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Rapid Economic Development and Job Segregation in Taiwan

Scott M. Fuess Jr. · Jack W. Hou

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Abstract Most segregation studies have focused on industrialized nations where the economic structure is stable. However, when an economy experiences rapid development, the changing nature of industries and occupations may have a profound impact on gender segregation. This study uses a rapidly developing economy—Taiwan—to examine this issue. Based on the *Yearbook of Manpower Survey Statistics*, the gender representation was stable across industries and job status during the study period (1978–1997). However, occupation segregation increased dramatically. Rather than signaling a rise in discrimination, we find evidence that points to a benign, welfare improving self-selection, rather than gender discrimination. We speculate that this demonstrates occupation choice of women is more family-oriented when economic growth and development allows them this luxury.

Keywords Discrimination · Gender · Occupation · Segregation · Taiwan

S. M. Fuess Jr.
Department of Economics, University of Nebraska, Lincoln, NE, USA
e-mail: sfuess1@unl.edu

S. M. Fuess Jr.
Institute for the Study of Labor (IZA), Bonn, Germany

J. W. Hou (✉)
Department of Economics, California State University, Long Beach, CA, USA
e-mail: jackhou@csulb.edu

J. W. Hou
School of Economics, Nankai University, Tianjin, China

Gender equality has been an increasingly important issue since the mid 20th century. Differential treatment by gender can be in the form of political, cultural, or economic disparities. The former two typically result in human rights abuse, and lesser social status for women. In terms of economics, we usually focus on the earnings gap or the issue of an unlevel playing field where women suffer from disadvantaged or more restricted opportunity sets. Of which, the earnings differential has been studied extensively for the U.S. and for many other economies. The reason is obvious. It is more blatant, more sensational (headline material), and the data is far more feasible. The issue on the inequality of opportunities is less studied precisely for the opposite reason; it is subtler, harder to fit into sound-bytes, and much of the information needed is absent.

In the last two decades, several advances have been made to analyze the issue of unequal opportunities. A growing literature has spun on Industrialized Countries (ICs) and Less Developed Countries (LDCs), with fairly consistent results: ICs exhibit a relatively level playing field compared to LDCs. However, the literature has neglected the possible effect of economic development on this equality of opportunities. Most ICs reached full economic development long before the gender issue became popular; just like most LDCs remained less developed both before and after the emergence of the gender equality debate.

However, there is a new class of economies that may offer us an opportunity to examine the effect of economic development on the issue of gender equality. These economies ascended from LDCs to the rank of Newly Industrialized Countries (NICs) during the last quarter of the 20th century. By these, obviously, we imply the Four Small Dragons: Hong Kong, Singapore, South Korea, and

Taiwan. As argued by many researchers (e.g., Hou 1993), the quality of the labor data in Taiwan is truly outstanding. In light of this, and other reasons that will become more evident later, we chose to examine Taiwan as our case study for the effect of economic development on gender segregation in the labor market. However, in terms of time series, we limit ourselves to data up to 1997. The reason is twofold. First, there was a tremendous increase in the number of Bachelor granting institutions in the 1990s,[1] which has caused havoc in the labor market (Wang 2003). Second, since 1997 Taiwan has had a stagnant economy. It started with the East Asia financial crises, followed by the stalemate/confrontation of Taiwan's relationship with China. The "cold war" across the Taiwan Strait has persisted to this day. Although, the landslide victory of the opposition Nationalist Party (KMT) in both the Legislature Yuan re-election (January 2008) and the Presidential election (March 2008) signaled that the Taiwanese people are frustrated with the economic stagnation and demand a new direction in their polity. Due to these factors, significant complications have been introduced since 1997, and we are not certain whether this can be dealt with in the macro time series data that we are employing. To limit the complication in interpretation, we restrict our sample to available data before 1997.

The remainder of the paper is organized as follows. In the "Literature Review" we review the literature that has examined labor market segregation in Taiwan. This is followed by a discussion of why we have chosen to study gender segregation in Taiwan, and our proposition on the effect of economic development. An outline of the methodology and the empirical evidence will be presented in the sections "Segregation in the Labor Market" and "Factors Affecting Segregation". The final section will provide a summary, present conjectures, and show the need for further studies.

Literature Review

Taiwan's economic performance in the past few decades has been impressive. Between the early 1950s and 1990s, expansion of real gross domestic product (GDP) per capita averaged more than 6.5% per year.[2] Indeed, Taiwan has transformed from a developing economy to a wealthy, industrialized one. Other Asian countries have experienced rapid expansion, but Taiwan continues to sustain one of the fastest rates of growth in the world. This progress has led scholars of economic development to study Taiwan in detail, to examine the factors that caused its rapid growth. There are also relevant insights for economists in other fields. The combination of Taiwan's rapid development and its relatively unregulated labor markets (neither minimum wage, affirmative action, nor anti-discrimination laws) provides an opportunity to investigate the purer aspects of labor market discrimination.

As in so many countries, the average earnings of female workers in Taiwan have been less than those of male workers. Researchers have sought to explain how much of this gender wage gap can be explained by economic factors—for example, work experience—with the residual illustrating the possible extent of wage discrimination. Using 1989 micro wage data for Taiwan, Kao et al. (1994) found that the bulk of wage differentials can be explained by "differences in human capital stock accumulation based on differences in expected lifetime labor force participation" (p. 369). They concluded that "lifetime work incentives" explain most wage differentials and predicted that "male and female wage differences will narrow as long as labor force participation rates among females are secularly increasing relative to those of males" (p. 372).

The finding that females in Taiwan earn less than males mostly because they invest less in human capital raises another question about possible discrimination. Have women invested less in human capital because they face unfavorable employment opportunities? The profile of workers changes greatly as an economy experiences rapid development. The focus of economic activity shifts from agriculture to manufacturing and then to services, especially information-based services. As the nature of industries and occupations has changed in Taiwan, how have employment patterns been affected? Part of the gender wage gap—even that part which can be explained by differences in work experience—could be due to job segregation. Women working in a particular industry or occupation may be paid on an equal basis with men. Nevertheless, women may tend to select or be crowded into industries or occupations that pay relatively low wages.

