《人文及社會科學集刊》
第十二卷第四期 (89/12), pp. 597-629


# Educational Expansion and Earnings Inequality in Taiwan: 1978-1995

Way Sun
National Central University

T. H. Gindling
University of Maryland Baltimore County

## ABSTRACT

In this paper we measure the wage compression and composition effects of educational expansion on the variance of real earnings in Taiwan from 1978 to 1995. We find that the wage compression effect of educational expansion is equalizing throughout the 1979-1994 period. We also find that the composition effect exhibits the inverted-U property. The composition effect is disequalizing in the early years (the late 1970s and early 1980s), and equalizing in the later years (the late 1980s and the 1990s). From 1978 to 1983 the disequalizing composition effect is greater than the equalizing price effect, causing the total impact of educational expansion on earnings inequality to be disequalizing. From 1983 to 1989 the equalizing wage compression effect is larger than the disequalizing composition effect, causing the total impact of educational expansion to be equalizing. From 1989 to 1995, both the wage compression and composition effects are equalizing, and therefore the total impact of educational expansion on earnings inequality was also equalizing. The overall impact of educational expansion in Taiwan between 1978 and 1995 was therefore equalizing. If there had been no educational expansion (and if the distribution and returns to other human capital had remained constant), the variance in the log of real earnings for paid employees would have increased rather than decreased.

**Key Words:** earnings inequality, compression effect, composition effects, price effect

---

* We would like to thank Gary Fields, Donald Robbins and two anonymous referees for helpful comments.
Received: Aug. 4, 1998; Accepted: Dec. 12, 2000

# I. Introduction

Policy makers show concern not only for the economic efficiency of public policy but also for its social equity. Most developing countries believe that it is rapid expansion of educational opportunities which holds the basic key to national development. In these developing countries, formal education is often the largest industry and the greatest consumer of public revenues. Government subsidization of education has been defended, in part, on the grounds that educational expansion, by making human capital more abundant, will reduce inequality in the distribution of pay.

The focus of this paper is on the impact of educational expansion on inequality in labor earnings in Taiwan. Total income includes not only labor earnings but also income from capital, land, transfers, entrepreneurial ability, etc. However, labor income has been shown to be the most important source of total income inequality; previous studies have shown that labor income accounts for more than half of total income inequality in Taiwan (Fei, Ranis and Kuo, 1978 and 1979). In this paper, using data from 1978 to 1995, we measure the degree to which educational expansion has increased or decreased earnings inequality in Taiwan.

# II. Theory

Theoretically, the impact of educational expansion on earnings inequality is ambiguous. Robinson (1976) and Knight and Sabot (1983), using a model of educational expansion between two education levels (high and low), show that educational expansion has two effects on income inequality: the "wage compression effect" and the "composition effect." The wage compression effect is the decline in the relative wages of (or rates of return to) more-educated workers as their relative supply increases, holding the distribution of education among workers constant. The wage compression effect is unambiguously equalizing. The composition effect of educational expansion is the increase in the proportion of workers in the more-educated group, holding returns to education constant. The impact of the composition effect on earnings inequality is ambiguous. In the context of educational expansion between two education levels (low and high), the composition effect of educational expansion will be dis-equalizing if begun from a situation where the more-educated group is relatively small, and will be

equalizing if begun from a situation where the more-educated group is relatively large. Specifically, "in a two-group model, a transfer of workers from the low- to high-education (and wage) group can be shown to raise the variance (or log variance) [of earnings] until the high-education group reaches a certain proportion of the total" (p. 1132, Knight and Sabot). Thereafter, further transfers from low- to high- education groups will reduce the variance of earnings. That is, the composition effect of educational expansion on earnings inequality can be described as an "inverted-U"; causing inequality to increase at first, and then later causing inequality to decrease. The composition effect of educational expansion is one theoretical justification for the famous Kuznets (1955) inverted-U hypothesis. In a two-group model, the turning point of this inverted-U depends on the difference in mean wages and on the difference in the variance of earnings in the two groups. Robinson (1976) calculates the turning point, $P_j$, to be . . .

$$(1) \qquad P_j=\frac{(s_2^2-s_1^2)}{2\,(X_2-X_1)^2}+\frac{1}{2}$$

where 1=low-paid education level, 2=high-paid education level, $s_i^2$ is the variance of earnings among workers in education group $i$, and $X_i$ is the mean earnings among workers in education group $i$.

The overall impact of educational expansion on earnings inequality depends on the sign of the composition effect and the relative magnitudes of the composition and wage compression effects.

## III. Pattern of Educational Expansion in Taiwan, 1978-1995

We use the Manpower Utilization Surveys of the Taiwan Area to estimate the proportion of paid employees with each level of education for the 1978-1995 period (Table 1).[1] The general pattern of educational expansion in Taiwan from 1978 to 1995 is consistent with a two-group model; over the 1978-1995 period the proportion of workers in the lower-paid education levels (primary and junior high) falls while the proportion of workers at the

1 Manpower Utilization Surveys of the Taiwan Area, Directorate General of Budget, Accounting and Statistics (DGBAS), Executive Yuan, Republic of China, 1978-1995. In our calculations, we use data from salaried workers only and the weights given in the Manpower Utilization Survey data tapes.

higher-paid education levels (senior high and above) rises.[2] Combining primary and junior high school to create the lower-paid education level, and combining senior high school, junior college and universities to create the higher-paid education level, we calculated the "turning point" for the composition effect of educational expansion in Taiwan. We calculated the turning point, $P_j$, using variances and means for the log of yearly earnings and data for each year from 1978 to 1983. The values for these 6 years ranged from 41% to 58%, with a mean of 52%. Based on these calculations and an examination of table 1, we predict that the turning point occurred in approximately 1989, when approximately 50% of the workers have a senior high school, junior college or university education. Therefore, based on an application of the theoretical analysis of Robinson (1976) and Knight and Sabot (1983) to Taiwanese data, we expect that the composition effect of educational expansion will show the inverted-U property — increasing from 1978 to approximately 1989, and then falling thereafter.

