

Interview with Prof. Fuhito Kojima, Director of the Market Design Center, University of Tokyo

Economic Theory Supplementing Price Mechanism

By Japan SPOTLIGHT

Capitalism evolves with the study and research of economics. Fuhito Kojima, professor at the University of Tokyo, began his research in 2020 on the social implementation of his theory of market designs to supplement the price mechanism in areas where the function of such a mechanism is limited. His research is conducted at the Market Design Center at the University of Tokyo, where he is working as a director. His pioneering contributions are introduced in the following interview.

(Interviewed on Jan. 25, 2021)

Limitations of the Price Mechanism in Fulfilling People's Needs

JS: There seems to be a keen sense today of the limitations of the price mechanism in our contemporary economy. Do you think there are more areas than ever where the price mechanism does not function very well, and do you think this could be a driving force for the evolution of capitalism?

Kojima: It is a difficult question. With the evolution of capitalism so far, the price mechanism has achieved what was not possible in ancient times. For example, earning interest by lending money was prohibited by Ecclesiastical law in Christianity in Europe in the Medieval Age, but as the influence of Catholic churches in Europe diminished around the 16th and 17th centuries, this prohibition worked less and less. In particular, as Protestantism expanded in the 17th and 18th centuries, earning interest by lending money became increasingly accepted. With the emergence of mercantilism in the 17th century and the Industrial Revolution in the 18th and 19th centuries, capitalism was born and now as capitalism evolves, market mechanisms are allowed to function in such financial business.

However, there are businesses that are banned for ethical reasons in our own age. Slavery or indentured servitude used to be allowed and merchandized in the market, but not any more in our age. So there are some that were prohibited by law or customs from market transactions in the past but now can be transacted in the market, whereas there are some that used to be allowed in the market in the



Prof. Fuhito Kojima

past but are now prohibited. Therefore, it is not clear whether the areas where the price mechanism fails to work are expanding or diminishing.

One thing that is clear is that a naive economic theory advocating permanently for the effectiveness of the price mechanism in making everything go well in any given area, which was accepted by many during much of the 20th century, is not considered valid anymore in spite of some of its merits. Whether a deal is to be done by the price mechanism or not will be determined by human ideas or social ethics. In our contemporary age, there are some deals in which the price mechanism is not used. So our economy is not moving towards one in which price mechanisms are almighty as once envisaged by economists who believed in their omnipotence.

JS: Recently, I think income inequality is an issue which the price mechanism has failed to resolve. We cannot achieve a sustainable economy without tackling the increase in income inequality. Is your theory of market design something that could supplement the price mechanism?

Kojima: In reality, even among capitalist nations, governments have been playing an important role in the economy for social reasons since the middle of the 20th century. We call it a mixed economy and it is not possible to leave everything to the price mechanism and let income inequality continue to grow, as that would make society unstable. I am working now on matching the need for daycare facilities and their supply. I note the thought in the government that

daycare services should not be left only to the price mechanism but should be provided to all people including the poor. Yes, how to provide such socially basic services like licensed daycare facilities among the people as equally as possible will be an important issue.

Brief Introduction of Market Design

JS: You are working on market design supplementing the price mechanism for a certain good or service to achieve the best match between people who need it and people who supply it. Could you explain briefly and exactly what market design is?

Kojima: Yes. There are markets for some goods or services where the price mechanism does not work. For example, in case where monopolies or oligopolies like GAFA can control market prices, or in cases where there are too many players in the market as in the case of the labor market and there is no rule to be applied to fix the prices and it would be difficult to achieve matches between so many job applicants and firms in need of workers, price mechanisms would not work well to achieve desirable market outcomes, as is assumed by classical naïve economists.

We economists working on market design theory would not pursue socialism in those failed markets but try to assist the players in those markets to design an orderly framework to match their needs and supplies among themselves. To be more specific, in the case of daycare facilities in Japan, most of them are licensed and once they get a license from the government they get a subsidy. But they would have to observe regulations such as fixing a monthly fee and thus they cannot determine monthly fees on their own; instead they have a fee fixed by the local government. With a price fixed lower than the market price, there would be excess demand for daycare facilities and some kids would have to be on the waiting list. In that case, they would have to rely on rationing rather than price. Each local government receives a preference list from the parents and rations the kids to each daycare facility accordingly. Among more than 1,000 local authorities in Japan, some adopt a good rationing method, some do not. Our job at the Market Design Center is to study these different rationing methods and advise them on how to improve the methods.

