

Occupational Access for Older Workers by Industry in Taiwan*

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Abstract

In response to the labor shortage expedited by population aging, enhancing the labor force participation rate (LFPR) of aged people is a key policy in developed countries. The rate of population aging in Taiwan is one of the fastest in the world. In Taiwan, the threat of labor shortage is escalating, while the LFPR of middle-aged and older workers remains far lower than the standards of member countries of the Organization of Economic Cooperation and Development (OECD). The present study aims to investigate the industry and occupation distribution of middle-aged and older workers in Taiwan between 2003 and 2013 from the perspective of labor demand. The Hutchens Index was adopted to measure the openness of recruiting aged workers in the various industries in Taiwan and to illustrate age-specific occupational segregation (OS) curves.

The findings showed that (1) the majority of jobs are skill level 2 jobs that do not require workers to be extremely skilled (total of four skill levels; Table 1). Many male workers continued their professional career after reaching retirement age, but financial hardship was the employment motivator for female workers in this group. (2) Newly employed middle-aged and older workers were largely distributed in low-skill, low-salary jobs. As workers grow old, “popular jobs” expand to include jobs with high skill demands, implying that the M-form occupation distribution after retirement age was far more obvious than before retirement age. (3) In terms of openness of recruiting aged workers, all professions in all industries preferred young workers over middle-aged and older workers. In addition, the top and bottom extremes of the occupation hierarchy were more accepting of middle-aged and older people workers, which verified the M-form occupation distribution of middle-aged and older workers. (4) The age-specific OS curve shows that the age difference of occupation distribution did not interact with gender or region. The Gini coefficients of OS based on gender and region were between 0.22 and 0.33.

Keywords: older worker, openness of recruiting aged workers, occupational segregation

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I. INTRODUCTION

Population aging is a common problem in developed countries, wherein the labor population diminishes concurrently with a decrease in the young adult population. In response, countries have gradually shifted to women, minorities, disadvantaged groups, middle-aged and older people, and other alternative human resources to alleviate the labor shortage problem (Flynn, 1997; van Dalen, Henkens, & Schippers, 2009; Lin & Huang, 2007). However, early retirement remains prevalent in numerous countries despite the labor shortage problem, leading to the stagnation of labor. In response, government administrations and employers in various countries have centered efforts in developing methods to prolong workers' work years, delay the mandatory retirement age, maintain a proactive economic life, amend the terms and conditions of public pension payment, promote the redesign of duties for middle-aged/older/aged workers, and strengthen vocational training for middle-aged/older/aged workers (Buck & Dworschak, 2003; Dutton, Flynn, & McNair, 2007; Flynn, 2010; Piktialis & Morgan, 2003).

The rate of population aging in Taiwan is one of the fastest in the world. Its labor force participation rate (LFPR) is far below the standards of numerous member countries of the Organization of Economic Cooperation and Development (OECD) and significantly lower than neighboring countries, such as Japan and South Korea (Fig. 1). The decline in the LFPR of aged workers may be caused by the lack of willingness to work. However, a more likely situation is the abstention of job searching caused by the difficulty securing re-employment once aged workers become unemployed. Examining the reasons for unemployment from the perspective of labor supply is undoubtedly a key method for resolving unemployment issues. Analyzing the acceptance of aged workers in various industries from the perspective of demand is equally important for the same reason. The present study aimed to discuss the openness of recruiting aged workers in various industries in Taiwan. Segregation curves were drawn using the research findings to illustrate occupational segregation by age (OS-age) and differences in the distribution of workers in different age groups (young and aged workers) and industry-occupation categories.

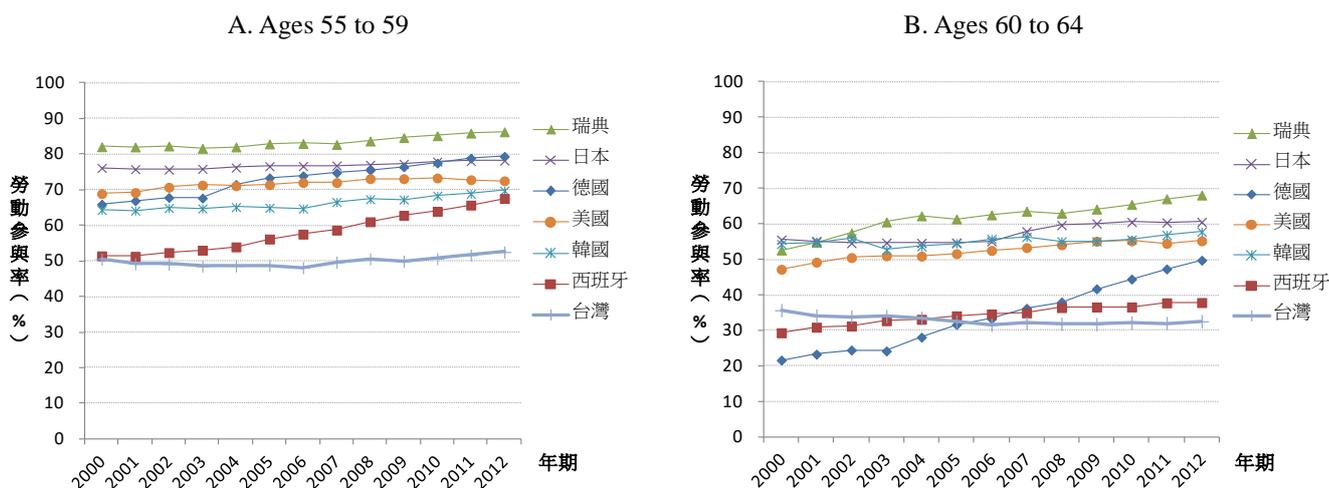


Figure 1. Comparison of the LFPR of Aged Workers in Different Countries (2000–2012)

Source: International data collected from the OECD Employment and Labour Market Statistics (database); Domestic data collected from the annual human resources statistics released by the Directorate-General of Budget, Accounting, and Statistics (DGBAS), Executive Yuan (Link: <http://www.dgbas.gov.tw/ct.asp?xItem=18844&ctNode=4943>)

II. Recruitment and Continued Service of Aged Workers

Enhancing the LFPR of aged people is a key policy in developed countries. An increasing trend in aged people's willingness to delay retirement or search for re-employment can be observed, and employers are becoming increasingly aware of the risks of a labor shortage. Nevertheless, a significant gap exists between employers' expected and actual behaviors. Enterprises typically recruit younger laborers instead of older workers (Harper et al., 2006).

2.1 Factors Affecting the Employment of Aged Workers

In the long-term, the labor demand of enterprises derives from consumers' demand for products and services. In specific skill and capital investment conditions, wherein the demand for immediate labor is fixed, enterprises are tasked with selecting the appropriate workers to meet consumer demand. The relationship between age and employment opportunity can be explained by three facets, specifically human capital, delayed compensation, and statistical discrimination.