Educational expansion into higher education levels is slower in the early years and faster in the later years — the proportion of workers with junior college or university education increased by 0.014 between 1978-1983, 0.031 between 1983-1989, and 0.058 between 1989-1995.[3] Therefore, we expect that the equalizing wage compression effect will be more pro-

2 Workers with less than a senior high school education have, on average, wages below the mean wage, while workers with above a high school education have, on average, wages above the mean wage. Prior to 1984, the mean wage of senior high school workers is above the over-all-years mean, after 1983 the mean wage of senior high school workers is below the over-all-years mean.

3 The more rapid educational expansion in the later 1980s is consistent with education policy implemented by the Ministry of Education. Since the early 1950s, higher education in Taiwan has been strictly planned by the government. Most important decisions regarding higher education are made by the Ministry of Education. For example, the Ministry determines the number of private and public junior colleges and universities, which fields of study may be offered at each institution, the tuition charge by both private and public institutions, and the number of students allowed to attend each university in each major. In the 1970s economic planners strictly limited growth in the number of students receiving higher education in Taiwan. Then, in the 1980s the number of students receiving higher education was allowed to increase at faster rates, modestly at first and then very rapidly after 1985. In another paper, Gindling and Sun (1998), we show that the increase in the number of students receiving higher education in Taiwan caused a fall in the wages of workers with higher education compared to the wages of workers with only a high school education.

**TABLE 1**
**Propotion of Paid Employees at Each Education Level**

| Year | Primary | Junior High | Senior High | Junior College | University |
|---|---|---|---|---|---|
| 1978 | 0.345 | 0.211 | 0.246 | 0.072 | 0.071 |
| 1979 | 0.365 | 0.205 | 0.229 | 0.068 | 0.067 |
| 1980 | 0.345 | 0.211 | 0.246 | 0.072 | 0.071 |
| 1981 | 0.343 | 0.209 | 0.248 | 0.068 | 0.075 |
| 1982 | 0.330 | 0.216 | 0.255 | 0.077 | 0.069 |
| 1983 | 0.305 | 0.216 | 0.271 | 0.082 | 0.074 |
| 1984 | 0.287 | 0.213 | 0.287 | 0.087 | 0.079 |
| 1985 | 0.286 | 0.221 | 0.287 | 0.090 | 0.068 |
| 1986 | 0.271 | 0.228 | 0.289 | 0.089 | 0.076 |
| 1987 | 0.254 | 0.215 | 0.306 | 0.102 | 0.080 |
| 1988 | 0.253 | 0.213 | 0.325 | 0.103 | 0.075 |
| 1989 | 0.233 | 0.205 | 0.333 | 0.106 | 0.090 |
| 1990 | 0.225 | 0.206 | 0.340 | 0.111 | 0.090 |
| 1991 | 0.219 | 0.206 | 0.345 | 0.114 | 0.092 |
| 1992 | 0.206 | 0.201 | 0.348 | 0.129 | 0.094 |
| 1993 | 0.195 | 0.196 | 0.355 | 0.133 | 0.100 |
| 1994 | 0.181 | 0.203 | 0.356 | 0.138 | 0.101 |
| 1995 | 0.170 | 0.194 | 0.363 | 0.146 | 0.108 |
| CHANGES BETWEEN SELECTED YEARS | | | | | |
| 1978-1995 | −0.175 | −0.016 | 0.117 | 0.073 | 0.037 |
| 1978-1983 | −0.041 | 0.005 | 0.025 | 0.010 | 0.004 |
| 1983-1989 | −0.071 | −0.011 | 0.062 | 0.024 | 0.015 |
| 1989-1995 | −0.063 | −0.010 | 0.030 | 0.040 | 0.018 |

nounced in the late-1980s and 1990s compared to the 1970s and early 1980s.

## IV. A Technique For Measuring the Wage Compression and Composition Effects of Educational Expansion

To measure the wage compression and composition effects of educational expansion we use a modification of a technique developed by Juhn,

Murphy and Pierce (1993) and used in Gindling and Robbins (1998). The Juhn, Murphy and Pierce technique decomposes the change in inequality into three parts: a part due to changes in the distribution of human capital (quantities) holding prices constant, a part due to changes in the wage premiums (prices) associated with this human capital holding the distribution of human capital constant, and a part due to changes in unobserved or unmeasured quantities and prices. The modification of the Juhn, Murphy and Pierce technique presented here and in Gindling and Robbins (1998) allows us to estimate quantity and price effects separately for education and other types of human capital.

