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What's behind the globalization of R&D?  
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**DAVID DOLLAR:** Hi, I'm David Dollar, host of the Brookings trade podcast Dollar and Sense. Today, my guest is Britta Glennon, a professor at the Wharton School at the University of Pennsylvania. The Economic Studies wing of Brookings recently published a book on the role of multinational corporations in today's world called "Global Goliaths." Britta coauthored a chapter called "The New Global Invention Machine" about the internationalization of research and development. It's a topic I found really fascinating, and that's what we're going to discuss today. So thank you for joining the show, Britta.

**BRITTA GLENNON:** Thanks so much for having me.

**DOLLAR:** So traditionally multinational corporations, particularly U.S. MNCs, did their research and development at home. But you show in your study that's changing. So what is this new pattern that is emerging?

**GLENNON:** Yes, so there's a few pieces to this. The first is just that there's been really significant growth in the amount of R&D that U.S. multinational firms are doing abroad. So this has grown four-fold since the mid-1990s. I do want to be clear that they do still conduct the majority of their R&D at home. It's something like 83 percent currently, but that's down from 95 percent or so in the early 1990s, and in some sectors this is even more staggering. In professional services, for example, 40 percent of R&D is now abroad. But regardless of how you cut it, there's really been a massive increase in R&D spending by U.S. multinational firms outside the U.S.

The second piece of this is that it's not just that there's been an increase, but also there's been a pretty dramatic change in the location, or the footprint, of foreign R&D. In 1989, U.S. multinationals did 74 percent of all of their foreign R&D in just five countries. So the UK, Germany, France, Japan, and Canada. Now, only 43 percent of all foreign R&D is being done in those five countries. In other words, U.S. multinational firms are doing foreign R&D in many, many more countries than before. Then if you take a closer look at all of these new locations, we call them new hubs in our chapter, a lot of them are actually in emerging economies. And what's kind of surprising about that is that this kind of challenges the way we traditionally think of comparative advantage.

Economists and management scholars have long thought that one of the main reasons why multinational firms do R&D abroad is actually to learn. So if you are a car manufacturer, you want to go to Germany and do R&D there and learn from kind of some of the top car companies in the world. Now, this change in location to emerging markets seems to challenge that idea.

Then the third piece of this new pattern is just that there's really rapid growth in cross-border collaboration. So, in other words, we are seeing that multinational subsidiaries aren't acting independently. There's a lot of collaboration between subsidiaries and between the subsidiaries and the parent. So what you are seeing is kind of these global innovation teams within the

multinational firm—this kind of network of R&D performing affiliates working with headquarters. So all of this is new. These are trends that were not really present 30 years ago.

**DOLLAR:** So that's interesting. So more research overseas, more collaboration, and more of it in emerging markets. It has obvious similarities to what's happened in production. What you are describing sounds a lot like production value chains combining the United States with China, for example. Now we are getting these research value chains doing the same things. So what's driving this? Why do we get these changes that you describe?

**GLENNON:** Yeah, so it does sound a bit like the manufacturing value chain, although there are some important differences. One of these, of course, is that still a lot of the R&D is kind of focused at home. But there are kind of traditional reasons that have been documented by a fairly large literature about why firms would want to go abroad. One is just to adapt. Perhaps you are trying to access the Chinese market so you want to set up an R&D subsidiary there to learn about Chinese tastes and to adapt your products and services accordingly. The second is to learn. That's what I just talked about with going to Germany if you are a car company. There, you are going to other advanced economies to learn from the best, to tap into scientific knowledge, et cetera.

So those are kind of the traditional reasons why firms would go abroad, but there are other reasons that we think are really underlying the more recent rapid growth. The one that we spend the most time on in the book chapter is technology. So, the increasing use of software and IT hardware.

The first thing to note here is that firms today, regardless of the industry, are much more likely to be using software and IT hardware than they were in the past. So let's return to our car example. Cars are now, in some ways, big computers. So a traditional manufacturing industry like a car company, they now have to hire lots of software engineers in order to build their cars. So what you are seeing is even across the most traditional manufacturing sectors, there is this need to hire software and IT experts. So you are seeing across the entire economy this broad surge in demand for these types of workers.