2.1.1 Age, Human Capital, and Productivity

Human Capital Theory (HCT; Polachek & Siebert, 1993) divides human life into two major periods. The first is the development of personal human capital earlier in life

(incl., knowledge and skills) and the second is the engagement of paid work. The theory also explains that investing in human capital enhances productivity and that workers' compensation is directly associated with productivity. Basically, workers with increased personal human capital (e.g., a higher level of education) receive a higher income. The majority of people invest a considerable amount of human capital in the first twenty to thirty years of their lives. They then enter the labor market and gain new knowledge and skills, transforming them into experienced workers. Over time, people's human capital gradually depreciates as a result of fatigue, health deterioration, and aging. The likeliness of demotion increases as the aging workers' productivity decreases. In addition, aging workers may opt to be transferred to a lower position with less stress and workload.

HCT proposed occupational retraining to prevent productivity degradation. Hutchens (1988) asserted that job training (incl., general and specialized job training) reduces the employment opportunities for aged workers. Employers typically prefer young workers for jobs that require general job training because the "amortization" period for the cost of training young workers is longer than that of aged workers. Therefore, the annual unit cost of training young workers is lower than aged workers. Similarly, employers also prefer young workers for jobs that require specialized job training. Specialized jobs generally offer a low starting salary with annual adjustments, which represents that the cost of training is shared between the worker and the employer (Becker, 1964). However, owing to the high training cost, employers expect to employ trained workers for as long as possible to maximize on their investment. Therefore, employers prefer employing young workers.

2.1.2 Delayed Compensation

Thurow (1975) collated previous observations and experiences and contended that the negative correlation between age and compensation is rarely observed. Instead, the researcher asserted that compensation is correlated to productivity. However, this correlation is not consistently evident throughout workers' careers. Many companies adopt the "delayed compensation" approach to supervise and manage their workers (Lazear, 1979; Lazear, 1981). "Delayed compensation" represents that workers are initially paid less than their marginal productivity, but later in their careers, they are compensated more than their marginal productivity. As productivity gradually declines with old age,

increased compensation encourages aged workers to seek out a successor and help his/her integrate into the workplace.

The business model characterized in Hutchens (1986), Hutchens (1988), and Hutchens (1993) indicated that the pay policy of delayed compensation effectively deters laziness, enhances productivity, and produces long-term employment relationships because workers are afraid of losing their delayed compensation. To this extent, employers refrain from employing aged workers because they are able to work for a fewer number of years, they are less motivated by delayed compensation, and they cost more to supervise and manage. A number of empirical studies on delayed compensation exist. Hutchens (1986) used the availability of a retirement pension, annual salary and bonus, and mandatory retirement plans to measure “delayed compensation,” and examined the correlation between the employment opportunities of aged workers and delayed compensation. The results showed that delayed compensation was negatively correlated to employment opportunities. Scott et al. (1995) asserted that in countries without national health insurance systems (e.g., the United States), health insurance is also a type of delayed compensation provided by enterprises. Therefore, companies that offer health insurance are less likely to employ new aged workers. Hirsch et al. (2000) found that workers over the age of 50 are less likely to be employed for jobs with large salary gaps between junior and senior workers or those that offer annuities or require computer skills. Hu (2003) discovered a negative correlation between training cost and employment age. The aforementioned studies all used data from the United States. Heywood et al. (1999) examined data from Hong Kong and found that companies that offer annuities, those that have developed a favorable internal labor market, and those that largely comprise senior workers are less likely to employ aged workers. Daniel and Heywood (2007) analyzed data from the United Kingdom, Adams and Heywood (2007) analyzed data from Australia, and Heywood et al. (2010) analyzed data from Germany; they all produced similar conclusions.

2.1.3 Age and Discrimination

Labor supply is heterogeneous. Employers cannot be absolutely certain of the productivity or the health of every job-seeker. They can neither predict the health of job-seekers over time nor determine whether job-seekers are able to keep pace with the

development of new technologies, particularly during the recruitment of new workers. Although qualification certificates, interviews, recommendation letters, and psychological evaluations can serve as support tools for recruitment, employers are typically biased by their “previous statistical experience” (Phelps, 1972); that is, they maintain a stereotypical impression of the behavior and development potential of “specific” workers. Many employers apply these statistical experiences to judge the future productivity of specific groups of workers. Judgments are inevitably biased when the collective experiences of worker groups serve as a basis for these judgments because no two workers are identical. Collecting the potential productivity information of individual job-seekers is a costly process. “Statistical discrimination,” or selecting the average abilities and qualities of a group of workers, is the economical alternative. Previous studies have also indicated that employers often screen job-seekers based on irrevocable criteria, such as gender, age, and social background (Van Beek et al., 1997).

Employers simultaneously exhibit positive and negative attitudes and perceptions towards aged workers. Harper, Khan, Saxena, and Leeson (2006) conducted a global research study characterizing positive attitudes into loyalty and trustworthiness and negative attitudes into low motivation, inflexibility, low productivity, slow learning, and inadequate technical competency. Similar characterizations were also presented in a number of European studies (Remery, Henkens, Schippers, & Ekamper, 2003; van Dalen, Henkens, & Schippers, 2009). Overall, attitude trends show that employers in the United Kingdom and the United States exhibited the most positive attitudes, and those in Turkey and Saudi Arabia exhibit the most negative attitude. Casey (1998) examined enterprises’ utilization of middle-aged and older labor in OECD countries and proposed several common concerns: (1) Middle-aged and older people are more costly than younger workers due to the operation of age/seniority-based payments systems; (2) they are less productive than younger workers because of poorer health or fewer, or less up-to-date, qualifications; (3) they are less willing/able to learn new skills; and/or (4) they have shorter expected stays with the company since retirement is close, thus making it not worth investing in their skills.

The Bureau of Employment and Vocational Training, Council of Labor Affairs, Executive Yuan, conducted a survey in 1996 and characterized several reasons why enterprises are willing to recruit middle-aged and older people: (1) experienced and

adaptable, (2) well-poised, (3) obedient, (4) focused, (5) well-versed and less prone to mistakes, and (6) reliable and less likely to resign. The survey also provided several reasons why enterprises are unwilling to recruit middle-aged and older people: (1) less lively, (2) outdated and stubborn, (3) poor health, and (4) difficult to place on rotation (Tseng and Li, 1999).