Using survey data for 1982, Gannicott (1986) reported that at least one-third of the gender wage gap could be explained by male–female differences in "work endowments," which include differences in industries and occupations worked. He also reported that 40% of the unexplained portion of the wage gap could be accounted for by gender-specific differences in work endowments. Consequently, he argued that a sizable component of gender wage differentials could be due to job segregation.

[1] In 1985, there were just 27 such institutions, but it increased by 70% to 46 in 1990, and further increased to 60 in 1995. In 1995, the Ministry of Education further "reformed" higher education regulations, which resulted in a surge of new bachelor granting institutions, resulting in 127 universities and 4-year colleges by 2000.

[2] Accounting for the relative expansion of transaction costs, Fuess and van den Berg (1996) found that Taiwan nevertheless experienced substantial total factor productivity growth.

Gannicott's study reflects only a single point in time, 1982, a year in which Taiwan's economic growth was comparatively slow. Besides the 1974 oil shock, in 1982 Taiwan registered its worst yearly growth rate in more than three decades. Gannicott's findings could reflect the relatively sluggish nature of the economy. In other rapidly growing Asian economies (for example, South Korea and Japan) female labor has been used as a buffer stock. During periods of economic expansion employment for women may rise relatively quickly as employers seek to avoid labor shortages, especially in manufacturing. Conversely, during periods of sluggish growth or recession employers may discriminate against women by adjusting female employment more than that of men.[3] By focusing on a slow-growth year for Taiwan, when job discrimination against women might have been pronounced, Gannicott's study may overstate the role of workplace segregation in wage discrimination.

With data covering a longer time period, 1978–1985, Hou (1991) reported a different result about the influence of job discrimination. He found that little of the unexplained portions of the gender wage gap could be attributed to occupational segregation or concentration of women in relatively low paying industries. Over this eight-year period, Taiwan's economy averaged a relatively brisk 7.5% (1982 notwithstanding) annual growth rate, with a 9.6% expansion in 1984. If the buffer stock relationship holds, there should have been comparatively little job segregation over this stretch.

Methodology and Propositions

Differential treatment across gender can be in the form of political, cultural, or economic disparities. Economic disparities can be due to an earnings differential or disparity in economic opportunity. The latter is less studied for a variety of reasons, as we have stated in the introduction. Here, we employ the Duncan & Duncan Index (DDI) (Duncan and Duncan 1955) to measure the degree of segregation in the job market. The technical details of the DDI are discussed in the next section. As with many economic indices, the DDI is subject to the ceteris paribus assumption. Among others, the DDI is a good measure of gender segregation if and only if both the job market structure and gender preferences remain stable. Though the latter may change over time, the concern here is the former.

Since its inception, the DDI has been used extensively to study gender segregation for industrialized countries (IC) and for less developed countries (LDC). The results were as expected; ICs tend to have a more integrated labor market compared to LDCs, and the U.S. is less segregated than Japan, but is not as good as many Western European countries. This index is essentially sound for ICs, as their economic structures have long matured (stabilized). It is somewhat suspect for LDCs, but generally acceptable if it has not progressed significantly during the sample period.

However, the DDI can be very misleading for the NICs (Newly Industrialized Countries), as they have undergone dramatic structural change: namely, they evolved from LDCs to become industrialized. As of now, the NICs typically refer to Hong Kong, Singapore, South Korea, and Taiwan, but there are many candidates waiting in the wings. Thus, accounting for "economic development" in the interpretation of the DDI has immediate relevance and ever increasing importance for the future as the LDCs strive for industrialization. In addition, this study also will further understanding of another category of countries: the former Socialist or Communist nations. As they would have undergone a radical political (rather than economic) structural change, the status of women in such economies is an open field needing investigative research.

It is well known that the *net* birth rate (*crude* birth rate minus infant mortality rate) exhibits an inverse U relationship with respect to socioeconomic development. Poor and less developed (a step above poor nations) economies have a much higher crude birth rate, but the poor economies also have a very high infant mortality rate, thus making the net birth rate for the less developed economies higher than that of the very poor nations. However, as the economy industrializes, the infant mortality rate continues to improve, but the crude birth rate drops substantially, thus leading to the aforementioned inverse U shape.

We suspect that occupational segregation may have similar traits. When the economy is under-developed, most jobs are in factories, where both men and women work together. As the economy develops and "takes off" (i.e., industrializes), the service sector emerges. Service jobs tend to have less overtime, have cleaner working conditions, and involve more personal contacts. Related to these is more flexible hours, thus allowing married females to handle both paid market work and the unpaid household production (Campione 2008). These are all characteristics that, perhaps, females value more than males. Then, we would see females leaving factories for the service sector, while men may disproportionately choose to stay. This would account for the observed segregation. It is likely that as the economy continues to develop, the manufacturing sector would decline as the service sector continues to grow, and the occupation distribution across gender may once more converge.

[3] On female labor as a buffer stock in South Korea, see Fuess and Lee (1994). In the case of Japan, see Hashimoto (1990), or Houseman and Abraham (1993).

The methodology is standard. For the measurement of segregation, we used the popular DDI. We then used regression analysis to examine the determinants of segregation. The explanatory variables included two binary dummy variables to account for the structural change of pre- and post-economic take-off, while the real GDP growth rate is used to filter out business cycle effects. The main focus was on the development variable: service sector as percentage of GDP.

As shown in the previous section, the results of the Gannicott and Hou studies indicate that there is an unresolved question about the extent of job segregation over time in Taiwan. Yet the degree of job segregation should be instrumental in assessing the extent of wage discrimination. This study analyzes employment patterns for women and men in Taiwan for a longer time frame than has been studied, namely 1978–1997. The sample period covers distinct phases in Taiwan's economic development. Although there had been relatively rapid growth before the mid-1980s, real GDP expansion accelerated greatly between 1984 and 1987, culminating in dizzying growth rates of 10.6% in 1986 and 12.4% in 1987. Given such frenzied expansion, we refer to the 1984–1987 stretch as Taiwan's "super boom", or the Rostovia take-off (Rostow 1960). The economy has since experienced less feverish growth, averaging 6.7% per year for 1988–1997. Thus, our study is more than a mere update of earlier research, as we can also examine how the gender distribution of employment across industries/occupations responds to phases of economic development (in contrast to economic "growth"). Starting with figures for female and male employment in general industrial categories, we calculated an index of segregation for each year between 1978 (the first year in Hou's original study) and 1997 (the year before the Asian financial crisis).[4] We investigated how female representation in industry groups changed over this 20-year span.

