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THE ET INTERVIEW: PROFESSOR KATSUTO TANAKA

Interviewed by In Choi[1]
Sogang Univesity
and
Eiji Kurozumi
Hitotsubashi University



Professor Katsuto Tanaka was born in Matsumoto City, Nagano Prefecture, in Japan on October 28, 1950. He lived in Nagano Prefecture until age 18 and went to Tokyo in 1969 to enter the Department of Economics of Hitotsubashi University. He earned his B.A. in economics in 1973 and his M.A. in economics in 1976 under the supervision of Professor Seiji Nabeya. He then went to Australian National University and received his Ph.D. in statistics in 1979 under the supervision of Professor Edward Hannan. After serving at Kanazawa University in Japan for 4 years, he moved to Hitotsubashi University in 1984. He was promoted to full professor in 1990 and has worked at the university until now.

Professor Tanaka's research has focused mainly on time series analysis, and he has made extensive contributions to time series methodology. His research

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topics include asymptotic expansions, testing for the constancy of regression coefficients, noninvertible moving average processes, long memory processes and wavelet analysis, among others. He has published dozens of influential articles in professional journals and research monographs and has written several books including *Time Series Analysis: Nonstationary and Noninvertible Distribution Theory* (Tanaka, 1996). He served as co-editor of *Econometric Theory* from 1992 to 1999. He has also received the T. C. Koopmans Econometric Theory Prize (1996), the Japan Statistical Society Prize (1998), and the Econometric Theory Award (1999).

In recent years, Professor Tanaka has played important roles in Japanese academia as dean of the Department of Economics of Hitotsubashi University, chairman of the Board of Directors of the Japan Statistical Society, and vice president of Hitotsubashi University.

Katsuto, thank you very much for taking the time to be interviewed for ET. We are very happy to do this interview. I believe it will be interesting to many people involved in econometric research. *ET* interviews usually start with a question on childhood and early education. How were yours? (C)

First of all, I thank both of you for taking the trouble to arrange this interview for me. It is my great honor to be interviewed, but I am ashamed of receiving honorable treatment in this way because my contribution to econometrics is only slight.

I was born in a small village surrounded by high mountains near the city of Matsumoto. Matsumoto is a castle town located geographically near the center of Japan. My elementary and middle schools were so small that there were only two classes in each year. I was a boy who liked playing outside. I enjoyed playing baseball until dark. I did not like studying. It was not so exciting as sports.

In the late '60s, I enjoyed my high school days, at least for the first year. I belonged to the track and field club and was a middle-distance runner. The exercise was hard, but I enjoyed it. Then tragedy struck in the second year. Every summer my high school organized a mountain climbing trip for the second-year students. There were about 100 applicants, including me. They were divided into two groups. In a trick of fortune, I was allocated to the second group. The first group started earlier, and they were well into their climb when the weather suddenly worsened and lightning hit them. As a result, 11 fellow students were killed; they were 16 or 17 years old. This was in the summer of 1967. It was terribly shocking; this was the first time I felt the fragility of life. Both the students who survived and other students all became very pessimistic about life. The latter half of my high school days was quite tough, but most of us eventually decided to live life as hard as possible on behalf of the victims.

It is 45 years since then. Despite this tragedy, I always recall my high school days with nostalgia. I myself married my high school classmate, Yoshiko, but life continued to be full of uncertainty: She died of cancer in her forties. Maybe I shall talk about her later.

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Was your hometown far away from Tokyo? (C)

Yes, about 200 kilometers, 2 1/2 hours by train.

When you entered Hitotsubashi University, the University of Tokyo, one of the top universities in Japan, was not accepting any students because of major turmoil there. Did you want to go to the University of Tokyo in those days? How did you feel about the turmoil? (K)

The late '60s were politically unstable. The Vietnam War was ongoing, and the antiwar movement happened in Japan, too. The movement spread to the universities, contributing to the so-called university turmoil or conflict. Some radical students broke into the University of Tokyo and occupied it. Because of this, there was no entrance examination for the University of Tokyo in 1969. Honestly speaking, I really wanted to apply there. It was somewhat discouraging, but—because I sympathized with their thoughts and claims—I was not too upset. More disappointing was the response of the University of Tokyo professors who could do nothing. I decided to enter Hitotsubashi University and chose economics as my major because I was thinking of becoming an economic bureaucrat. The other subjects were not very attractive to me. I liked mathematics, but I had no plans to become a researcher.

