

GENDER DIFFERENCES IN VOCATIONAL SCHOOL TRAINING AND EARNINGS PREMIUMS IN TAIWAN

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ABSTRACT

International capital mobility and economic restructuring have brought training and skills acquisition to the forefront of policy dialogues. Taiwan has gone beyond most countries in promoting vocational education and setting strict quotas for schooling. Although the education plans do not have separate targets for men and women, they have gendered outcomes. Estimates of earnings premiums using ordinary least squares and quantile regression techniques indicate that only men have gained consistently higher premiums from vocational school compared to general schooling. Women who were denied access to the university system have forgone college premiums that exceed those of men. Also, the commerce track, in which women cluster, yields an earnings penalty compared to general schooling, while the technical track, in which men predominate, yields an earnings premium. Policy reforms based on relaxing education quotas and enforcing equal opportunity legislation would provide women with more rewarding education and career options.

KEYWORDS

Education, skills, segregation, wage gap, Taiwan, quantile regression

JEL Codes: J24, O2, J31

INTRODUCTION

International capital mobility and structural shifts in local labor markets have brought discussions of training, skills acquisition, and workforce development to the forefront of policy dialogues around the world. Questions of how workers and students can acquire new types of vocational training often take center stage in these discussions. Common sources of vocational training include work-site training in firm-specific locations, vocational and career tracks within general academic secondary schools, and specialized vocational schools and junior colleges. Feminist literature has established that global economic integration has gendered effects, and education policies that help close gender gaps can serve to complement national strategies for adjustment and growth. However, as advocates point to the documented benefits of specialized vocational schooling, skeptics argue that the earnings premiums from general academic schooling may exceed those of vocational schooling.¹ In these debates, policy-makers and academics have paid little attention to sex segregation within vocational schools and how this segregation contributes to persistent wage gaps between men and women. Yet evidence emerging from industrialized countries suggests that sex segregation

constitutes a prominent feature of vocational schooling. For example, in the United States, men make up 93 to 94 percent of students in technical courses such as carpentry, welding, and electrical work in a sample of twelve states analyzed by the National Women's Law Center (2002), while women make up 86 percent of students in service areas such as cosmetology, childcare, and health aide. While a neoclassical framework would point to free choice as the reason for these gender differences, this explanation ignores continued obstacles that women face – including social norms, discrimination, and exclusion – as they enter their education tracks (Shoshana Neuman and Adrian Ziderman 2003). These figures raise an interesting question for industrializing countries on the next rung of the development ladder: are vocational schools similarly skewed in the sex distribution of students across specialized areas of study?

This study adds valuable evidence from Taiwan to the growing scholarly and policy discourse on how to help workers adjust to the forces of globalization through skill enhancement and new training opportunities. Across East Asia, tremendous economic growth has occurred simultaneously with the chance for male and female workers to attain higher levels of education, upgrade their skills, and earn higher wages. Growing educational and skill levels among East Asian workers in turn have contributed to rapid industrialization and growth. Not content to rest on the laurels of successful macroeconomic performance, most governments stepped in with active policy strategies to achieve universal enrollment rates in primary and secondary school, greater access to high quality tertiary education, and expanded opportunities for vocational training.

Yet Taiwan's government has surpassed most others within and outside of Asia by strongly promoting vocational education at the secondary school level. Vocational high schools in Taiwan are designed to equip students with technical skills and a strong work ethic, thus preparing students to enter the workforce after graduation or to continue study in a technology institute. These schools offer a range of sub-fields, including agriculture, technology, commerce, law, and education. Vocational training has occurred primarily through the formal school system rather than through firm-specific provision. An important reason is that Taiwan's industrial structure is dominated by small- and medium- sized enterprises that are less able to provide costly vocational education (D. Ashton et al. 2002). In the past few decades, the government has explicitly manipulated the education system to meet the economy's growing demand for skilled labor in manufacturing and high-tech industries. In achieving this objective, a series of manpower plans has divided students into academic or vocational tracks at the secondary school level and set strict quotas for each. These planning efforts have placed increasing emphasis on vocational schooling and have pushed the ratio of vocational school students to general academic students far above ratios for most other countries. Taiwan's persistently high indicator over time, which has

decreased only slightly in recent years, contrasts sharply with the accepted view of an inverse U relationship between per-capita income and the ratio of vocational to general secondary school students (Graziella Bertocchi and Michael Spagat 2004).

