

Behaviormetrics:

Quantitative Approaches to Human Behavior 18

Keiko Nakao *Editor*

Multidimensional Aspects of Occupational Segregation

Time Series and Cross-National
Comparisons

 Springer

Behaviormetrics: Quantitative Approaches to Human Behavior

Volume 18

Series Editor

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This series covers in their entirety the elements of behaviormetrics, a term that encompasses all quantitative approaches of research to disclose and understand human behavior in the broadest sense. The term includes the concept, theory, model, algorithm, method, and application of quantitative approaches from theoretical or conceptual studies to empirical or practical application studies to comprehend human behavior. The Behaviormetrics series deals with a wide range of topics of data analysis and of developing new models, algorithms, and methods to analyze these data.

The characteristics featured in the series have four aspects. The first is the variety of the methods utilized in data analysis and a newly developed method that includes not only standard or general statistical methods or psychometric methods traditionally used in data analysis, but also includes cluster analysis, multidimensional scaling, machine learning, corresponding analysis, biplot, network analysis and graph theory, conjoint measurement, biclustering, visualization, and data and web mining. The second aspect is the variety of types of data including ranking, categorical, preference, functional, angle, contextual, nominal, multi-mode multi-way, contextual, continuous, discrete, high-dimensional, and sparse data. The third comprises the varied procedures by which the data are collected: by survey, experiment, sensor devices, and purchase records, and other means. The fourth aspect of the Behaviormetrics series is the diversity of fields from which the data are derived, including marketing and consumer behavior, sociology, psychology, education, archaeology, medicine, economics, political and policy science, cognitive science, public administration, pharmacy, engineering, urban planning, agriculture and forestry science, and brain science.

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ISSN 2524-4027

ISSN 2524-4035 (electronic)

Behaviormetrics: Quantitative Approaches to Human Behavior

ISBN 978-981-99-8512-8

ISBN 978-981-99-8513-5 (eBook)

<https://doi.org/10.1007/978-981-99-8513-5>

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The registered company address is: 152 Beach Road, #21-01/04 Gateway East, Singapore 189721, Singapore

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Introduction



Keiko Nakao and Aya Wakita

1 Meritocracy in Post-industrial Societies

It had been believed that the process of industrialization would promote meritocracy in many societies. Higher technological innovations would create higher level of industries, and such industries would require jobs that need higher human capital. In highly industrialized societies, people with higher level of education and with higher skills would be needed. Therefore, it was thought that industrialization would promote meritocracy.

In the area of social stratification research, it had been taken for granted that the level of a person's education would affect his/her occupational status (e.g., Blau and Duncan 1967; Treiman 1970). The Blau–Duncan classic model for status attainment established that higher education as well as higher father's social status leads to high-status jobs. That principle has been the case in industrialized meritocratic societies. In other words, in today's performance-based society, it has been believed that a high level of education is the ticket to attaining a high occupational status. As for the social stratification literature, however, Featherman et al. (1975) proposed a hypothesis stating that industrialized countries with a nuclear family system and market economy showed similar levels of relative mobility. Later, this hypothesis was tested and supported (Erikson and Goldthorpe 1992). The idea that industrialization promotes meritocracy may have been applied during the period when the countries were going

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© Springer Nature Singapore Pte Ltd. 2024

K. Nakao (ed.), *Multidimensional Aspects of Occupational Segregation*,

Behaviormetrics: Quantitative Approaches to Human Behavior 18,

https://doi.org/10.1007/978-981-99-8513-5_1

through industrialization; it may not be always clear after industrialization (post-industrialization). However, given the effects of education on occupation, it would be possible that countries become more meritocratic even during post-industrial societies.

Post-industrialization is said to be characterized by more growth in occupations in the service sector, industry sophistication, and women's labor participation, which would promote meritocracy (Bell 1973; Esping-Andersen 1999). Countries with higher post-industrialization would have more jobs that require high educational levels, which will increase the importance of achieving higher education. In fact, many nations are experiencing an expansion of higher education. Furthermore, among the those with bachelor's degrees, it was reported that effects of socioeconomic origins are not as important (Torche 2011). From the perspective of educational premium, meritocracy is strong in post-industrial societies. However, if we focus on gender, could we say that meritocracy is still strong?