Do you think you could be a good bureaucrat? (C)

No, I do not think so. Later, I realized I have no aptitude for it.

I guess Hitotsubashi is as difficult as the University of Tokyo to get into. (C)

Yes, indeed. It is a very competitive place.

How was college education in Japan in those days? (C)

I entered Hitotsubashi University in 1969. Eiji was born in that year. At that time, we were in the middle of the university turmoil. Soon after entering Hitotsubashi, the student union decided to go on strike. There were no lectures for several months in the first year. This continued until the second year. For me, the first two years of the university were a time of no study. In the third year, peace and order returned to the university. Each student was required to find a supervisor for tutorial purposes. Unfortunately, no particular field in economics attracted me. No econometrics course was offered for the first two years. An elementary statistics course was offered, but it was not very interesting. So I had great trouble in deciding my field. I chose statistics by elimination. At that time I met Professor Seiji Nabeya, a statistician with a profound knowledge of mathematics. Actually, he was a graduate from the Department of Mathematics, University of Tokyo. I joined his tutorial.[2] His tutorial was very severe, but he was an excellent teacher. I was greatly influenced by him. As a result, I decided to enter graduate school and become a researcher. Fifteen years later, when I came back to Hitotsubashi on the academic staff, I met him again and could write several joint papers

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with him (Nabeya and Tanaka, 1986, 1988, 1990a, 1990b). It was hard work, but it is now a valuable and pleasant memory. Maybe I shall return to a story about him later.

I know that you wrote a bachelor thesis in Russian at Hitotsubashi University. Why did you learn Russian and why did you write it in Russian? (K)

I used to enjoy learning foreign languages, which enabled me to have a cross-cultural experience without going anywhere. I learned German at the university and learned French and Russian by myself, although I have almost forgotten them. The reason I wrote my bachelor thesis in Russian is that it offered no original contribution. So, I just felt that added value was necessary, which led me to write it in a foreign language.

That must have been an interesting experience for you. You also did your Master's course at Hitotsubashi. How was it? (C)

At first, I studied mathematical statistics. My supervisor was Professor Nabeya, and we read a book written by the Russian statistician Nikolai Cencov. Professor Nabeya could also read Russian. The book was written in Russian. There was no English translation in the early '70s. The book was very unique in the sense that it was based on a differential geometry approach. That idea was very fresh. It was translated into English in the early '80s, and the differential geometry approach became popular. The English title is *Statistical Decision Rules and Optimal Inference* (Cencov, 1982), and it was published by the American Mathematical Society. This approach regards estimation as a projection of data onto the model and defines the distance between them in terms of the Riemann metric. However, I did not pursue the topic seriously, partly because it seemed to just reinterpret known facts and I found little interest in doing that.

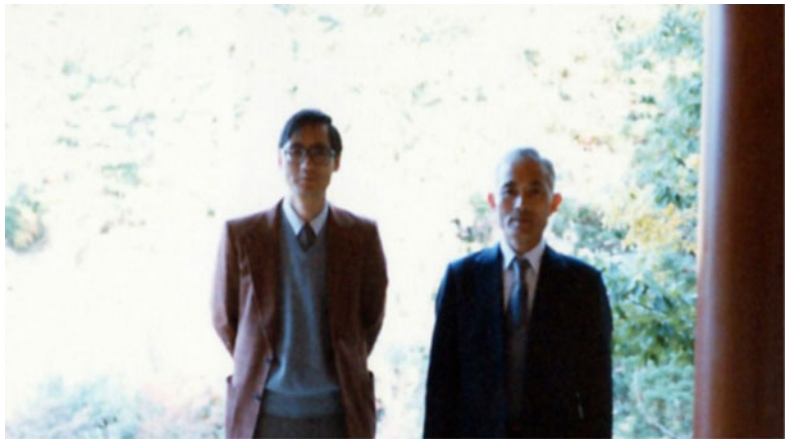


FIGURE 1. Katsuto Tanaka and Professor Seiji Nabeya.