Once channeled into the vocational school track through the strict system of enrollment quotas and test score criteria, men and women have diverged considerably in their specializations. About three-quarters of male workers with vocational school majored in a technical track during the 1980s and 1990s and took subsequent jobs as machinery and electronic assemblers. In contrast, an average of 85 percent of female workers had vocational school majors in commerce, with subsequent occupations as bookkeepers, cashiers, sales clerks, and other clerical jobs. In Taiwan's economy, students having only a vocational school background can face some serious disadvantages in their access to subsequent academic and labor market opportunities. With recent reductions in financial support from public sources resulting in depreciated structures and faulty equipment, vocational schools have become a less desirable "terminal system," while general academic schools are considered a more prestigious and well-funded "preparatory system" (Hueih-Lirng Laih and Ian Westbury 1998). The skewed distribution of specializations within vocational school by sex leaves women at an even greater disadvantage in obtaining well-paid jobs that are created as the economy continues to shift to technology-intensive manufacturing and research and development. This study of male and female earnings premiums for majors in different disciplines provides a finely tuned benchmark for assessing the impacts of a policy strategy that targets vocational education. As noted in Andrew Horowitz and Christoph Schenzler (1999: 17), the separation of broad education levels into areas of specialization provides "a rare opportunity" to measure how developing countries value different skill sets. There is no shortage of studies on earnings premiums by gender for years and levels of education. Evidence on gender differences in earnings premiums for the content of education is less common, despite indications that differences in educational content or area of study contribute to later occupational segregation and wage disparities across gender (Eric Eide 1994; Francine Blau and Lawrence Kahn 2000; Andrew Gill and Duane Leigh 2000). Estimates of earnings premiums for Taiwan using both ordinary least square and quantile regression techniques indicate that only men have gained consistently higher premiums from vocational school compared to general schooling. Results also show that women who were denied access to the university system through the quota and exam-based policies are forgoing earnings premiums for college educations that exceed those of men in all years. Furthermore, female workers gain lower premiums from vocational schooling in commerce, where they are clustered, compared to technical vocational schooling and general academic education. Although the government's structured education plans did not have separate targets for male and female students, the plans have resulted in gendered

outcomes, which implies that new incentives for technical training and relaxed quotas for university admission can enhance women's relative labor market opportunities.

INSTITUTIONAL AND HISTORICAL CONTEXT

Since the 1970s, both men and women in Taiwan have experienced gains in education, skill levels, and wages, but the distribution of these gains has been unequal: a sizeable male – female wage gap persists. As illustrated in Figure 1, the female-to-male earnings ratios remained relatively flat between 1978 and 2002, the period for which we have comparable gender disaggregated data. The earnings ratio stood at about 65 percent from the late 1970s through the mid-1990s, and this differential persisted in spite of women closing the gender gap in educational attainment and experience. The solid line represents the ratio of average earnings for women to average earnings for men. This unadjusted ratio has only recently begun to improve, reaching 74 percent in 2002. The dotted line refers to the wage ratio that would occur after factoring out the effects of differences in “observable” worker characteristics such as average hours worked, level and type of education, potential experience and tenure, and location. Once adjusted for observables, the gender gap was actually getting worse in the 1990s. Note that the gap between the two lines closed over time as women caught up to men in terms of the observable characteristics. In other words, the observable differences explained less and less of the difference between women's and men's wages over time. To better understand how institutional changes have affected the educational tracks of male and female students, the remainder of this section offers a description of Taiwan's education system and how it has evolved over time.

In Taiwan, the first nine years of compulsory schooling consist of a six-year enrollment in primary school followed by the completion of three years in junior high school. Upon graduation from junior high, students are required to take an entrance examination in order to determine placement in either an academic or a vocational track. The academic track includes enrollment in senior high school with a general academic curriculum. After graduation from a general academic high school, students may complete entrance examinations for national universities or three-year junior colleges. The vocational track allows students to enter vocational school or a five-year industry-oriented junior college after completing junior high school. Graduates from vocational school typically seek employment in a technical or vocational field; some graduates pursue further education in a four-year institute of technology or in a two-year junior college. Students obtain entrance to these institutions by passing an examination or through special selection.

Like other governments in the region, Taiwan emphasizes investment in human capital as a cornerstone of the economy's rapid economic development. However, Taiwan stands out among its neighbors for its

structured education plans that over time have increasingly targeted vocational training within the formal school system. This public investment has taken shape primarily through a set of Manpower Development Plans

Figure 1 The female-to-male earnings ratio in Taiwan, 1978 – 2002

Notes: The figure is based on a sample of non-farm paid workers age 15 – 65 from Taiwan's Manpower Utilization Survey. The adjusted ratio is computed using the earnings decomposition technique developed by Alan Blinder (1973) and Ronald Oaxaca (1973), which isolates the elements of the gender pay difference due to gender differences in observable characteristics such as education and experience.

(MDPs) designed to shape the education system and its expansion to match the economy's labor demands. One of the first major reforms launched in 1968 by the MDPs was to extend compulsory education from six to nine years. This reform resulted in a substantial increase in the number of junior high school graduates in the 1970s. Another feature of the plans was to increase the number of students in the vocational track of secondary school. Successive plans have specifically targeted the enrollment distribution of students between academic and vocational tracks in secondary school. The government has also invested heavily in new vocational schools and five-year colleges, particularly those with engineering and technical curricula. The government has further manipulated the distribution of study areas within higher levels of education, with a growing emphasis on engineering and science majors in national universities at the expense of the humanities and social sciences.²

The MDPs have established enrollment quotas that determine the number of students able to pass entrance examinations for both the general academic and vocational secondary school tracks. The Ministry of Education fixes the quotas, which are designed to meet the economic demand for workers at different educational levels. In 1965, before the adoption of the first MDP, only 39 percent of high school students were enrolled in a vocational track. The first MDP in 1968 set a target share of 60 percent, and this target was reached by 1975. The share of vocational students in high school peaked at approximately 69 percent in 1986 and remained fairly stable until the late 1990s when this number began to decrease to about 55 percent by the mid-2000s. The peak number of vocational school students coincided with the lifting of martial law in Taiwan, an enormous political change that prompted an educational reform movement. Individuals and non-governmental organizations worked together to demand greater access to general education, more self-choice, and multiple channels for attaining higher levels of education. In response, recent education plans have emphasized goals related to the quality of education and mobility across the system rather than specific quantitative targets.