2.2 Occupational Segregation by Age

Enterprises typically adopted a principle “continued employment of aged labor and recruitment of new labor” concerning the utilization of human resources. The industry and occupation distribution of young and aged workers are becoming increasingly different amidst the transition of industrial structures and improvement in the education of the new generation. Similar to occupational segregation by gender or race, Hutchens (1988) and Hutchens (1991) created segregation curves using the data contained in the US 1983 Current Population Survey (CPS) to illustrate the employment differences between young workers and aged workers (using 55 years old as the cut-off point). The findings showed that relative to the employment of new young workers and existing aged workers, the occupation distribution of junior aged workers was more concentrated, implying fewer employment opportunities.

Later, Hirsch et al. (2000) adopted a similar method to analyze the CPS data of five years (1980, 1987, 1991, 1996, and 1998). The researchers defined aged workers as workers aged 50 years or older to calculate the Gini coefficient. The results indicated that in a 20-year period, the age-specific OS conditions remained relatively similar. In summary, enterprises with the following attributes are more inclined to (1) recruit young workers over aged workers, (2) adopt an age/seniority-based payment system, (3) adopt a corporate pension system, (4) have union organizations, (5) require strong computer skills, and (6) require night shift or rotation workers. Enterprises that seek to fill flexible or part-time positions are more willing to employ aged workers. Alternatively, the hypothesis “enterprises that seek to fill high-risk positions, high-intensity, or physically demanding positions favor young worker” was rejected. However, this could be because of a reduced number of young job-seekers.

III. METHODOLOGY

Article 2, Item 4, of the *Employment Service Act* ratified in 1992 in Taiwan states “The term ‘ Middle-Aged and Older Persons’ means nationals aging from forty-five to sixty-five.” However, the use and implied age group for the terms “middle-aged and older workers” and “aged workers” are inconsistent among studies and countries. In South Korea, workers between the ages of 50 and 54 are deemed “semi-aged workers.” In Japan, workers between the ages of 45 and 54 are deemed “moderately aged workers,” and those aged 55 or older are deemed “aged workers” (Chou, 2007). The World Health Organization (WHO, 1993) defined “aging workers” or “older workers” as workers aged 45 years or older. A report examining the 21 OECD countries released by the Employment, Labor, and Social Affairs Committee defined workers aged 50 years or older as “older workers” (OECD, 2006). Subsequently, Flynn and McNair (2007) conducted a qualitative study on numerous employers in the UK and defined “older workers” as workers eligible for annuity payments or those aged 60 years or older. Other previous studies provided different interpretations of aged workers. Some defined aged workers as workers over the age of 50 (Adams & Heywood, 2007; Heywood et al., 2010; Hirsch et al., 2000; Hotopp, 2005), while others provided a definition of 55 years and older (Adler, 2009; Dixon, 2009; Hutchens, 1986; Hutchens, 1988; Van Dalen, 2009). In the present study, we examined both industry and occupation, which required a large sample size. To increase the number of samples obtainable, we selected “middle-aged and older workers” aged 45 and older as the research subjects.

We first examined the sub-survey of the Manpower Survey, specifically the Manpower Utilization Survey, between 2002 and 2013 to elucidate the openness of recruiting aged workers in various industries in Taiwan. A total of 365,816 samples aged 45 and older were obtained by combining the 12 years of data. Then, we analyzed the “Population and Housing Census”[§] of 2010 to determine the OS by age situation in Taiwan. A total of 1,728,530 employed samples were collected. “Employed samples” refers to “employed people assuming specific work,” “students that work after school or during holidays,” “home keepers that work in their spare time,” and “employed people

[§] The “2010 Population and Housing Census” is not a comprehensive census. Rather, an “official registration coupled with a sample survey” was adopted determine the total number of permanent residents in the Taiwan and Fujian areas and their demographics. Then, roughly 16% of the census region was selected to survey the residents in the selected region.

that are unable to work.”

3.1 Openness of Recruiting Aged Workers in Different Industries

The Hutchens Index (Hutchens, 1986) is the most common index for determining the openness of recruiting aged workers.

$$I(i) = \frac{k_i(o)}{k_i(a)} = \frac{\text{Proportion of Newly Employed Middle - Aged and Older Adults}}{\text{Proportion of Employed Middle - Aged and Older Adults}}$$

where, i represents occupation, industry, or company. The index represents an attempt to separate the effects of demand-side factors from supply-side factors (potential aged labor). It is assumed that the size of aged labor will influence both the proportion of employed aged workers and the proportion of newly employed aged workers, while demand-side factors will influence the age composition of newly employed aged workers disproportionately to the age composition of external labor supply. The Hutchens Index adopts the suitable employment opportunities for aged workers (that is, the current age composition of workers) in the current industry or enterprise as the basis for comparison to determine whether the industry or enterprise “welcomes” (greater than 1) or “denies” (smaller than 1) the new employment of aged workers. Although the Hutchens Index is widely applied, appropriate positions in the enterprise (or industry) and age-based applicant data must be available for subsequent confirmation; otherwise, low values may be the result of the absence of an appropriate position or the lack of aged applicants, rather than indicating the enterprise’s (or industry’s) unfriendliness of recruiting new aged workers.

“New employment” is largely defined as “5 years or less” or “17 months or less” in the current position. The former definition is used to compare the new employment in different countries (e.g., the US, UK, Australia, and Germany; Heywood et al., 2010; Hirsch, 2000; Hutchens, 1986; Hutchens, 1988; Daniel & Heywood, 2007; Adams & Heywood, 2007). The latter definition was proposed in the Manpower Utilization Survey to analyze the independent problems concerning new employment. The latter definition better defines “new employment.”

In terms of the definition and classification of industry and occupation, industry refers to the sector of economic activity to which the worker’s workplace belongs and occupation refers to the duties or tasks assumed by the worker. Industry classifications

should encompass various, but mutually exclusive, economic activities. Establishment is the measure used in the International Standard Industrial Classification of All Economic Activities. The Standard Industrial Classification of the Republic of China (Ninth Edition) currently contains 19 Sections, 89 Divisions, 254 Groups, and 551 Classes.

The framework for the Standard Occupation Classification of the Republic of China is based on the United Nations International Standard Classification of Occupations (ISCO). Occupation classifications are categorized into sections, divisions, groups, and classes. Classifications are based on the job content and the skill required to perform the job. Therefore, jobs with similar traits are grouped into an occupation. “Skill” is characterized into facets of “skill level” and “skill domain.” These two facets also serve as a basis for occupation classification. “Skill level” involves job complexity and scope. It is sub-characterized into four skill levels based on job characteristics, necessary skill types, necessary education level, and training.** “Skill level” is the basis for classifying sections and divisions. Jobs in the first skill level are simple, routine labor-related jobs (e.g., movers) that require stamina and endurance. These jobs typically require an education level of elementary school or higher. Jobs in the fourth level require professionals with theoretical or practical application and knowledge (e.g., doctors). These jobs demand superior reading/writing, planning, and communication skills. They typically require workers to have received higher education. Besides Section 1 “Legislators, Senior Officials, and Managers” and Section 0 “Armed Forces Occupations,” the remaining sections (Section 2 to Section 9) correspond to one skill level. The sections of the Standard Occupation Classification and their corresponding skill levels are tabulated in Table 1. “Skill domain” refers to the types of skills required for a specific job. It is characterized based on knowledge domain, use of tools and machinery, production material, and product type. These characterizations are typically applied to the section, group, and class classifications of the Standard Occupation Classification. The Standard Occupation Classification (Sixth Edition) currently contains 10 Sections, 39 Divisions, 135 Groups, and 380 Classes.