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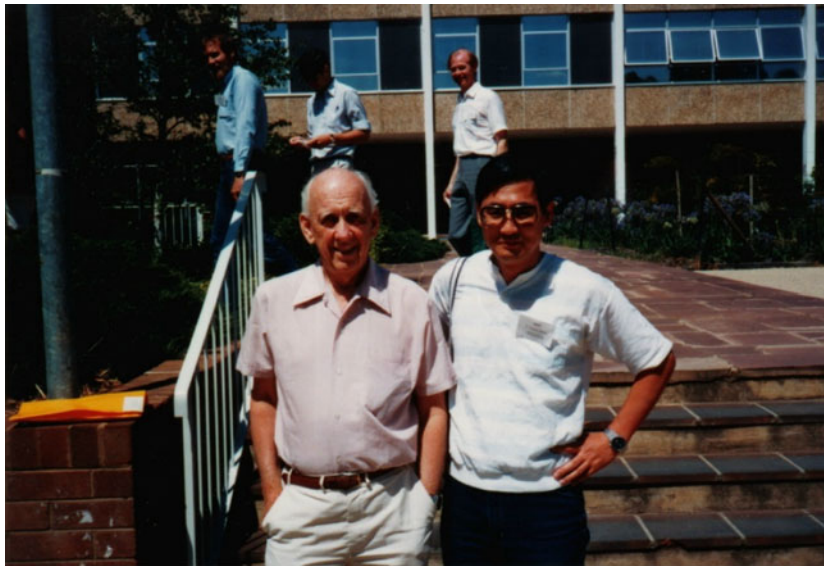


FIGURE 2. Ted Hannan and Katsuto Tanaka at ANU in 1986.

During your Master's course, you went to Australian National University (ANU) as a visiting student. How did that happen? (K)

I happened to know that the Ministry of Education was offering a scholarship for Master's students to study abroad for one year. I decided to go to Australia because I was looking for different research areas and came to be interested in Professor Ted Hannan's work on time series analysis. At that time I was already married to Yoshiko, my high school classmate, and had a baby son, Atsushi. I found it quite hard to get by in Australia because the scholarship from the Ministry of Education was not enough. Yoshiko allowed me to go alone while she took care of our son at her parents' place.

At ANU, you worked with Edward Hannan, a famous time series statistician. How was he as a supervisor? Do you have any stories about him? (C)

Of course, I had never met Ted before, but I wrote a letter to him asking if I could study under his supervision. He quickly replied to me favorably. Because I was not a formal student of ANU, but a visiting student, ANU did not take care of me at all. However, Ted was very kind and did everything for me. I wrote to him several times asking about various things. Each time, he quickly replied to me. Ted was 54 years old when I first met him. He was very strict in studies, but he was very kind and had a warm heart in his ordinary life. The academic staff and students used to enjoy tea time twice a day. Professor Pat Moran, a very famous probabilist, was also there. At tea time, Ted always offered topics to talk about, and he was at the center of the conversations.

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I have a very impressive story of Ted Hannan. I had a question which I wanted to ask him. I went to his room. The door was open, and I could see him thinking seriously about some kind of problem. It was a spring afternoon. The sunshine that reflected from Lake Burley-Griffin projected his figure through the window, as if something like an aureole was shining on him. I stood still for a while in front of his room. I still remember that scene clearly. During my stay I did some work on recursive estimation of time series models. At the end of my stay I wrote a joint paper (Hannan and Tanaka, 1978) with him. My first experience studying abroad was over in December 1975.

