EconoFact Chats: The Risks and Rewards from International Supply Chains
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I'm Michael Klein, executive editor of EconoFact, a non-partisan, web-based publication of the Fletcher School at Tufts University. At EconoFact, we bring key facts and incisive analysis to the national debate on economic and social policies, publishing work from leading economists across the country. You can learn more about us and see our work at www.econofact.org.

Michael Klein
National security is something that is frequently in the news. The country needs to be protected from the threat of foreign military action. Less often we hear about economic security, the country's protection from foreign economic threats. Sometimes economic security is mentioned in the context of trade deficits, but economists tend to have a more benign view of these since they reflect an excess of investment over savings in a country. Other sources of concern about economic security were highlighted during the pandemic, when international supply chains were disrupted. And an ongoing concern is the concentration of advanced microchips in countries that face geopolitical threats like Taiwan and South Korea.

What are the most important concerns about international economic security? What policies are in place or should be in place to address these concerns? To answer these questions, I'm very pleased to welcome back to EconoFact Chats, my Fletcher colleague Professor Christopher Miller. Chris is the author of *Chip War*, the book that won the 2022 *Financial Times* Book of the Year Award. Chris, thanks for joining me once again on EconoFact Chats.

Christopher Miller
Well, thank you for having me back.

Michael Klein
Chris, to begin, how would you define economic security in the context of international economic relations?

Christopher Miller
Well, I think economic security is best thought of as the effort to identify and then mitigate ways in which economic relations can be used as a form of political leverage by another country. And so, there's a couple of different categories of economic security that I think are worth flagging. One is I think the use of choke points, where your economy, or your manufacturing base might rely on a specific input from another country. A second, more traditional, is the use of economic sanctions in the financial sphere, which of course the US has been a frequent user of in the past.

And then a third, and this is the more challenging sphere…a third is thinking about the ability to manufacture what your industrial base might need in a crisis, which of course requires both thinking through crisis scenarios, and also putting probabilities on different crisis scenarios emerging. These are the types of calculations that I think you have to think about when trying to understand how to assess an actor on economic security.

Michael Klein
So, we've seen all of these relatively recently. With choke points, you can think about the rare earths from China and China threatening to cut those off. With sanctions, there were sanctions on Russia when it invaded Ukraine…financial sanctions. And then manufacturing what you need, that's a really important point that you've obviously given a lot of thought to. In that case, one would think that international supply chains would make a country very vulnerable. But they also make a country more productive. So, what's the trade-off here?

Christopher Miller
Yeah, you know, I think there's a natural impulse to see supply chains as a source of vulnerability, but I think we should be pretty careful before drawing that conclusion. And if you look at the pandemic, which you mentioned at the outset, I can certainly see how people would look at the pandemic and say, 'Wow, what a great risk we ran by relying on supply chains.' But you could also say, look, we had a once-in-a-hundred-years pandemic and only faced shortages of most goods for the first couple of weeks of the pandemic. And many of the shortages that existed weren't necessarily about international supply chains, they were about just the challenges of managing supply and demand given the unpredictability involved. So, I think we shouldn't assume if the word "international" is in front of supply chains that that necessarily means excessively vulnerable or risky supply chains, because that's just often not the case. But second, I think you're right to say that even if there is more risk in certain international supply chains, that does have to be balanced against the benefits of them. And so, we need to think not only about the worst-case scenarios, but also about the likelihood that the worst-case scenarios actually materialize, and then have that next to the opposite side of the equation, which is the benefit from specialization that comes from the division of labor.

Michael Klein
Yeah, economists think of that as sort of one of the core ideas of economics—the idea of comparative advantage, and countries focusing on those things that they do best. So, people might think this international supply chain is a problem of the modern era, but in your blog, you describe how access to certain metals, but not iron and coal, were important for steel production at the time of World War I. Can you explain that?

Christopher Miller
Yeah, you know, I think there are some things that are certainly new about supply chains, others of which have a long history. You can go back to the 1700s and find people in the United Kingdom worrying about their ability to acquire certain types of materials that they used in shipbuilding, which they sourced from Russia or from the Baltic Sea region. And that's been replicated every generation, whether they're commodities sourced from abroad that are necessary for an industrial base—think rubber before World War II, or manganese, which as you mentioned, was used in strengthening metal in the middle of the 20th century. I think the difference today is that in the past, it was often you were trying to source a commodity for your industrial base, whereas today it's not just the commodities, it's a series of intermediate inputs that are also necessary in your industrial base as well. And really, that only dates back to the past 50 years. Before roughly 1970, there really wasn't much at all sourcing of intermediate inputs into countries' manufacturing bases. And so that's made our manufacturing much more efficient, now that we've started doing that, but it also means that our manufacturing bases can face shutdowns if they lack even, in some cases, a single component sourced from abroad.

