Video Transcript for "Japan's Emergence as an Innovating Economy"
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The Japanese economy slowed down in terms of its growth rate in the 1970s. The entire industrial world slowed down. These were turbulent times. Oil prices were shooting up through the roof, inflation was rising more generally, industrial economies were slowing down, their industrial structures were changing, but the Japanese economy continued to grow faster than all of the other advanced industrial economies. Everybody was growing more slowly, but Japan continued to outperform.

And the other thing that was happening inside the Japanese economy was that the sources of that growth were changing. Light manufacturing and materials intensive heavy industries were growing much more slowly. R&D intensive and skill intensive manufacturing industries were growing much more rapidly. And the research and development spending and the patenting of Japanese firms began to surge and by the end of the 70s, Japanese firms had very quickly emerged as serious competitors in high technology industries U.S. firms had long dominated, including autos and auto parts, electronics and in industrial machinery.

In semiconductors, Japanese firms emerged as particularly important competitors. Japanese firms ended the 70s with a roughly 25% global market share in memory chips. By the mid-1980s their market share was about 65%, so very rapidly over the course of the 1980s they were displacing some of the best and brightest Silicon Valley firms of that era. They were starting to dominate an industry that had literally been invented in the United States, mostly here in Silicon Valley.

By the mid-1980s the titans of Silicon Valley, many of them anyway, were living in mortal fear of being out-innovated by the Japanese. Now as this emerged there was a group of scholars that sought to explain the seemingly rapid and seemingly surprising emergence of Japanese firms as high technology competitors by pointing to the role of government policy, and in particular they were pointing to the industrial policies that had been implemented by what was then known as the Ministry of International Trade and Industry. These policy interventions, it was suggested, were really the things that caused Japan to move from being a fairly low tech manufacturing power to a fairly high tech or a very high tech manufacturing power. And a number of these books—*Japan As Number One* by Ezra Vogel, *MITI and the Japanese Miracle* by Chalmers Johnson, *Trading Places* by Clyde Prestowitz—became bestsellers and catapulted their authors to academic celebrity.

Now in many cases what these experts were advocating was an old idea: infant industry policies. Alexander Hamilton, the most famous founding father today thanks to the Broadway musical, actually suggested that the United States engage in a policy of deliberately protecting its infant manufacturing firms from foreign competition in order to develop an indigenous manufacturing industry in the United States. And the great classical political economist John Stuart Mill gave this idea his blessing in his very important economic writing in the early 19th century.

The basic idea is that a government offers temporary import protection to local entrepreneurs in an industry the government wants to develop because it believes that this industry is well-suited to the characteristics of the country – it's just that there are other producers elsewhere in the world that have gotten a head start and make it very difficult for local firms to get into the game without a little bit of help from the local government. So protect the domestic market, at least a little bit, from foreign goods and perhaps offer some low-cost financing for a period of time to help these local producers get off the ground. And if this experiment is successful then within a few years this infant industry will have grown up, it will be competitive, you can remove the subsidies, you can remove the tariffs or import quotas that are protecting these local firms from foreign competition, and they will thrive and they will compete and they will be an economic asset for the nation.

In the 1980s, mainstream trade theorists begin to construct trade models with what are now called technological externalities, basically features of the model that can make industrial policy actually quite effective in theory, and in fact the creators of these models—people like Paul Krugman who eventually won the Nobel Prize for this work, Jean Grossman of Princeton, Elhanan Helpman now of Harvard, Jim Brander and Barbara Spencer of the University of British Columbia—they were all responding to what seemed to be happening in Japan. They might not admit this today, but they were actually reacting to the stories that people like Ezra Vogel and Chalmers Johnson and Clyde Prestowitz were telling. And these new models that were created seemed to offer quite sophisticated arguments in favor of Japan-style industrial policy.

Now the models were quite technically sophisticated, mathematically dense, but the basic idea can be illustrated in this series of figures. In these models there were firms, they were very stylized firms but they were firms, and they were creating economically useful new technology and as they did so they were drawing on two different inputs. The firms were drawing on their own R&D spending, of course, but they were also drawing on a general stock of knowledge, the state-of-the-art, the technological knowledge that would be common to engineers and technologists in that industry. Now if they were successful in creating economically useful new technology, then they would be generating two kinds of outputs. Now one would be the new product or service in which the new technology was embodied, and they can make a profit selling that new

product or service, but over time the new technology embodied in that new product or service would eventually be reverse engineered by other engineers working for other firms in that industry, would eventually become an addition to the general stock of knowledge upon which this firm and other firms could build.

That was a technology spillover, and that technology spillover was very important in these models. What it meant was that over time the stock of general knowledge upon which inventors built got higher and broader. So at the firm level, firms could combine a steady level of own R&D expenditure with a steadily expanding stock of general knowledge that made their own R&D investment more valuable because it could be combined with this ever larger pool of general knowledge. Because of that, diminishing returns to R&D never sets in at the firm level, the stock of general knowledge grows over time with outbound, and innovation driven growth can continue in the economy forever.