Even though we combined 12 years of data from the Manpower Utilization Surveys, the sample size was not sufficient to analyze at the Division level of classification.

** Please refer to the “Standard Occupational Classification System of the Republic of China” for detailed descriptions of the four skill levels (DGBAS, 2011).

Therefore, we classified industries into 19 sections and occupations into 10 sections to discuss the openness of recruiting aged workers in different industries and occupations. In actuality, combining industry and occupation distributions (19×10=190 sections) to analyze the openness of employment produces more accurate results on the employment accessibility of aged workers. However, an immense sample size is required to support this approach.

The “2010 Population and Housing Census” contains 17 million valid samples. However, it does not provide data concerning years of employment. Therefore, the Hutchens Index cannot be used to discuss the openness of recruiting aged workers in different industry and occupation distributions. Alternatively, we analyzed the OS by age conditions in 2010.

Table 1. Standard Occupational Classification System of the Republic of China

Occupation	Skill Level
1 Legislators, Senior Officials, and Managers	4
11 Legislators, Senior Officials, and Chiefs	
12 Administrative and Commercial Managers	
13 Production and Specialized Services	
14 Hospitality, Retail, and Other Establishments Services Managers	3
2 Professionals	4
3 Technicians and Associate Professionals	3
4 Clerical Support Workers	2
5 Service and Sales Workers	
6 Skilled Agricultural, Forestry, and Fishery Workers	
7 Craft and Related Trades Workers	
8 Plant and Machine Operators and Assembly Workers	1
9 Elementary Laborers	
0 Armed Forces Occupations	-

Source: Standard Occupational Classification System of the Republic of China (DGBAS, 2011)

3.2 Occupational Segregation by Age

Similar to occupational segregation by gender or race, Hutchens (1991) created age-specific OS curve to illustrate the difference between the industry-occupation distribution of people in different age groups (young and old). These curves were used to calculate the Gini coefficient and determine the degree of segregation.

Assume that T=number of occupations and i=number of groups. x_{ij} represents the

number workers in the j^{th} occupation of the i^{th} group. Assume that $i=1$ or 2 , where 1 represents young workers, and 2 represents aged workers and that $T=1, 2$, or 3 . In the matrix below (y_A), T1, T2, and T3 comprised 1, 10, and 7 young workers and 2, 1, and 6 aged workers, respectively.

$$y_A = \begin{bmatrix} 1 & 10 & 7 \\ 2 & 1 & 6 \end{bmatrix}$$

In the matrix below (y_B), T1, T2, and T3 comprised 3, 5, and 12 young workers and 3, 7, and 4 aged workers, respectively.

$$y_B = \begin{bmatrix} 3 & 5 & 12 \\ 3 & 7 & 4 \end{bmatrix}$$

The preceding two matrices can be converted into proportions when attempting to resolve the problem, “Which matrix has a more uniform occupation distribution based on age composition?” The proportions can then be illustrated as two relative segregation curves (Hutchens, 1991). We used y_A as an example to explain the illustration of the segregation curve.

Let $s_{ij} = \frac{x_{ij}}{\sum_{j=1}^T x_{ij}}$, $i=1,2; j=1,2,\dots,T$, represent the number of people in the i^{th} group of the j^{th} occupation. First, arrange the relative ratio of the two groups of people in the i^{th} occupation (s_{1j}/s_{2j}) from lowest to highest. Then, plot the accumulated occupation proportion of the first (young workers) and second (aged workers) groups on the horizontal and vertical axes.

When $y_A = \begin{bmatrix} 1 & 10 & 7 \\ 2 & 1 & 6 \end{bmatrix}$, $y_A^* = s_1; s_2 = \left[\left(\frac{1}{18}, \frac{10}{18}, \frac{7}{18} \right); \left(\frac{2}{9}, \frac{1}{9}, \frac{6}{9} \right) \right]$.

Let $q_j(x) = \frac{s_{1j}}{s_{2j}}$ and $Q_A(x) = [q_1, q_2, \dots, q_T] = \left[\frac{1}{4}, 5, \frac{7}{12} \right]$, where $Q'_A(x) = \left[\frac{1}{4}, \frac{7}{12}, 5 \right]$ after arrangement. Therefore, the three sets of coordinates for drawing the curve were

$\left(\frac{1}{18}, \frac{2}{9} \right), \left(\frac{8}{18}, \frac{8}{9} \right), \left(\frac{18}{18}, \frac{9}{9} \right)$. Similarly, $y_B^* = \left[\left(\frac{3}{20}, \frac{5}{20}, \frac{12}{20} \right); \left(\frac{3}{14}, \frac{7}{14}, \frac{4}{14} \right) \right]$, and the three sets of coordinates were $\left(\frac{5}{20}, \frac{7}{14} \right), \left(\frac{8}{20}, \frac{10}{14} \right), \left(\frac{20}{20}, \frac{14}{14} \right)$.

The occupation distribution of y_A and y_B based on age composition is illustrated in Fig. 2.

