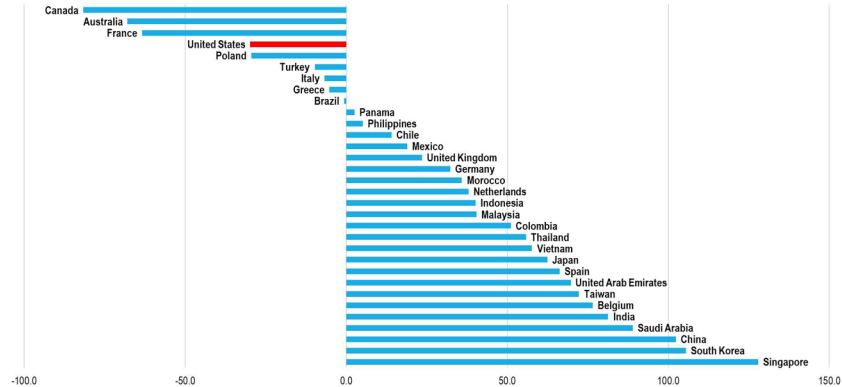


Figure 8 Container Port Productivity Index (Value), National Average, 2023. Source: World Bank. Note: A value of 0 represents a time performance similar to the global average. A value above zero represents a time performance above the global average. A negative value indicates a time performance below the global average.

Increasing the efficiency of port operations is fundamental, but requires addressing very uncomfortable issues related to labor and automation. Terminal automation is fundamental in the medium-to-long term, as ports run out of land to deal with traffic growth and the associated logistics. A core strategy is to increase the utilization level of this land, which may require a change in vision and a push for additional automation. Ports should not be perceived as mere pieces of interchangeable real estate. They are strategic assets fundamental to national economic and geopolitical security.

Conclusion: A National Maritime Supply Chain Strategy

To conclude, American ports, particularly container ports, are in a tight spot. They are adapting to several barriers to their performance, many of which are outside their control. Our port system needs to reflect this adaptability with a national supply chain strategy. One potential element of this strategy is greater autonomy for port authorities with expanded governance. Many are landlords who may be required to act more as entrepreneurs. As observed worldwide, port authorities and terminal operators have acquired or merged with others. Some have developed parent companies in logistics, infrastructure development, drone technology, and information technology. American ports have much to benefit from this perspective.

The United States has a long maritime tradition that supported its national commercial ambitions, a tradition which, unfortunately, has been substantially eroded. It will need to be revamped to reflect the challenges of the 21st century.



**Statement before the
Joint Economic Committee**

***“Barriers to Supply Chain Modernization
and Factor Productivity Enhancements”***

A Testimony by:

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**June 5, 2025
210 Cannon House Office Building**

Chairman Schweikert, Ranking Member Hassan, distinguished Members of the Committee, my name is Sujai Shivakumar, and I am honored to share my views with you on this important topic pertaining to our nation's innovation strategy. I am a Senior Fellow at the Center for Strategic and International Studies, where I direct the program on Renewing American Innovation. As a bipartisan, nonprofit policy research organization dedicated to advancing practical ideas to address the world's challenges, CSIS's purpose is to define the future of national security. The program on Renewing American Innovation aims to revitalize innovation system to enhance our economic competitiveness and strengthen our national security in the emerging world order. CSIS does not take policy positions, so the views represented in this testimony are my own.

Thank you for giving me the opportunity to testify today about how we must center manufacturing in our nation's innovation system for greater economic competitiveness, broad-based workforce participation, technological leadership, and national security.

Rebuilding U.S. capacity to innovate and manufacture advanced technologies is critical for U.S. economic competitiveness and national security. Renewing manufacturing in the United States is a national strategic objective: manufacturing not only creates jobs, stimulates economic growth, and reduces dependency on foreign suppliers like China, but also reinforces the U.S. innovation system by reconnecting R&D to production.

Innovation without production is a recipe for vulnerability: when technologies are invented in the United States but scaled and manufactured elsewhere, we forfeit not only economic returns but also the technical know-how, iterative learning, and supply chain coordination that are critical to sustained technological advantage.

In the United States, short-term financial pressures on firms, weak workforce training systems, and persistent scale-up challenges have delinked innovation from production.¹ Public capital markets and shareholder expectations often reward short-term returns over long-term investment in new production capacity. As a result, many American firms have prioritized outsourcing and offshoring, eroding domestic capabilities over time. The structural separation between "innovate here" and "produce there" has led to an erosion of the "industrial commons"—the networks of skills, suppliers, and know-how needed to support manufacturing innovation. This separation not only limits America's ability to capture the full economic and security benefits of its advanced innovations but also threatens the nation's long-term capacity to invent, build, and lead in critical sectors.

The consequences of this structural R&D-manufacturing gap are evident. As the United States outsourced more development and manufacturing work, it steadily degraded the industrial commons. As a result, many foundational technologies—such as solar panels, lithium batteries, and semiconductor components—originated in U.S. labs but were scaled and industrialized in East Asia.² This pattern has eroded manufacturing leadership and generated national security vulnerabilities.