Even if female employment has not been confined to specific industries, jobs for women may have been concentrated in particular occupations. Using very broad categories for different types of work, we calculate an index of occupational segregation, examining how female representation changed in paid employment versus other, lower status work. Measuring segregation with the most general work status categories available provides a "lower bound" indicator of job discrimination. Suppose the proportion of females in regularly paying jobs increased, women still may have been confined to lower paying or otherwise less prestigious jobs. Using data for occupational groups, we compute another segregation measure to evaluate the concentration of women across fields of work.

We hypothesized that this perspective (segregation across occupation) may be most interesting. The traditional view of an increase in segregation is that it indicates an increased extent of labor market discrimination. This may be true in an economy at a steady state, but during rapid economic development, the story may be more complicated. A stylized fact of development is the emergence of the service sector. If there is a systematic difference in utility functions by gender, there could be self-selection leading to a rise in measured segregation.

If such an observed segregation does exist, it would be interesting to see whether it is driven by discrimination or by self-selection. In general, it is difficult to disentangle these two factors, yet the rapidly changing Taiwanese economy provides a valuable exogenous variation to separate these two factors. This is indeed what we try to achieve here. We also acknowledge the limitations of our data and will discuss options for additional research.

Segregation in the Labor Market

Measuring Segregation

To gauge crowding in different types of work, we used the well-known segregation measure developed by Duncan and Duncan (1955). For time period t, the index S_t is given by

$$0 \leq S_t = \sum_i | w_{it} - m_{it} | /2 \leq 100, \quad (1)$$

where w_{it} (m_{it}) is the percentage of women (men) in job category i. The index shows the percentage of women (or men) that would have to be reassigned to accomplish gender balance in each category. If the index is 100, there is absolute segregation; if it is 0, females and males are equally represented in each group.[5]

The segregation measure is sensitive to the extent work categories are aggregated, with greater aggregation resulting in a lower measure. For comparisons over time, the same number of similarly aggregated categories should be used (Beller 1985).

Segregation by Industry

To see whether employment patterns have changed across industrial sectors, we used Eq. 1 to calculate an index of industrial segregation (SII_t). In order to identify segregation at the broadest possible level, we used the most general industrial categories available over time. Taiwan's government publishes employment data in its *Yearbook of Manpower Survey*

[4] The Asian financial crisis has had a profound impact across the region, and indeed worldwide. We did not want the effect of this event to bias our estimates or conclusions.

[5] For discussion of the index and its properties, see Beller (1985), Fuchs (1989), and King (1992).

Table 1 Job segregation in Taiwan by industry—1978, 1986, 1995, 1997

Industrial Category	1978		1986		1995		1997	
	% of Females in:	% of Males in:	% of Fem.	% of Males	% of Fem.	% of Males	% of Fem.	% of Males
Agriculture, etc.	22.79	25.95	14.29	18.69	7.75	12.31	7.03	11.22
Mining and quarrying	0.44	1.24	0.02	0.58	0.09	0.23	0.06	0.30
Manufacturing	37.97	27.19	39.70	30.67	28.29	26.32	27.79	28.16
Electricity, gas, water	0.10	0.55	0.14	0.62	0.14	0.56	0.14	0.54
Construction	1.66	10.16	1.55	9.69	3.70	15.73	2.85	14.04
Commerce	16.79	14.27	20.30	16.22	25.73	18.39	26.18	18.86
Transportation, storage, communication	1.95	6.31	2.10	7.22	2.32	6.98	2.44	6.76
Finance, insurance, real estate	1.32	1.10	2.13	1.45	4.76	2.61	5.23	2.90
Business services	1.03	0.69	1.34	1.08	2.96	2.16	2.99	2.37
Community, social, personal services	13.57	8.72	15.11	9.56	21.00	11.07	22.03	11.240
Public administration	2.39	3.82	3.19	4.23	3.27	3.65	3.27	3.70
Index of segregation (SII_t)	18.70		19.59		22.19		21.06	
Index of segregation (SII)	1978–1997		1978–1986		1987–1997			
Mean	20.20		19.60		20.70			
Standard deviation	0.98		0.64		0.87			

Annual employment figures (measured in thousands of persons) by industry are reported in Directorate-General of Budget, Accounting and Statistics, Executive Yuan, *Yearbook of Manpower Survey Statistics* (Taipei: Republic of China, 1996, 1998). The index of Segregation is calculated according to the formula: $SII = \Sigma_i|w_i - m_i|/2$, where $w_i(m_i)$ is the percentage of women (men) working in industry i

Statistics.[6] This publication reports annual observations for the number of women and men working in each of 11 industrial sectors.[7] Extending Hou's original sample period as far as possible, while avoiding the Asian Financial Crisis, we used yearly observations for 1978–1997.

Table 1 presents the percentage of females and of males in each industrial category and the segregation indices (SII_t) for those years. The table presents employment and segregation index numbers for the starting year (1978) and the ending year (1997); to spotlight any intermediate trends, 1986 and 1995 (the first and tenth years following Hou's sample) are also presented. For 1978 the segregation index was 18.70, indicating that nearly 19% of female workers would have to have changed industries to achieve gender balance across industrial categories. Figure 1 shows how the gender distribution of workers across industries changed after 1978. As the economy slowed in 1982, gender segregation jumped but then fell shortly thereafter. From the mid-1980s the SII measure rose, peaking in 1995 at 22.19 before dipping to 21.06 in 1997.

The employment data presented in Table 1 can be used to determine which industries were most segregated. In 1978 four sectors accounted for the bulk of gender imbalance across industries. More than 51% of all working women were in manufacturing or services (excluding business services), but less than 36% of men worked in these areas, meaning these two sectors alone accounted for more than two-fifths of measured segregation. Construction and transportation were male-oriented industries, employing over 16% of men but less than 4% of women, which accounts for more than one-third of the SII measure. The segregation pattern for 1986 is similar to that for 1978, with the same four industrial sectors accounting for most industrial segregation.