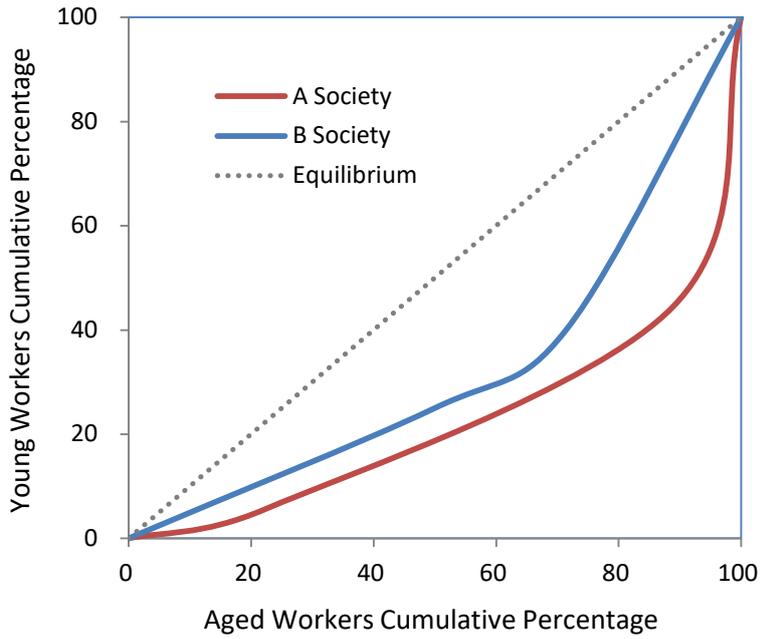


Figure 2. The Age-Specific OS Curve

Assuming that in every occupation, the population of aged workers was relatively similar to the population of young workers ($q_1(x)=q_2(x)=q_3(x)$), then the cumulative percentage of aged workers in the k^{th} occupation would always be consistent with that of young workers in the same occupation, and the segregation curve would be the OA line illustrated by the OA line in Fig. 3. As the curve deviates from the IA line, the unevenness of the distribution increases. Thus, the segregation curve provides a preliminary answer to “Which matrix has a more uniform occupation distribution based on age composition?” If all the nodes (occupations) of the y_B curve are below the y_A curve, then y_A achieves a more uniform distribution. If the two curves cross over, then uniformity cannot be determined by visually analyzing the curves.

Once the segregation curves were produced, we calculated the “Gini coefficient” to determine the degree of segregation. The Gini coefficient ranges between 0 and 1, where a value closer to 0 denotes increased uniformity (Hutchens, 1991).

$$G = 1 - \sum_{i=1}^T (s_{1i})(s_{2i} + 2 \sum_{j=i+1}^T s_{2j})$$

IV. Openness to Recruit Aged Workers and Occupational Segregation by Age

We used the “Report on the Manpower Utilization Survey” between 2002 and 2013 to determine the industry and occupation distribution of middle-aged and older workers. The same data were used to analyze the openness of recruiting aged workers. Finally, we used the “2010 Population and Housing Census” to analyze workers’ age-specific OS conditions.

4.1 Industry and Occupation Distribution of Middle-Aged and Older Workers

A. Industry Distribution

Table 2 shows that before the age of 55, men were largely employed in the “Manufacturing,” “Construction,” and “Wholesale and Retail” industries (shaded fields). However, the proportion of male workers in the “Agriculture, Forestry, Fishery, and Husbandry” industry increased exponentially after the age of 60. Workers in the “Agriculture, Forestry, Fishery, and Husbandry” industry are largely self-employed, and the retirement age in this industry is relatively inconsistent. Therefore, almost half of the male population worked in the “Agriculture, Forestry, Fishery, and Husbandry” industry after the age of 65, followed by the “Wholesale and Retail” and “Manufacturing” industries. Notably, a relatively smaller proportion of men was employed in the “Health and Social Welfare” industry. However, this proportion steadily increased with age, indicating that the retirement age of professional workers was higher than other workers.

Before the age of 55, women were largely employed in the “Manufacturing,” “Wholesale and Retail,” and “Accommodation and Catering” industries. Similar to men, the proportion of female workers in the “Agriculture, Forestry, Fishery, and Husbandry” industry increased exponentially after the age of 55. Forty percent of women over the age of 65 worked in the “Agriculture, Forestry, Fishery, and Husbandry,” followed by the “Wholesale and Retail,” “Manufacturing,” and “Accommodation and Catering” industries. In addition, the proportion of women in the “Health and Social Welfare” was higher than that of men in all age groups before the age of 65. However, “Health and Social Welfare”

industry exhibited a slight decrease in the proportion of female workers with age, implying that the majority of women in the “Health and Social Welfare” assume an entry-level position with little ambition or qualification for delayed retirement. The occupation distribution conditions reinforce the observations on industry distribution.

Table 2. Industry Distribution of Middle-Aged and Older Workers in Taiwan between 2002 and 2013

Industry	Men						Women					
	45-49	50-54	55-59	60-64	65-69	70+	45-49	50-54	55-59	60-64	65-69	70+
Agriculture, Forestry, Fishery, and Husbandry	6.10	8.67	14.43	28.73	46.46	58.65	4.19	6.92	13.92	29.20	42.98	52.24
Mining and Quarrying	0.11	0.11	0.09	0.10	0.07	0.15	0.06	0.01	0.04	0.04	0.00	0.00
Manufacturing	26.64	24.68	20.55	13.05	8.29	4.72	25.16	21.55	16.83	11.61	7.99	3.36
Electricity and Gas	0.51	0.74	1.10	0.88	0.12	0.00	0.09	0.12	0.26	0.29	0.00	0.00
Water Supply and Remediation	0.99	1.29	1.50	0.81	0.28	0.10	0.82	0.88	0.93	0.86	0.20	0.13
Construction	15.21	14.55	12.34	7.90	3.72	0.85	2.86	2.72	2.11	1.69	0.73	0.16
Wholesale and Retail	14.63	14.77	14.95	16.18	18.07	17.24	18.09	18.96	19.79	20.30	26.28	31.33
Transportation and Warehousing	6.92	7.29	7.64	6.17	2.89	0.65	1.99	1.92	1.89	1.51	0.26	0.00
Accommodation and Catering	4.26	4.18	4.22	4.51	3.43	2.47	10.22	11.13	11.28	9.87	7.82	6.51
Information and Communication	1.54	1.58	1.49	0.91	0.49	0.29	1.08	1.03	0.57	0.52	0.10	0.00
Finance and Insurance	2.37	1.87	1.91	1.39	0.41	0.20	5.08	4.74	3.84	2.61	0.63	0.00
Real Estate	0.75	0.76	0.62	0.54	0.31	0.59	0.73	0.35	0.39	0.18	0.00	0.00
Professional, Scientific and Technical Services	2.78	1.98	2.08	1.69	2.28	1.19	2.54	2.11	1.98	1.74	1.47	0.29
Support Services	2.33	2.66	3.25	3.24	2.40	0.90	2.56	2.98	3.16	2.64	2.02	0.17
Public Administration and Defense; Compulsory Social Security	4.56	4.48	4.05	3.38	1.81	1.68	4.13	5.06	4.75	2.74	0.47	0.21
Education	3.62	3.39	3.29	2.95	1.38	0.93	8.46	7.42	5.62	3.02	0.44	1.21
Health and Social Welfare	1.94	1.76	1.73	1.72	2.27	3.40	4.14	4.29	3.66	2.97	1.78	0.91
Art, Entertainment, and Recreation	0.72	0.70	0.49	0.61	0.70	0.48	1.26	1.12	0.96	0.73	0.54	0.00
Other Services	4.04	4.52	4.27	5.24	4.65	5.52	6.53	6.71	8.03	7.49	6.29	3.48
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: “Report on the Manpower Utilization Survey” (2002 to 2013)

Note: Shaded fields are the top three industries. Unit: Percentage

B. Occupation Distribution

Before the age of 55, the top three professions for men were “Craft and Related

Trades Workers,” “Plant and Machine Operators and Assembly Workers,” and “Technicians and Associate Professionals.” These results were consistent with the industry distribution observations. The proportion of “Skilled Agricultural, Forestry, Fishery, and Husbandry Workers” increased exponentially after the age of 55, reaching roughly half of all male workers after the age of 65, followed by “Service and Sales Workers” and “Legislators, Senior Administrators, Business Executives, and Managers.”