The Juhn, Murphy and Pierce (1993) technique is based on the simple earnings equation

$$(2) \qquad Y_{it}=X_{it}B_t+u_{it}$$

where $Y_{it}$ represents the (log) of real earnings for individual $i$ in year $t$, $x_{it}$ is a vector of individual human capital characteristics for individual $i$ in year $t$, the elements of the coefficient vector $B_t$ can be interpreted as the wage premium, or price, for each human capital characteristics in year $t$, and $u_{it}$ (the residual) is the component of earnings accounted for by factors we cannot measure or observe.

We want to separate the effects of two types of human capital variables, education and others. Letting "$a$" denote the education variables and "$b$" denote the other human capital variables, we can re-write equation (2) as

$$(3) \qquad Y_{it}=X_{it}^{a}B_t^{a}+X_{it}^{b}B_t^{b}+u_{it}$$

Juhn, Murphy and Pierce (1993) think of the residual ($u_{it}$) as being composed of two components: an individual's percentile in the residual distribution, $0_{it}$, and the distribution of the earnings equation residuals, $F_t(0_{it}|X_{it})$. Specifically,

$$(4) \qquad u_{it}=F_t^{-1}(0_{it}|X_{it})$$

Analogously, we think of each variable within $X_{it}^{b}$ as being composed of two components, an individuals percentile in the distribution of each variable within $X_{it}^{b}$, $n_{it}$, and the distribution of each variable within $X_{it}^{b}$, $G_t(n_{it})$. Therefore, the vector of variables within $X_{it}^{b}$ can be represented as:

$$(5) \qquad X_{it}^{b}=G_t^{-1}(n_{it})$$

Define $\boldsymbol{B}$ as the average returns (prices) for observable characteristics over all the years, $\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it})$ as the average (inverse) cumulative distribution of residuals over all the years, and $\boldsymbol{G}_t^{-1}(\boldsymbol{n}_{it})$ as the vector of the over-all-years average (inverse) cumulative distribution of each variable within $X_{it}^b$. Adding and subtracting $X_{it}^a\boldsymbol{B}^a$, $X_{it}^b\boldsymbol{B}^b$, $\boldsymbol{G}_t^{-1}(\boldsymbol{n}_{it})\boldsymbol{B}^b$, and $\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it})$, equation (3) can be re-written as

$$(6)\qquad Y_{it}=X_{it}^a\boldsymbol{B}^a+\boldsymbol{G}_t^{-1}(\boldsymbol{n}_{it})\boldsymbol{B}^b-[X_{it}^b-\boldsymbol{G}_t^{-1}(\boldsymbol{n}_{it})]\,\boldsymbol{B}^b+X_{it}^a[B^a-\boldsymbol{B}^a]$$
$$+X_{it}^b[B^b-\boldsymbol{B}^b]+\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it})+[F_t^{-1}(0_{it}|X_{it})-\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it})]$$

(Equation 6 is the analogous to equation (3) in Juhn, Murphy and Pierce, 1993.) "Armed with this simple framework, we can reconstruct what the wage distribution would look like with any subset of components held fixed" (Juhn, Murphy and Pierce, 1993, page 428). For example, with fixed observable prices, a fixed distribution for $X^b$, and a fixed residual distribution (but allowing the distribution of $X^a$ to vary over time), wages would be determined as

$$(7)\qquad Y_{it}^1=X_{it}^a\boldsymbol{B}^a+\boldsymbol{G}_t^{-1}(\boldsymbol{n}_{it})\boldsymbol{B}^b+\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it})$$

With fixed observable prices and a fixed residual distribution (but allowing the distribution of $X^a$ and $X^b$ to vary over time), we can generate wages by

$$(8)\qquad Y_{it}^2=X_{it}^a\boldsymbol{B}^a+X_{it}^b\boldsymbol{B}^b+\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it}),$$

(Equation 8 is the same as equation (4) in Juhn, Murphy and Pierce, 1993.) With fixed prices for b and a fixed residual distribution (but allowing the prices for a and the distribution of $X^a$ and $X^b$ to vary over time), yields

$$(9)\qquad Y_{it}^3=X_{it}^a\boldsymbol{B}_t^a+X_{it}^b\boldsymbol{B}^b+\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it}),$$

Allowing all observable prices and observable quantities to vary over time, but maintaining a fixed residual distribution, yields

$$(10)\qquad Y_{it}^4=X_{it}^a\boldsymbol{B}_t^a+X_{it}^b\boldsymbol{B}_t^b+\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it}),$$

(Equation 10 is the same as equation (5) in Juhn, Murphy and Pierce, 1993.) Finally, allowing observable prices, quantities and the distribution of residuals to change through time, we obtain

$$(11)\qquad Y_{it}=X_{it}^a\boldsymbol{B}_t^a+X_{it}^b\boldsymbol{B}_t^b+u_{it},$$

In practice, we estimate an earnings equation with right-hand-side variables which include: dummy variables for junior high and below, senior high

school, junior college, and university; a quartic for experience; years of tenure; a dummy variable for sex; and a dummy variable for marital status.[4] In practice, the average (over-all-years) prices, $\boldsymbol{B}^a$ and $\boldsymbol{B}^b$, were estimated with a pooled regression using data from all years. Following the procedure outlined in Juhn, Murphy and Pierce (1993), we compute $\boldsymbol{F}_t^{-1}(\boldsymbol{0}_{it}|\boldsymbol{X}_{it})$, the average residual for each percentile group in the distribution of residuals, based on the workers actual percentile in each year's residual distribution and the average cumulative distribution over the full sample (for all years). To calculate each component of $\boldsymbol{G}_t^{-1}(\boldsymbol{n}_{it})$ we use a procedure similar to that used to calculate the average residual distribution. For example, the average distribution for experience was computed based on the workers actual percentile in each year's experience distribution and the average cumulative distribution of experience in the full sample (for all years). The average distributions for sex, tenure and marital status were calculated in the same way.