¹ National Research Council, *Government-Industry Partnerships for the Development of New Technologies* (Washington, DC: The National Academies Press, 2003), <https://doi.org/10.17226/10584>.

² Harvard Business Review, "Restoring American Competitiveness," July 1, 2009, <https://hbr.org/2009/07/restoring-american-competitiveness>.

The ambitious CHIPS and Science Act, passed with strong bipartisan support in 2022, shows what focused policies can achieve. It is already reshoring advanced semiconductor manufacturing to the United States. The CHIPS Act’s comprehensive approach establishes direct federal incentives to expand domestic semiconductor fabrication, builds up the broader ecosystem of suppliers and facilities, and invests in the workforce pipeline needed to sustain long-term competitiveness.

About 95 percent of CHIPS Act incentives will support semiconductor fabrication, focusing on bolstering some of the most capital-intensive segments of the value chain.³ These incentives span the semiconductor value chain, from integrated device manufacturers (IDMs), which design and manufacture their own chips, to contract manufacturers (foundries), which manufacture chips designed by other firms, to outsourced semiconductor assembly and test (OSAT) firms, which assemble, package, and test the chips to ensure they work.

Most CHIPS funds are designed to boost fabrication capacity—and are successfully catalyzing private investment. The legislation has already begun to unlock an unprecedented wave of private capital and commitments to build domestically. In fact, since the CHIPS Act was signed, the Semiconductor Industry Association reports over \$540 billion in U.S. semiconductor investments, investments which are projected to triple total U.S. chip manufacturing capacity over the next decade.⁴ Even though numbers for both demand and supply are in flux,⁵ they represent a dramatic, game-changing surge in U.S. manufacturing capacity for both advanced and mature chips.

However, this new impetus to renew manufacturing has also revealed critical challenges in the U.S. manufacturing supply chain and ecosystem, particularly on the workforce, infrastructure, and regulatory fronts.

- **Support Talent Development:** First, the semiconductor industry requires both highly skilled engineers and technically trained workers, yet the U.S. education and training systems have not scaled to meet this demand. A 2022 report released by the Semiconductor Industry Association (SIA) found that 58 percent of necessary manufacturing and design jobs might go unfilled by 2030.⁶ Institutions like Purdue University are addressing this volume gap, but more support for their exceptional efforts and those of other universities are needed. We must continue to attract and retain talent from both inside and outside our borders.⁷

³ Chris Borges, Yutong Deng, and Julie Heng, “Innovation Lightbulb: Tracking CHIPS Act Incentives,” CSIS, April 25, 2025, <https://www.csis.org/analysis/innovation-lightbulb-tracking-chips-act-incentives>.

⁴ Semiconductor Industry Association, “2024 State of the U.S. Semiconductor Industry,” Accessed May 30, 2025, <https://www.semiconductors.org/2024-state-of-the-u-s-semiconductor-industry/>.

⁵ Kearney PERLab and SEMI, “Braving the Storm: Navigating an Uncertain Future | State of Semiconductors 2025,” <https://www.kearney.com/service/product-excellence-and-renewal-lab/state-of-semiconductors-2025>.

⁶ Semiconductor Industry Association, “Chipping Away: Assessing and Addressing the Labor Market Gap Facing the U.S. Semiconductor Industry,” Accessed May 30, 2025, <https://www.semiconductors.org/chipping-away-assessing-and-addressing-the-labor-market-gap-facing-the-u-s-semiconductor-industry/>.

⁷ Remco Zwetsloot, *Winning the Tech Talent Competition*, (Washington, DC: CSIS, October 2021), <https://www.csis.org/analysis/winning-tech-talent-competition>; Julie Heng and Yutong Deng, “Innovation Lightbulb: Not Just Attracting But Retaining International STEM Students,” CSIS, April 11, 2025, <https://www.csis.org/analysis/innovation-lightbulb-not-just-attracting-retaining-international-stem-students>.

Decades of underinvestment and neglect in vocational education, fragmented apprenticeship systems, and the absence of a coherent federal-state workforce strategy have created a mismatch between industry needs and available and potential talent. Moreover, misaligned incentives across educational institutions, students, employers, and policymakers have stymied systemic reform. If we are to meet the workforce demands of this unique industry, we must prioritize national strategies for technical education, such as successful programs from The National Institute for Industry and Career Advancement (NIICA).⁸

- **Bolster Infrastructure Needs:** Second, we face infrastructure gaps. New fabs cannot operate efficiently without upgrades to reliable electricity, transportation, and water systems with the necessary capacity—all areas of longtime neglect.⁹ Accordingly, the United States needs to make infrastructure investments into utilities and supply chains to support semiconductor manufacturing. These are not just technical bottlenecks but national challenges, which make legislation like the Inflation Reduction Act and Bipartisan Infrastructure Law key supports and proactive investments for innovation and manufacturing.
- **Reform Obstructive Regulations:** Third, we face outdated and dysfunctional regulatory processes. Projects that are urgent for national competitiveness often face years-long hurdles driven by permitting delays, lengthy environmental reviews, and inconsistent local approvals.¹⁰ For example, according to the Council on Environmental Quality (CEQ), between 2013–2018, the Environmental Impact Statements required under The National Environmental Policy Act (NEPA) took an average of 4.5 years to complete.¹¹ Modernizing regulatory frameworks to ensure clarity, speed, and predictability, while still safeguarding environmental and community protections, is essential for rebuilding manufacturing at speed and scale.