Before the age of 55, the top three professions for women were “Service and Sales Workers,” “Technicians and Associate Professionals,” and “Clerical Workers.” The proportion of “Skilled Agricultural, Forestry, Fishery, and Husbandry Workers” increased exponentially after the age of 55, reaching roughly 40% after the age of 65, followed by “Service and Sales Workers” and “Unskilled and Manual Workers.” Dissimilar to men, the rank of “Legislators, Senior Administrators, Business Executives, and Managers” for women exhibited no significant increases. Rather, a significant increase was exhibited in “Unskilled and Manual Workers,” implying that financial hardship was the employment motivator for female workers in this group.

Table 3. Occupation Distribution of Middle-Aged and Older Workers in Taiwan between 2002 and 2013

Occupation	Gender/Age		Men					Women				
	45-49	50-54	55-59	60-64	65-69	70+	45-49	50-54	55-59	60-64	65-69	70+
Legislators, Senior Administrators, Business Executives, and Managers	9.29	9.52	9.59	9.28	7.89	7.06	3.34	2.88	3.82	3.11	1.73	1.62
Professionals	6.49	5.32	5.14	5.04	3.95	4.13	7.52	6.28	4.04	2.66	0.74	1.04
Technicians and Associate Professionals	17.29	15.55	13.58	8.85	4.51	2.41	18.01	15.91	11.90	7.52	2.95	1.32
Clerical Workers	3.78	3.51	3.22	2.90	1.35	0.96	15.60	13.30	10.72	6.47	2.55	0.98
Service and Sales Workers	14.84	14.91	15.36	17.30	20.10	17.85	24.95	27.11	28.77	29.45	33.14	33.46
Skilled Agricultural, Forestry, Fishery, and Husbandry Workers	5.90	8.40	14.22	28.45	46.08	58.44	3.97	6.49	13.40	28.03	42.39	51.47
Craft and Related Trades Workers	19.55	19.14	15.73	9.83	4.82	1.82	3.44	3.41	3.66	2.12	2.67	1.82
Plant and Machine Operators and Assembly Workers	18.16	17.80	15.79	11.10	5.89	2.31	13.92	12.32	9.24	6.16	3.19	1.42
Unskilled and Manual Workers	4.71	5.86	7.36	7.26	5.40	5.02	9.26	12.31	14.46	14.49	10.63	6.86
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: “Report on the Manpower Utilization Survey” (2002 to 2013)

Note: Shaded fields are the top three industries. Unit: Percentage

C. Current Status of Newly Employed Workers

Only a small percentage of newly employed workers were aged 45 or older (workers that have worked less than 17 months), roughly 5%. In terms of the level of education (Table 3), the majority of male workers under the age of 55 were in the “High School/Vocational High School” and “College/University” groups. By comparison, the majority of male workers over the age of 55 were in the “Elementary School/Illiterate” group. Similar trends were exhibited in female workers. The majority of workers between the ages of 45 and 49 were in the “High School/Vocational High School.” The number of workers in the “Elementary School/Illiterate” group increased with age. An unstable employment situation can be confirmed when the majority of new aged workers are those with low human capital.

Table 4. The Level of Education of Newly Employed Middle-Aged and Older Workers in Taiwan between 2002 and 2013

Gender/Age Education	Men						Women					
	45-49	50-54	55-59	60-64	65-69	70+	45-49	50-54	55-59	60-64	65-69	70+
Elementary School/Illiterate	13.02	23.61	35.87	50.52	48.01	65.81	22.37	36.63	51.51	69.60	67.19	100.00
Junior High School	23.66	18.33	16.01	9.66	18.45	5.14	21.06	18.35	11.84	8.08	19.25	0.00
High School/Vocational High School	34.50	28.78	22.15	19.03	17.23	0.00	37.78	28.70	18.95	13.62	9.82	0.00
College/University	25.10	25.81	23.09	17.34	10.85	26.83	17.25	14.99	15.72	7.87	3.74	0.00
Graduate Institute	3.73	3.47	2.88	3.44	5.45	2.23	1.53	1.34	1.98	0.84	0.00	0.00
Total	100	100	100	100	100	100	100	100	100	100	100	100

Source: “Report on the Manpower Utilization Survey” (2002 to 2013)

Unit: Percentage

Besides the “Agriculture, Forestry, Fishery, and Husbandry” industry, the industry occupation distribution of newly employed workers was similar to that of workers aged 45 and older (unlisted data). Differences were found in the occupation distribution data. The differences between the occupation distribution of newly employed middle-aged and older workers and all the middle-aged and older workers in Taiwan are tabulated in Table 5. We divided the occupation distribution proportion of newly employed workers by the occupation distribution proportion of all workers in the corresponding age groups (relative risk rate). A value greater than 1 implied that the probability of newly employed middle-aged and older workers assuming a specific occupation was higher than general middle-aged and older workers.

Table 5 shows that the proportion of newly employed workers in the “Agriculture, Forestry, Fishery, and Husbandry” industry was far smaller than that of all workers. A smaller difference was exhibited between newly employed male workers and all male workers between the ages of 45 and 54. All other age groups achieved a value of 0.5 or less, suggesting that the probability of new workers assuming specific roles was less than half that of general middle-aged and older workers. By comparison, the proportion of newly employed workers in the “Unskilled and Manual Workers” was significantly higher than general workers, achieving an average value of 2 in all age groups and genders. These results suggest that the probability of newly employed workers becoming unskilled and manual workers was twice that of general middle-aged and older workers. The reason for the high proportion of the aged population in the “Agriculture, Forestry, Fishery, and Husbandry” industry is because unlike other occupations, the occupations in this industry do not have fixed retirement ages, resulting in “Agriculture, Forestry, Fishery, and Husbandry” becoming the industry with the largest employment population. However, this trend was not observed in newly employed aged workers, implying that newly employed aged workers seldom secure employment in this industry. The majority of newly employed aged workers are concentrated in the “Unskilled and Manual Workers” and “Service and Sales Workers.” These professions require little to no professional skill and offer low salaries. This trend is particularly evident among newly employed women over the age of 60, with roughly 70% distributed between the “Unskilled and Manual Workers” and “Service and Sales Workers” groups (unlisted data; calculable using Table 3 and Table 4).