Then you were formally accepted as a Ph.D. student at ANU. How was your life there? (K)

Yes. In August of 1976, I was formally admitted to enter the Ph.D. program in the Department of Statistics at ANU. I guess that Ted was kind enough to strongly recommend me, so I was accepted. This time, I was accompanied by my family. ANU was generous enough to pay the airfare for us. A very spacious university apartment was also offered. Of course, the ANU scholarship was very good. We had no financial problems. The study environment was also very good. Every Ph.D. student was given his or her own office.

In the second year, we had a daughter, Yuki. Her name was taken from a very popular Australian tree, Eucalyptus. We were additionally supported for her birth by both ANU and the Australian government. Australia was much like a dream-land for us. We enjoyed our stay very much. Canberra is a very beautiful town and is a good place for families. I was very impressed by the Australian way of life. They are never hasty and enjoy life from the heart even if they are busy in everyday life. I also enjoyed discussions and socializing with some of the Ph.D. students. Among them were William Dunsmuir, Bob Kohn, and Vic Solo. I still keep in touch with them, as shown in the picture.



FIGURE 3. William Dunsmuir, Vic Solo, Bob Kohn, and Katsuto Tanaka.

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What kind of research did you start as a graduate student? (C)

As a theme of my Ph.D. thesis, I selected analysis of time-varying parameter models, including the Kalman filter. In one chapter, I dealt with the identification and estimation problem associated with that model. To write this chapter I learned much from Professor Michio Hatanaka, who was at ANU in 1978 as a visiting professor. Later we published a joint paper about a related problem (Hatanaka and Tanaka, 1985).

Was he very mathematical? (C)

Yes, he was. I learned much from him. Another topic I studied in my thesis was testing for the constancy of the regression coefficient (Tanaka, 1983b). The alternative is that the coefficient follows a random walk. The problem is now very familiar to econometricians as a reversed unit root test, where the null hypothesis of stationarity is tested against the alternative of a unit root. I used the locally best invariant, or score, test, which is derived from the derivative of the log-likelihood evaluated under the null. Usually, under some regularity conditions, the score statistic tends to normality, but it is not the case here. That fact was surprising to me. This was around 1978. There was no such argument about the unit root problem, at least not around me. I did not think of Brownian motion at all. My interest was toward stationary processes until the mid-'80s.

There is another thing to mention about my Ph.D. thesis. Professor Clive Granger, one of the 2003 Nobel Prize co-winners, was one of the outside examiners of my thesis. I was happy to receive favorable comments from him. He also gave a series of lectures at ANU in 1977, discussing such topics as forecasting, causality, and so on. These were main topics of his 1977 joint book with Paul Newbold, *Forecasting Economic Time Series*. Earlier they had published a paper about spurious regression in 1974 (Granger and Newbold, 1974), and the topic was also described in their book, but he did not mention spurious regression at all in his lecture. Spurious regression was almost neglected in the literature at that time. It took more than 10 years for it to become popular. Later, I occasionally met him at various conferences. In 1993, he happened to visit Japan, and I invited him to give a talk at Hitotsubashi.

After receiving your Ph.D. in 1979, you took a postdoctoral fellowship at MIT. How was that experience? (C)

As my Ph.D. work was approaching an end, I told Ted that I wanted to go to the USA. Ted was kind enough to write a recommendation letter to some universities in the USA. There were a few offers, and I chose MIT. At MIT, I was located at the Center for Computational Research in Economics and Management, which was affiliated with the Sloan School of Management. Some econometricians and statisticians, like Edwin Kuh and Roy Welsch, were there. They were preparing a book entitled *Regression Diagnostics* (Belsey, Kuh, and Welsch, 1980). I had

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a lot of free time there and spent much time preparing papers on the basis of my Ph.D. thesis. The American way of life was totally new to us. It was city life. It took some time to settle down, but we enjoyed the different culture.

After MIT, you moved to Kanazawa University. It was your first position in Japan. How did you like it? (K)

We came back to Japan in 1980 after four years of absence. I got a lecturer position at Kanazawa University. Kanazawa is a beautiful castle town, facing the Sea of Japan. My hometown, Matsumoto, is located in the mountain area. So life in Kanazawa was quite fresh and full of fun. I used to enjoy fishing in the sea with my son, Atsushi, who had just entered primary school. I am still in contact with colleagues at Kanazawa University. Kanazawa is blessed with seafood. I still occasionally visit Kanazawa to enjoy fresh seafood.