Despite a downward trend in the proportion of students attending vocational school, Taiwan still emphasizes vocational education more than most of its neighbors. To support this argument, Table 1 reports the

vocational share of all junior high, vocational, and senior high school students across Asian countries. Results indicate that Taiwan stands out as having the highest share of all secondary school students enrolled in vocational school since 1980. Consistent with the progression of its education policy, Taiwan's focus on vocational schooling increased the most between 1970 and 1980 and has persisted over time. Often a source of comparison, South Korea also demonstrates a consistently high share of vocational school students over time. Shares in Thailand, Lao PDR, and Indonesia have fallen the most since 1970 as governments placed more emphasis on investing in general academic schooling.

Taiwan's academic senior high school students have generally funneled into the national university system, while it has been more difficult for students in vocational school to gain entrance into the university system. Hence the demand for more enrollment spaces in the academic senior high schools has grown and exceeded the supply. In response to growing dissatisfaction among the Taiwanese public with the enormous emphasis on entrance examinations and the high levels of stress among students, the government implemented the Multi-Route Promotion Program for entering high school students in 2001. This program has expanded the admission opportunities for senior high school to include entrance through an application procedure and selection by recommendation. Education planners are considering further adjustments to help boost the number of senior high school students relative to vocational school

Table 1 Vocational share of secondary school enrollment in Asia, 1970 – 98 (in percent)

students. Despite these reforms, scores on the entrance exam remain the dominant factor in entrance determination for senior high school. The slow pace of educational reform and the continued belief that test results are the key for further educational advancement have ensured the critical role of special schools for test preparation (known as “cram schools”) in students' efforts to prepare for entrance exams.

DATA DESCRIPTION

The remaining empirical work on relative earnings premiums for vocational education is based on repeated cross-sections of Taiwan's Manpower Utilization Survey, an extremely rich household-survey database, covering the period 1978 – 2002.³ The survey collects information on labor force status, monthly earnings, and weekly hours worked in addition to the demographic characteristics of the respondents. The empirical work uses three different subsamples of the data: the civilian population, worker sample, and earnings sample. The civilian population includes all respondents aged 15 to 65, excluding those who are in the military or institutionalized. The average number of respondents is just over 50,000 per year, roughly half of whom are women. We use this sample to construct the labor force participation rate series by summing the sample weights for the total

civilian population and the labor force by sex, education, and potential experience. Potential experience is calculated as age minus years of schooling minus six years. Years of schooling are imputed assuming completion of the stated school level. Because our sample retains only preretirement age individuals, the calculated participation rates are slightly higher than those presented in government publications.

The worker sample is a subsample of the civilian population that excludes farmworkers. It includes all other individuals with positive hours worked (whether paid or not) and at least one year of potential experience.

By limiting the scope of the sample to non-agricultural employment, the results are less subject to transient shocks such as bad weather.

The earnings sample is a subsample of the worker sample. It includes all paid, full-time (40 hours or more), non-farm employees with at least one year of potential experience and three months of job tenure. The restrictions on potential experience and tenure are designed to exclude individuals with low labor-force attachment. Since reported earnings of employers and the self-employed may also include profits from capital investments, we exclude them from the earnings sample. The average annual size of the worker sample is about 25,000, and the earnings sample is about 17,000. In both cases, women comprise almost 40 percent of the sample. The worker sample is used for calculating employment shares by sex, education, and potential experience; and the earnings sample is used for the regression analysis.

Each of these samples contains six education categories: 1) primary education and below, 2) junior high school, 3) academic senior high school, 4) vocational school, 5) junior college, and 6) college and above. The survey only includes information on the highest level of schooling attended, not the highest level completed or years of school attended. For individuals with vocational school, junior college, or college attainment, the survey contains further information on major area of study. We aggregate the survey options for major area of study and construct dummy variables for three categories: 1) technical, which includes survey response options for science, industry, agriculture, and medicine; 2) commerce, which is a single survey response option that encompasses secretarial, clerical, and sales skills; and 3) other, which includes survey response options for humanities, law, military/police, education, and miscellaneous. Since earnings are reported on a monthly basis and hours worked are reported on a weekly basis, we use monthly earnings as the unit of labor compensation rather than constructing an implicit hourly wage.⁴ The earnings data are deflated using the Consumer Price Index.