Following Juhn, Murphy and Pierce (1993), we calculate the distribution of $Y_{it}$, and $Y_{it}^1$ through $Y_{it}^4$ for each year. We then attribute:

(i) Changes over time in inequality in the distribution of $Y_{it}^1$ are an estimate of changes in earnings inequality allowing the distribution of education to change while holding constant: the distribution of the other human capital variables, the prices of education, the prices of the other human capital variables, and the distribution of unobservables. We call this the contribution of "education quantities" to changes in the distribution of earnings; it is our measure of the composition effect of educational expansion.

(ii) Changes over time in inequality in the distribution of $Y_{it}^2$ are an estimate of changes in earnings inequality allowing the distribution of all types of human capital to change while holding constant: education and other human capital prices, and unobservables. Any additional changes in inequality in the distribution of $Y_{it}^2$ beyond changes in inequality in the distribution of $Y_{it}^1$ capture changes in earnings inequality due to changes in the distribution of other human capital variables, holding all else constant. We

4 Unlike Juhn, Murphy and Pierce (1993), we do not include interaction terms between experience and education. While excluding the interaction terms makes the functional form less flexible than that used in Juhn, Murphy and Pierce(1993), using the less flexible functional form permits us to estimate quantity and price effects separately for education and experience.

call this the contribution of "other quantities" to changes in the distribution of earnings.[5]

For example, to calculate the contribution of other quantities to the change in the variance we first subtract the variance of $Y_{it}^2$ from the variance of $Y_{it}^1$, and then report the changes in this difference over time.

(iii) Any additional changes in inequality in the distribution of $Y_{it}^3$ beyond changes in inequality in the distribution of $Y_{it}^2$ capture changes in earnings inequality due to changes in education prices, holding all else constant. We call this the contribution of "education prices" to changes in the distribution of earnings; it is our estimate of the wage compression effect of educational expansion.

(iv) Any additional changes in inequality in the distribution of $Y_{it}^4$ beyond changes in inequality in the distribution of $Y_{it}^3$ capture changes in earnings inequality due to changes in the other human capital prices, holding all else constant. We call this the contribution of "other prices" to changes in the distribution of earnings.[6]

(v) Finally, additional changes in inequality between $Y_{it}$ and $Y_{it}^4$ can be attributed to changes in the distribution of the error terms (quantities and prices that we do not observe). We call this the "contribution of unobservables."[7]

Changes in the prices of (returns to) education may be due to either changes in the supply of more educated workers or to changes in the demand for more educated workers (increases in the supply would tend to reduce returns to education and be equalizing, while increases in the

---

5 The sum of the contribution of education quantities and other quantities equals the contribution of "total observable quantities."

6 The sum of the contribution of education prices and experience prices equals the contribution of "total observable prices."

7 To calculate the quantity effects in the decomposition described above we first changed the distribution of education (equation 7) and then changed the distribution of the other human capital variables (equation 8). Similarly, to calculate the price effects we first changed the prices of education (equation 9) and then changed the prices of the other human capital variables (equation 10). An alternative decomposition, or "path," would be to first change the quantities (or prices) of the other human capital variables, and then change the quantities (or prices) of the education variables. We calculated wage and compression effects using this alternative path. The results of this alternative path, which are presented in appendix 1, are consistent with the results presented in the body of this paper.

demand would tend to increase returns to education and be disequalizing). Our measure of the wage compression effect is a precise estimate of the wage compression effect only if demand remains unchanged — that is, only if changes in returns to education are caused only by changes in the relative supply of more educated workers. Robbins and Zveglich (1996) and Gindling and Sun (1998) show that the data used in the present paper are consistent with the hypothesis of stable or slowly increasing relative demand for more-educated workers over the 1978-1995 period. Therefore, the estimate of the earnings compression effect that we present is probably an underestimate of the true equalizing earnings compression effect.

