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エディトリアル

Measurement and Analysis of Service Sector Growth

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Japan's service sector is widely regarded as suffering from sluggish productivity growth and a number of policies to enhance the efficiency of Japan's service sector have been proposed. However, there is substantial uncertainty about the accuracy of these perceptions of productivity growth and about the policy prescriptions because of serious data limitations. In particular, it is quite difficult to create appropriate price indicators for service output that correctly reflect changes in service quality. This means that real value-added growth and productivity improvements in the service sector are not necessarily measured correctly. This limitation impedes the design of strategies to enhance productivity growth in the service sector. The majority of Japan's GDP is now created in the service sector. Therefore, in order to design evidence-based growth strategies, it is becoming more and more important for the Japanese government to measure service activities correctly.

To design appropriate growth strategies for the service sector, the following long-term research program is needed. First of all, ways to accurately measure deflators and real value-added in the service sector are required so as to provide the foundations for analysis and policy discussion. Secondly, the mechanisms of service sector growth as well as the determinants of service quality and service sector productivity need to be examined. And thirdly, the potential for productivity improvements in the service sector need to be analyzed. Each of these three tasks is formidable and requires extensive research. Against this background, this program takes a long-term approach that seeks to address these tasks step by step.

As a first step of this long-term research program, the Economic and Social Research Institute (ESRI) in fiscal 2015 embarked on a research project to examine issues related to the measurement of service activities from an international perspective. This special issue contains four studies based on this project. Although each of the studies constitutes only part of the long-term program, together they

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represent a good first step toward a better understanding of the service sector.

The first study, by Fukao *et al.*（2016）, covers the first task of the research program, the measurement of deflators and value-added. It provides a survey and assessment of methods of constructing deflators for five service sectors in the SNA statistics across countries and offers alternative methods for the estimation of deflators and real value-added. The study focuses in particular on the fact that price indexes tend to be incomplete due to conceptual issues and constraints on the information available. The other three studies attempt to measure the quality of services and to either quantify the contribution of service quality to output growth in a particular industry or investigate the determinants of productivity. Specifically, the second and third papers both measure the quality of retail services, but employ quite different methodologies. Using retail sector data at the regional level, the study by Honda *et al.* measures quality changes in Japan's retail sector by incorporating observable characteristics of retail services, such as retailers' opening hours and the variety of products they offer, into the demand equation to represent the quality of services. The study also quantifies the impact of quality improvements on consumer welfare. Meanwhile, the study by Sato *et al.* uses product- and retailer-level barcode data of retail transactions. They assume that if households are willing to purchase the same product from firm A at a higher price than from firm B, this indicates that firm A provides higher quality retail services than firm B. Based on this kind of inference, they measure differences in service quality across firms and estimate the rate of substitution. The fourth paper by Inoue *et al.* measures the quality of academic research using various indicators and tries to entangle the mechanisms which determine the productivity of research activity. The following provides a more detailed outline of each study.

The study by Fukao *et al.* compares approaches to the measurement of service sector deflators in Japan and other developed countries and examines the extent to which differences in methodologies affect measured output and TFP growth. Information on the methodologies used for the compilation of deflators is scarce and scattered, so that their survey makes a valuable contribution. Furthermore, they consider possible alternative methods of measuring deflators.

The fundamental reason why it is difficult to construct service sector deflators is the lack of appropriate price indexes. Even within the market sector, proper price indexes are difficult to obtain. For example, in the Japanese SNA（JSNA）statistics, the

construction deflator is created based on the cost of labor and intermediate inputs. That is, the JSNA takes an output = input approach for the construction sector and measures output by the amount of input (nominal production cost/input price). This means that measured TFP growth of this sector will by definition be zero. In addition, the JSNA does not take capital inputs and changes in labor quality into account. Therefore, the JSNA underestimates growth of the construction sector and TFP. Meanwhile, in the case of wholesale and retail services, deflators are not based on margin prices per unit, which is how prices of such services should be measured. In the case of non-market services, such as medical services and education, transaction prices do not necessarily reflect how consumers value a particular service, so that we need to directly measure the quality of such services using indicators such as curative ratios and test scores.