Just to highlight this, the U.S. IT workforce grew by 112 percent between 1993 and 2010. The overall workforce grew only by 70 percent. So American firms have met that increase in demand in part by hiring foreign workers. So, hiring skilled immigrants. You can see this in H-1B visa data as just one example. It's really dominated by workers in computer-related occupations. In the 1990s, firms are really meeting a lot of this demand through hiring immigrants. But then we saw this tightening of immigration restrictions in the 2000s and multinational firms could no longer meet that demand by importing workers. So what they did is they went abroad instead. They shifted some of their R&D activity and their R&D workers to their foreign affiliates where they could hire the human capital that they needed.

One of the things that actually also made it possible for them to do this is that same technology. So you have the Internet which allows you to collaborate in real time. You have

kind of this inherent modularity in a lot of these technologies which means you can kind of split it up and assign kind of different pieces of it to different teams in different locations. So actually, the inherent characteristics of the technology itself also enabled this. So basically, what we are saying is that a combination of these immigration restrictions, the search for human capital, and the growth in the importance of IT and software were kind of these core drivers of this surge in foreign R&D.

**DOLLAR:** There were a couple of numbers in your chapter, Britta, that really jumped out at me. One is that it used to be that about six percent of patents were software related and now 40 percent of patents in the U.S. are. I was really struck by that.

So you identify these new hubs, particularly Israel, India, and China. Does each have a particular niche or characteristic, or are they all the same?

**GLENNON:** So there are some similarities across the three, but they also each have their own very unique characteristics. If we take India, software is really key there. So you have lots and lots of relatively low-cost software engineers in India, and that's a really major driver for U.S. multinational firms who have chosen to R&D [inaudible]. So the idea is they are kind of tapping into this raw talent and integrating that talent into this broader R&D system. The other kind of advantages of India are that you have the common language. So, most Indians speak English. Then you also have this large diaspora, India diaspora, in the U.S. So that makes this integration smoother.

Israel human capital is also a really important draw, although it looks a bit different. Part of this is because of the institutions in Israel. The Jewish population in Israel has to serve in the military when they are young, and the most intellectually gifted are sorted into these elite intelligence units. They are then trained in cybersecurity and software engineering tasks that are really central to Israeli national security. And what that means is that when they are done with their military service and they enter the private sector, they are already really, really highly trained in a lot of these technical skills that any company that's interested in IT software experts could want. So these are distinctively highly-skilled people, and they are in domains that these firms are very interested in.

Another piece of this is also the startup culture in Israel. There's lots of these startups, and interestingly, unlike in the U.S. where many startups are interested in an IPO, in Israel the goal is often actually to be acquired by a U.S. multinational firm. And, like with India, there's also a very extensive Israeli diaspora in the U.S. So actually, a lot of the Israeli managers of these foreign affiliates have worked in the U.S., they were educated there, or they have spent lots of time there, have family, et cetera. So that also helps with the integration into this system.

Then let's take China. Again, human capital, big draw. Again, a little bit unlike Israel. Here, it's really the cost and the scale that's significant. One thing that's a little bit different about China as compared to India and Israel is that a lot of the R&D there is this adaptive kind. So the goal really is trying to access the Chinese market. Similar to India and Israel, the diaspora is playing a

big role here, too. They are helping multinational firms recruit talent, they are helping them navigate the tricky business environment there.

So you can see basically across these three different countries, they all have their own unique characteristics but there are some themes. All three have this big diaspora that's helping the multinational firm form these connections between the foreign affiliates and headquarters. In all three, the local human resources and IT software is also this really key driver as well. So there's kind of these unique characteristics and these common themes.

**DOLLAR:** You know, I was living in China starting in the early 2000s and covering this period you are talking about and I remember when they just announced they were doubling the university slots. It's a big country, so imagine you suddenly double the university slots, say, in America. I remember thinking it was a little bit crazy because that's a very big, discrete change and it's hard to develop great universities quickly. And they might have overdone it a bit, but they are turning out I think your figure was over a million science and engineering students per year.