By 1997 the pattern of employment had changed. After 1986 women became much less likely to work in manufacturing, of which the proportion of women workers dropped from 39.7% to 27.8%. Meanwhile, the representation of women in services jumped dramatically, to 22%, to nearly double the proportion of men in the sector. Furthermore, by the late 1990s the commerce sector became more female-oriented. In 1978 there was a slight disparity in commercial employment, with 16.8% of women working in this sector compared to 14.3% of men. By 1997 the gender gap in commerce had widened considerably, with 26.2% of Taiwanese women working there compared to only 18.9% of men. Construction also became more segregated. So by 1997 imbalances in services, construction, and commercial employment accounted for more than two-thirds of the SII measure.

[6] For the annual employment figures (thousands of persons) used in this study, see Directorate-General of Budget, Accounting and Statistics, Executive Yuan, *Yearbook of Manpower Survey Statistics* (1996, 1998).

[7] Each industrial category includes paid employees and self-employed workers (with unpaid family workers counted as self-employed).

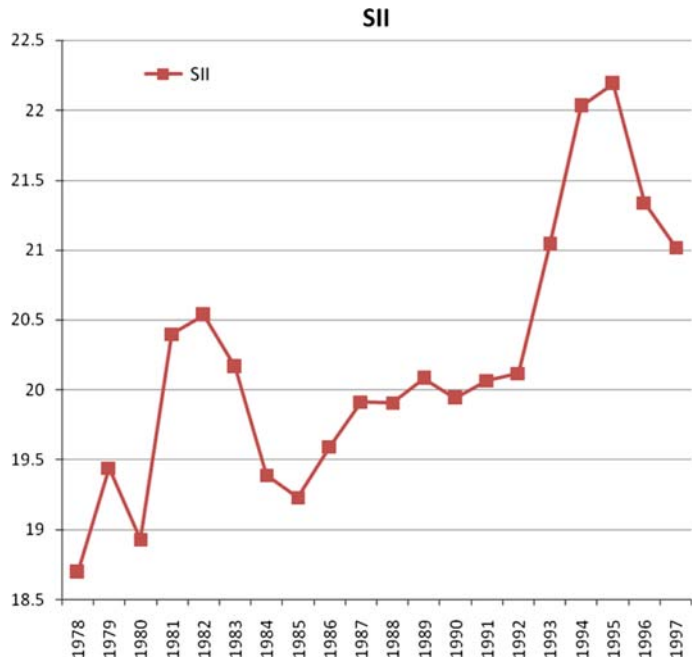

Fig. 1 Segregation index by industry (SII)

Segregation by Status of Work

Although industrial segregation appears to be unrelated to economic "diversification," there is evidence that segregation is directly related to economic growth. Moreover, the rise in the SII measure over the sample period may mask more dramatic changes in the gender distribution of employment. Even if the proportions of women and men across industries had been stable, there may have been changes in the representation of females in different types of occupations. To observe occupational segregation at the broadest possible level, that is, to establish a lower bound measure for job discrimination, we focused on the most general work categories used by Taiwan's government: (1) self-employment, (2) employer, and (3) paid employment. These categories distinguish between broadly different types of work. A self-employed person operates an enterprise for profit. This category also includes casual and informal endeavors, which are regarded as less prestigious than regularly paying jobs. Furthermore, self-employment includes unpaid family work. A family worker toils in an enterprise owned and operated by a relative from the same household. Because such work is performed under family direction for no pay, it is considered to be of relatively humble status. Self-employment in Taiwan typically signifies different types of work by gender. Men often manage small family businesses or shops. In contrast, women frequently serve as unpaid family workers.

Employers own and operate their own business enterprises and hire paid employees. Paid workers are employed by firms and receive regular compensation. This last category includes full-time workers earning salaries, so it encompasses relatively prestigious jobs. It also includes paid employees in part-time or temporary jobs, many of whom are women. If female representation in paid work increases, it may reflect a concentration in lower paying and or casual/part-time jobs. Nevertheless, if the proportion of women in paid employment increases, there is movement away from unpaid or irregularly compensated work.

We distinguished between paying jobs in the private and public sectors. The public sector may be seen to "lead by example" for fair labor standards (Hou 1993). If the government does indeed set a good example, either by discriminating less against women or providing preferable job characteristics, then female representation may be greater than that of males in public sector paying jobs. Table 2 presents the percentages of women and men in each work status category for selected years. Using Eq. 1, we calculated measures of segregation by status of work (SIS_t), which is also presented in the table.

Gender distribution across work status appears to have been fairly stable in Taiwan. Throughout the sample period there was a greater proportion of women than men in paying jobs: 84–88% of women held paying jobs, compared to 65–69% for men (see Table 2). Males were more likely than females to be employers or self-employed. The SIS measures seem steady, averaging 20.07 for 1978–1986 and 19.87 for 1987–1997. A reallocation of one-fifth of female workers would have been necessary to achieve balanced gender representation. But, there have been fluctuations across the job status groups.

Over the 20-year sample period both self-employment and private sector paying jobs became somewhat more gender balanced (see Table 2). This improvement, however,

Table 2 Job segregation in Taiwan by status of work—1978, 1986, 1995, 1997

Work status	1978		1986		1995		1997	
	% of Females in:	% of Males in:	% of Fem.	% of Males	% of Fem.	% of Males	% of Fem.	% of Males
Self-employed	13.88	29.72	12.24	27.96	10.04	23.24	9.81	22.57
Employer	1.28	4.55	1.60	6.40	2.19	7.78	2.35	8.09
Paid employment:								
Private sector	71.85	51.84	73.37	52.05	74.15	57.69	74.05	58.18
Public sector	12.99	13.90	12.80	13.59	13.63	11.29	13.79	11.16
Index of segregation (SIS_t)	20.01		21.32		18.79		18.50	

Index of segregation (SIS)	1978–1997	1978–1986	1987–1997
Mean	19.80	20.07	19.87
Standard deviation	0.81	0.76	0.82

Annual employment figures (measured in thousands of persons) by work status are reported in Directorate-General of Budget, Accounting and Statistics, Executive Yuan, *Yearbook of Manpower Survey Statistics* (Taipei: Republic of China, 1996, 1998). The index of segregation is calculated according to the formula: $SIS_t = \Sigma_i |w_i - m_i|/2$, where $w_i(m_i)$ is the percentage of women (men) working in job status i

is offset by increased segregation among employers and public sector workers. Whereas the classification "employer" became more male-oriented, public sector work indeed became more female-oriented. In 1978, government employment was practically gender balanced; since then the female employment share has increased while that of males has dropped. Though Fig. 2 does seem to show a pattern of general decline of the SIS since 1986, the magnitude prevents us from making too much of a conjecture based on this.