Michael Klein
Why would it be different if you couldn't get manganese to make steel, or you couldn't get a microchip to make a car? What's the distinction there? One is a commodity, one is manufactured, but it seems both of them serve as kind of weak links in the chain of supply.

Christopher Miller
Yeah, well, the key is really the interchangeability. So, if manganese is only produced from a single mine in the world, then you could envision a real choke point emerging. But for most commodities, that's actually not the case. Most commodities you can source from multiple different countries, and when you lose access to one country, the world price rises and new mines or new sources become increasingly available. With manufactured inputs, what we find, at least in some cases…and the more complex the end product, like cars or airplanes, the more this dynamic is present—that the time it takes to replace one microchip with another one, for example, is so large that even though there are other microchip suppliers out there, they can't provide the types of specific chips you need with the software written for those chips in a relevant timeframe. And so that's why, for example, during the period of the pandemic, the semiconductor shortage caused vast disruptions to the auto industry. It wasn't actually that we had a net shortage of semiconductors – we actually produced more semiconductors each year of the pandemic, but we didn't have the right types, and car companies couldn't just swap out one for the other, and so they left cars sitting on their parking lots in the factory for many months, often while they were waiting for the final chip to arrive. And so, it's that specialization in the production process that makes manufactured inputs more likely to create the sort of choke point dynamic than a raw material would.

Michael Klein
So, Chris, can you just speak briefly to the question of what are the different types of microchips and where are they made?

Christopher Miller
Well, it's a tricky question because there are thousands and thousands of different types of microchips. In a typical car, it might have a thousand different types – some of them managing the semi-autonomous driving features, some of them managing fuel injection into the engine or the battery if you have an electric vehicle. Every sensor in the car will have its own type of chip. There will be very simple chips that make the doors unlock when you press the unlock button or make your seat recline if you press the seat recline button. And this specialization speaks to the difficulty of swapping one in and others out. When it comes to the highest-end semiconductors, the vast majority are made in Taiwan. And so, in data centers or smartphones or computers, around 90% of the most advanced chips come from just one company in Taiwan. And that level of concentration is particularly pronounced for advanced chips, but actually, for many types of sensors and automotive and industrial semiconductors, there's still only a couple of players that have the bulk of the market share, and so it's not as though these are easily replaced if you lose supply from your primary provider.

Michael Klein
And yet with Taiwan, there aren't as many other examples where a place where microchips are being produced is claimed by a very large, powerful country to actually be part of it, and there is a threat of invasion, right?

Christopher Miller
Yeah, that's right. I think the Chinese threat to Taiwan is indeed unique, and the fact that it overlaps with Taiwan's pretty unique capabilities in chip manufacturing does place this question at the center of our debates about economic security today.

Michael Klein
Chris, you were recently on a podcast with Dan Kim and Jordan Schneider, and Dan referred to what he called the ‘Four Cs’ for economic and national security. These were capacity, capability, competition, and criticality. Can you describe what each of these means and the role played by each?

Christopher Miller
Well, I think, you know, there's different metrics for thinking about how you define economic security, and I think there's debate among policymakers and among people who think about these issues as to what the right metrics are. But I think the four criteria that Dan laid out does provide one helpful framework for thinking about whether you ought to prioritize a product in terms of

economic security. I don't know that that's the only way to think about it, and I think right now, my view would be that academics and analysts are still trying to get their heads around what the right way to think about this question set is, so that you can cast your net not too broadly and involve, you know…you could easily involve half of GDP in a definition of economic security—that would probably be too broad in my view…but also not so narrowly that we end up with problems like the type that we've faced for the past couple of years, where you rely on a single country for a critical input.

Michael Klein
So, capacity…Building capacity could mean, and I guess it would mean, redundancy. But that's like the problem of the costliness of over-insuring. So, there are trade-offs between security and efficiency. How would you think about the best level of capacity and have this trade-off between being redundant, and then having security, but also by that being more inefficient?