CHANGES IN THE GENDER COMPOSITION OF TAIWAN'S WORKFORCE

Taiwan's labor force structure has seen tremendous change in recent decades, particularly in the surge in women's labor force participation and the large increase in vocational workers. As shown in Table 2, the female

labor force participation rate has risen by about 10 percentage points, from 41 percent in 1978 – 82 to 51 percent in 1998 – 2002. Similar to trends in other industrialized countries, married women, in particular, are driving this result, with their participation rising by about 17 percentage points over the same period. The average participation rate for women has risen at all education levels, with the largest increases for women with high school, vocational school, and college educations. Note that for presentation purposes, Table 2 groups together individuals who have junior college and four-year college educations. The participation rate for men, however, has slowly declined from about 79 percent to 76 percent. This decline for men is consistent with trends observed across industrialized countries. As a result, women have gone from comprising one third of the labor force to comprising over 40 percent (Table 3). This increase in the female share of the labor force has occurred at all levels of educational attainment. Looking at these aggregate trends by experience level, new male and female entrants (those with one to six years of potential experience) show little change in labor force participation overall since 1978 (Table 2). Still, the female share of new entrants increased slightly throughout the 1980s and 1990s (Table 3). The biggest increases for women occurred at the higher levels of experience. The average participation rate for women with

Table 2 Labor force statistics by sex, education, and experience (in percent), 1978 – 2002
 Average male labor force participation rate Average female labor force participation rate

25 – 33 years of experience has risen from 41 to 58 percent overall. This increase is being driven by the higher labor force participation of married women during the period. As a result, women’s labor force share rose considerably for workers with higher levels of experience, from 29 to 38 percent. Collectively, these descriptive statistics show that whether by education or experience, the relative supply of women in the labor market has been increasing, with the most rapid gains occurring during the 1980s.

Figure 2 shows the distribution of all workers by different levels of educational attainment. Both men and women have increased their average level of education over time. Whereas individuals with primary education or less comprised over half of the labor force for both sexes earlier in the period, their share dropped to less than one fifth by 1998 – 2002. Both men and women recorded the largest increases at the college level. However, male and female workers showed considerable differences in their average educational attainment at the junior high and vocational school levels. Across all sub-periods, the male share of the labor force with just a junior high education exceeded that of women, by as much as

Table 3 Average female share of the labor force, 1978 – 2002 (in percent)

7 percent after 1993, and the share rose slightly over time for men while it

dropped for women. In contrast, across all sub-periods, the female share of the labor force receiving vocational school training was about 5 percent higher than the male share.

Reflecting the government's efforts to track students into vocational schooling in the 1970s and 1980s, the number of labor force participants with vocational school training has grown rapidly. As illustrated in Figure 3, the number of labor force members receiving vocational school training

Figure 2 Labor force composition by education groups, 1978 – 2002

more than tripled during the period with large increases for both male and female workers. Men and women differ dramatically in their major area of study within vocational school. In 1978, about 65 percent of male workers entered a technical track while in vocational school. Examples of occupations frequently linked to this kind of educational background include

Figure 3 Labor force participants with vocational school attainment by major area of study

machinery assemblers, precision-instrument makers, and electronics assemblers. The proportion of male workers with technical tracks among all male workers with vocational training rose steadily over time, to 80 percent by the 1990s. In contrast, an average of 85 percent of female workers during the period had vocational school majors in commerce. Training in commerce is most commonly linked to occupations as bookkeepers, accountants, cashiers, sales clerks, and other clerical jobs. As more women entered vocational tracks in technical fields, the proportion of female workers with vocational school training in commerce dropped slightly. Gender-differentiated patterns in vocational school specializations are not unlike patterns in occupational clustering observed in the US and other industrialized countries.

These stark differences in vocational school majors between men and women raise some important questions relating to why students enter into particular majors in vocational school and whether men and women differ in their reasons for attending vocational school. The human capital theory of school choice indicates that individuals make schooling decisions based on their comparative advantages in order to maximize their lifetime earnings. In terms of decisions involving schooling tracks (academic versus vocational) and choice of major, individuals place themselves in the track most appropriate to their individual abilities and preferences. Neoclassical theory would predict that women with long-term plans to take time off for raising children are less likely to choose technical specializations if they believe that their human capital benefits most from continued on-the-job training, and spending time out of the labor force causes technical skills to depreciate. Building on such a framework, specializing in a commerce-related field would conceivably involve less additional on-the-job training

compared to a technical field, and a worker could exit and reenter without much perceived atrophy in job-related skills.

However, because students in Taiwan have to test into an education track, their choices are highly constrained and do not necessarily conform to the predictions of human capital theory. Students are constrained by the number of spots available in universities and the particularly strong role of entrance exams in allocating those spots. Entrance exams are probably the single most important contributing factor in determining an individual's education track. While in principle students could always choose a lower track, they do not have the choice of an upper track if they do not make the grade. As argued in Bertocchi and Spagat (2004), an emphasis on vocational schooling as the education system evolves could actually reflect the policy goal of exclusion by an elite group that fears losing political power and high social status. Because the government's tracking system makes it difficult for individuals to respond to market signals when making their education choices, standard estimation strategies do not shed much light in gauging whether men and women are influenced differently by these constraints. Yet previous studies on gender and schooling provide some insight into whether men and women experienced different outcomes as a result of Taiwan's restrictive education policies.