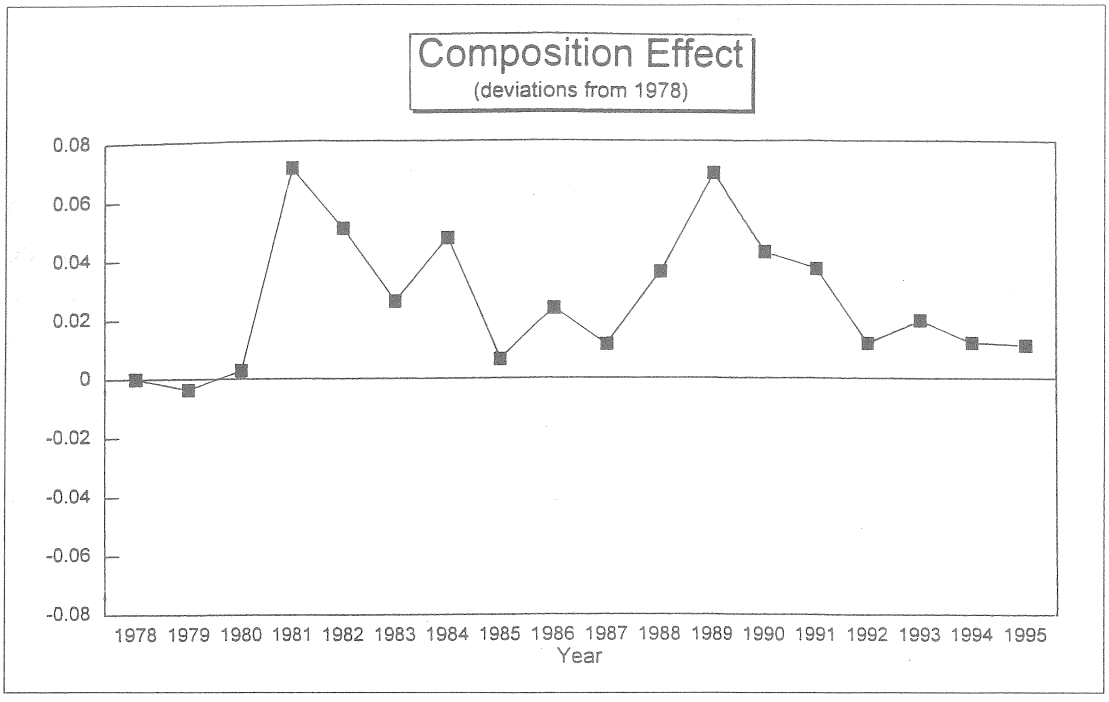
## V. Wage Compression and Composition Effects of Educational Expansion on the Variance of the Log of Real Earnings in Taiwan, 1978-1995

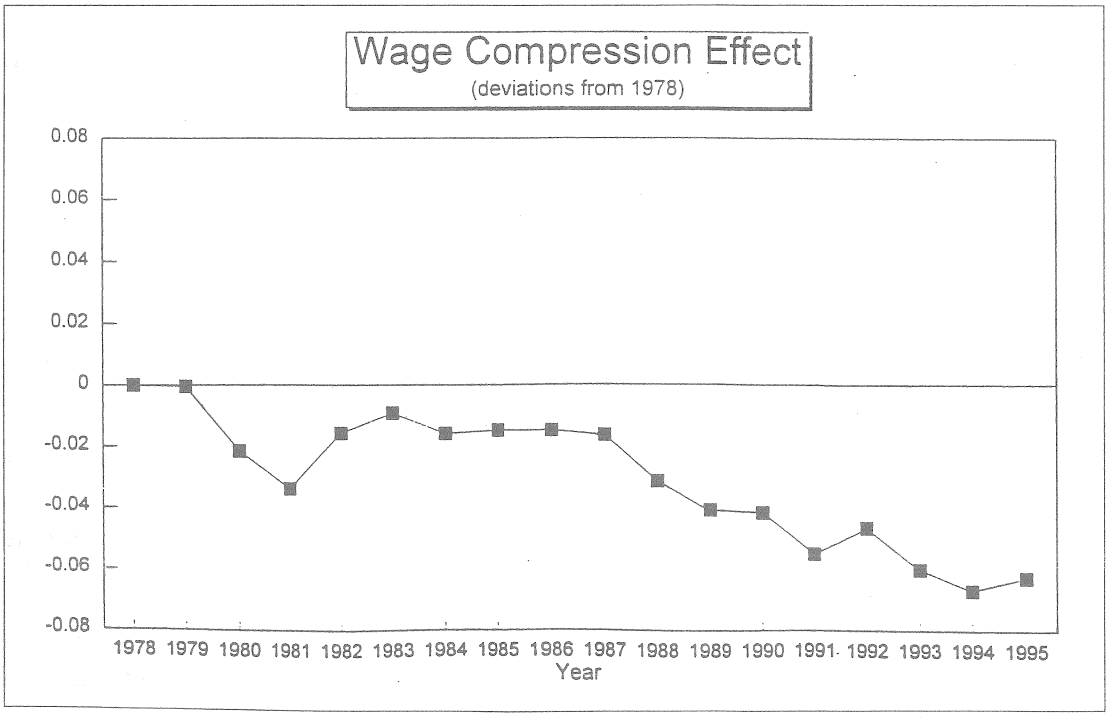
We use the technique described in the last section to decompose the variance in the log of real yearly earnings of paid employees in Taiwan.[8] Over the entire 1978-1995 period the overall variance in the log of real earnings falls from 0.225 in 1978 to 0.200 in 1995.[9] Figure 1 and table 2 present

8 Following the procedure in Juhn, Murphy and Pierce (1993), we use the sample of paid employees only (excluding self-employed, owners and un-paid family workers) because of problems with using the wages of all workers to estimate returns to education. For example, the wages of the self-employed may include returns to physical capital as well as returns to the labor input, and are therefore not appropriate for measuring returns to human capital such as education. We also calculated the composition and wage-compression effects of educational expansion using data from all workers (with positive earnings, who report that they are working, and have non-missing age, education, sex and marital status). We report the results using the sample of all workers in appendix 1. Yearly earnings in nominal New Taiwan Dollars are deflated using the Consumer Price Index (1991=100).