Can tariffs encourage manufacturing renewal in the U.S.? The threat of high tariffs is now being used as a negotiating tool in trade talks with a number of foreign countries. In making the case for tariffs, the administration has claimed that higher import costs will stimulate domestic production. There is unquestionably a need to address unfair trade practices and non-market behavior by other countries. However, in today's era of globalized innovation and manufacturing, tariffs alone are not sufficient to convince firms to rebuild industrial capacity. In fact, high or

⁸ NIICA, “The National Institute for Industry and Career Advancement,” <https://www.niica.org>.

⁹ John VerWey, “No Permits, No Fabs,” Center for Security and Emerging Technology, October 2021, <https://doi.org/10.51593/20210053>.

¹⁰ President’s Council of Advisors on Science and Technology, *Report to the President: Ensuring Long-Term U.S. Leadership in Semiconductors* (Washington, DC: Executive Office of the President, January 2017), https://obamawhitehouse.archives.gov/sites/default/files/microsites/ostp/PCAST/pcast_ensuring_long-term_us_leadership_in_semiconductors.pdf.

¹¹ Phillip Singerman, Sujai Shivakumar, Gregory Arcuri, and Hideki Tomoshige, “Streamlining the Permitting Process for Fab Construction,” CSIS, *Commentary*, August 29, 2022, <https://www.csis.org/analysis/streamlining-permitting-process-fab-construction>; Phillip Singerman and Alexander Kersten, “Implementing CHIPS: The Nepa Permitting Challenge,” CSIS, *Commentary*, May 1, 2023, <https://www.csis.org/analysis/implementing-chips-nepa-permitting-challenge>.

volatile tariffs can introduce uncertainty, reduce investment confidence, and risk spurring the development of parallel supply chains that bypass the United States.¹²

Consider how the imposition of Biden-era export controls, for example, has spurred China to double down on its existing deeply subsidized development efforts. The result has been increased state investment, the emergence of new AI chip architectures like DeepSeek, and a sharp rise in research output in critical technology fields. According to the Emerging Technology Observatory at Georgetown University, China is at present producing twice as many research papers as the United States on chip design and production, reflecting their high-level focus on this industry.¹³ These efforts are showing substantial and even surprising progress and are only destined to grow,¹⁴ because China sees this as a vital national competition. Meanwhile, the United States debates whether we should stay in the market for advanced U.S.-owned semiconductor production.¹⁵ The answer, of course, is that we should.

In short, a tariff-only strategy does not address the necessary incentives for investment, workforce development, infrastructure build out, and regulatory relief for renewing U.S. manufacturing. We can work to reroute semiconductor manufacturing supply chains, but we also need to invest in a domestic ecosystem that can support it—indeed, allow it to flourish. The successful CHIPS and Science Act is a start to the response, but far more is needed. It cannot be a “one and done” approach. We need expanded support for semiconductor research to maintain the U.S. edge in chip design and materials science. We also need stronger public-private partnerships to facilitate shared infrastructure, accelerate tech transfer, and support innovative firms through the “valley of death.” We have to see this contest as a long-term game. Follow-on support for the industry through tax incentives and related programs will be needed. For the United States to succeed in this high-stakes competition, substantial and sustained public support will be essential.

¹² Sujai Shivakumar, Charles Wessner, and Tom Howell, “The Limits of Chip Export Controls in Meeting the China Challenge,” CSIS, *Commentary*, April 14, 2025, <https://www.csis.org/analysis/limits-chip-export-controls-meeting-china-challenge>.

¹³ Iris Deng, “China Leads US in Quantity, Quality of Chip Research, Report Finds,” South China Morning Post, March 5, 2025, <https://www.scmp.com/tech/tech-war/article/3301171/tech-war-china-leads-us-quantity-quality-semiconductor-research-report-finds>.

¹⁴ Sujai Shivakumar, Charles Wessner, and Thomas Howell, *Investing in Science and Technology* (Washington, DC: CSIS, June 2024), <https://www.csis.org/analysis/investing-science-and-technology>.

¹⁵ Sujai Shivakumar, Charles Wessner, and Thomas Howell, *Too Good to Lose: America’s Stake in Intel* (Washington, DC: CSIS, November 2024), <https://www.csis.org/analysis/too-good-lose-americas-stake-intel>.