Segregation by Occupation

Taiwan's government also reports employment figures for men and women for seven broadly defined occupational groups. To measure the extent to which women have been concentrated in certain fields of work, we used Eq. 1 to calculate segregation by occupation (SIO_t). Table 3 presents the share of women and of men in each occupational group for 1978, 1986, 1995 and 1997. It also reports the SIO measures. The figures in the table show that there have been *dramatic increases* in occupational segregation, especially in recent years.

For 1978, the measure of occupational segregation is only 9.66: less than 10% of the female workforce required relocation to accomplish gender balance across occupational groups. There was nearly equal representation in professional and technical jobs (with 11.2% of women and 9.9% of men working in these fields). In service occupations there

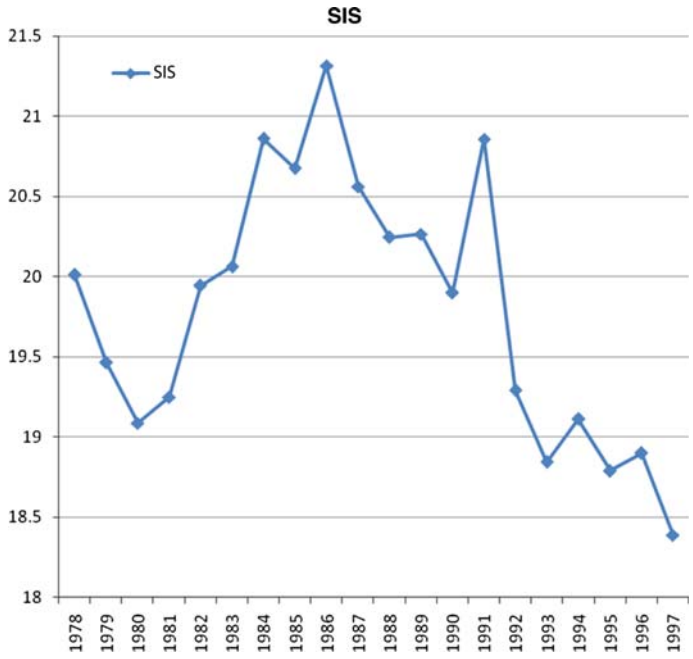

Fig. 2 Segregation index by job status (SIS)

Table 3 Job segregation in Taiwan by occupation—1978, 1986, 1995, 1997

Occupation group	1978		1986		1995		1997	
	% of Females in:	% of Males in:	% of Fem.	% of Males	% of Fem.	% of Males	% of Fem.	% of Males
Legislators and government administrators, executives and managers	1.12	4.04	1.37	5.37	1.63	6.82	1.69	6.45
Professionals	4.68	3.25	5.05	3.75	7.31	4.43	7.91	4.94
Technicians and associated professionals	6.54	6.69	9.20	8.42	15.11	14.58	15.36	15.64
Clerks	9.85	4.04	11.67	4.17	18.78	4.0	19.73	4.04
Service workers, shop and market sales	15.61	13.20	18.92	14.79	22.22	12.67	22.86	13.03
Agricultural workers, forestry and fishing	22.34	25.65	14.18	18.48	7.66	12.15	6.92	11.06
Production workers, machine operations	39.85	43.10	39.62	45.01	27.29	45.37	25.54	44.83
Index of Segregation (SIO_t)	9.66		13.70		27.75		28.48	

Index of segregation (SIO)	1978–1997	1978–1986	1987–1997
Mean	18.02	12.19	22.78
Standard deviation	6.63	1.53	5.11

Annual employment figures (measured in thousands of persons) by industry are reported in Directorate-General of Budget, Accounting and Statistics, Executive Yuan, *Yearbook of Manpower Survey Statistics* (Taipei: Republic of China, 1996, 1998). The index of segregation is calculated according to the formula: $SIO_t = \Sigma_i|w_i - m_i|/2$, where $w_i(m_i)$ is the percentage of women (men) working in occupation i

also was little disparity (respective shares for females and males, 15.6% and 13.2%). Among laborers and machine operators, male representation somewhat exceeded that of females (43.1% compared to 39.9%). As symmetric as the gender distribution was in 1978, some disparities are notable. Men were four times more likely than women to work in executive or managerial jobs. In contrast, women were more than twice as likely to work in clerical jobs as men.

The segregation index averaged 12.19 between 1978 and 1986, but by 1986 it had climbed to 13.70. This trend is mild compared to the remarkable increase after 1986 (Fig. 3). Between 1987 and 1995 the SIO measure more

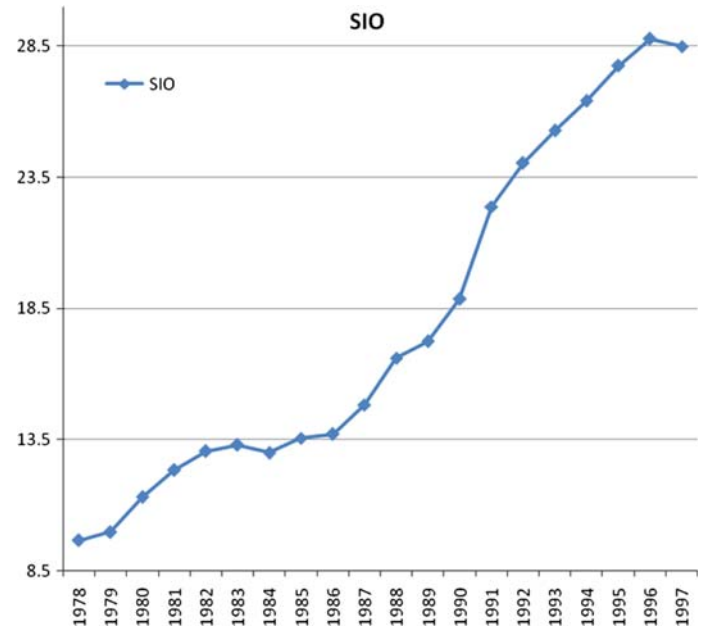

Fig. 3 Segregation index by occupation (SIO)

than *doubled*, climbing to 27.75. By 1997, 28.48% of working women would have to have been in different occupations to achieve gender balance. Over the entire sample period, segregation by occupation nearly *tripled*.