On the supply side, previous research suggests that institutional features, particularly societal norms, are more likely to constrain women's educational choices. Although Taiwan has one of the highest income economies in Asia, son preference can still play a role in household decision-making. Yu-Wei Chu (2002) argues that if children do not pass the entrance exam to attend an academic high school, parents are more likely to invest in a cram school for their sons than they are for their daughters. Daughters are more likely to be channeled toward vocational school after the first failed attempt at the entrance exam. Furthermore, in Taiwan, husbands' negative views about having working wives discourages women's labor force attachment more than the presence of young children in the family (Hwei-Lin Chuang and Hsih-yin Lee 2003). Young women may take these negative views into account when they make their education choices, an argument supported with evidence from Julie Hotchkiss and M. Melinda Pitts (2003) that higher expected future wages from more technical jobs can be swamped by other factors, such as family characteristics and health, in the education and labor market choices that women make. Also, evidence from Taiwan shows a sizeable wage penalty for work intermittency for women with at least an academic high school or a vocational school education (Chuang and Lee 2003). This wage penalty can also discourage women from investing in more technical and career-oriented vocational tracks.

On the demand side factors such as social norms, school policies and practices, and state-level barriers also help to explain the high level of sex segregation in vocational schools. The human capital approach to school choice rules out the possibility that demand-side factors can affect men and women differently. As argued in David Colander and Joanna Woos (1997),

institutional demand-side factors could be at work in production practices that favor insiders (men) at the expense of outsiders (women). In the context of Taiwan's vocational schools, admissions procedures in the more technically oriented vocational schools could favor men and make it more difficult for women to enter. Furthermore, Elizabeth Bigelow (1989) finds a stigma against career guidance and counseling in Taiwan, a stigma that could prevent young women from learning more about the advantages of career and technical education tracks. The study also finds strong resistance to change in the educational system, particularly in situations where student desires to pursue their own education goals conflict with serving national needs. A growing literature on Taiwan demonstrates that the pay gaps and job segregation have resulted from employer and state hiring, training, employment, and labor control policies in the context of patriarchal gender norms.⁵ Within this context, women face barriers to some types of training, or they are steered away by gender-specific advertisements.

METHODOLOGY FOR ESTIMATING EARNINGS PREMIUMS

The close examination of school majors can help to better understand gender differences in wage determinants. Literature on the gender wage gap points to differences in the content of schooling as important explanatory factors. For example, Astrid Kunze (2005) finds striking gender differences in the types of training undertaken by young skilled West German workers completing vocational apprenticeships, with women concentrated in clerical services and men in technical services. The study argues that sex segregation in vocational training explains a large portion of the gender wage gap following training, which leads to permanent disadvantages for the wage profile of women in the labor market. Other work shows that distributional changes in major areas of study in postsecondary education have contributed substantially to a decline in the gender wage gap in the US. Calculations in Eide (1994) indicate that convergence between men and women in the distribution of college majors, holding gender differences in premiums for college major constant, accounts for a substantial portion of the narrowing in the gender wage gap.⁶

Skeptics of vocational schooling argue that skills gained tend to be job-specific, while skills gained from academic schooling are more general and can be transferred across different types of jobs. Problems also emerge when students who have completed vocational education at the secondary level have difficulty gaining entrance into the national university system. Vocational school critics argue that the focus should be on strengthening general education at the primary and secondary levels with employers providing work-site vocational training.⁷ In contrast, vocational school advocates have found high premiums for vocational education compared to general academic education.⁸ Workers with job-specific skills from vocational schools are readily available to perform a specific set of tasks and can

potentially work more efficiently. Hence general academic education, followed with employer-provided training in job-specific skills, is not necessarily the more efficient method of increasing worker productivity. Proponents emphasize the need to carefully consider vocational schools as a viable method for enhancing the skills and earnings potential of young workers.

These studies are part of a larger body of work estimating the impact of schooling on labor market earnings. A common approach is to specify a human capital earnings function to represent the equilibrium relationship between years of education and earnings. The partial derivative of log earnings with respect to education indicates the earnings premium for an additional year of school. In examining earnings premiums for different levels of schooling and major areas of study, we follow the standard approach in equation (1) and use Ordinary Least Squares (OLS) to estimate separate human capital earnings functions for male and female employees in a given year.