Expansion in service industry does not necessarily require workers with high human capital. During the age when countries were going through industrialization, lower manual workers were much in demand; however, post-industrialization would require more workers that are lower non-manual (Esping-Andersen 1999). Diminishing manufacturing industries and expanding of service industries would promote hiring routine non-manual workers such as service workers and sales workers. Female workers are in demand in order to fill these vacancies.

There has been a series of research conducted on the relationship between gender and occupation in the area of occupational gender segregation. For example, Charles and Grusky (2004) pointed out that there are two possible features in terms of the effects of gender during the era of post-industrialization, namely service-sector expansion and economic rationalization. According to Charles and Grusky, service-sector expansion changed industrial structure that would increase jobs that are perceived to be "appropriate for women." Such changes made unpaid work that women used to assume inside home for the family payable business, namely interpersonal service jobs. For this type of work, it is necessary for workers to have emotional labor or interpersonal skills that women were said to possess. Office workers and administrators in service industry have also become increasingly feminized. Thus, post-modernized nations tend to have more female non-manual workers and horizontal occupational gender segregation, indicating that women tend to be allocated to non-manual occupations and men to manual occupations.

It is not only unmarried females who were hired to assume such lower non-manual jobs. Married women also participated in a way of part-time or flexible work. Workplaces for routine non-manual workers have become female-oriented and dominated by wives and mothers with domestic responsibilities. Feminizing the lower non-manual sector strengthened vertical occupational gender segregation among non-manual workers: upper non-manual occupations are occupied by men and lower non-manual occupations by women.

On the other hand, economic rationalization would promote the division of labor and reduce self-employment in sales or small businesses, and would increase the number of large businesses. Therefore, economic rationalization has created routine,

unskilled, and non-manual jobs for women. This also contributes to the increasing demand for women in non-manual occupations, and vertical occupational gender segregation in non-manual sectors.

However, service sector expansion and economic rationalization have also created managerial occupations in service industries and new opportunities for elite women. In addition to Charles and Grusky's explanation, we can emphasize that the number of professional and technical (associate professional) workers related to "feminine" skills is increasing during the post-industrialization era, especially in the medical and welfare industries. These changes may enhance meritocracy and weaken vertical occupational gender segregation in non-manual workers if highly educated women are allowed to attain upper non-manual occupations.

According to an international comparison (Charles and Grusky 2004), gender egalitarianism is associated with high levels of horizontal occupational segregation and low levels of vertical gender segregation in the non-manual sector. On the other hand, post-industrialization increases horizontal segregation and vertical segregation among non-manual occupations. Post-industrial countries have a high proportion of women among managerial, clerical, and service/sales workers and a high proportion of men among craft, operative, and labor workers.

In short, the relationships between educational attainment and occupation are still observed today; it does not necessarily mean that meritocracy is strong in post-industrial nations, once gender is considered as an attribute. Rather, post-industrialization enhances an overall horizontal gender occupational segregation and a vertical gender occupational segregation within non-manual occupations. For better-educated females, however, there would be a better chance to obtain upper non-manual occupations.

2 Analyses Focusing on Japan

In this book, therefore, we would examine the occupational segregation focusing on gender and education within Japan and compare it with other countries. What would we clarify by conducting such empirical analyses? By focusing on educational attainment and gender, we would first be able to clarify one of the important issues. That is whether an occupational gender segregation happens at all educational levels, including both higher and lower educational levels. We can examine the educational premiums for men and women and their changes caused by the industrial structure from a gender perspective.

Furthermore, by examining with other countries' data, we would be able to determine whether Japan is a unique case or the situation is common to all post-industrialized nations. We will proceed with our analyses focusing on Japan first. There are two reasons for that. First, compared with other industrialized countries, gender inequalities are quite large in Japan. As with other countries, women's work participation is increasing. However, the laws and work regulations are based on familism, more so compared with other nations (Esping-Andersen 1999). Thus,

women's status at work remains low in Japan. There is a greater percentage of women working as non-regular workers: more than half of the working women are non-regular workers such as part-time workers. There is the large wage gap between non-regular workers and regular workers. Women's careers tend to get interrupted due to such work regulations under familialism (Brinton 2001). Therefore, women are likely to obtain non-regular jobs, which leads to female marginalization at work. Furthermore, even among regular workers, the gender wage gap is pronounced (Yamaguchi 2019).