As for research I came to be interested in asymptotic expansions of time series statistics (Tanaka, 1983a, 1984). A series of asymptotic expansion papers by Peter Phillips influenced me very much. His papers dealt with difficult topics, but his way of writing is always well organized and very clear. In particular, I read in detail his 1977 *Econometrica* paper (Phillips, 1977), which derives asymptotic expansions associated with the AR(1) model. I also verified his computations. There was one result I could not derive. It was about the asymptotic expansion of the distribution of the t-ratio. I wrote a letter to him, demonstrating my computation. He quickly replied to me and expressed his gratitude. It was around 1981, and a corrigendum was published in 1982 (Phillips, 1982). Peter visited Japan in 1983. It was the first time I met him. Since then, I have always been stimulated by his ingenious work. Later, I had opportunities to meet him at several places in the world such as Yale, Canberra, Kyoto, Seoul, Auckland, and Warwick. In the late '80s, he asked me to serve as associate editor of ET and co-editor later. It was hard work but was a valuable experience.

Edgeworth expansions sometimes produce strange results. For example, probabilities become greater than one. Do you have any explanation for that? (C)

If the sample size is small, it sometime happens. It is a small-sample problem.

You moved to Hitotsubashi in 1984. How was your research there? (K)

At that time I still continued to work on asymptotic expansions, like the expansions for the maximum likelihood estimators (MLEs) for autoregressive moving average (ARMA) models. Then I wrote a first joint paper with Professor Nabeya about asymptotic expansions of the distributions of the periodogram and related statistics (Nabeya and Tanaka, 1986). We were involved in much computation in the summer of 1984. It is a good old memory.

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Then I gradually changed my research interest to the study of nonstationary time series. It was only in 1984 that I first read Dickey and Fuller's (1979) JASA (*Journal of the American Statistical Association*) paper on unit root testing. They derived the asymptotic distribution of the sum of squares of random variables following the random walk. This was what I had wanted to derive in my Ph.D. thesis. It was essentially the same as the distribution of the score statistic for testing the constancy of the regression coefficient. Their paper was very stimulating. However, in terms of the computation of the distribution, we had to rely on simulations. I also noticed that some related papers had already appeared in the early '80s in JASA.

My main interest, however, was in how to compute the distribution of the statistic, by first deriving the characteristic function and then inverting it. The statistic is a quadratic functional of the Brownian motion. The approach taken by Dickey and Fuller's paper and others is the so-called eigenvalue approach, which is not applicable to general problems unless the eigenvalues of the matrix in quadratic forms are known. So, I wondered how to tackle the problem in my own way.

Was that the start of your research on unit root testing using the Fredholm determinant approach? (C)

That's right. I thought there should be a general approach that could deal with the distributions of nonstandard statistics. I again did joint work with Professor Nabeya on this problem. We found a classical paper by Anderson and Darling (1952) and arrived at the Fredholm determinant. Their theorem says that the characteristic function of the quadratic functional of Brownian motion is given by the negative square root of the Fredholm determinant. Intuitively, this is a direct extension of the case of ordinary quadratic forms in normal random variables. Now the problem was how to derive the Fredholm determinant of the associated kernel function. We successfully obtained Fredholm determinants of some kernels arising from various test statistics in the mid-'80s.

Meanwhile, I came across some discussion papers by Peter Phillips on unit roots and related topics. They were all stimulating papers. He discussed unit root tests and spurious regressions very elegantly in terms of the functional central limit theorem and the continuous mapping theorem. The asymptotic theory behind the problems was probably well known to probabilists, but Peter first developed such theories for econometricians. I again followed his work.