But maybe not at the same rate for all countries. It's logical to think that within a country firms can easily meet, they can observe what they're doing, they can interact at conferences, and this knowledge flows pretty easily across firms within a country. But if you've got two groups of firms and they are separated by the Pacific Ocean and they exist in different countries and they speak different languages and there's not a lot of employee transfer across that ocean, then it's possible to imagine that there's not one but two or many different stocks of general knowledge and firms have very good access to the stock of general knowledge that exists in their own country and it's actually pretty hard for them to access the stock of general knowledge that exists abroad.

Now if you've got this fragmentation of the global knowledge stock into different national bits, then that actually creates the possibility for industrial policy to be very powerful. What if you've got a temporary subsidy, let's say, that encourages firms in your country to invent and therefore add to the general stock of knowledge that they can draw upon? Well if they invent more quickly for a period of time, then that builds the stock of general knowledge such that it becomes larger, perhaps permanently larger, than the stock of knowledge that this firm's rivals abroad can build upon. So a temporary policy intervention can produce a permanent source of technological advantage. All right, that was the argument that people like Chalmers Johnson and Ezra Vogel were trying to make in words. The great trade economists of the 1980s made this argument very eloquently and the kinds of mathematical models that economists find convincing.

So if you read the books that are written by Chalmers Johnson and Clyde Prestowitz, you'll see a lot of frustration in those books directed towards economists. Economists are portrayed as this group of religious zealots that had such an abiding faith in the perfection of the market that they simply can't imagine that government intervention could lead to a better outcome than the market would select, but that's just not right. The

most brilliant economists in the country in the 1980s were developing exactly the kinds of economic models in which, in theory, industrial policy intervention of a certain kind could have a permanent impact on comparative advantage. So the question is not can economists conceive of this working in theory, the question is does the economic data support the idea that it worked in practice in Japan. And the answer to that question appears to be no.

So the great thing about trying to assess empirically whether industrial policy worked in Japan or not is in Japan's democracy. Its government keeps good data records, and so you can actually go back to the historical record and you can look at import tariffs and import quotas and how high they were and how they differed across industries. Now the industrial policy argument would tell us that Japan's bureaucrats were very strategic, that they skillfully protected the sectors that later emerged as technological world beaters. But the sequence of events is that you protect first, and the technological capability emerges, and then you lower the barriers as these firms are storming global markets and sweeping all before them.

Well, you know, in the early 1960s Japan was a fairly protectionist country and the evidence indicates that its import tariffs were particularly high in transportation equipment, so cars. But even by the late 1960s, pressure outside Japan had forced the Japanese government to substantially lower its import tariffs and nontariff barriers to imports of manufactured goods. And by the early 1970s, long before Japanese cars were storming global markets and threatening Detroit with bankruptcy, import tariffs in Japan were already very, very low, generally below 10%, and they were quite uniform across sectors. So the historical evidence just really doesn't support the view that import tariffs were what generated this technological advance. The real technological advance emerged after the import tariffs were already low and pretty uniform.

But what about subsidies? So it's true that in the 1950s government affiliated financial institutions in Japan financed a pretty large fraction of the corporate investment, the industrial investment of Japanese firms. But even by the mid-60s, early 70s that fraction had fallen very substantially. As the Japanese economy grew, the importance of government-directed finance shrank very substantially. So government finance was almost completely unimportant as a source of industrial equipment investment long before Japanese firms emerged as technology leaders in their industries. Again, the data doesn't really support the argument. And finally Kent Calder, who is actually a political scientist, went back to the records on taxes and subsidies and he actually tried to calculate how much financial largesse Japanese industries received from the government versus how much they paid to the government in taxes. And so he sort of calculated the net financial benefit showered on different Japanese industries and he looked at this in the 1950s and he looked at it again in the mid-1980s.

Now the industrial policy argument would tell us that net financial largesse was concentrated in the industries that later became Japan's world beaters – but what the actual data suggest is that the industries that got the financial largesse in Japan were industries like mining and agriculture, industries in which Japan was fundamentally uncompetitive. The industries that emerged as world beaters, like motor vehicles and electrical machinery, consistently and significantly paid more to the government in taxes than they got in subsidies or low-cost loans or other forms of financial largesse.

So again when you actually look at the data, the industrial policy argument—which could work in theory—just doesn't find a lot of empirical support. And the best paper on this is the 1983 article by Gary Saxonhouse. It wasn't actually published until many years later, but in 1983 Gary Saxonhouse, an economist at the University of Michigan, painstakingly deconstructed the argument that industrial targeting was driving Japan's technical advance. I mean he just cites fact after fact and numerical comparison after numerical comparison and when you read that article you just can't help but come to the conclusion that Japanese R&D subsidies were quite modest, especially in comparison to U.S. subsidies of R&D and of high tech industry more generally. You see the significant government aid that Japan provided went to the less competitive, less technologically dynamic industries, and you see that official trade barriers were low and increasingly uniform across products and industries.