Secondly, Japan has a different situation compared to the United States and European post-industrial nations from the perspective of industrial structure. In the past, it had been observed that Japanese occupational gender segregation is characterized by more women working in manual occupations (Charles et al. 2004). Thus, horizontal occupational gender segregation is relatively small. Oda et al. (2014), that analyzed the statistical data in Japan using models from Charles and Grusky (2004), pointed out that Japan's post-industrialization is somewhat weak. Table 1 presents the employment by industry in 16 societies, consisting of 14 societies analyzed in chapter "An International Comparison of Occupational Segregation by Sex: Through a Comparison of 14 Countries" and 2 in chapter "Comparison of Occupational Segregation in East Asia: Analyzing the Structure of Segregation by Educational Background and Gender" (South Korea and Taiwan) published by ILO (2022). Even in 2019, Japan shows a lower percentage of service sector workers than countries like the U.S., the UK, the Netherlands, and France, which supposedly experienced post-industrialization. Japan is at the similar level as Korea and Italy.

Japan is characterized by strong gender inequality and a middle level of post-industrialization. Therefore, it is very meaningful to clarify the multidimensional aspects of occupational segregation focusing on Japan. The effects of (post-) industrialization might be totally different depending on educational level. Speaking more concretely, under both industrialization and post-industrialization, highly educated women would be able to get chances having higher occupational statuses. However, post-industrialization would give women with lower education lower non-manual workers' positions.

As shown in Fig. 1, highly educated women have increased dramatically in the recent years in Japan. The number of 4-year university graduates is at a level close to that of males (Ministry of Education, Culture, Sports, Science and Technology Japan 2021). Figure 1 demonstrates the percentages of students who go on to 4-year universities and 2-year colleges after graduating from high schools. Under such circumstances, there are some women with highly successful occupations. Iwama (2008) pointed out the polarization of women's status. We need to find out whether Japan is as meritocratic as the US and European countries. Hence, the similarities (or dissimilarities) in occupational status between highly educated men and women must be examined. We can clarify the effects of (post-)industrialization and gender inequalities on occupational segregation focusing on Japan first and conducting international comparison in our analyses.

Table 1 Employment by sector in 2000, 2010, and 2019

	Year 2000			Year 2010			Year 2019		
	Services (%)	Industry (%)	Agriculture (%)	Services (%)	Industry (%)	Agriculture (%)	Services (%)	Industry (%)	Agriculture (%)
Vietnam	22.3	12.4	65.3	29.6	21.7	48.7	35.3	27.4	37.2
India	24.0	16.3	59.6	26.7	21.8	51.5	32.3	25.1	42.6
China	27.5	22.5	50.0	34.6	28.7	36.7	47.2	27.4	25.3
Thailand	32.2	19.0	48.8	41.1	20.6	38.2	45.7	22.8	31.4
Philippines	47.0	15.9	37.1	51.4	15.7	32.9	58.2	19.0	22.8
Malaysia	49.5	32.2	18.4	59.1	27.6	13.3	62.8	27.0	10.3
Poland	50.3	31.1	18.7	56.6	30.3	13.1	58.7	32.2	9.2
Taiwan	53.3	38.7	8.0	57.3	37.3	5.4	58.2	36.7	5.0
Hungary	59.8	33.8	6.5	64.8	30.7	4.5	63.1	32.2	4.7
South Korea	61.3	28.1	10.6	68.4	25.0	6.6	70.4	24.5	5.1
Italy	63.0	31.8	5.2	67.6	28.6	3.8	70.3	25.8	3.9
Japan	63.5	31.4	5.1	70.4	25.6	4.1	72.4	24.2	3.4
France	69.6	26.3	4.1	74.8	22.3	2.9	77.1	20.4	2.5
UK	73.3	25.2	1.5	79.6	19.2	1.2	80.9	18.1	1.0
U.S	73.9	24.4	1.6	78.9	19.6	1.4	78.8	19.9	1.4
Netherlands	75.1	21.6	3.3	79.2	17.7	3.1	81.8	16.1	2.1