Christopher Miller
Well, I think it is a trade-off, and in most cases, I think we've on net benefited from the fact that we've engineered supply chains to be maximally efficient, and to not have excess inventory on site. But there are some places where I think that's not true. I think there'd be broad agreement that in medical supply chains, you'd like a bit of redundancy because the cost of not having access to a specific medicine is probably much larger than the cost of having a bit of excess inventory in stock. I think when it comes to other types of products, you don't want to have a lot of spare capacity, and so thinking about building excess capacity is something that ought to be done very, very carefully, and it has to be balanced against, for example, stockpiling, which you can also do to mitigate these types of risks or trying to find other ways to mitigate risk because, of course, as you say, spare capacity is not in itself a good thing.

Michael Klein
Capability, my understanding of it is it addresses the issue of whether we're at the cutting edge of technology. That seems to be at risk now with the government's cutback of funding for basic research, which ultimately is a source of innovation. How important do you think capability is, Chris? And do you think it is, in fact, at risk in this country now?

Christopher Miller
Well, I think capability is very important. I think no country has absolute capabilities across the cutting edge of every single field. You mentioned comparative advantage earlier—that's the point, is that some people are better at some things, some are better at the other things. And so, I think capability we've also got to be clear-eyed about the fields in which we have a plausible case to be the best, most efficient, most advanced producer in the world, and fields where the expertise is in other countries and we're comfortable with that. And so, I think here too, prioritization is really important, and simply saying we want to be the best at everything is a, I

guess, a nice aspiration, but not very practical as a matter of implementation. I think for…in terms of thinking about capability, I think there's a mix of inputs. I agree that having a strong R&D base in basic science is certainly important…has been for many decades as an input into US success. I also think, though, that a lot of the key innovations are commercialized at the industry level rather than the academic level. And so, I worry less about US competitiveness when it comes to the basic science, and I worry more about competitiveness when it comes to actually taking new ideas that are formulated in academia and carrying them over to prototyping and bringing them to market. And that's a sphere where, because capital costs are lower, it's been easier for that to happen, especially in kind of hardware-focused fields in other countries. I think that's a space where the US does need to invest more in making sure that great ideas actually turn into great prototypes.

Michael Klein
The third C is competition, and to my mind, it seems to be at odds with the first two since building capacity and fostering capability sound to me a little like industrial policy, which has an element of the government picking winners. Do you think that's the case?

Christopher Miller
Well, I would think about competition not in the sense of competition within the domestic market, but competition internationally. You know, another way to phrase this might be diversification. And the insight would be that if you've got two suppliers, you're in a much more resilient position than if you have a single-source supplier. And so, my view is that we should give a very careful look to any sort of products that we only source from a single country and make sure that a) we're comfortable with that from a security perspective, and b) that we're comfortable with it from an economic perspective. Because I think there are some cases—rare earth magnets being a great example—where we've not only developed a dangerous and politically weaponizable dependence on one country, but we've also seen that country manipulate the market in a way that only a monopolist can do. And so, thinking in terms of resilience and not being overly dependent on a single monopolistic supplier, I think, is probably how I'd conceptualize that point.

Michael Klein
And the fourth C is criticality, which is a word I had not heard before, but it makes it so there are four Cs instead of three Cs and something else. And the question there seems to be are we addressing the critical markets. In particular, the 2022 CHIPS and Science Act, where the acronym stands for Creating Helpful Incentives to Produce Semiconductors, was meant to bring microchip manufacturing to the United States after decades when the fabrication of semiconductors moved to places like Taiwan and South Korea. Was this the right set of goods to target? And how successful has this been? And I ask that question knowing that you're the celebrated author of *Chip War*.