The segregation index rose so dramatically because of growing disparities in three occupational categories. Between 1986 and 1997, the gap in clerical employment continued to widen, with the female share of such jobs rising to 19.7% while remaining at 4.0% for men. There also were dramatic shifts among production workers and service workers. In 1978, services were fairly gender-balanced; by 1997 female representation far exceeded that of males (employing 22.9% of women but only 13.0% of men). Similarly, in 1978 the male share of production jobs was greater than the female share by 3.2 percentage points (43.1% versus 39.9%); by 1997 male dominance had grown to 19.3 percentage points (44.8% versus 25.5%). Indeed, gender imbalances in clerical, service, and production jobs accounted for more than three-fourths of the SIO measure.

Factors Affecting Segregation

The figures reported in Table 1 indicate that the measure of industrial segregation increased almost one-fifth between 1978 and 1997, with most of that jump occurring after 1986. For segregation by job status, Table 2 showed a very slight decrease over the sample period, but with a rise in the early portion and the drop in the second half. Of course, clearly the occupation segregation is the most interesting, as the SIO almost tripled over the sample period (Fig. 4 puts all three indices in the same picture and clearly brings the relative magnitude into perspective). Based on the literature, this leads one to conclude that gender discrimination has dramatically worsened in Taiwan, and that serious concerns should be raised. We, however, disagree, and will propose an alternative interpretation.

To examine possible determinants of labor market segregation, we performed simple least squares regression analysis, using the three segregation indices (SSI, SIS, and SIO) as the dependent variables. With observations only for 1978–1997, there are not sufficient degrees of freedom to develop elaborate econometric specifications. Nevertheless, results from a simple specification can be instructive.

The explanatory variables include measures of Taiwan's economic growth and development. To account for the economy's growth, we use the logarithm of Taiwan's real GDP. The distribution of employment may be affected by more than just expansion of the economy, as we have argued earlier. Our sample period encompasses the take-off of Taiwan's rapid economic development (Hou 1996). When an economy's basis shifts from agricultural production (initial phase) to manufacturing (secondary phase) and then to services (tertiary phase), the profile of work changes dramatically. To account for structural shifts in the economy, we used as an explanatory variable the percentage of GDP accounted for by "tertiary-type" activities. Specifically, we used the percentage of GDP due to construction, commercial and financial activities, transportation, and business and personal services.

It is not clear whether the coefficients on the growth and structural shift variables will be positive or negative. Economic growth and development create new jobs, possibly opening new career opportunities for women.

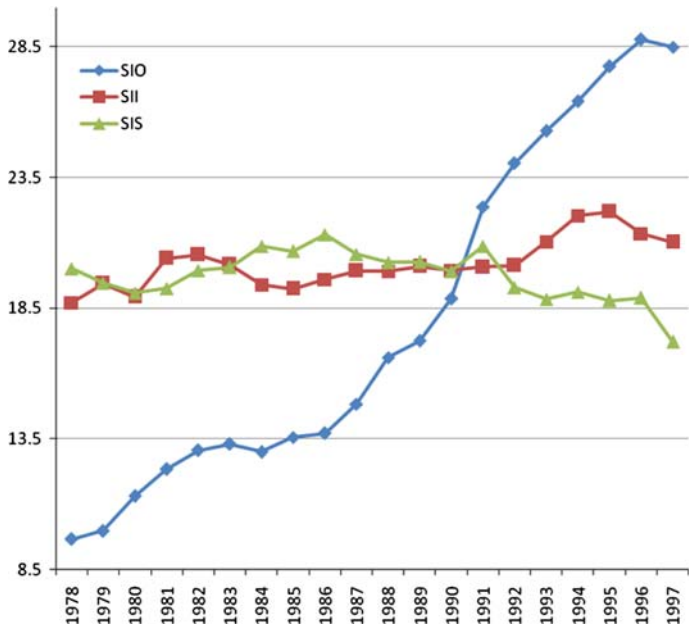

Fig. 4 Segregation index: SII, SIS, SIO

Table 4 Factors affecting labor market segregation

Dependent variable[a]	SII	SIS	SIO
Constant	−26.5369 (−1.3019)	20.8713 (1.2620)	−158.3234*** (−4.7946)
Log of real GDP[b]	2.9164* (1.8152)	0.6460 (0.4955)	9.3282*** (3.5840)
Tertiary activities as % of GDP[b]	0.0569 (0.5786)	−0.2229** (−2.7949)	0.7520*** (4.7223)
Pre-Super Boom (=1 for 1979–1983; 0 otherwise)	1.2884* (1.9193)	−1.0409* (−1.9111)	1.5868 (1.4591)
Post-Super Boom (=1 for 1988–97; 0 otherwise)	−0.7615 (−1.4821)	0.1198 (0.2874)	−1.3314 (−1.5995)
F-statistics	12.1766***	14.2305***	296.1687***
Durbin–Watson statistic	1.4024	1.7921	1.7150
Adj. R^2	0.7018	0.7359	0.9842

[a] Refer to Tables 1, 2, and 3 for calculation of the segregation indices

[b] Taiwan's real GDP and components thereof are reported in the *Quarterly Economic Trends*, published by the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Taipei: Republic of China. Tertiary activities include construction, commercial and financial activities, transportation, and business and personal services

* $p < .05$; ** $p < .01$; *** $p < .001$

Consequently, growth and development may have a negative impact on (i.e., reduction of) the segregation measure. When Taiwan's economy was less developed the spectrum of work was relatively narrow, limiting employment choices. For example, in the early years of industrialization it was common for both men and women to perform assembly line work in manufacturing. As economic progress occurred, work became much more diversified, which may have led employment patterns of men and women to diverge. For example, job discrimination may have channeled women to work in particular industries/occupations. Even without discrimination, women and men may have exhibited different preferences for job characteristics. Then, as job diversity became a reality, it is conceivable that self-selection contributed to gender segregation. Consequently, economic growth and development may exert a positive influence on the segregation measure.