My interest was still how to compute the limiting distributions of statistics arising from unit root or cointegrated processes. My idea about distributions is that it is one thing to establish weak convergence and quite another to compute the associated distribution. It may be argued that simulations are just enough for that purpose. This may be true in general, but there are some delicate cases where we have various competing tests and we would like to compare the powers of those tests using power envelopes. In that case, exact computation of the power may be desirable. Of course, computing the distribution is not always possible, but it is

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basically possible as far as quadratic functionals of the Brownian motion or the ratio statistics of quadratic functionals are concerned.

The Fredholm determinant approach was used for some goodness-of-fit test statistics in Anderson and Darling (1952), and you used it for the problems related to parameter constancy and unit roots. Do you know of any other applications of the Fredholm determinant approach? (C)

Basically, it can be applied to statistics that are in the form of a quadratic functional of Brownian motion. For example, Geoffrey Watson (1961) suggested a goodness-of-fit test on a sphere. His statistics take the form of a quadratic functional of Brownian motion. I just derived the distributions of his statistics using the Fredholm determinant approach. His statistics have multiplicity two, which makes the problem more interesting.

I also have used the Fredholm determinant approach for the stationarity test under structural breaks. It was hard to find the Fredholm determinant for that problem. (K)

You took a sabbatical in the late '80s, and went to Australia and the UK. How were your visits there? (K)

In 1986, I had a chance to stay at ANU for 1 year with my family. I had ample time to do research. I did some work on unit root tests, cointegration, and other work. During my stay at ANU, Professor Nabeya also visited ANU, and we enjoyed the Australian way of life, continuing our joint work.

Just after ANU, I went over to the UK in 1987. I first stayed at Cambridge for 3 months. Then I moved to London to stay at the London School of Economics for 5 months. I was not accompanied by my family this time because my children wanted to go to school in Japan. Cambridge was a very quiet but exciting place. I felt as if I were lost in the Middle Ages. I used to enjoy drinking beer at various pubs with Steve Satchell. Once I had high-table dinner at Trinity College, which Steve organized. After dinner, we moved to another room to enjoy liquor. I felt that this tradition was inherited from the age of Isaac Newton. I was very impressed by the English tradition. At the London School of Economics, I met Professors Andrew Harvey and Jim Durbin. Neil Shephard was also there as a Ph.D. student. One night, Professor Durbin took me to the Royal Statistical Society dinner. Before dinner there was a presentation of a paper followed by discussions. I recognized that the *Journal of the Royal Statistical Society* publishes some papers with discussions in this way. I was lucky to be present on that occasion.

In the UK, I continued my work on unit root tests and cointegration. Then I came to be interested in noninvertible moving average (MA) models. I was interested in the distributional properties of the estimators of the noninvertible MA(1) coefficient, which was relatively unexplored. I wrote a joint paper about this problem with Steve Satchell (Tanaka and Satchell, 1989). The idea of testing for an MA unit root (Tanaka, 1990) also grew out of this research.

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You wrote a book on time series analysis (Tanaka, 1996), which is about applications of the Fredholm determinant approach to some time series problems. Could you tell us about that book? (C)

After I came back to Japan, I still continued my work on nonstationary and noninvertible time series models. As research results accumulated, I just thought that I would write a time series book because I wanted to collect my research results in a unified way; writing a book enabled me to include detailed results, which is impossible when just writing papers.

I wrote to Ted Hannan about this and he supported me. It was 1993. I was to visit him in 1994, but he died in January 1994 after a sudden heart attack. Then Professor Geoff Watson, who was one of the editors of the Wiley series, helped me very much in publishing the book. In the autumn of 1994, I had a chance to visit Helsinki, where I met Pentti Saikkonen. At that time I was writing the final cointegration chapter, on which he gave me valuable comments. In any case, it took me 3 years to complete the book. The book was reviewed in various journals like *Econometric Theory* (1998), JASA (1998), *Journal of Time Series Analysis* (1997), *Computational Statistics & Data Analysis* (1998), *IEEE Transactions* (1997), and the *Journal of the Japan Statistical Society* (1998). It was my honor. It was also my honor that I was awarded the Japan Statistical Society's prize in 1998.