Christopher Miller
Well, you know, I think it's a good question to ask, actually, because if you ask any industry whether they are critical, they will say yes. And there's a good argument to be made that pretty much everything is critical, that's why we value the things that we collectively purchase. And so if you started to make the opposite list of things that don't matter, I think you'd find pretty quickly that you'd have a small list because the moment you tried to put something on the list, someone would say, ‘well, it matters to me,’ or "that's a source of my job,’ or ‘that's what my business sells.’ So actually, we do need to be, I think, pretty specific and discerning when it comes to defining criticality. And I would posit that there are two basic axes on which to measure criticality. Number one would be how much of a problem do you have, a social problem, a political problem, if you lack access to a given type of product? And again, this is probably not best measured in monetary terms. I think you have a bigger social problem if you lose access to certain types of medicines than you might if you lose access to products that might be more expensive but less socially disruptive. So that would be axis number one. And number two, which I think is also tricky in its own way, is how important is a given product or sector to the further advance of technology? Because I think one of the things we've learned is that due to ecosystem effects, if you lose access or if you lose the ability to innovate on products that are at the cutting edge in a given field, you'll often struggle in adjacent fields as well. And conversely, your competitors, if they do well in one field, will often be likely to do better in an adjacent field as well. And so, thinking about what is the technological frontier, what are the sectors where I would like to be doing well in the long run, and do I feel comfortable being fully reliant on another country or another adversary in some cases to provide those products? I think that's a key input into the definition of criticality. The challenge with both of these axes of criticality is that they have a substantial degree of ‘I know it when I see it,’ which is, of course, not the optimal type of test for any sort of policy debate, but I think the reality is that's where we are. We've got to embrace that because the alternative is just to pretend that these problems don't exist, and we find ourselves in a worse situation.

Michael Klein
It seems that this argument is often made in terms of military uses versus civilian uses, but do you think that's a false dichotomy?

Christopher Miller
Yeah, I do. I think there are certain cases where you need a product for military use and obviously that, I think, very clearly falls under a security rubric. But what we've seen over the last couple of years is an increasing use of primarily civilian products in military systems. Because every major military is talking about trying to benefit more from the innovation that's happening in civilian markets. So, militaries are themselves becoming more civilian in their supply chains. And at the same time, because manufacturing supply chains are getting more complex and relying more on intermediate goods sourced from other countries, there are more

points of potential leverage that countries are trying to weaponize against the others. The US has cut off certain semiconductors to China, China's retaliated by cutting off rare earth magnets. Japan then has restricted the export of certain types of chemicals. You can devise a long list of products where major powers are trying to shift others' political calculus by controlling their access to certain types of products. And that to me is well speaking to why if you're just thinking of what goes in a fighter jet, you're missing the broader picture of there being a whole lot of economic and national security significance to products that aren't necessarily important because they're part of a missile system, for example.

Michael Klein
Another dichotomy, one that was in the Biden administration, was the talk of friend-sourcing, that is, sourcing from countries with which you're allied as opposed to sourcing from countries where you might have some tensions…although maybe we have fewer friends in the world now than we did four or five years ago. But does it matter if the United States doesn't fabricate vital products like microchips or the machines needed to make them if they're being produced in Europe or in Korea?

Christopher Miller
So, I would be pretty comfortable with that as an outcome, but I would note that despite conversation about friend-shoring, it hasn't actually happened. If you look at the trade data, what you find is that the rest of the world has become increasingly reliant on inputs from China. The decline in US imports from China has largely been a factor of the fact that Chinese inputs have been going to third countries in Southeast Asia or in Mexico, and then imported in the US. So, the end reliance on Chinese inputs is still quite substantial. And in the key industries that I think you'd focus on, what you find is that there's been a lot less progress on friend-shoring than the political rhetoric would suggest. So, I would say friend-shoring is a great idea, and I wish it were tried.

Michael Klein
So, I'd like to close after all this talk about the threats of offshoring, of its benefits. So, if you were to list a few benefits of offshoring, Chris, what would they be?

Christopher Miller
I think lower cost, and because of lower cost, greater product variety, higher quality, and as a result of all of that, probably more rapid innovation. I think all of these things are true. And in my view, I think we should be as specific as possible about what the challenges are when we talk about supply chains, when we talk about economic security, so that in being specific, we can a) actually address the real challenges which are certainly present, but b) not do so at such enormous cost that we threaten our prosperity. And that's a balance that I think we can do more to strike well because it does seem to me wrong to conflate the existence of international supply

chains with the inherent existence of economic security challenges, and indeed, I think if we try to address economic security challenges by undoing international supply chains, we'll find that the cost becomes far too high to stomach and we won't actually succeed in addressing the real threats and challenges that we do face.

Michael Klein
So, this has been great because you're pointing out how seemingly simple solutions are, in fact, not solutions at all, but there are a lot of subtle points and there are a number of different dimensions along which we need to consider these really important issues. So, Chris, thanks very much for joining me once again on EconoFact Chats. I always enjoy our conversations.

Christopher Miller
Well, thank you again for having me.

Michael Klein
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