**GLENNON:** Exactly. Yeah. So just the mass scale is just such a major appeal for these firms.

**DOLLAR:** So let's turn and talk about some of the policy issues raised by these developments. I think there are quite a few. You already mentioned the issue of U.S. immigration and some of the changes in policy. What would you recommend as a kind of ideal U.S. immigration policy looking at this particular set of issues around research and development and innovation?

**GLENNON:** I guess the short answer is we should have far fewer restrictions on skilled immigration of all forms, right? So whether it's employer-sponsored non-immigrant visas like H-1B or L-1 or LPT, or education based F-1, or work sponsored green cards, restrictions on all of these need to be much lower than they currently are. These high restrictions are limiting the ability for U.S. firms to stay competitive globally. It's pretty clear that multinational firms need skilled human capital to conduct R&D; that's been one of the primary drivers of this surge. We are emphasizing IT and software, but it's not just limited to that. This may change. The point is that you need the skilled human capital. And if firms can't hire the skilled immigrants they need, they are just going to find it somewhere else. So it's also not a very effective means of keeping knowledge work for Americans in the U.S. It might actually be the impetus for pushing said work abroad.

I think the other point is just how effective diasporas have been in helping these firms be successful in other countries. They have really served as a human bridge between their American employers and the communities in their home countries. So, on pretty much every level, these are really significant piece of the innovation system.

**DOLLAR:** Yeah, and a big part of that diaspora for all the examples you mentioned—Israel, India, China—that includes students coming to the United States. That's how a lot of the kind of overlap gets started. Some of those students end up staying, or they may stay for a while and then go back and it kind of creates a deep connection between the different countries.

**GLENNON:** Yeah, absolutely.

**DOLLAR:** So what about from the developing country point of view—India, China. What can they do to be strengthening their participation in these kind of international innovation networks?

**GLENNON:** I think the number one thing is really just investing in human capital. That's what multinational firms are looking for. They are looking for talented human capital to plug into their global R&D systems. So developing countries that want to be a part of that really just should be prioritizing investing in educating their population. I wouldn't necessarily suggest trying to only invest in IT or software, because that may be a trend that will change. One thing that is never going to change is the importance of educating human capital. So that would be my number one recommendation.

**DOLLAR:** In your chapter, you also talk about the importance of intellectual property rights protection in developing countries and cite some weakness in India. Is that still relevant?

**GLENNON:** Absolutely. So firms are very worried about their technology being stolen by domestic companies. And the more that they are concerned about that, the less they are going to do cutting edge technology in those countries. So if you can invest in your IP system, ensure that any IP theft is going to be prosecuted, then firms are going to be less concerned about conducting R&D.

**DOLLAR:** So there's a lot of talk in the U.S. now about decoupling from China, particularly in high tech fields. So one of the things that really struck me about your chapter is that the trends you describe seem to be running completely counter to this narrative in the U.S. that we need to separate our two economies in these high tech fields. So do you think decoupling is realistic, and what are likely to be its costs given this work that you have done?

**GLENNON:** Yeah, so I think decoupling is an extremely hard thing to do, and in some ways people keep predicting this. So with the U.S.-China trade war people thought, “oh, this will cause decoupling.” Then people thought COVID will cost decoupling. Now people think political pressure will cause decoupling. You know, it hasn't happened. If anything, it's gone in the other direction in some ways.

I mean, I do want to be clear that I don't want to say that U.S. companies have not decreased their dependence on China at all. I think, in fact, they have tried to reduce their dependence on China by shifting some of their activity to other parts of Asia or to Mexico. I'll note, very few have done any reshoring to the U.S. I suspect this will continue to some degree because companies do worry about rising tensions and the implications for their business model. So the map is shifting a bit, but companies have really struggled to do this entirely whether it's manufacturing or R&D. There are just still too many benefits to having operations in China, especially when it comes to scale. There are just very few other places that can offer the kinds

of economies of scale that China can—and can not only offer these economies of scale, but offer it with fairly highly skilled human capital and other resources.