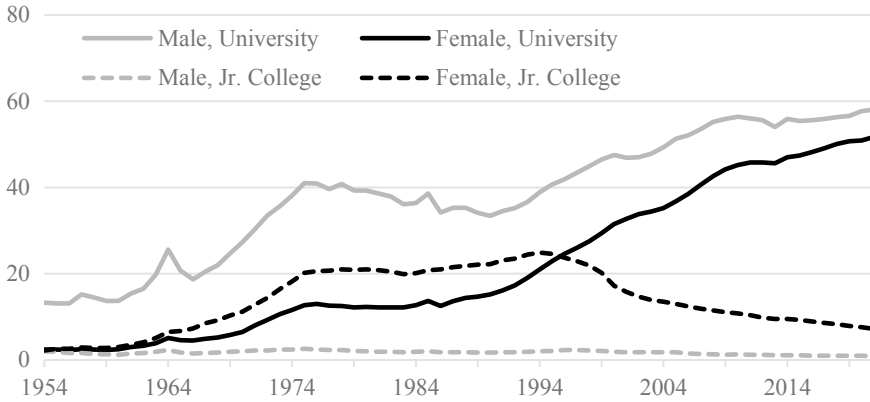


Fig. 1 Percentage of students who go on to universities or junior colleges

2.1 Methods (Correspondence Analysis)

In analyzing the data, we used correspondence analysis, focusing on the multidimensional aspects of occupations. If we used an index such as the Occupational Prestige Scores or the Socio-economic Index (SEI), we would only be able to see a unidimensional aspect of occupations, assuming that there were linear relationships between educational achievements and occupational status. We would need to overcome such assumptions. Researches in occupational segregation have shown both horizontal and vertical segregations. In addition, occupational images consist of two different dimensions: prestige and gender type (Glick et al. 1995). Occupational status is not unidimensional, but multidimensional. That is why we need to treat occupational status as categories and to use categories as small as possible.

There has been a trend in the area of social stratification research, which is called micro-class analysis. It is a response to criticisms about the current measures of social status not being appropriate because they no longer reflect the reality of the current situations (e.g., Weeden and Grusky 2012). A Japanese sociologist, Miwa (2009), points out the need to apply a more micro-level approach to clarify social disparities in Japan. That includes those analyses using more detailed occupational categories.

As Weeden and Grusky (2012) argues, it is difficult to believe that traditional broad occupational categories accurately measure contemporary hierarchical structures. Grusky, relying on Durkheim's perspective in his "division of labor theory," argued for the need to focus on disaggregated occupational categories to understand contemporary society in terms of occupations.

Class analysis based on micro occupational categories has been continuously conducted since the 2000s. It is not clear whether Grusky's assertion that Marxist class theory based on a macro perspective is no longer persuasive in contemporary society, where meritocracy is progressing, is valid. However, there is no doubt that the focus on disaggregated occupational categories has appealed to many researchers conducting class analyses to understand contemporary society.

This study is not a criticism for such macro-analysis. Instead, it empirically examines the components of occupations on which macro class analysis was based. In other words, we focus on the multidimensionality of occupations.

The premise of Grusky's argument that traditional occupational categories are becoming inadequate to capture current classes can be interpreted as the fact that the social significance of occupations in contemporary society has become increasingly diverse. This implies the need not only to subdivide occupations but also to reconfigure them. Indeed, segmentation of occupational categories is practiced in micro-class analysis. However, in light of the transformation of the social structure, including post-industrialization, it is also important to reconstruct occupational categories according to the dimensions constructed in the society in question, rather than assuming only the hierarchical structure of occupations. Especially for cross-national data analyses, we may use somewhat larger categories based on available data.

Next, we will discuss the analytical technique; correspondence analysis. This study will examine the relationship between attributes and occupations in contemporary society by disaggregating and reconstructing occupations through correspondence analysis.

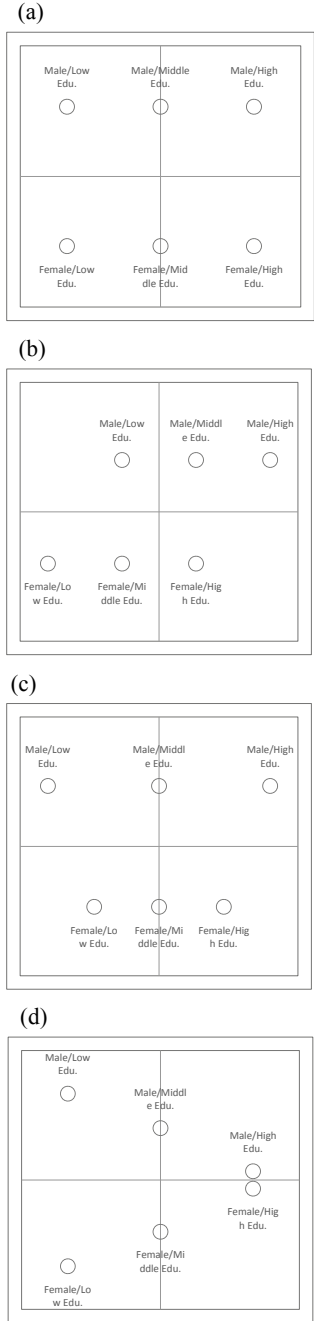
What is correspondence analysis? Correspondence analysis is a multivariate statistical technique that allows us to examine the relationships between two or more variables. It estimates distance between categories as similarity or dissimilarity from the perspective of correspondence with other variables, and display them on one or more dimensional spaces. Thus, a distance between the categories indicates how similar they are.