Over the 1979–1983 interval, Taiwan's economy was afflicted first by a rise in oil prices (1979–1980) and then a recession in its major export markets (1982). Economic growth slowed steadily. Then during the "super boom" of 1984–1987 the economy's stock market soared and real economic growth accelerated sharply. Thereafter Taiwan pulled back from its frantic growth but the economy still continued to expand. To see if the comparatively slow growth before and after the super boom contributed to labor market segregation, we used the indicator variables "pre-super boom" (activated for 1979–1983) and "post-super boom" (activated for 1988–1997).

The simple regression equation we estimated is:

$$\begin{aligned}\text{Segregation Index} = {} & \beta_0 + \beta_1 \text{ Log of Real GDP} \\ & + \beta_2 \text{ Tertiary Activities as Percentage} \\ & \text{of GDP} + \beta_3 \text{ Pre - Super Boom} \\ & + \beta_4 \text{ Post - Super Boom} + \varepsilon \end{aligned} \quad (2)$$

where ε is the disturbance term.[8] We present the estimated equation in Table 4.

Focusing first on industrial segregation, economic development and diversification (Tertiary Activities) showed no significant impact on segregation. Other things equal, GDP growth is associated with greater gender segregation by industry (significant at the 10% level). Segregation was more pronounced for the relatively sluggish years of 1979–1983 than for other years. The gender gap widened prior to the "super boom." In contrast, segregation was not significantly greater after the boom. As Taiwan's economy has matured, perhaps female labor has become less of a buffer stock during episodes of slower growth.

Turning to segregation by work status (SIS), the distinguishing finding is that the relative expansion of tertiary-type activities inhibits gender segregation by work status. The coefficient estimate on the Tertiary Activities variable is negative and significant at the 5% level. As Taiwan's economy has developed new "types" of work—more office and service-oriented jobs relative to informal or unpaid family work—segregation by work status has fallen significantly.

[8] We used the augmented Dickey–Fuller (ADF) test to test the stationarity of the time series. For the segregation indices used in this study, the logarithm of real GDP, and the economic development variable, we were unable to reject the null hypothesis of a unit root, that is, the null hypothesis of nonstationarity. But, as discussed by Enders (1995), if there is structural change, then the ADF test is biased toward nonrejection of a unit root (see pp. 243–245). Considering the transformation of Taiwan's economy over the sample period, because of structural change we may be unable to confirm stationarity of the time series of interest. But if the series are cointegrated, then OLS regression can still be implemented. Using the cointegration testing procedure developed by Johansen (1991), we found that each segregation index was cointegrated with the GDP and development variables, so we proceeded with OLS regression analysis.

From the above, we found that, in Taiwan, women have become more likely than men to work in paying jobs. Furthermore, economic development has tended to reduce segregation by work status. These findings may tempt one to conclude that job discrimination in Taiwan has not increased in recent years.[9] Such a conclusion may be misguided. After all, women may have been concentrated in relatively low paying, non-supervisory jobs/occupations. Such crowding would not show up in SIS measures, which only reflect segregation by status of work.

Focusing on segregation by occupation, the regression results are markedly significant and different from the previous two sets of estimates. The coefficients on the economic growth and economic development variables are both significantly positive. Slower economic growth has not resulted in greater occupational segregation. Unlike some other Asian economies, female labor in Taiwan apparently has not been used as a buffer stock when the economy has slowed. Moreover, the more diversified Taiwan economy has become, the more pronounced the occupational segregation.

It remains a crucial matter to explain why Taiwanese economic development has been associated with increased occupational segregation. Could it be that industrialization, and the consequent diversification of work, has created new opportunities to discriminate against women, crowding them into secretarial or otherwise less prestigious service jobs? Or could it be that a rising segregation index is not a sign of discrimination per se, but is actually indicative of welfare-improving, occupational self-selection?

In the earliest stage of Taiwanese industrialization, jobs were concentrated in manufacturing, where both men and women toiled as production workers in factories, hence the relatively low degree of occupational segregation. As the economy passed through its take-off stage, service-type tertiary occupations became more predominant. Such white-collar jobs tend to have less overtime and more flexible work schedules (Golden 2008), have cleaner and safer working conditions, and provide capacity for more responsible interactions. They also may not have an established reputation for discrimination. If women have a relatively strong preference for such characteristics, then we will observe a disproportionate shift of females from assembly line work as they select office or other service-type jobs. In fact, by 1997, female representation in "professional" occupations had become 60% greater than that for men. This disparity is even more pronounced in clerical and sales categories (Table 3).[10]

With aggregated data, it is not obvious which is the better explanation for the increase, job discrimination or more benign self-selection? If the occupational discrimination hypothesis is true, we would expect occupational gender gaps to persist, with worsening imbalances in the clerical (more female-oriented) and managerial (more male-oriented) categories. As shown in Table 3, the crowding of females into clerical jobs has continued unabated. But the gender gap for executive jobs, though still extant, has not widened noticeably since the mid-1980s.

If the self-selection hypothesis is true, then we would not expect gender imbalances to worsen in the future. As the economy continues to develop and manufacturing declines relative to information-based office work, we would expect men to be shifted into white collar, service-type jobs. Indeed, there is also some support for this view. Technicians became more prevalent over the sample period and were gender balanced (Table 3). Between 1988 and 1997, ceteris paribus, occupational segregation did not increase; as shown in Table 4, the coefficient estimate on the Post-Super Boom variable is actually negative, though insignificant.[11] Looking at the time path of occupational segregation depicted in Fig. 3, it is tempting to speculate that the gender segregation has stabilized since 1997, possibly tapering off.

It may be worth pointing out that after controlling for the effects of economic growth and economic development, the segregation index has actually decreased over time. This is shown by the two binary dummy variables, as the sign of the coefficients switched from positive to negative, implying that the average segregation index was higher in the pre-super boom period than the post-boom period. Though the estimates are not very significant, they are significant at a 10% (one-tailed test) level. This, again, perhaps signals the more benign nature of this dramatic hike in gender segregation.