The notation y denotes the natural logarithm of real monthly earnings, and X denotes a set of worker characteristics that affect earnings. Within X , we represent the education characteristics using a set of dummy variables for education level attained, including major area of study where applicable. Other variables in the X matrix include log monthly hours worked, years of potential experience and its square, years of establishment-specific tenure and its square, and binary variables for regional location, urban status, marital status, and preschool children (women only). The notation e is a random error term assumed to be normally distributed with variance σ^2 . The estimated coefficient b_1 for each education level and major area of study represents the equilibrium earnings premium by sex for that type of education and training.⁹

The standard approach yields estimates that are performed at the mean of the conditional earnings distribution. However, quantile regression techniques can produce relative earnings premiums by education across the full distribution of earnings. First introduced in Roger Koenker and Gilbert Bassett (1978) and further discussed in Moshe Buchinsky (1994, 1998), the quantile regression model can be considered a location model and written as

The notation y_i denotes the natural logarithm of earnings for the sample of individuals $i=1$ to n , and X_i is the matrix of characteristics. Now β_y is the vector of quantile regression coefficients and u_{yi} denotes the random error term with an unspecified distribution. The expression $Quanty(y_i | X_i)$ denotes the y th conditional quantile of y_i , conditional on the matrix of characteristics X_i , with $0.5 \leq y \leq 1$. Equation (2) assumes that u_{yi} satisfies the restriction that $Quanty(u_{yi} | X_i) = 0$.

For a given quantile y , the coefficients β_y can be estimated by solving the following minimization problem

where $r_y(l)$ is a check function defined as $r_y(l) = \frac{1}{4}yl$ for $l \leq 0$ and $r_y(l) = \frac{1}{4}(y-1)l$ for $l > 0$. One can trace the entire distribution of log earnings, conditional on the observed characteristics, by steadily increasing y from 0 to 1. Given the constraint placed by a limited number of observations, it is practical to estimate a finite number of quantile regressions. Each coefficient in the vector β_y is then interpreted as the marginal change in the y th conditional quantile of earnings due to a marginal change in the regressor of interest.

RELATIVE EARNINGS PREMIUMS FOR VOCATIONAL EDUCATION

Results indicate quite a dynamic wage structure in the face of Taiwan's large shifts in employment, the increased supply of better-educated workers, the government's heavy investment in vocational schools, and the persistent sex segregation within vocational schools. This section examines these labor market features in the context of relative earnings premium estimates for different levels of schooling and major areas of study. Beginning first with trends in broad levels of education, Figure 4 illustrates education penalties and premiums relative to academic senior high school for both male and female employees. These results are the coefficients on the education variables from the male and female log earnings regressions, with academic senior high serving as the deleted dummy variable. The full regression results can be found in Appendix Tables 1 and 2. Consistent with trends in other countries, the figure shows a clear stepwise increase in earnings premiums with rising educational attainment. Workers with only a primary school or junior high school education experience sizeable earnings penalties throughout the period compared to workers who have attained an academic senior high education.

Although male and female workers have experienced sizeable earnings premiums for college educations, these premiums dipped and then stagnated somewhat during the mid-1980s to mid-1990s, followed by an increase through the early 2000s. The fluctuations are especially pronounced for men. This decline in college premiums corresponds to a large increase in the supply of students following decisions by education planners to increase the number of available spots in colleges and universities (T. H. Gindling and Way Sun 2002). Structural shifts toward more skillintensive industries and factor-specific technical change after 1995 explain the increase in earnings premiums for a college education (James Vere 2005). However, these structural shifts appear to have favored men and resulted in a smaller boost in premiums for women with college educations.

Patterns for vocational schooling also differ by sex. For men, premiums for vocational school compared to an academic high school education are greater than zero in most years. In contrast, women who pursue vocational

school education most often experience no gain or even an earnings

Figure 4 Earnings penalties and premiums by education levels, relative to academic senior high school, 1978 – 2002

penalty compared to women who have obtained an academic high school education. This result implies that for those individuals who did not attain a college education, men who were channeled into vocational school through the restrictive education policy still obtained higher premiums compared to senior high school, while women did not. Another important implication of the exam-oriented entry system into higher education and the vocational school targets is that women who were denied access to the college and university system are forgoing earnings premiums for college educations that exceed those of men in all years. This result of consistently higher female earnings premiums for college education compared to male earnings premiums conforms to previous findings that earnings premiums for greater levels of education are higher for women than men internationally.¹¹

When we categorize the education variables according to major area of study, we find that for both men and women, certain types of vocational education are indeed superior to academic senior high school. Table 4 reports OLS regression coefficients on the dummy variables for education level and major area of study as averages between 1978 and 2002, and Appendix Tables 3 and 4 report the complete regression results with standard errors. As shown in Table 4, the premiums for a technical track in vocational school compared to academic senior high school are positive for both male and female workers. However, similarities by sex stop here. For men, premiums for a commerce track in vocational school compared to senior high school are consistently positive over time. In contrast, in all but the final sub-period, female workers actually experience an earnings penalty for a vocational school education in commerce compared to general academic education. Results for other types of vocational school training (such as law, humanities, and education) compared to senior high school are mixed depending on the time period. For men, penalties for vocational school training in these other areas have, on average, turned into premiums over time, while women have experienced the reverse trend. Overall, results in Table 4 suggest that the commerce vocational track where women cluster yields an earnings penalty compared to academic senior high school, while the technical track where men are more prevalent yields an earnings premium.

