Session 5: Measuring Innovation: What is the Measure for "Outcome" of Innovation and how to Evaluate "Effect of the Policy Instruments"

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M. Kuroda
We have four presenters today, who will talk about measurement of innovation, a topic in which we are all interested. We will then have a discussion on this topic.

How to evaluate service output

Takanobu Nakajima
In the case of service output, consumption and production occur at the same time, and the service is unable to be stored. But services are not necessarily perishable; for example, people go to the dentist not because they enjoy the treatment, but because it is hoped that their teeth will be in good shape for some time to come.

Service price gives three kinds of information about the depreciation of capital goods: exhaustion, deterioration and obsolescence. There are two kinds of obsolescence. One is in technology, embodied obsolescence, which means that when a new invention or new product appears, an old one just disappears and loses its value. Disembodied obsolescence arises not from new inventions, but from shifting demand. Based on this theory, we can say that the change in price for a service can be interpreted as the change in service flow.

In haircut service price in Tokyo, we can observe that from 1970-2004, over more than 30 years, the price has risen 6.6 times. Does this mean that the real price changed? Based on the obsolescence or appreciation theory, the demand shift theory, this obsolescence effect or appreciation effect will show up as a temporary asset price change. The background is that: the simultaneous upward shift of demand and supply curves observed.

In the case of the service industry, one of the characteristics is labor intensive production, i.e., low substitution between capital and labor. Economic growth usually raises the real wage rate, and the rising wage rate may make an upward shift in the supply curve without technical change. In the case of technical change, there is normal substitution between capital and labor. As a result of the upward shift of the supply curve, it is very important whether the upward shift of the demand curve may occur or not. But if a rise in real price occurs, it should be evaluated as output growth, not simply inflation. If we apply typical productivity measurements to service consumption, it could cause misunderstanding. Therefore it is time to reconsider especially in advanced pathways how to evaluate service output.

Q&A/Comments

Question 1. I am not fully convinced by the haircutting example; it is demonstrated that technical change and intermediation such as marketing played a major part in price. Also, haircutting is to some extent a utility service, as everyone has to get his or her haircut at some point.

T. Nakajima
What I was arguing is that consumer-side desire changes have transformed demand for services.

Question 2. Is it possible for durable services to actually increase in value after a time of consumption. Is there a possibility of appreciating the flow in the future?

T. Nakajima
As time passes services probably decrease, especially in medical services, although there is some durability, as the purpose is to maintain health until the next time the services are required.

Question 3. How should we consider the utility we can get from durable goods versus services, and how can we measure durable services as services? Consumer demand was a crucial factor.

Question 4. What does this topic have to do with innovation?

T. Nakajima
In environmental issues, customer evaluation of the environment could be very important. The unidentified speaker said that that was the same as if the consumer were purchasing a house.

Question 5. Look at the example of Apple's iPod, in which Apple itself manufactures virtually nothing; instead they have designed the machine and decided how to provide the service, to great effect in the market.

Question 6. It is interesting that customer evaluation of a service is related to productivity; if customer evaluation could be accurately measured, it could boost the gauge of productivity for some firms with high quality physical products as well.

T. Nakajima
I agree. That is exactly right.

M. Kuroda
Japan has had difficulty in comparing productivity between subsectors. The value of the service can completely be agreed upon, but the quantity of the service is completely different. It might be the productivity of the subsector is quantity over labor.

The Different Effects of Intellectual Property Rights on Intra-firm and Arm's-length Technology Transfer

Banri Ito
Here I discuss the effects of stronger intellectual property rights (IPR) on technology transfer using evidence from Japanese firm-level data.

The purpose of the paper was to test the effects of strong IPR on international technology transfer, using large Japanese firms' labor data. IPR protection encourages not only innovation, but also technology transactions through the declining transaction cost through establishment of property rights. IPR protection may be harmful for developing countries, because they have to pay more for IPR. This is the main reason for North-South conflict on this issue. However, if your IPR system can increase the technology inflow, which is expected to have positive effects on economic growth, the developing countries might feel IPR is useful for their countries. Also, if stronger protection in the developing countries harms the technology inflow to these countries, the developed countries have to devote more resources to the manufacturing of existing goods, so that the speed of innovation slows down. This is a crucial instrument to consider global innovation.

To test the relationship between IPR and technology transfer, we have to measure the IPR protection level for each country, and measure the technology transfer volume. There is a possible gap between the actual coverage and the legal coverage; actual enforcement is weaker than legal provision. However, IPR in almost all countries is stronger compared with five years ago.