Summary and Concluding Remarks

This study has examined employment patterns for women and men in Taiwan for 1978–1997, calculating an index of job segregation by (1) industry, (2) status of work, and (3) occupation. Gender representation has become more unbalanced across industries, with most of the gender gap occurring between 1986 and 1995. Though segregation by status of work has been stable, women have tended to

[9] Even the measure of industrial segregation (SII) drops after 1995.

[10] This could signal that females are crowded into lower pay occupations, as was found for the U.S. (Edwards 2005). But, it could also be that such occupations better suite childcare concerns or provide more family friendly policies (Pedersen et al. 2009).

[11] If sufficiently detailed microeconomic data were available for Taiwan over time, then the issue of occupational selection could be analyzed in more detail.

concentrate more than men on paid employment; self-employment and business ownership have been more male-oriented.[12] Segregation by occupation has soared, however, more than *doubling* over the 1986–1995 span and nearly *tripling* for 1978–1997. Gender gaps in clerical, service, and production jobs also have widened substantially.

In an earlier study, Hou (1991) reported that hardly any of the observed gender wage gap in Taiwan could be explained by occupational segregation. His analysis covered the 1978–1985 period. This study has shown that there was comparatively little occupational segregation over this span. Thus, it should not be surprising that Hou's study attributed little influence to job segregation as a determinant of wage discrimination.

The evidence presented in this study also showed the dramatic increase in the gender segregation in terms of occupation since then. As the increase in occupation segregation occurred around the same time as the economic take-off of Taiwan, we hypothesized that the increased diversity of jobs as a result of economic development (in contrast to the economic growth) may have led to the observed apparent increase in gender segregation. Indeed, regression analysis supports this hypothesis. After controlling for economic growth and structural change (to account for the economic take-off), the data exhibits a strong positive association between economic development and the increase in gender segregation across occupations. Due to data limitations, we cannot proclaim a definitive conclusion. However, the evidence we have shown here is certainly tantalizing. To truly answer this, a micro data set is needed. Such a data set does exist (for Taiwan), and further research is certainly warranted.

In addition, Fig. 3 does seem to suggest that the magnitude of gender segregation by occupation may be decreasing. Whether this is genuine, or simply in the eyes of the beholder, is too early to tell. If it is decreasing, then it does raise another interesting prospect: an inverted U-shaped segregation curve. In other words, the degree of segregation (by occupation) rises with industrialization, and when the economy is fully industrialized and matured, segregation begins to decline. This is merely speculation at this point, as we have even weaker evidence to substantiate this. However, if this relationship does exist, it may be more real than some of the other inverted U-shaped relationships that have been presented in the literature, as we are using pure time series data.[13]

[12] Here again, differences in preferences may play a role. Women, especially married females with children, have to balance housework with "market" work. Paid employment, especially white collar jobs, allows this much better, as compared to self-employment or business ownership (Craig 2007).

[13] The celebrated Kuznets Curve is perhaps the most well known. Though the original work of Kuznets (1955, 1963) was based on time series data, most of the ensuing research has relied on mostly cross-section data and hence much more suspect, as one can sometimes reverse the result simply by eliminating one or two countries (the outliers) from the sample.

Another important aspect of gender discrimination is in the wage gap. Kao et al. (1994) found that differences in lifetime work incentives were largely responsible for the gender wage gap observed in Taiwan. They predicted that as labor force participation of females increased relative to that of males, the gender wage gap would narrow. Indeed, female labor force participation has grown relative to that of males. But what if occupational segregation (as we have found) leads women to be crowded into relatively low-paying occupations?

Given the recent dramatic rise in occupational segregation, previous studies of the extent of job and wage discrimination in Taiwan should be reconsidered.[14] We would expect future research to examine whether the significant shift in occupational patterns occurring during Taiwan's rapid economic development can be attributed to pernicious job discrimination or some purposeful but benign change in labor supply behavior. It also remains to be seen whether increased job segregation has resulted in wage discrimination against women.

As stated earlier, this study is limited by the nature of the data employed. The above aspects cannot be properly addressed unless micro cross-section data is used (such as the Manpower Utilization Survey of Taiwan). Our findings suggest evidence that the apparent rise in gender segregation could be the result of structural change in the economy. This naturally leads to the question of whether the Taiwanese pattern is shared with the other three Dragons (Hong Kong, South Korea, and Singapore). If the answer is yes, then it would be overwhelming evidence supporting our welfare-improving self-selection hypothesis. If the patterns in these other countries are counter to the pattern seen in Taiwan, then further study is needed to answer the question of why Taiwan is unique.

In addition to the NICs, the economies in transition also present a unique opportunity to study the effect of economic structural change on the gender segregation (and other forms of discrimination) in the labor market. We believe that a dramatic rise in the segregation index must be present. The reason is simple. Gender equality was politically imposed by the "classless" idealism of the

[14] With women concentrated more in clerical and service occupations and men tending to work more in executive and production jobs, the gender wage gap may well have widened. This prediction is supported by preliminary findings of Hou and Huang (2008), which can be viewed as a follow up of Hou (1991). However, if one extends the findings of Pan et al. (2008) for Taiwan, this could indirectly stem from the fact that women sought fewer work hours, which prevented them from having higher earnings.

Communist ideology. With the fall of communism, the labor market is perhaps returning to its "discriminating" nature. In other words, the rise in gender segregation is more malicious as compared to the benign nature in Taiwan. The degree may vary. For example, it is perhaps more discriminatory in Russia, while the cause in China may be more mixed (i.e., real discrimination combined with some degree of self-selection).

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Author Biographies

Scott M. Fuess Jr. is Professor of Economics and Chair of the Department of Economics, University of Nebraska, Lincoln. He is also Research Fellow of the Institute for the Study of Labor (IZA), Bonn, Germany.

Jack W. Hou is Professor of Economics, California State University, Long Beach. He is the senior coeditor of *Contemporary Economic Policy*, and the President of the Western Social Science Association. He is also Distinguished Adjunct Faculty of Nankai University, China.