9 The variances are calculated using data from paid workers only. The decrease in the variance is relatively small and the direction of the change between 1978 and 1995 depends on the measure or inequality and specific data set used. For example, using data for all workers (including self-employed workers and owners) we find that the log variance increases from 0.305 in 1978 to 0.368 in 1995. On the other hand, Fields and O'Hara (1996), using the same data source and data from all workers, report that the Gini coefficient of earnings falls from 1980 to 1993. Bourguignon, et al. (1998), using data from all workers and the Income and Expenditure Surveys, also report a fall in the Gini coefficient of earnings from 1979 to 1994.

**FIGURE 1**
**Composition and Wage Compression Effects on the Variance of the Log of Real Earnings: 1978-1995**



estimates of the composition and wage compression effects on the variance of real earnings.[10] Each point in the top panel of figure 1 ("Composition Effect") represents the change since 1978 in the variance of the log of real earnings due to the composition effect of educational expansion. A point below the "zero" line indicates that the change in the variance due to the composition effect since 1978 was negative (equalizing), a point above the "zero" line indicates a positive (disequalizing) composition effect. An increase between any two years indicates that the composition effect was disequalizing between those two years, and vice-versa. Similarly, each point in the bottom panel ("Wage Compression Effect") is the change since 1978 in the variance of the log of real earnings since 1978 due to the wage compression effect of education expansion. Both graphs use the same scales on the vertical axis so that it is easy to compare the relative magnitudes of the two effects.

To minimize the impact of possible sampling errors, in table 2 we measure the composition and wage compression effects based on three-year centered averages around the beginning and end years of the period studied. The numbers presented in table 2 measure how much the wage compression effect or composition effect would have changed the variance in total earnings holding all else constant. A positive number in table 2 means that the effect would increase the variance, a negative number means that the effect would decrease the variance. For example, between 1979 and 1994 (3-year centered averages) the wage compression effect (the change in education prices) alone would have decreased the variance of the log of real earnings by 0.056 (holding constant: the prices of other human capital, and the distribution of education, experience, gender, marital status and tenure). Between 1979 and 1994, the total impact of educational expansion (the wage compression plus the composition effects, holding returns and distribution of the other human capital variables constant) would have decreased the variance by 0.042. Put another way, if the education levels of Taiwanese workers had been the same in 1995 as they were in 1978, the variance of real earnings would have been 0.042 higher than it actually was (that is, it would have been 0.242 rather than 0.200).

As expected, the wage compression effect of educational expansion is

10 In calculating the composition and wage compression effects, we weight the data using the weights from the Manpower Utilization Survey data tapes.

**TALBE 2**
**Composition and Wage Compression Effects of Educational Expansion Between Selected Years (3-year Centered Averages)**

| | 1979-1994 |
|---|---|
| Change in the Variance of the Log of Real Earnings | −.020 |
| *Change in Variance of the Log of Real Earnings Due to the:* | |
| Composition Effect | .014 |
| Wage Compression Effect | −.056 |
| Total Effect of Eductional Expansion (wage compression plus composition effect) | −.042 |

| | 1979-1983 | 1983-1989 | 1989-1994 |
|---|---|---|---|
| Change in the Variance of the Log of Real Earnings | .018 | −.026 | −.013 |
| *Change in Variance of the Log of Real Earning Due to the:* | | | |
| Composition Effect | .042 | .008 | −.035 |
| Wage Compression Effect | −.006 | −.024 | −.025 |
| Total Effect of Educational Expansion (wage compression plus composition effect) | .036 | −.016 | −.060 |

equalizing throughout the 1978-1995 period. Also as expected, the equalizing wage compression effect is more pronounced in the later years as the rate of educational expansion increased. As noted earlier, because the education price effect is the result of changes in both supply and demand, and because previous work suggests that the relative demand for more-educated workers may have increased slightly from 1978 to 1995, the measured wage compression effect is probably an under-estimate of the true wage compression effect.

As expected, the composition effect exhibits the inverted-U property. From 1978 to 1989, the composition effect is disequalizing.[11] After the

11 Although the pattern is erratic — increasing from 1978 to 1981, then decreasing from 1981 to 1987, then increasing again from 1987 to 1989 — the overall contribution of the composition effect between 1978 and 1989 is clearly disequalizing.

turning point, which we calculated to be approximately 1989, the composition effect is consistently equalizing (from 1989 to 1995 the composition effect is equalizing in each year but one). Thus, the results we present generally support the validity of the theoretical models presented in Robinson (1976) and Knight and Sabot (1983).

From 1978 to 1983, the disequalizing composition effect is greater than the equalizing price effect, causing the total impact of educational expansion on earnings inequality (the sum of the composition and the wage compression effect) to be disequalizing (although recall that our estimate of the wage compression effect is an underestimate, and that therefore the true effect of educational expansion may be equalizing even from 1978 to 1983). From 1983 to 1989 the equalizing wage compression effect is larger than the disequalizing composition effect, causing the total impact of educational expansion to be equalizing. From 1989 to 1995, both the wage compression and composition effects are equalizing, and therefore the total impact of educational expansion on earnings inequality was also equalizing.

Compared to the total change in the variance of real earnings between 1978 and 1995, the impact of educational expansion on earnings inequality was large in Taiwan. Between 1978 and 1995, if there had been no educational expansion (and if the distribution and returns to the other human capital characteristics had remained constant), the variance in the log of real earnings for paid employees would have increased rather than decreased.