For the construction sector, Fukao *et al.* find that the deflator is substantially overestimated and that real value-added and TFP growth from 1973 to 2012 would be 21 percentage points higher than in the official statistics if labor quality is properly adjusted for in the calculation of the construction sector deflator.

Margin prices in wholesale and retail services are very difficult to measure and the Bank of Japan has just begun collecting information for four items. Focusing on one of the items, plastics, Fukao *et al.* compare the margin price per unit in the wholesaling of plastics with its counterpart in the producer price index. They find that the margin price increased more than the PPI for plastics, indicating that the measured real value added and TFP are overestimated.

For education and health care, Fukao *et al.* employed direct measures of the output of these sectors. This approach counts the number of units (such as students in the case of education and patients in the case of health care) who received services and, where possible, adjusts for the quality of services. Their results indicate that the direct approach represents a possible way to measure the output of non-marketable services. They recognize, however, that their quality adjustment is crude and more work is needed to develop an appropriate method for quality adjustment.

Next, Honda *et al.* examine the welfare gains resulting from the entry of new retailors. In the 1990s, the market share of two retail formats, supermarkets and convenience stores, expanded in Japan in the wake of deregulation. Using region-level data (for 189 regions covering the whole of Japan) for five categories of food retailing

outlets – namely, generalized merchandized stores (GMS), specialized supermarket stores, department stores, traditional stores, and convenience stores – for the years 1997, 2002, and 2007, they estimate a nested logit consumer demand function. They obtain price data for each outlet category, for each region, and for each year from the *National Survey of Prices*. The other data, such as sales shares, operating hours, floor space, goods in stock for sale and the method of payment, are taken from the *Census of Commerce*. Using these data and the estimated coefficients, they estimate how the consumer surplus changed during the 1990s and the 2000s.

They then decompose the change in the consumer surplus into the contribution of changes in prices, quality, and the number of outlets. Their estimates show that from 2002 to 2007, the consumer surplus increased annually by a little less than 2%, of which three quarters are explained by price decreases, while one quarter is accounted for by quality improvements. The contribution of changes in the number of outlets is small. These results indicate that quality improvements made a substantial contribution to consumer welfare, so that the present price index for the retail sector in Japan's GDP statistics, which does not account for quality change, overestimates price increases and possibly underestimates the growth of real output in the retail sector.

Since the paper uses observable characteristics to represent the quality of services, the result of the analysis help to identify how retailers can improve the quality of the services they provide. In constrast, proxy variables do not measure quality itself and careful scrutiny regarding the choice of proxy variables is needed. Another promising avenue for future research is to investigate whether quality improvements raise productivity. For example, one characteristic for which convenience stores are highly valued is their long opening hours, but long opening hours inevitably incur both private and social costs. Incorporating marginal costs and mark-ups into the model would be useful but requires detailed data on inputs.

The study by Sato *et al.* pursues a different approach to measure the quality of retail services by incorporating quality in a system of simultaneous equations for demand and supply. From data on prices and quantities they estimate elasticities of substitution and recover quality, marginal costs, and mark-ups. This approach was originally developed by Hottmann *et al.* (2014) for analyses focusing on the manufacturing sector in the United States and adapted by Hottmann (2016) for analyses focusing on the U.S. retail sector. For the estimation, they use point of sale

data consisting of barcode-level purchase records at individual retailers. Using the estimation results, they calculate how much service quality contributed to retail sector growth and try to correct the price index for retail services by adjusting for quality improvements.