A notable observation in Table 5 was the relative radicalization of the occupation distribution of newly employed workers over the age of 65. The likeliness of newly employed male professionals (highest skill level; Table 1) was four-times that of general middle-aged and older professionals. Although this trend was slightly less evident for the 65 to 69 age group, the relative ratio was greater than 1 (2.10 and 3.62 for men and women, respectively). “Clerical Workers” and “Plant and Machine Operators and Assembly Workers” were also popular occupations. The skill requirements for these occupations are relatively low. However, the computerization of modern jobs demands a specific level of education. Another popular occupation was “Unskilled and Manual Workers.” This occupation has the lowest skill requirement, implying that the M-form

occupation distribution after the retirement age was far more obvious than before the retirement age.

Table 5. Differences in the Occupation Distribution of Newly Employed Middle-Aged and Older Workers in Taiwan between 2002 and 2013

Occupation	Men						Women					
	45-49	50-54	55-59	60-64	65-69	70+	45-49	50-54	55-59	60-64	65-69	70+
Legislators, Senior Administrators, Business Executives, and Managers	0.62	0.65	0.47	0.66	0.10	0.51	0.51	0.39	0.68	0.93	0.00	0.00
Professionals	0.56	0.80	0.87	1.47	2.10	5.14	0.48	0.39	0.69	0.77	3.62	0.00
Technicians and Associate Professionals	1.02	0.83	0.93	0.72	1.10	0.00	0.73	0.78	0.88	0.44	1.36	1.86
Clerical Workers	1.32	1.28	1.47	1.24	2.50	4.09	0.65	0.46	0.84	0.75	2.44	0.00
Service and Sales Workers	1.31	1.37	1.28	1.23	1.61	1.60	1.27	1.26	1.03	0.92	0.86	2.03
Skilled Agricultural, Forestry, Fishery, and Husbandry Workers	0.70	0.65	0.41	0.40	0.26	0.22	0.37	0.30	0.32	0.39	0.11	0.10
Craft and Related Trades Workers	0.68	0.67	0.71	0.69	0.73	0.00	0.66	0.55	1.21	0.77	2.90	0.00
Plant and Machine Operators and Assembly Workers	1.06	0.95	0.79	1.00	2.41	5.13	1.09	0.94	0.74	0.89	1.33	0.00
Unskilled and Manual Workers	2.50	2.83	3.32	3.58	3.82	3.54	2.25	2.32	2.07	2.88	3.95	3.54

Source: "Report on the Manpower Utilization Survey" (2002 to 2013)

Explanation: Occupation distribution proportion of "new workers" divided by the occupation distribution proportion of all workers. The shaded fields indicate that the proportion of "new workers" is twice that of "general workers." The bold fields indicate that the proportion of "new workers" is half that of "general workers" (0.5 or less).

4.2 Occupational Segregation by Age

A. Openness of Recruiting Aged Workers in Different Industries

We adopted the Hutchens Index (Hutchens, 1986) to measure the openness of recruiting aged workers in different industries in Taiwan. An index value greater than one denotes that the industry is open to employing middle-aged and older workers as new workers, whereas an index value less than 1 denotes that the industry denies the employment of middle-aged and older workers as new workers. Considering the sample size, we combined the industries into three collective industries, namely, the primary industry (agriculture, forestry, fishery, and husbandry), secondary industry (mining, manufacturing, plumbing, electricity, and construction), and tertiary industry (business and services). After merging the industries, many occupations still had insufficient samples to apply the Hutchens Index. Therefore, we adopted the definition of "newly employed

workers” used by a number of previous studies (Heywood et al., 2010, Hirsch, 2000; Hutchens, 1986; Hutchens, 1988; Daniel & Heywood, 2007; Adams & Heywood, 2007); that is, “workers that have worked less than five years in their current job.”

The index values for all professions in all industries were less than 1 (Table 6), suggesting that the middle-aged and older workers were unwelcome in the entire employment market. If an index value of 0.6 and higher were considered “relatively less unwelcome” (shaded fields), the most probably reemployment occupations for middle-aged and older people were distributed in the two extremes, namely, “Legislators, Senior Administrators, Business Executives, and Managers” and “Unskilled and Manual Workers.” In the Secondary Industry, “Service and Sales Workers” and “Skilled Agricultural, Forestry, Fishery, and Husbandry Workers” were the most welcoming occupations. Overall, “Legislators, Senior Administrators, Business Executives, and Managers” and “Unskilled and Manual Workers” were the most welcoming occupations for middle-aged and older people. These results verify the M-form occupation distribution of middle-aged and older workers.

Table 6. Openness to Recruit Middle-Aged and Older Workers in Different Industries in Taiwan (Hutchens Index, 2002–2013)

Industry	Occupational Section									Total
	1	2	3	4	5	6	7	8	9	
Men										
Primary Industry	0.61	0.00	0.54	0.31	0.64	0.53	0.62	0.67	0.81	0.53
Secondary Industry	0.59	0.34	0.38	0.41	0.84	0.75	0.43	0.43	0.73	0.43
Tertiary Industry	0.68	0.33	0.43	0.48	0.53	0.85	0.29	0.55	0.75	0.51
Total	0.64	0.31	0.41	0.46	0.54	0.53	0.40	0.47	0.75	0.46
Women										
Primary Industry	-	0.00	0.00	0.25	0.61	0.51	0.46	0.59	0.69	0.50
Secondary Industry	0.48	0.40	0.30	0.27	0.81	0.62	0.57	0.53	0.70	0.49
Tertiary Industry	0.65	0.29	0.42	0.35	0.55	0.59	0.59	0.67	0.87	0.53
Total	0.61	0.29	0.40	0.33	0.55	0.51	0.57	0.53	0.82	0.50

Source:” Report on the Manpower Utilization Survey” (2002 to 2013)

Explanation: The Hutchens Index refers to the difference between the proportion of newly employed middle-aged and older workers and all middle-aged and older workers in specific industries and occupations. New workers refer to workers with less than five years work experience in a single occupation. “-” refers to no available samples.

Occupation Section: 1 = Legislators, Senior Administrators, Business Executives, and Managers; 2 = Professionals; 3 = Technicians and Associate Professionals; 4 = Clerical Workers; 5 = Service and Sales Workers; 6 = Skilled Agricultural, Forestry, Fishery, and Husbandry Workers; 7 = Craft and Related Trades Workers; 8 = Plant and Machine Operators and Assembly Workers; 9 = Unskilled and Manual Workers.