## VI. Conclusions

In this paper we measure the wage compression and composition effects of educational expansion on the variance of real earnings in Taiwan from 1978 to 1995. We find that the wage compression effect of educational expansion is equalizing throughout the 1979-1994 period. Consistent with the theoretical model presented in Robinson (1976) and Knight and Sabot (1983), we find that the composition effect exhibits the inverted-U property; the composition effect is disequalizing in the early years (the late 1970s and early 1980s), and equalizing in the later years (the late 1980s and the 1990s).

From 1978 to 1983, the disequalizing composition effect is greater than the equalizing price effect, causing the total impact of educational expansion on earnings inequality to be disequalizing. From 1983 to 1989 the equalizing wage compression effect is larger than the disequalizing compo-

sition effect, causing the total impact of educational expansion to be equalizing. From 1989 to 1995, both the wage compression and composition effects are equalizing, and therefore the total impact of educational expansion on earnings inequality was also equalizing. The overall impact of educational expansion in Taiwan between 1978 and 1995 was equalizing; if there had been no educational expansion (and if the distribution and returns to other human capital had remained constant), the variance in the log of real earnings for paid employees would have increased rather than decreased.

# Appendix 1
# Alternative Sample and Alternative Path for the Decomposition

## i. Alternative Sample

We also calculated the decomposition results using a sample which included all workers (with positive incomes, who report that they are working, and report their age, education, sex and marital status). The results of the decomposition using this sample are reported in figure A1 and table A1. The results presented using the sample of all workers are consistent with those presented in the body of this paper. Specifically, the composition effect is disequalizing from 1978 to 1989, and then equalizing from 1989 to 1995, while the wage-compression effect is equalizing throughout the 1978–1995 period.

## ii. Alternative Path

In the decomposition described in section IV, to calculate the quantites effect we first changed the distribution of education and then changed the distribution of the other human capital variables. Similarly, to calculate the price effects we first changed the prices of education and then changed the prices of the other human capital variables. An alternative decomposition, or "path," would be to first change the quantities (or prices) of the other human capital variables, and then change the quantities (or prices) of the education variables.

We calculated composition and wage compression effects using this alternative path. The results, presented in table A2 and figure A2, are consistent with the results presented in the body of this paper regarding the wage compression effect of educational expansion — the wage compression effect is equalizing throughout. The results regarding the composition effect of educational expansion are similar but not always the same as in the body of the paper. One difference between the results in figure A2 and those in the body of the paper is the turning point, 1987 rather than 1989 — in figure A2 the composition effect becomes consistently equalizing after 1987 (rather than after 1989). Also, in figure A2 the "inverted-U" characteristic of the composition effect does not show up as clearly. From 1978 to 1987 the composition effect is, overall, neutral — falling from 1978 to 1980, rising to 1982, falling from 1982 to 1985, then rising again from 1985 to 1987,

so that by 1995 the contribution of education quantities to earnings inequality is only slightly disequalizing compared to 1978. Then, after 1987 the composition effect is (except for two years) consistently equalizing.

**TABLE A1**

**All Workers: Changes in the Contribution of Observable Education and Other Human Capital Quantities and Prices, and Unobservables the Total Change in the Variance in the Log of Real Earnings (3-year Centered Averages)**

| | 1979-1994 | 1979-1993 | 1983-1989 | 1989-1994 |
|---|---|---|---|---|
| Total Change in Variance | 0.08211 | 0.03766 | −0.01465 | 0.05910 |
| Total Observable Quantities | 0.34675 | 0.06157 | 0.21695 | 0.06822 |
| Education Quantities | −0.032 | 0.078 | 0.022 | −0.132 |
| Other Quantities | 0.379 | −0.016 | 0.195 | 0.201 |
| Total Obsevable Preces | −0.34288 | −0.0414388 | −0.22294 | −0.078504 |
| Education Prices | −0.094 | −0.007 | −0.040 | −0.047 |
| Other Prices | −0.249 | −0.034 | −0.183 | −0.032 |
| Unobservables | 0.078 | 0.018 | −0.009 | 0.069 |

