Does a suspension of recruitment effect the *hensachi* of neighboring universities*?*

Keywords: Japan; university rankings; hensachi; agent-based model

Extended Abstract

This study tries to clarify the fundamental mechanisms behind *hensachi,* a unique Japanese way of ranking universities, via a simulation approach using an agent-based model.

Hensachi refers to a standardized score representing students' academic ability, through which students can estimate the possibility of passing the entrance examination of certain universities. Technically speaking, *hensachi* is a standardized test score turning an absolute evaluation (the original score) into a relative evaluation (*hensachi*) with a mean of 50 and standard deviation of 10. Accordingly, *hensachi* shows not only the absolute academic ability of students, but also their relative position among all examinees (Goodman & Oka 2018).

Hensachi was first introduced into the Japanese education system in 1957, for use in guidance counseling. In 1965, "*Keisetsu Jidai*", a well-known magazine for Japanese university information, developed a *hensachi* scale for universities to indicate the degree of difficulty of admission, by calculating the average *hensachi* of the successful entrants for each university. This change is representative of a conceptual evolution for *hensachi*, wherein they were no longer only a variable considered at the individual (micro) level but became an indicator for selectivity of universities at the macro level. Ever since this conceptual evolution, *hensachi* has been an extremely important variable in higher education studies including, but not limited to, the research on admissions, evaluation, retention, and employability.

Despite having been acknowledged as an important variable, criticisms towards *hensachi* have persisted since its inception. In particular, researchers in the field of educational sociology continue to argue that overemphasis on *hensachi* could reify meritocracy in such a way as to threaten the public mission of the education system in Japan. Furthermore, what *hensachi* means for universities has yet not been adequately examined. For example, universities' promotional messages tend to present *hensachi* as an indicator of university prestige, which is itself the result of good performance in education and research. However, it is inappropriate to interpret *hensachi* as an improvement in the quality of university, considering that the suspension of recruitment by neighboring universities can increase the number of applicants, which inevitably results in an increase in *hensachi* as well. This problem highlights the need to examine the validity of *hensachi.* In this study, we try to understand the fundamental mechanisms behind *hensachi* in a simulation approach using an agent-based model.

Firstly, we set up a 160×120 world, made up of 19 regions with different prosperity degree. In each region, agents (universities and students) are set up, and the number of agents depends on the prosperity degree of each region, so that we got a world with 52 universities and 100,000 students in all.

To represent the various characters of the universities, we set up three parameters for each university, generated in standard normal distribution $(\theta_1, \theta_2, \theta_3)$. Students are able to perceive these parameters and evaluate universities in own weight $(\delta_1, \delta_2, \delta_3)$. For student i, the evaluation for university j is $\theta_{i1}\delta_{j1} + \theta_{i2}\delta_{j2} + \theta_{i3}\delta_{j3}$.

Secondly, we set up 3 parameters (k_1, k_2, k_3) for each student to represent their academic ability. The *hensachi* of each student is measured by a mock exam which is composed of 100

questions based on Item Response Theory (IRT). The total number correct responses T_i of student i will be calculated into *hensachi* by Eq. (1).

$$H_i = \frac{T_i - \overline{T_\iota}}{std(T_i)} \times 10 + 50 \quad \text{Eq. (1)}$$

Thirdly, we let each student select one university to apply. We set a threshold, where for each student, universities that too far away (being 70 away from student's location), or too selective (the *hensachi* of university being 10-point superior to student's *hensachi*) will not be considered in the university selection. For those universities that remained within consideration, students will make a stochastic decision to select one of them based on their preference. Once applicants are determined, an entrance exam will be held in each university, which consists of 100 questions based on IRT. Then, each university will adopt top 500 scoring applicants. (Figure 1)

Then, the university *hensachi* will be updated by the results. In this study, we make the *hensachi* of university to be the *hensachi* of the student whose probability of success is precisely 50%. In fact, for every university, both the distribution of *hensachi* of the succeed group and failed group are assumed to be a normal distribution, so that the *hensachi* of university can be calculated by the mean and the variance of the failed group, μ_f and ${\sigma_f}^2$, besides the mean and the variance of the succeed group, μ_g and ${\sigma_g}^2$, as Eq. (2).