I will say I think companies are increasingly worried about IP leakage, technology transfer, government interference in China. So, I think they are increasingly wary of putting truly cutting-edge R&D there, but I just don't see total decoupling happening unless companies are actually forced to do so somehow. And even less likely is that any reshoring would happen.

Now if it were to occur for some reason, this would really damage the global innovation system. The scale of investment in innovation matters a lot. It takes—we've seen over the past few decades larger and larger teams are needed to make scientific advances. So there's clearly kind of the scale of investment and innovation that's needed. One of the advantages of the globalization of knowledge creation is that it allows you to get that scale. It helps you to boost productivity growth by leveraging human capital around the world to meet those increasing demands and scale. So if you're going to decouple, if you are going to withdrawal from the global economy, that's really going to harm the global innovation system and the advances that are possible.

**DOLLAR:** If we could get down in the weeds a little bit. One of the other things I learned from your paper—one of the things that you are doing to tease out this collaborative research is taking advantage of patent records in the U.S. that list the addresses of the inventors. I just found that kind of heartening in a way that there's so many patents now where you've got co-invention between American-based researchers and, say, Chinese-based researchers or Indian-based researchers. That's really quite remarkable. And given where we are, I very much agree with you that decoupling is not realistic, and we actually haven't really seen much of it. But if we were to go down that road, it would almost certainly have a devastating effect on innovation and ultimately on our prosperity.

**GLENNON:** Yeah, absolutely.

**DOLLAR:** So last question for you, Britta. I think we can agree that this wholesale decoupling between the U.S. and China is a bad idea. There's a lot of advantages to this integration that we've got in the world. But there are real national security issues between China and the United States; lots of important things on which we differ. So I have more sympathy not for decoupling, but for looking at some of the security issues related to the development of particular technologies.

Do you think we can really kind of protect off the technologies that have national security implications and still get most of the benefits of this kind of integrated system? Or are we implicitly taking on some national security risks through this system? That's a big, speculative question by the way, but I'd like to hear your thoughts on that.

**GLENNON:** Yeah. So this is, of course, the big question everyone is trying to grapple with right now. I don't think there's an easy answer to it. An ideal world, you would be able to silo off

anything that was national security related and keep that somewhere safe, et cetera. One of the challenges, of course, is that we don't actually always know what is national security related. Things that don't seem to be currently might be in a year or two.

One way that you can try to do this is actually leveraging the increased interdependence from different geographic locations. So if each of these subsidiaries were an independent operation, then that would mean that something like technology transfer would be quite damaging. But if there are interdependencies, then actually technology transfer from one subsidiary may not be very useful unless you get information from other members of the team based in other countries. So that's one thing that firms can do, and, in fact, a lot of firms already do. So that's one possibility, but I think this is very much an ongoing question that people are struggling to answer. I do think it's possible to benefit from this globalized R&D while protecting technologies [inaudible].

**DOLLAR:** That point about interdependence, I really like that. You and I both threw some cold water on the U.S. idea of decoupling, but you also have this Chinese intention to develop indigenous innovation. They are putting a lot of effort into trying to stimulate the innovation within their own economy, but you and others present evidence that they are actually not making that much progress and that they benefit more from this kind of collaborative research and integration than from their indigenous innovation efforts. That I find encouraging.

**GLENNON:** Yes, absolutely. I think even if you look at the case of COVID vaccines we see some of this. International collaboration is really what brought us these vaccines.

**DOLLAR:** I'm David Dollar and I've been talking to Britta Glennon about her contribution to a new book called "Global Goliaths." It's a book from the Brookings Economic Studies wing on multinational companies, and her co-authored chapter is about the internationalization of research and development. So thank you for sharing your ideas, Britta.

**GLENNON:** Thanks so much for having me on here. I really enjoyed our conversation.

**DOLLAR:** Thank you all for listening. We'll be releasing new episodes of Dollar & Sense every other week, so if you haven't already, please subscribe wherever you get your podcasts and stay tuned. Dollar & Sense is part of the Brookings Podcast Network. It's made possible by support from Chris McKenna; Anna Newby; Camilo Ramirez; our audio engineer, Gaston Reboredo; and other Brookings colleagues.