One important merit is that it does not assume linearity in the associations. Let's look at the relationship between years in education and occupational status. When both variables are interval measures, you would normally apply regression models to analyze the data. However, correspondence analysis takes the stance that each variable is categorically measured and finds the configuration that would maximize the relationship. Other than expected dimensions such as status, education, and gender, we can examine whether there is something else that would make difference determining configurations of occupations. In other words, you could elicit how occupations differ based on the categories in education or gender.

For example, take a look at the pattern seen in Fig. 2. This is an example of taking education as the first dimension and gender as the second dimension.

Figure 2a presents a pattern in which status is approximately equal between men and women with the same educational levels. Figure 2b, on the other hand, describes a situation in which status varies by gender. Males have higher status than females. Females with high education would be the same as males with middle education. Figure 2c shows the pattern in which education affects differently for males and females. The distance between the categories is longer for males. This implies that the effect of education is greater for males than females. Finally, Fig. 2d is the pattern in which gender effect depends on educational levels. If one attains high education, gender difference is small. The theory of industrialization would have predicted this pattern, meritocracy.

Fig. 2 Examples of configurations



Correspondence analysis is powerful when focusing on several different dimensions that characterize an occupation, as described above. Theoretically, after going through the industrialization and the post-modernization within each country, it is not surprising that the meaning of occupations has become more complicated and varied. Other than status, we need to investigate what kind of dimensions occupations have.

By conducting this type of analyses, we will be able to obtain results on multidimensional occupational segregation associated with gender and educational levels. Dimensions obtained from our analyses may not necessarily correspond with horizontal/vertical segregation. However, these analyses would certainly provide important knowledge for research on occupational gender segregation.

2.2 Brief Description of Chapters

Here, we will briefly introduce the chapters of this book. Chapters “[Multidimensional Structure of Occupational Segregation by Education and Gender: Time Series Comparison in Japan from 1980 to 2010](#)” through “[Occupation Segregation for Immigrants in Japan: Using Custom-Made Census Data in 2010](#)” focus on analyses in Japan and demonstrate the Japanese features. In chapter “[Multidimensional Structure of Occupational Segregation by Education and Gender: Time Series Comparison in Japan from 1980 to 2010](#)”, we first investigate a time-series comparison in Japan from 1980 to 2010. We then identify what has been happening in Japan. In chapter “[Occupational Segregation by Education and Gender in Japan: Focusing on Employment Status and Marital Status](#)”, we looked at the effect of gender focusing on employment status and marital status. They are important factors related to women’s labor participation. We also examined immigrants in Japan, which has recently increased in number (chapter “[Occupation Segregation for Immigrants in Japan: Using Custom-Made Census Data in 2010](#)”). Analyses in chapter “[Occupation Segregation for Immigrants in Japan: Using Custom-Made Census Data in 2010](#)” include not only gender but also ethnicity, pointing the importance that there are various attributes to consider in Japan.

The following chapters focused on the cross-cultural analyses between Japan and other countries: the United States (chapter “[Multidimensional Structure of Occupational Segregation in Japan and the United States: Comparison of Trends from 1980 to 2010](#)”), East Asian societies (chapter “[Comparison of Occupational Segregation in East Asia: Analyzing the Structure of Segregation by Educational Background and Gender](#)”), and 14 countries, including European countries, Asian countries, and the U.S. (chapter “[An International Comparison of Occupational Segregation by Sex: Through a Comparison of 14 Countries](#)”). Detailed comparisons between the US and Japan reveal the effects of post-industrialization and gender egalitarianism (chapter “[Multidimensional Structure of Occupational Segregation in Japan and the United States: Comparison of Trends from 1980 to 2010](#)”). While the US is more advanced in post-industrialization and gender egalitarianism, Japan is not progressing much. The