Japanese firm data shows a positive and significant effect of IPR protection on arm's length technology transfer, but the effect on inter-firm technology transfer is restricted to high R&D intensity firms. Second, the IPR effect on technology transfer is concentrated in non-OECD countries. IPR harmonization would stimulate global innovation through increasing international technology transfer. This is the main implication. This study provides some evidence, but could not clear the impact of IPR or technology transfer on productivity and innovation directly.

Q&A/Comments

Question 1. Can you give some clarification between technology transfer and technology exports?

B. Ito
Technology transfer is not necessarily technology export; technology transfer has a broader coverage, but technology exports are restricted to the exchange of technology transactions for a patent or know-how.

Question 2. Did you take into account the final destination of technology exports? There is a distinction between technology exported to China for manufacturing purposes versus technology exported to the United States as a final product.

B. Ito
This data did not capture the final destination of the technology, but that that would be an important issue.

Question 3. Does the current study also cover licensing of FDI?

B. Ito
There are a number of studies on the effects of IPR on FDI and licensing. But I want to distinguish between technology flow and production flow, and FDI expresses production flow.

Question 3. There are differences in industrial practice; pharmaceutical industries typically pursued exclusive licensing, while non-exclusive licensing was more common in electronics. Whether IPR licensing is done by portfolio or individually for revenue purposes makes a difference.

B. Ito
The effects on global innovation of strengthened IPR in developing countries. Currently, innovation is only occurring in the North countries, and production is occurring in the South. If the IPR harmonization, namely, strong IPR protection in a developing country, harms technology transfer, the developed countries have to give more resources to the manufacturing of existing goods. Resources are taken from the R&D sector, and innovation slows down. In this study, IPR can increase technology transfer, opening up more resources to the innovation sector.

Question 4. You used WEF data and cited some problems; I would add that there are several more, including subjectivity and uneven survey distribution among different people and countries, and inconsistent year-to-year response rates.

R. Dasher
At the same time, it is a well-known survey.

Measurement of TFP by Commodity-Level and the

evaluation of Technology Linkages

M. Kuroda
Total factor productivity (TFP) is one of the methods for evaluating the outcome of innovation. It offers a way to connect engineers and social scientists such as economists.

In Japan, input and output data for almost 400 commodity levels in available for every five years from 1960, offering valuable data for investigating TFP. The growth rate of TFP is measured by commodity levels, showing changes in economic structure and the impacts of the technologies on the economy. The measure of TFP is a residual of the growth rate of output and the growth rate of input. Therefore, all of the positive factors are included in the major method of TFP, a big problem. Other issues are capital service, discount value of the flow of return from subsidiaries in the future, and measurement of capital service prices. Another difficult factor to measure is the value of in-house software programs, which account for significant R&D.

Within commodity levels, there are linkages and connections. There are two measurements for TFP. One is own TFP, each commodity that we can observe. Another is a sort of linkage, or "unit" TFP. Sometimes when we observe a time series, some commodities increase in own TFP, and then the commodity impacts other products, because that product is input to other products. Process innovation and production of one device, for example semiconductors, opens up to product innovation in non-ferrous metal products. The input itself is not from the semiconductors, but semiconductors opened up process innovation, and process innovation changed the products of the semiconductor.

There is still much left to do in analyzing this problem. An index of openness and competitiveness by industries must be created, but it is very difficult to do so. Connecting factors such as social systems, small industries, large industries, regional level, macro levels, local levels, R&D and intangible assets and subsectors must also be considered.

Q&A/Comments

Question 1. How does difference in own and unit TFP compare to the whole question of innovation, especially given Japanese companies' keiretsu style of management? Because of close linkages between companies, what looks like a productivity change may in fact not really be related to innovation.

M. Kuroda
Because of the keiretsu system in Japan, this study is a measurement not of firms, necessarily, but of the social system.

Question 2. According to this data, the level of TFP during the oil shocks was quite low, despite the fact that the oil shocks initiated a great deal of innovation to get around the problem of high oil prices. This may indicate that there is a time lag.

Question 3. It could be interesting to look at the change in TFP from one period to the next.

M. Kuroda
The measurement of the TFP itself is a residual, and a sort of description of outcomes. Therefore is it difficult to evaluate future TFP.

T. Nakajima
How can you explain the downturn of TFP growth after the burst of the bubble in Japan and the TFP downturn observed from 2000-2004?

M. Kuroda
There were changes in the system or market failures. I tried to show the links between TFP change in various sectors. For instance, even when IT investment increased and equipment production centers had high TFP, associated sectors such as equipment installation, did not see as much TFP.