B. Occupational Segregation by Age

The occupation statistics of young, middle-aged, and older published in the “2010 Population and Housing Census” were used to illustrate the age-specific OS curves. The Gini coefficient was used to measure the segregation index. The curves are illustrated in Fig. 4, along with the segregation indices based on gender and region. The age-specific OS of women was higher than men (the Gini coefficient for men was 0.22, and that for women was 0.29), suggesting that the women’s occupation distribution exhibited significant generational differences. However, the distance between the two curves was relatively close and ran parallel, implying that age differences of occupation distribution did not interact with gender. In other words, occupation age differences were present in both men and women. From the perspective of region, age-specific OS gradually increased in the sequential order of Northern Taiwan, Southern Taiwan, Eastern Taiwan, and surrounding islands (Gini coefficients=0.23, 0.26, 0.28, and 0.33, respectively). Similarly, the curves ran parallel, suggesting that the age differences of occupation distribution did not interact with region. Overall, the Gini coefficients of age-specific OS in Taiwan were similar to those in the United States between 1983 and 1998 (Hirsch et al., 2000).

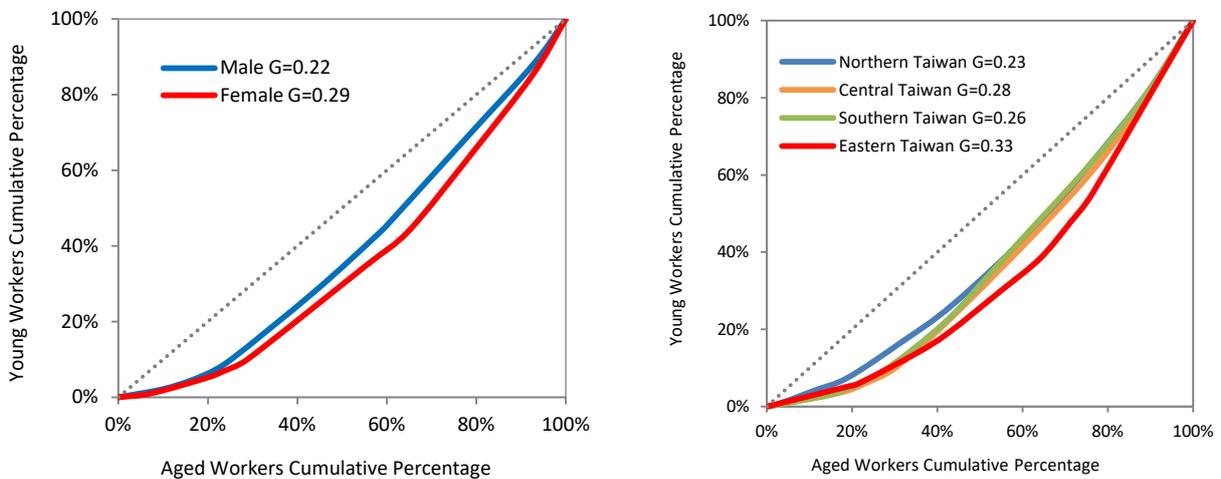


Figure 4. The Age-Specific OS Curves of Taiwan (2010)

From the perspective of industry, the lowest uniformity between the occupation distributions of middle-aged and older workers and young workers was in “Support Services” (e.g., rental, labor recruitment and supply, travel and reservation, security and

investigation, green construction and services, and sales and office support). Other industries also manifested differences. However, these differences were less obvious than those exhibited in the “Support Services” industry. The industries with the lowest age-specific OS were the “Agriculture, Forestry, Fishery, and Husbandry” and “Accommodation and Catering” industries.

Table 7. Age-Specific OS Index Based on Industry (2010)

Industry	Segregation Index	Industry	Segregation Index	Industry	Segregation Index
Agriculture, Forestry, Fishery, and Husbandry	0.087	Transportation and Warehousing	0.179	Support Services	0.350
Manufacturing	0.254	Accommodation and Catering	0.107	Public Administration and Defense; Compulsory Social Security	0.232
Construction	0.146	Information and Communication	0.267	Education	0.218
Other Industrial Services *	0.125	Finance, Insurance, and Real Estate	0.195	Health and Social Welfare	0.216
Wholesale and Retail	0.137	Professional, Scientific and Technical Services	0.161	Art, Entertainment, Recreation, and Other Services	0.161

Source: “Population and Housing Census” (2010)

Explanation: *Other industrial services include mining and quarrying, electricity and gas, water supply and remediation

V. Conclusion

The present study aimed to elucidate the industry and occupation distribution conditions of middle-aged and older workers. The Hutchens Index was adopted to measure the openness of recruiting aged workers in the various industries in Taiwan. Moreover, age-specific OS curves were illustrated to extrapolate whether aged workers are being segregated into specific occupation classifications. The findings indicated that before the age of 55, the industries with the most male workers were “Manufacturing,” “Wholesale and Retail,” and “Construction,” and those with the most female workers were “Accommodation and Catering.” After the age of 60, workers were concentrated in “Agriculture, Forestry, Fishery, and Husbandry.”

In terms of occupation, the majority of jobs are skill level 2 jobs that do not require workers to be extremely skilled (total of four skill levels; Table 1). After the retirement age, the proportion of male workers in the “Legislators, Senior Administrators, Business

Executives, and Managers” increased. By comparison, the proportion of female workers in the “Unskilled and Manual Workers” increased, suggesting that many male workers continued their professional career after reaching the retirement age, but financial hardship was the employment motivator for female workers in this group. Newly employed workers (workers that have worked less than 17 months) were largely distributed in the “Unskilled and Manual Workers” and “Service and Sales Workers” groups, which contained low-skill, low-salary jobs. As workers grow older, “popular jobs” further expand to the “Professionals” group, which contain jobs with high skill demands, and the “Clerical Workers” and “Plant and Machine Operators and Assembly Workers” groups, which contain jobs that demand a specific level of computer skills, implying that the M-form occupation distribution after retirement age was far more obvious than before retirement age.

In terms of the openness of recruiting aged workers, the index values for all professions in all industries were less than 1, suggesting that the middle-aged and older workers were unwelcome in the entire employment market. “Legislators, Senior Administrators, Business Executives, and Managers” and “Unskilled and Manual Workers” were the most welcoming occupations for middle-aged and older people. These results verify the M-form occupation distribution of middle-aged and older workers.

Finally, the age-specific OS curves show that the age-specific OS of women was slightly higher than that of men. Moreover, the curves ran parallel, implying that age differences of occupation distribution did not interact with gender. From the perspective of region, age-specific OS gradually increased in the sequential order of Northern Taiwan, Southern Taiwan, Eastern Taiwan, and surrounding islands. Similarly, the curves ran parallel, suggesting that the age differences of occupation distribution did not interact with region.

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