For example, some local governments limit the number of wishes to three or five. In such cases, they would not have information about wishes with priority lower than three or five. That could hinder the best matching. We can show them in theory or quantitatively that it would be better not to limit the number of wishes on the list. We

design a system where each kid would be accepted by some daycare facility with a limitless preference list. There are largely two frameworks for rationing provided by us. One is based on the order of wishes and the other is based on the priority index of each family fixed in accordance with its need for a daycare facility.

The first one is to look at only the first wish on each applicant's list and assign those wishes among the available facilities. We would have to assign those left out from the first rationing to the facilities in the second on their preference lists if the first wishes are full.

The second one is to look at those with a better priority index for a facility first and assign them to the best facility among those with vacancies. The first one may look better. However, many parents would think about their priority of facilities after considering each facility's popularity. For example, if I have two facilities in mind as the first choices but both of them are very popular, I would see a large likelihood of failure to be accepted by both of them. So thinking about the risk of failing to be accepted by both of them, I would mention in the priority list my third choice as the first one. This risk-averting choice would eventually result in frustration and dissatisfaction with the rationing and in the worst case there would be kids on the waiting list.

We can mathematically prove that the second method would eliminate such concerns. What the applicants have to do in this method is just to tell their preferences honestly. Our mathematical theorem proves that nobody would be annoyed by this method. In reality, economists in the United States recommended such methods in school selection systems. I hope we can see a sign of change in the Japanese daycare facility system through communication with local governments.

JS: This looks like one of the applications of game theory.

Kojima: Yes, it is. In terms of game theory, the authentic preference list-oriented method would not achieve optimal equilibrium. The index-oriented method was invented by economists David Gale and Lloyd Shapley, and we call it the Gale-Shapley algorithm. In this method, in terms of game theory terminology, the dominant strategy would be to tell the truth about the wishes in order to achieve the optimum. This theory has been developed most extensively in the US.

Application of Market Design

JS: Has the theory of market design been applied to

the US education system in practice?

Kojima: Yes. The preference-list oriented method was adopted in the school selection system in Boston and we call it the Boston method. With the economists' suggestions, reforms were achieved in the middle of the 2000s. Thus, in Boston, this method is not used anymore, nor in New York or Chicago.

JS: Can market design be applied to the Covid-19 vaccine distribution as well? If so, how?

Kojima: This is a domain where we cannot give a clear answer yet. However, I can tell you points for consideration. In market design, first of all, we need to listen to an applicant's wish and his or her personal situation and then we would provide the relevant framework to satisfy the applicants' needs.

This is the basic idea of market design. In the case of vaccine distribution, we would need to consider each applicant's personal situation, such as their underlying health condition, age, whether they are medical staff or not, as well as their preferences. We would need to consider different vaccines as well. For example, whether we could keep the vaccine at normal temperature or not would make a difference. In thinking about what combination of the different vaccines would maximize the number of vaccine recipients, this difference is crucial. Whereas the Pfizer vaccine needs a deep freezer for preservation, AstraZeneca's is preserved at normal temperature. Therefore, giving the AstraZeneca vaccine to people who could have the Pfizer one would be a waste of vaccines. AstraZeneca's vaccine must be sent with high priority to medical facilities where a deep freezer is not available. We use advanced mathematics for the relevant combination for those different vaccine rationings.

Market Design Center at the University of Tokyo

JS: Could you give an outline of your center's mission and work at this moment?

Kojima: Yes. The Market Design Center is a research organization studying market design as an economic theory. However, its other mission is the social implementation of market design theory. We are working with people outside the university as well as people inside it to explore the application of matching theory or market design theory to real-life issues and get feedback from those applications. The example of the daycare facilities that I introduced is exactly one

of those applications and we are now about to move to social implementation of this issue in collaboration with some local authorities and business firms providing daycare services.

As to the application of matching theory for arranging contact between people, we are also about to start a project on allocation of medical doctors all over Japan. A matching algorithm is already used for assignment of medical residents who have just graduated from a faculty of medicine at university, a little more than 9,000 per year, among medical institutes all over the nation. We have been working on possible improvement of such assignment and we are now pursuing its social implementation.