More detailed quantile regression results for earnings premiums for vocational school relative to academic senior high school at various percentiles of the male and female earnings distributions are presented in Table 5. One advantage of these results is that they indicate how the profitability of investing in education varies across the distribution of

workers with varying outcomes in labor market compensation. For men, earnings premium estimates at the median tend to be lower than estimates performed at the mean. This result implies that men in the upper half of

Table 4 Average earnings penalties and premiums by level of schooling and major area of study, relative to academic senior high school,

the earnings distribution are pushing up mean premium estimates for these schooling levels. For women, however, the point estimates for the vocational school variable tend to be negative and almost all are imprecise, implying that women across the earnings distribution see no earnings boost from attending vocational school. Another notable difference across gender is that for men at the upper end of the distribution, premiums for vocational schooling are positive and significant in almost all years, while the opposite is true for women. The result implies that among those workers without a college education, men at the upper tail of the distribution are seeing the greatest advantage from being channeled into the vocational track rather than the general education track, while women in the upper tail experience either no boost at all or a small penalty from the vocational school track.

Table 5 Quantile regression results for earnings premiums and penalties for vocational school relative to academic senior high, 1978 – 2002

These earnings premiums are closely related to differentials in starting salaries, and gaps in starting salaries between recent male and female graduates remain a salient feature of Taiwan's workplace. Because male students in the vocational stream tend to be tracked into technical training while female students tend to receive more training in commerce, the final part of the analysis compares starting salaries for male and female workers in these two areas of study in vocational school. To construct sample statistics for starting salaries, we compute the average salaries for recent vocational school graduates in four categories that differ by sex and major.¹² Results, illustrated in Figure 5, indicate that while real starting salaries for vocational school graduates have risen steadily over time, some noticeable differences between men and women have persisted. While recent male graduates see no consistent advantage over time for having a technical background, women's starting salaries are higher for technical training compared to commerce training in almost all periods. The figure also shows that even though starting salaries are far more dependent on sex rather than the type of major in vocational school, the gender gap tends to be higher among workers with commerce backgrounds compared to workers with technical training.¹³ Also apparent is the large increase in the salary gap between men and women until the mid-1990s. As more students were tracked into vocational school, men and women with comparable training and

experience faced growing discrepancies in starting salaries. The most recent evidence points to a reversal in this trend and a narrowing in the starting salary gap between men and women, with the reversal occurring sooner and more dramatically for workers with technical vocational backgrounds.

Several labor market trends could explain the growing gap in starting salaries for vocational school graduates, at least until the mid-1990s. Previous work on Taiwan suggests that unexplained pay gaps within occupations grew during the period, while sex segregation across very detailed occupation categories also may have occurred (Joseph Zveglic and Yana Rodgers 2004). Another explanation centers on the surge in women's labor force participation, which appears to have had more of a dampening effect on the relative wages of younger women than older women (Chun-Hung Lin and Peter Orazem 2004). Also, a shift toward salaried jobs in Taiwan helped male workers but penalized female workers (Gu' nseli Berik 2000). Technological restructuring and competition from international trade also have contributed to women's absorption into lower paying jobs and a relative lack of bargaining power in wage negotiation situations (Stephanie Seguino 2000; Gu' nseli Berik, Yana Rodgers, and Joseph Zveglic 2004). Greater capital mobility in Taiwan's female-labor intensive industries has left women more vulnerable to losses of bargaining power in negotiation settings.

Figure 5 Starting salaries for recent graduates of vocational school with technical and commerce majors, 1978 – 2002

CONCLUSION

This study has found a high degree of sex segregation in Taiwan's vocational school enrollment across different types of career preparation. Taiwan's planning efforts have had a great impact on workforce development and shaping the labor force for the changing needs of economic growth and restructuring. However, women appear to have taken on a supportive role in this workforce development, with training largely focused on clerical and secretarial skills, while men have taken on a leading role with training focused on the acquisition of engineering and technical skills. In addition, earnings premium estimates indicate that only men have gained consistently higher premiums from vocational school compared to a general education track. In contrast, vocational school majors in commerce, where women are clustered, yield earnings penalties compare to academic senior high school. These differential patterns in skill development for such a large proportion of new labor market entrants have crucial implications with regard to who stands ready to obtain new employment opportunities that are largely concentrated in high-tech manufacturing industries.

In principle, an emphasis on vocational education at the secondary level may help increase productivity in the face of changing labor market

demands through the heightened flexibility of workers. As Taiwan experiences industrial restructuring, women face persistent difficulties in obtaining newly created jobs in high-tech industries that demand workers with scientific, engineering, and technical skills. A vocational school system with such skewed distribution by sex certainly does not help women as the economy goes through its process of structural transformation. The findings present an opportunity to consider alternative policy instruments that enhance the educational opportunities for all students as they train for rewarding jobs. The government's manpower planning efforts ought to create clear incentives for women to train for highly paying jobs in technology- and skill-intensive manufacturing industries. Less structured policy options include opening up alternative tracks in the secondary school system and allowing student demands rather than government limits or testing constraints to determine enrollments.