Your wife passed away in her forties. It must have been very sad. (K)

Well, I have to say that, in the autumn of 1997, my wife, Yoshiko, was diagnosed with an ovarian cancer, and her condition was very bad. She struggled against the cancer for two years and died in 1999 at the age of 49. She tried every cure, but in vain. She must have had fear for death in her heart, but did not show it. I will not forget the resolution she showed. She was a very devoted woman with a sacrificial spirit. What I am owes much to her.

Beyond research, you held administrative positions at the university. Did you enjoy these positions? (C)

No, not at all. During my wife's illness and after her death in 1999, I was involved in administration work of various kinds like educational affairs of the graduate school, executive work of the faculty and university. In 2005, I was elected dean of the Faculty of Economics, consisting of about 70 members of the academic staff. I served as dean for 2 years. In 2008, I was appointed as one of vice presidents. My term was 2 1/2 years. My duty concerned making a medium-term future plan and suggesting a significant plan for the university. Among the plans was increasing the number of foreign students. One of the barriers to foreign students studying in Japan was the Japanese language. It was urgent to increase the number of lectures delivered in English. University people tend to be conservative, but the situation is now improving. Maybe, Eiji can help on this point.

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We are trying to increase the number of lectures in English. Recently, when we hire someone, we check whether she or he can teach in English. (K)

In any case I did my best at my duties, but I did not like such administration work and found myself not suitable for such work. There is much politics, which I dislike.

You also wrote some books in Japanese, including textbooks. Could you tell us about those books? (K)

Yes, I wrote some books in Japanese, including textbooks. Fortunately, my introductory-level statistics textbook, first published in 1998, is adopted at many universities. In that book, I described an interesting application of median to a voting method: At our graduate entrance examination committee of about 80 people, candidates were evaluated as pass or fail by voting in order. In other words, the candidate who got the best score is evaluated first. A ballot is distributed and collected after voting. Pass or fail is decided by the majority rule. Voting continues in this way until fail becomes the majority. This is a very time-consuming method. I suggested the following method of voting. Each member of the committee writes on the ballot the number of candidates who deserve pass, and the median of these numbers turns out to be the solution. That is, the number of candidates who pass the examination. With this method we vote only once. This method has completely the same information as voting one by one. It may happen, if the committee consists of an even number of people, the median cannot be



FIGURE 4. Katsuto Tanaka and his family.

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uniquely determined. This corresponds to the case where the vote is a tie. There should be no problem if we decide how to deal with that case beforehand. The fact that the two methods yield the same conclusion is based on the assumption that, with the method of voting one by one, each voting result does not affect the behavior of the successive voting, one kind of independence assumption. I found this fact very interesting and educational, so I included it in the book.

Nowadays, you are working on wavelet analysis (Tanaka, 2004). Do you think it is useful? What do you think of its future? (C)

I have devoted myself very much to statistical inference on nonstationary and noninvertible time series models. It started in the mid-'80s and continued for 10 years. In the late '90s I became interested in wavelet analysis, which is supposed to share advantages of both the time and frequency domains. I think that wavelet analysis is very useful for data analysis. Especially, it has an advantage in estimating long-memory models because the wavelet transform simplifies the structure of the covariance matrix. Computation and maximization are also simplified. However, it is not amenable to statistical inference like testing. This is because the distributions of wavelet-based statistics are too complicated to derive. This is a weak point of wavelet analysis, and it may be one of the reasons it is not popular in econometrics. People in econometrics like testing. But I hope that the situation will change for the better.

I am now also interested in statistical inference associated with continuous-time models. At the moment, the fractional Ornstein–Uhlenbeck process is very interesting to me (Tanaka, 2008, 2013). It is driven by fractional Brownian motion, which is quite different from ordinary Brownian motion in that it is not a semimartingale, so the usual Ito calculus is not applicable. The increments of the fractional Brownian motion are not independent and have a long-memory property. Statistical inference is very complicated for these processes. In particular, the distributions of various estimators in these models are hard to compute. As for the estimation of the coefficient in the fractional Ornstein–Uhlenbeck process, its MLE was explicitly derived by some probabilists using the fractional version of Girsanov's theorem. They also obtained the corresponding characteristic function so that we can compute the distribution of the MLE. Interestingly enough, it is much harder to do that for the least squares estimator because Girsanov's theorem is not applicable. The Fredholm determinant approach is also inapplicable because we cannot derive any plausible differential equation equivalent to the integral equation with the covariance kernel of the fractional Brownian motion. Finding an alternative approach has been challenging me for some years.