They assume a representative consumer whose decision-making process with regard to consumption can be decomposed into three tiers. In the lowest tier of the decision-making process, the consumer allocates expenditure across products (each product is identified by barcode) in a given product group (products are grouped into 302 product groups) and retailer. In the middle tier, the consumer allocates expenditure across product groups at a given retailer. Finally, in the highest tier, the consumer allocates expenditure across retailers. The authors consider a utility function that allows the elasticity of substitution of the lowest tier (substitution across products) to differ from that of the middle tier (substitution across product groups) and the elasticity of substitution of the middle tier (substitution across product groups) to differ from that of the highest tier (substitution across retailers).

In their framework, products with an identical barcode are not perfect substitutes if they are sold at different retailers. Moreover, retailers are assumed to set the price of each product under Bertrand competition. It is also assumed that each retailer faces a fixed market entry cost for each product group. From the model, the authors can quantify the contribution of the four different sources of retailer heterogeneity, that is, differences in service quality, differences in product scope (consumers prefer retailers offering a wider scope of products), differences in marginal cost, and differences in the markup rate, to the dispersion in sales (and sales growth) across retailers.

They conducted a structural estimation of the above model using a massive dataset of purchase histories of about 50,000 respondents. Their database covers the period from the second quarter of 2010 to the fourth quarter of 2014 and contains information about the average price and quantity of each product (barcode) sold at each retailer. In the dataset, there are 1,288 retailers and on average, 532,260 different products were sold per quarter.

Using the estimation results, they decompose the cross-sectional variation in retailer sales into the four components. Their variance decomposition analysis indicates that 55% of the overall size distribution can be attributed to firm quality and 26% can be attributed to scope. The markup plays almost no role in determining firm size. Moreover, the marginal cost term accounts for 19% of the overall size distribution.

The overall results show that costs play a relatively smaller role than quality in the determination of firm size.

Finally, Inoue *et al.* provide another exercise in the measurement of quality, focusing on academic research in this case, and make a first attempt to understand the mechanisms determining the quality and productivity of academic research.

They propose novel measures of the quality of academic research such as the number of studies published in top journals and the number of studies cited in clinical guidelines, in addition to conventional measures of quality such as the number of published papers and the number of citations. Using these quality measures, they investigate the mechanisms determining academic productivity. The determinants they analyze consist of two categories. The first category, externalities, includes agglomeration and network effects. Agglomeration effects refer to conventional economies of scale, while network effects refer to the beneficial effects of collaborating with coauthors. The second category of determinants includes the structure of networks and the attributes of coauthors. They examine – first descriptively and then quantitatively – how these determinants are linked to outcomes. Their unit of analysis is individual studies or individual researchers rather than research institutions as is in previous analyses.

They find that agglomeration effects are limited to places very close by: agglomeration effects are positive at the faculty level, but diminish very rapidly moving to the university, city, and nationwide level. Looked at from the opposite perspective, given that agglomeration effects at the city or national level are small, it is nevertheless possible to create scale economies within a faculty, like an island in the ocean. Turning to network effects, the overall results are similar to those for agglomeration, except that long-distance networks, especially overseas network, are very effective in promoting quality research. As for the effects of network attributes, quantitative measures such as the number of coauthors' published papers and citations are positively associated with the quantity of research output but not the quality. On the other hand, qualitative measures such as the number of studies in top journals are positively associated with both the quality and the quantity of research output. Fostering collaboration to improve the quality of research requires high quality coauthors.

The measures of research quality produced by the authors, exploiting information

on citations in clinical guidelines, represent a promising first step and it would be desirable if they could develop them further. In addition, it is possible to imagine alternative approaches. For example, academic papers often lead to patents which have a market value. Another example is that academic research generates medical technologies that improve individuals' health. The value of the human capital of such individuals could be used to attach a value to research outcomes.

I hope that this special issue provides a reasonably comprehensive review of current approaches to the measurement of the prices and quality of services and of the examples we have picked to show how they can be improved. There is vast scope for further work, however. Substantial effort will be required to achieve our long-term research goals and both I myself and my collaborators will do our best to meet the challenge.