Question 5. In my organization, some member countries fail to adapt the positive benefits of technology. Is it possible to link TFP across sectors in a community-based approach?

M. Kuroda
I am not sure myself, but that might be a secure idea about connections or social systems to measure productivity.

Question 6. There is a discontinuity in the lack of common language. There is a very strong contradiction between local ambition and the way that some others try make more than a profit, by switching right away to the next model; yet we are quite far away from seeing the framework of the next model.

Question 7. What are the reasons behind the decline in TFP in 2000-2004?

M. Kuroda
There was a slowdown in the productivity of services, but I not know yet why it occurred at that time.

Measuring Innovation

Richard Dasher
Let us go back to the question of what the object of measurement itself was. If innovation is a process of discovering new ideas and technologies and implementing them in the real world so as to have a positive effect, then measuring innovation means measuring change in one or more values over time. It is very difficult to establish a benchmark for comparison; you can only guess what would have happened if an innovation had not occurred.

The other challenge is including the value of indirect benefits as well as the asset value of intellectual property created. Are we really looking at the efficiency and impact of a process, or are we looking at the valuation of a specific instance of this process of innovation? However, technology transfer is not only a factor of the producer of a technology; it is a factor of the recipient. To compare several related innovating groups means looking at the processes of innovation, its impact, and you are also looking at the aggregate value of all the instances

of innovation. Another reason to measure innovation would be to determine the appropriate rewards to a researcher.

I compare the notion of evaluating innovation with the process of evaluating a college professor for tenure, which involves subjective, forward-looking evaluation; it may be that such subjective evaluation is also necessary to accurately measure innovation. It takes a large amount of time and effort to evaluate a candidate for tenure at a university, and measurements of innovation are likely to improve the more time and effort we put into the measurement process. However, the quantitative measurement that goes into looking for a candidate for tenure for a university results in a yes or no decision. When measuring innovation, the actual score will be of the greatest value.

Although the process of tenure evaluation is very subjective, the crucial point is that it measures total impact, which is what also matters for innovation—measuring what someone or something has accomplished up to a point, with the intent of predicting future impact. Multiple evaluators could help reduce the possibility of skewing of the results.

In closing, if you are comparing an innovation policy instrument for a government—this is really what I was thinking of—you have to determine what the impact of that instrument is based on observable evidence up to now and the likely impact that that innovation instrument will have in the future.

Q&A/Comments

Question 1. What do you think about a ranking or score in light of the WEF, which ranks countries by innovation? A country's score can change greatly year to year, and policy makers are always anxious to know the reasons for the drop in rank.

R. Dasher
I would not recommend comparing innovation scores too much; rather, it should be an index.

M. Kuroda
Rank is important to classify abilities, but it can create a self-fulfilling prediction by impacting future performance.

R. Dasher
This is precisely what happens in the tenure process, and what determines what is an important paper and what is not.

Question 3. This is a very interesting way of evaluating innovation. Another way would by evaluating countries in terms of their potential for innovativeness.

R. Dasher
Again, here I am primarily looking at measuring policy instruments; this process would not apply to evaluating how innovative a country is. Measuring the overall capacity of the country is different from measuring a government program which is designed to stimulate innovation and seeing whether it is having any effect. I would be interested, however, to see what the newest approaches to company valuation by investors are, as companies investing are also attempting to measure the likelihood of success.

Question 4. A model could be created to produce and score options for innovation policymakers.

R. Dasher
I do not want to leave an important issue like innovation simply to policymakers. A simple score would not include a great deal of background information that would be valuable to decision-making.

Jarl Lennart Grundberg
Tenure is the collision of one social logic, which is the so-called scientific logic, and another logic, be it industrial or domestic. If the politicians are the ones who make quantification measurements, they are the ones setting the pace of society. There is great variation in Europe concerning tenure.

R. Dasher
Innovation by definition involves the creation of ideas, and also their input and imitation. Scientists measure someone in their own field when it comes to looking at tenure, which has a negative effect on some young professors who are trying to do very different approaches. Evaluating innovation from a multidisciplinary approach would therefore be positive.

J. Grundberg
Innovation as you define it seems to signify a discontinuity legitimized by some social sphere, either the industrial or the market sphere at the crossroads with other disciplines.