Do you think it is disadvantageous to work in Japan as an econometrician/statistician rather than in North America and Europe? (K)

It may be disadvantageous in terms of research environment, but, for me, it is very tough to survive abroad. Overall, I prefer to live in Japan. The Japanese

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system seems to allow more freedom in research in the sense that the so-called achievement-based system is not well established. Some Japanese people may object to my view, but it enables us to do research that cannot be done in a short period. We need to do research that takes time without worrying about short-term evaluations.

I hope the Korean government listens to you. They are very nearsighted these days regarding evaluations. Anyhow, how do you select your research topics? (C)

In principle, I select research topics that interest me. It turns out that most problems I select are difficult to solve, but it is OK because I cannot feel a sense of accomplishment if the problem is easy to solve. I believe that the powerful charm of research is to solve a difficult problem. This is the way I select my research problems.

What do you think of the future of time series analysis? (K)

I must say that, within the framework of stationary time series, it is quite hard to propose challenging problems, except in long-memory time series. There, however, seems a fruitful future for nonstationary time series coupled with financial data, panel data, and so on. In particular, continuous-time long-memory models will be important. Some new areas have also developed, like spatial time series analysis. I think that time series analysis is necessary and will be developed as long as time series data is accumulated with the passing of time.

Recently fewer young people go abroad to study economics and statistics. What do you think of this phenomenon? Do you recommend young people go abroad or study in Japan? (K)

I just feel that young people are a little bit conservative. They may think that they can get worldwide research information through the Internet. So they tend to stay within Japan. I, however, do recommend that they study abroad. There are so many things that they can get by studying and living abroad, which contributes to and is beneficial to their futures.

You have visited several universities as a visiting scholar. Do you have any special impressions of those universities? (C)

I have visited several universities in the USA, Europe, Asia, Australia, and so on. I always enjoy staying there because I like seeing the differences and similarities between their education, research, and administration systems and those of Japan. Most of the time, I feel that the Western systems are more efficient and functional, whereas the Japanese system is redundant and loose. I am not saying that the Japanese system is totally poor. I am sure that it has some advantages. Every

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system reflects the history of each country and each university, which is very interesting to me.

Any advice for future econometricians and statisticians? (K)

Young people who wish to do research have to start from the results already obtained in the literature. The knowledge I had when I was a Ph.D. student more than 30 years ago is now too old and elementary. It is the destiny of research that old results are always replaced by new and better results. Finding a good problem is always difficult and takes time, but it is an important process of research that we cannot avoid. It is also desirable to be able to do research worth pursuing without worrying about short-term evaluations.

On the personal side, what do you usually do on weekends? (C)

My two children have grown up and are living independently. I am now living alone and have much time to spare for myself. I like playing sports like golf, tennis, and so on. I regularly socialize with my high school and other friends and enjoy golf and tennis camp. I hope to be able to continue playing for at least another 10 years.

Thank you very much for spending your time with us. It was very interesting and informative. I enjoyed it and learned much. (C)



FIGURE 5. Eiji Kurozumi, Katsuto Tanaka, and In Choi.

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NOTES

1. This interview was conducted after the 2012 Hitotsubashi–Sogang Conference on Econometrics held in Seoul, Korea, on November 17, 2012. The questions and comments from In Choi are marked by (C) and those from Eiji Kurozumi by (K). Address correspondence to In Choi, Department of Economics, Sogang University, Seoul, Korea; e-mail: inchoi@sogang.ac.kr; inchoi@gmail.com).

2. A tutorial in Japan refers to a group of students who participate in research under the supervision of professors. It usually consists of a small number of students to facilitate close interactions among students and professors.

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