Another project for social implementation is the application for organizational personnel assignment, which is strongly requested by the business side. It has long been a key issue for business firms to mobilize human resources and assign employees to the jobs they are most suited to. In recent years, they found that it was very difficult for any personnel management expert to achieve a perfect allocation of human resources among the relevant jobs. Then, in some companies, an algorithm was attempted to be introduced for personnel assignment. The case of Google is well known. They introduced a matching algorithm for personnel assignment five years ago. We are now talking with some Japanese companies to explore such applications.

JS: Would mathematics help realize “the right person in the right place” rather than a human personnel policy expert?

Kojima: Yes. If a firm's personnel affairs department orders an employee to be transferred to some post, there will be some cases when they are unhappy about the transfer and quit. On the other hand, in some companies, they create an artificial labor market inside the company. In those companies, divisions or departments are asked for open recruitment for any vacant posts and employees are recommended to apply for those posts freely. But this system does not work well either, since recruit information is not well managed and in some cases there are very few employees available at the time of personnel transfer or in some cases employees are not well informed of where to go to access such open recruitment information.

In the case of Google, they stopped such open recruitment within the company once a year and created three occasions for personnel transfer in the company every year and asked all the sections to issue open recruitment on those occasions and employees wishing for a new assignment to go to a job interview for recruitment in one

of those sections. After those interviews, any assignment would be ultimately fixed by a matching algorithm. This system, I believe, would be well accepted by a Japanese company making regular personnel transfers customary. So we started collaborating with some Japanese companies on its application.

This is an interesting project to meet an employee's wishes for job assignment and job satisfaction as well as a business section's needs for the best and fittest for the job simultaneously.

Expansion of the Applications of Market Design

JS: The role of local governments will be more important in Japan as decentralization increases. Do you think the application of market design will increase accordingly?

Kojima: Yes. I think there are some local governments in Japan that are very active in engaging in ambitious initiatives. They are ready to listen to our proposals. I am not quite sure about the role of local governments in Japan in the future, but I believe we should pursue the best allocation of roles between local governments and the central government. In the case of daycare facilities, local governments have good connections with each facility and detailed information about each facility's specific situations, and taking advantage of these they establish new facilities or ask some facilities to increase their capacity to accept more kids.

What's more, there would be room for improvement to standardize the matching method which is now left to each local authority's own decision. If it is standardized by the central government or any other public policy organization, the cost of matching would be enormously reduced. With the introduction of standardized software for matching algorithms, all local governments could use it.

JS: What you have mentioned so far about market design's social implementation is totally related to social policy issues such as education, healthcare, daycare facilities, and so on. Would that lead to a modification of inequality?

Kojima: Yes. And I would like to add one more thing. For the question of medical residents I mentioned in particular, as medical service is of a public nature, we will need to provide a minimum sufficient medical service for remote areas. In Japan, medical doctors are not allowed to go anywhere to work. In order to maintain

a minimum medical service for a remote area, the government has set a cap on the number of medical residents assigned to large cities like Tokyo or Osaka. The current system or algorithm in Japan leaves some room for improvement to meet those medical residents' wishes for job assignments.

At the Market Design Center, we want to pursue a reform of the system that better balances their personal wishes with the social need for minimum medical services even in remote areas. We hope we can accomplish our mission to contribute to social policy making to meet both personal and social needs. In areas where the price mechanism works well, resource allocation should be left to prices; but in areas where it does not work well, we should introduce market design and promote it for social implementation.

Future Mission of Market Design Center

JS: Will the Market Design Center's work increase from now on in fields where market design will have expanded application?

Kojima: Yes. In Japan there is much potential for expansive use of market design, as its social implementation is far behind that in the US or other advanced nations, probably because it is not socially acknowledged yet. I believe we will have lots of work to do in filling up the gap.

JS: What would you like to do in order to enhance public perception of market design in Japan?

Kojima: We would like to publicize our views and analyses as much as possible. Our center was opened in autumn 2020. We organized an inaugural symposium then for the public. Recently, one of our research fellows, Dr. Shunya Noda at the University of British Columbia, issued a policy report on market design for Covid-19 vaccine distribution. We would like to continue such efforts in communication for the interest of the public. I would also like to issue my views on the economy and business in the light of market design in the media. Such efforts to expand exposure of our center to the media would help us raise the social perception of market design.

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