$$x = \frac{\left(\mu_g {\sigma_f}^2 - \mu_f {\sigma_g}^2\right) \pm \sqrt{\left(\mu_f - \mu_g\right)^2 {\sigma_f}^2 {\sigma_g}^2 - \left({\sigma_f}^2 - {\sigma_g}^2\right) ln\left(\frac{n\sqrt{{\sigma_g}^2}}{m\sqrt{{\sigma_f}^2}}\right)}}{\left({\sigma_f}^2 - {\sigma_g}^2\right)} \quad \text{Eq. (2)}$$

In order to verify if the suspension of recruitment will increase the *hensachi* of the neighboring universities, we are going to make one university stop accepting new students at term 10 and observe the *hensachi* of other universities for another 10 terms.

The simulation results show that the *hensachi* of other universities has increased after one university stopped accepting students (Figure 2). Moreover, *hensachi* of the neighboring universities seem to increase more. To confirm the conclusion above, we conduct a regression analysis towards the spillover effects (Table 1). The result clearly shows that especially the universities nearby and holding the similar *hensachi* will achieve a larger spillover effect, which indicates that the improvement in the quality of university is not a necessary condition of *hensachi* rising. For the fundamental mechanisms behind *hensachi*, it is the interaction between universities that is the key factor.

References

Roger Goodman & Chinami Oka (2018) The invention, gaming, and persistence of the *hensachi* (standardized rank score) in Japanese education, *Oxford Review of Education*, 44(5), 581-598.

Figures

Figure 1 Example for students' university selection

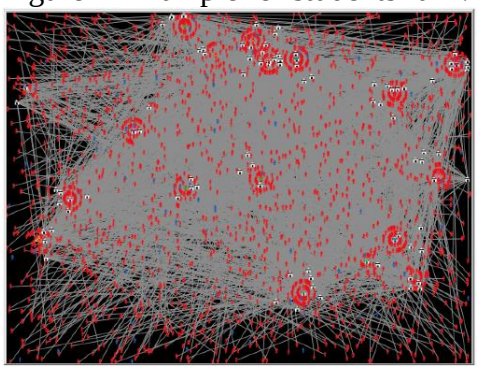

Figure 2 The average *hensachi* of universities within a certain range

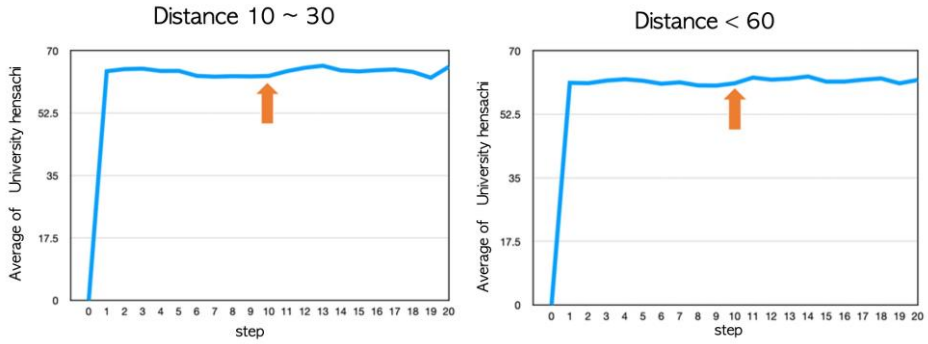

Table 1 Spillover effects

Y=Change of *hensachi* from the last term

	Estimate	SE	tStat	pValue
(Intercept)	-0.09676	0.29888	-0.32376	0.74619
distance	0.001655	0.004452	0.37171	0.71019
distance＊term11	-0.03416	0.019407	-1.7603	0.078669
hensachi diffrence＊term11	0.22448	0.11387	1.9713	0.048973