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Chairman Keating, Ranking Member Fitzpatrick, members of the Committee, and distinguished guests, thank you for the opportunity to address you today.

I am on the faculty of the Harvard Business School, where I have taught for the past 15 years. Prior to that I spent 28 years in industry, doing product development and manufacturing during a time when the globalization of supply chains really took root. After I started my first job out of school in November 1979, I spent much of the next decade working with European partners and suppliers, and during subsequent years I have had factories in the U.S., Europe, Asia, and Latin America reporting to me. When I teach about operations management and supply chains at the school, I come from the perspective of one who has studied both the theory and lived the practice.

What I hope to convey today is some of the basic logic around why supply chains are structured the way they are, how the U.S. is deeply interconnected at so many levels to Europe, and why I believe a more nuanced understanding of these connections can help us to build a more robust partnership with Europe and more resilience for ourselves.

I think the most important concept to understand is supply chain tiering, the consequences of which were really highlighted during the pandemic (**Exhibit 1**). For pretty much any product, a final assembler is fed by a network of suppliers, who in turn are fed by their own networks of suppliers, and so on. In many industries like automotive, this can go as much as nine layers deep or even more. This helps explain many of the disruptions we have experienced, as you only need to lose one supplier somewhere in those tiers to make it difficult or impossible to assemble your product. And many of those suppliers are connected by logistics links that span the globe.

Why do we have this tiering? The most important reasons are technological complexity and the benefits of specialization. In most technology-intensive industries, it is impossible for one organization to not only do everything itself, but to also be the very best in the industry at everything needed at the same time. Rather, you want to be able to choose from companies who are the best at making each of those components. If you look at a modern notebook computer (**Exhibit 2**), being the best at designing the processor requires different skills than designing the best disk or solid state storage drives, and a whole different set for manufacturing the battery, keyboard, or flat panel display. If you visit the factories of these manufacturers, as I have, you immediately see how different the capabilities needed for each of them are (**Exhibit 3**).

One consequence of this is that supply chains have a global reach, and European companies often are critical links. A great example is the global semiconductor value chain. In this chart (**Exhibit 4**), I show the most critical links in the production of leading edge semiconductor chips like the ones in your iPhone or notebook computer. The Dutch company ASML has gotten a lot of attention for being the only source for those $150 million plus extreme ultraviolet (EUV) lithography machines that are used by companies like TSMC to make chips in Taiwan, and maybe next year in Arizona. Those machines use an optical engine that is manufactured by Zeiss in Oberkochen, Germany, which incorporates Bragg reflector assemblies that in my opinion probably only Zeiss has the capability to engineer, or at least they have a 10 year plus lead over anyone else in the world. That scanner also uses an amazing 13.5 nanometer laser plasma light source made by Cymer in San Diego. ASML worked closely with IMEC in Belgium and Albany NanoTech in New York to perfect these machines.

ASML assembles scanners in the Netherlands, and then ships them all over the world, to places like TSMC Fab 12, 14, 15, or 18 in Taiwan, where they produce wafers filled with chips designed by Apple, Intel, AMD, Nvidia, or Qualcomm using software design tools from Synopsis or Cadence, and they ship finished wafers to outsourced assembly and test facilities across Asia to be packaged and tested before going to circuit board assembly lines in China where they are put into phones and computers and all sorts of things. It is truly a miracle of global cooperation and coordination, and you can see the critical role of European firms.

One of the other benefits of these global supply chains is that producers can develop scale efficiencies and leverage cost advantages of being in one location or another. Last year I worked on a project in which we tried to trace the supply chains of generic pharmaceuticals, and while this is generally opaque, we made some progress on for steroid drugs (**Exhibit 5**). You'll see in this chart that a key precursor for many steroid drugs is 4-androstenedione, and I was surprised to find that even many Chinese and Indian makers sourced it from Germany. In this little corner of the pharma active pharmaceutical ingredient (API) market, as well as in another study I did on consumer toiletries, I was intrigued to find EU companies occupying prominent roles in many chemical supply chains. If you go back to the notebook computer example I started with, Merck KGaA in Darmstadt, Germany is the global supplier of the critical liquid crystal material that makes all of those displays work. I visited their factory a number of years ago, and it was an amazing place. EU companies play an essential role in many areas. I visited the Novo Nordisk facility in Kalundborg, Denmark five years ago where I saw

half the world's supply of insulin being manufactured, and I also visited Chr. Hansen, who makes the cultures and enzymes for yogurt and cheeses consumed daily by 1.5 billion people globally, including probably most of the ones you find in supermarkets here. When you are making chemicals, or growing cultures, scale translates into lower costs and economic efficiency.

With these interconnections, we also have to be careful to understand the implications of our trade policies (**Exhibit 6**). I was talking to the CEO of Long-Stanton Manufacturing Co. a few years ago. The company has been in metal fabrication since 1835, and this is a tooling fixture (show) that he gave me a few years ago. They use it when they manufacture brackets for the carbon fiber brakes in the landing gear of the Boeing 787. They buy the steel from Voetsalpine in Austria, and then they ship finished parts to Safran Landing Systems in the U.S. and France. Safran assembles the gear, and ships it to North Charleston, South Carolina where Boeing assembles them into aircraft. There is a lot of aerospace trade between Europe and the U.S., whether its European made components for Boeing aircraft designed with Dassault Systèmes software and assembled here, or American made components like engines, actuators, avionics, auxiliary power units, and countless other components going there. Those brake units have to dissipate a tremendous amount of energy in a rejected take-off, so the steel is a special high-performance alloy. When we imposed steel tariffs a few years ago, Long-Stanton tried to find a domestic source, but there were none to be found. Voetsalpine is the only supplier qualified by Boeing and Airbus. Faced with sudden cost increases, the company had to scramble as Safran looked for other options. Sure Long-Stanton could file for an exemption, but that was a lengthy process, and I remember this was an existential crisis for them.

Europe and the U.S. are highly interconnected, and interdependent. While we are still a technology leader, global R&D spending and leadership are much more distributed than they were 50 or 30 years ago, when it disproportionately favored the U.S. If we were to view the EU and North America plus some East Asian allies together, you would have very comprehensive coverage of all of the advanced technologies I can think of. Partnership with Europe makes a lot of sense – one in which we work together to ensure more resilience and mutual benefit. I think cooperation with Europe is critical to American competitiveness, both now, and in the future.

Thank you very much. I would be happy to answer your questions.