Beyond continued reforms in education policy that increase opportunities for student choice, one of the major policy initiatives to help more women advance in engineering and technical tracks would be stronger enforcement of equal opportunity legislation. Improved enforcement would provide women with greater access to a wider range of occupations and industries and also would open up access to new training opportunities. The "Gender Equal Employment" bill, which prohibits discrimination in training, hiring, and employment, was first introduced in the parliament in 1989. Business groups and pro-commerce ministries in the government resisted the bill for over a decade, in fear that it would reduce firms' competitiveness in world export markets (Fen-ling Chen 2001). Threats by business groups to move their subsidiaries out of Taiwan if the bill were to be passed proved particularly effective in the recessionary environment of the early 1990s. The bill remained in parliament until 2001 when it was signed into law, but enforcement has been problematic (Gü nseli Berik 2005; Wen-Chi Grace Chou, Patricia Fosh, and Deborah Foster 2005). As the economy continues to shift toward competition in high-tech goods and research and development, workforce development for male and female workers takes on greater importance than before. Policy reforms based on relaxing education quotas and enforcing equal opportunity legislation will meet feminist objectives by providing women with more suitable education options and more rewarding career opportunities. These policy reforms will also provide essential workforce training for meeting Taiwan's industrial and trade policy objectives.

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NOTES

- 1 Advocates and skeptics also dispute the social rates of return to vocational schooling in cost-benefit analyses. The conventional wisdom holds that social rates of return to vocational schooling are lower than returns to general schooling. For example, George Psacharopoulos (1994) finds that for a sample of twenty-five countries, the average rate of return to government investments in general secondary education (15.5 percent) is considerably higher than the average for vocational education (10.9 percent). Hence the labor market benefits of vocational-trained workers may not be large enough to justify the high costs to governments of delivering vocational schooling. In contrast, Paul Bennell (1996) concludes that the large majority of country studies find social rates of return for general secondary education that are not significantly higher than those for vocational secondary schooling.
- 2 This section on Taiwan's education system, policies, and trends draws on Jennie Hay Woo (1991), Flora Tien (1996), Robert Wu (2000), and Ministry of Education, Republic of China (2002).
- 3 The data are obtained from the Executive Yuan's Directorate-General of Budget, Accounting, and Statistics (DGBAS Various years).
- 4 Individuals are asked to report weekly working hours for the previous week, which in most cases was the third week of May. Respondents whose incomes are relatively stable are asked to report their earnings for the month of April, while those with unstable or seasonally fluctuating incomes are asked to report their average monthly work income over a year's time. Non-monetary compensation is excluded. We impute monthly earnings for individuals with top-coded earnings as 1.2 times the top-code. This imputation affects only 4 observations per year on average.
- 5 See, for example, Lucie Cheng and Ping-Chun Hsiung (1994).
- 6 Yet further work in Linda Loury (1997) shows that increases in the market value of

women's skills relative to those of men for a given major accounts for much of the closing of the gender gap. For other US evidence on college major and wage outcomes see Charles Brown and Mary Corcoran (1997) and Gill and Leigh (2000).

7 Closely related, critics also argue that the content of vocational school should be generalized, with an expansion of post-graduation academic options available to students in the vocational track. See, for example, Indermit Gill, Amit Dar, and Fred Fluitman (1999).

8 Within East Asia, relatively high premiums for vocational education compared to general education are found in Thailand (Thammarak Moenjajak and Christopher Worswick 2003) and Singapore (Chris Sakellariou 2003). T. H. Gindling, Marsha Goldfarb, and Chun-Chig Chang (1995) report almost identical premiums for vocational school and high school in Taiwan for the 1978 – 91 period. This study does not further disaggregate vocational school by major areas of study.

9 Potential problems with selectivity bias in earnings premium estimates have received much attention in the literature (for a recent discussion, see David Card [2001]). In particular, schooling is not exogenous and unobserved ability affects both wages and school attainment. The most common approach is to control for selection into school levels by using family background characteristics. Unfortunately, the data for Taiwan do not offer options for good instruments. We conducted some sensitivity tests using business owner within the household and other household income as instruments in a two-step selection correction procedure and results did not change in any substantial way.

10 Note that the coefficients for vocational school, junior college, and college are similar in magnitude, sign, and precision if we drop workers with only primary and junior high school educations completely out of the sample.

11 For example, see Psacharopoulos (1994), Philip Trostel, Ian Walker, and Paul Woolley (2002), Christopher Dougherty (2003), and George Psacharopoulos and Harry Patrinos (2004).

12 We define “recent” graduate in the workforce as any full-time employee in the worker sample who has up to six years of potential experience and up to six years of tenure with the same employer. Choosing a smaller experience category led to some education-sex cells with zero observations in some years.

13 We also compared starting salaries of recent graduates of academic high school with those of recent graduates of vocational school (with all majors grouped together). However, for both men and women, the differences across these two school levels were extremely small. Although vocational school students in Taiwan may be stigmatized, they are doing about the same in terms of starting salaries as academic high school students who fail to go on to college.

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