If we want to explain Japan's technological surge, we just can't point to industrial policy as the driving factor. Now there was later research that extended this scholarship. Richard Beeson and David Weinstein in the 90s statistically tested the relationship between productivity growth at the industry level and government's industrial policy tools and they found no relationship.

In a series of papers with Mariko Sakakibara, who is now a professor at UCLA, I looked at the industrial policy instrument that is perhaps the one that economists would be most enthusiastic about, the Japanese government bringing Japanese firms together into research consortia, allowing them to collaborate on pre-commercial research and providing financial incentive to do this. If there was any industrial policy instrument that might be precisely targeted in a way that would build technological capability, it would be this. But we did the numbers, we did the math, and at the end of the day we were forced to conclude that while this tool probably did raise innovation in the targeted areas, the effects were very modest. Again if you want to explain the emergence of Japan as an innovating economy, you just can't point to government intervention as the deciding factor.

Stanford researcher Thomas Rohlen made an enormous contribution to our understanding of this question when he published a landmark study of the Japanese educational system in 1983. The book was called *Japan's High Schools,* and it was based in part on field research that Professor Rohlen had done in the 1970s. And he came to a

number of conclusions about the economic impact of Japan's educational system that are quite important for answering the question [you] just posed.

Rohlen concluded that because of its longer school year, in the 1980s Japanese students effectively acquired four more years of education going through their K–12 system than their American counterparts did. And even by the mid-1960s, Japanese students were dramatically outscoring their European and American peers on tests of mathematics and science. And this outperformance existed at all grade levels and in all quantiles of the ability distribution. So their top 10% outscored our top 10%, their next 10% outscored our next 10%, all the way down to the bottom. And this outperformance wasn't trivial. In the mid-60s Japanese students were performing at twice the level on some of these tests as their American counterparts. Rohlen concluded that the average Japanese high school graduate in the 1980s probably had the same level of basic knowledge as the American college graduate. Now let's just pause a minute and let the implications of that sink in.

If you are moving into higher tech industries, if you want to become an innovating nation, there's nothing more important than the basic human capital of your workforce. And what seems evident from Thomas Rohlen's work is that the human capital accumulation in Japan was phenomenal, and by the early 1970s they had laid a very strong foundation for the nation's subsequent movement into high technology industries and into innovation. And Japanese universities were generally not regarded as being as good as American universities—certainly there was no Japanese university that had the cachet and global scientific impact of, say, Stanford—but in the 1980s, Japan was graduating more than twice as many engineers per capita as the United States and its ordinary workers had dramatically higher levels of competence in science and math. And in undergraduate curricula, four times as many Japanese students were choosing engineering-related subjects as American undergraduates were. And you know what's true for Japan is actually true of industrial East Asia more generally. If you compare the skills that students in Taiwan and South Korea acquire in school with the skills of German or American or Indian or Mexican or Brazilian students, the differences are very, very striking.

So in this graph that you can see, Eric Hanushek, who is an economist who works on education and has had an affiliation with Stanford in the past, it shows that in terms of average cognitive ability (that's measured by these blue bars) the Asian economies are real standouts. They just consistently score much higher in terms of average student achievement. The red line tracks the fraction of students that score one standard deviation above the OECD average—so this is looking at how many students are performing at a really outstanding level—and in that regard the Asian countries are even more spectacular in terms of their outperformance. And the performance of Taiwan and South Korea in terms of educating their people relative to the performance of India or Mexico or Brazil or Ghana is really quite breathtaking. I mean if you want to

understand why Taiwan and South Korea have become successful high-tech economies and Mexico and Brazil have not, surely a very important part of the explanation can be found in the basic human capital foundation that exists in these countries.

Comparisons of test scores suggest that other East Asian countries have done an even better job of educating their students than the Japanese schools did, and Professor Hanushek has actually tested the statistical relationship between human capital formation as measured by these tests and the rate at which different regions or countries around the world converge to the income and output levels per capita of the rich countries. And what he finds is that educational performance explains a lot.

And he's not the only one: there's an Australian economist named John Romalis. In the mid 2000s, he published a study in which he tried to explain the evolution of the export structure of countries around the world by measuring among other things their human capital. And very interestingly, he finds that once you control for the expansion of human capital in industrial East Asia—and other things like the investments they were making in physical capital—you can basically explain the change in their export structure. You can explain their rise as exporters of high-tech products. To put it another way, there's really nothing left over for industrial policy to explain. I think that's a pretty powerful set of results.