R. Dasher
As a matter of fact, elements of this definition were extracted from yesterday's discussions.

Measuring Innovation

J. Grundberg
The European Innovation Scoreboard (EIS) is part of a strategy to increase Europe's competitiveness through innovation. The index gives an overview of the aggregate national innovation performance. It contains innovation drivers, five indicators that measure structural conditions that are required to have innovation potential. These are things like science and engineering graduates and the general level of higher education in the country. Another input dimension is knowledge creation, with four indicators, including investments in R&D activities and R&D expenditure both on public side and business side as a percentage of GDP. The third input dimension, innovation and entrepreneurship, has 16 indicators. The first output is applications; that measures performance and value added in the sector. The final output dimension is IP, which measures patents, trademarks, and so forth

The highest performing countries, which are called innovation leaders and innovation followers, usually do well in all of the five dimensions. In the innovation system, you need to look at all these five dimensions, input and output, of course, if you

have a mature innovation system.

Innovation leaders, scoring well above the average, include the US, Japan, Switzerland, Germany, the UK, and some of the Nordic countries. They are what we call innovation leaders, who score well above the average. Then there are other major advanced economies such as France and Canada that fall into the category of innovation followers. They score below the innovation leaders. Next come the moderate innovators and the catching up countries that fall below the average score.

One of the few future challenges for the coming EIS, to try to identify how countries' performance can change over time. Rankings have changed quite rapidly since the EIS was started in 2002. It is also difficult to tell which indicators, such as patents and R&D expenditures actually measure innovation. Many indicators were included for policy reasons rather than for relevance to innovation. Also, there has been some lag in collection of statistics on the service sector, which is quite important for innovation. Most of the indicators used in this data do not capture the type of innovation represented by Google or Starbucks, instead allegedly skewing toward national defense, etc. How can we correct this and come to identify these service innovators?

Non-R&D-based innovation is not necessarily the same as non-technological innovation. Non-R&D innovators are companies that do not perform their own in-house R&D. Instead, they purchase patent licenses, know-how and trademarks from other companies or actors who have actually produced the R&D, with the objective of introducing new products and services.

There is no clear connection between one particular input and output in innovation. When the survey is used to advise member states on how to improve their innovative capacity, we sometimes get the question of how should to improve a particular output? There is the concept of here on innovation efficiency. With IPR as well, there is not yet a clear model for the innovation process and how inputs relate to outputs.

There are some preliminary studies that show differences between countries' innovation performance correlated with social capital, in the form of trust and perception of corruption in the country, and technology flows. That touches upon the general cultural differences between nations.

Venture capital fluctuates enormously between years, sometimes blurring the picture. Then the causality problem is going to be there as well, but these are more technical problems, at least for the European Commission to keep working on, and for us if we want to keep measuring innovation on a broader scale.

Q&A/Comments

R. Dasher
Are the indicators weighted in the survey, and if so, how?

J. Grundberg
The indicators were not weighted, but the presence of some yes/no questions poses challenges, as does a certain level of subjectivity in country responses.

R. Dasher
That would be an interesting topic to pursue in future. Why is Turkey such an outlier in the data?

J. Grundberg
There might be a data problem with Turkey.

There are different measuring standards in Turkey than the EU, so the data might not fit properly. The university system, for instance, is completely different.

M. Kuroda
What does this study say about convergence?

J. Grundberg
The index only looks at innovative capacity today based on historical data; it is not predictive of trends. Innovation leaders seem to have similar types of indicators, showing a certain path. However, the data still has only been collected in the short-term.

Question 5. Does the index contained an analytical path or model? Each type of institutional framework should have a corresponding model.

J. Grundberg
There is no specified model, and the indicators have changed over the years to a certain extent.

R. Dasher
The index may be less of an index and more of a landscape of a moment in time; not too much should be read into the data.

Question 6. How does the index measured the homogeneity or variety within the European Union? One of the EU's major advantages is its combination of competition and coordination among the countries.

J. Grundberg
I agree, but would add that within each country as well there is competition between the two biggest cities. What this index does is provide a snapshot of each country and allow policymakers to learn from each other.

The question about homogeneity assumes that there is a unified EU innovation system, which in fact there is not. There is also significant variation among the different states of the United States.

Question 7. Is there was any causative relationship between specific inputs and outputs?

J. Grundberg
Basically there is not, although it is good question. Another thing to note is that the data we collect in a certain year for a given indicator may actually be data from a prior year; not all data is collected at the same intervals, so the correlation is not clear.

R. Dasher
An underlying model is a big issue, as is the mental language we use to discuss these issues.

M. Kuroda
It will be difficult to formulate basic models without uniform language.

R. Dasher
We may want to adopt a taxonomic approach of splitting innovation apart to look at individual components more closely, asking what the different kinds of things that we want to measure are, rather than saying that we are going to try to measure innovation.

M. Kuroda
Thank you for this discussion. I suggest that we keep closer in touch before the next conference.