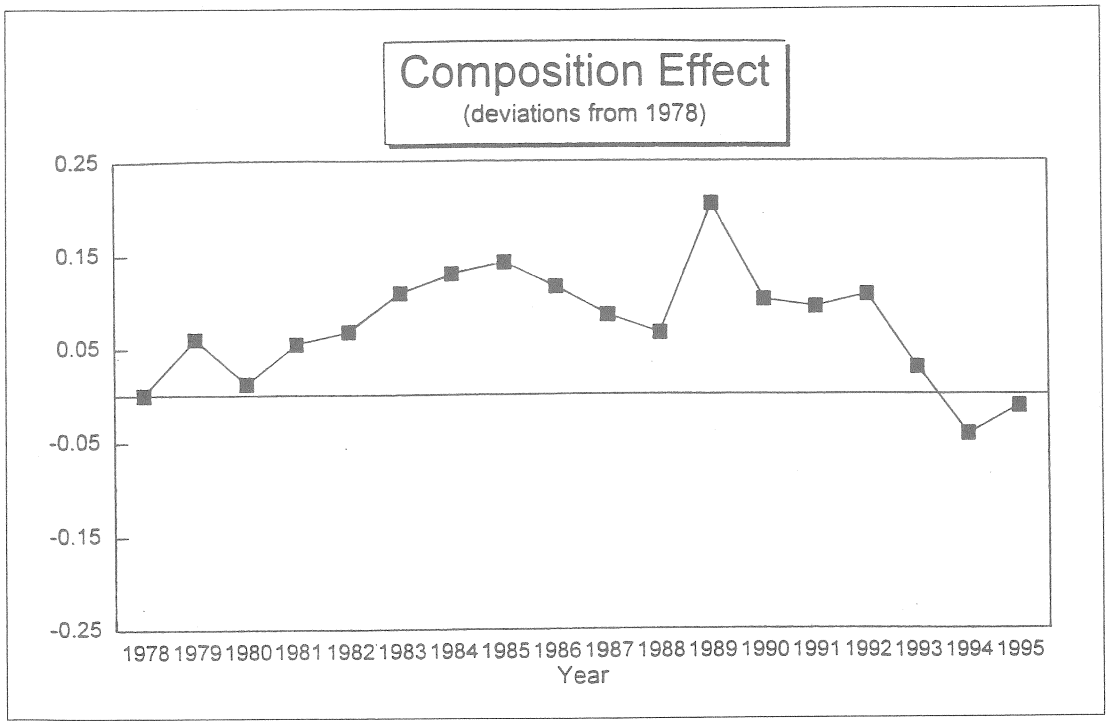
**TABLE A2**

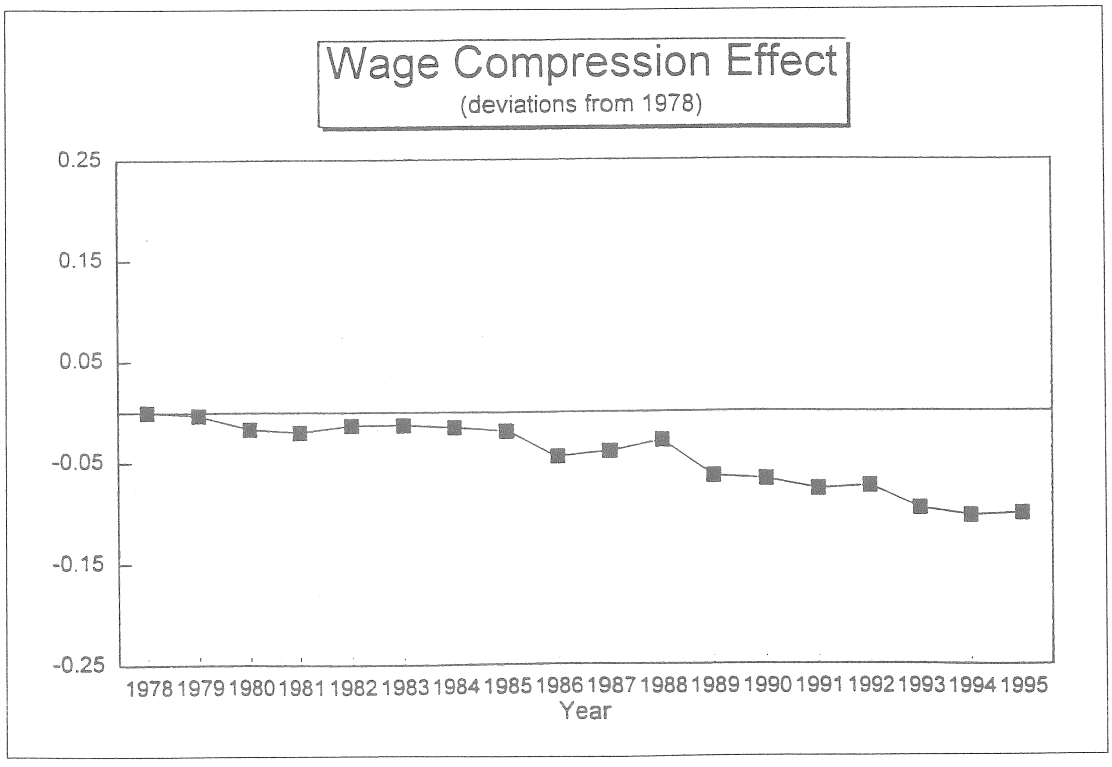
**Alternative Path: Changes in the Contribution of Observable Education and Other Human Capital Quantities and Prices, and Unobservables to the Total Change in the Variance in the Log of Real Earnings (3-year Centered Averages)**

| | 1979-1994 | 1979-1983 | 1983-1989 | 1989-1994 |
|---|---|---|---|---|
| Total Change in Variance | −0.02025 | 0.01814 | −0.02564 | −0.01275 |
| Total Observable Quantities | 0.20662 | 0.09974 | 0.10682 | 0.00005 |
| Education Quantities | −0.008 | 0.002 | −0.003 | −0.006 |
| Other Quantities | 0.214 | 0.098 | 0.110 | 0.006 |
| Total Observable Prices | −0.208551 | −0.087429 | −0.111559 | −0.00956 |
| Education Prices | −0.209 | −0.092 | −0.110 | −0.006 |
| Other Prices | 0.000 | 0.005 | −0.001 | −0.003 |
| Unobservables | −0.018 | 0.006 | −0.021 | −0.003 |

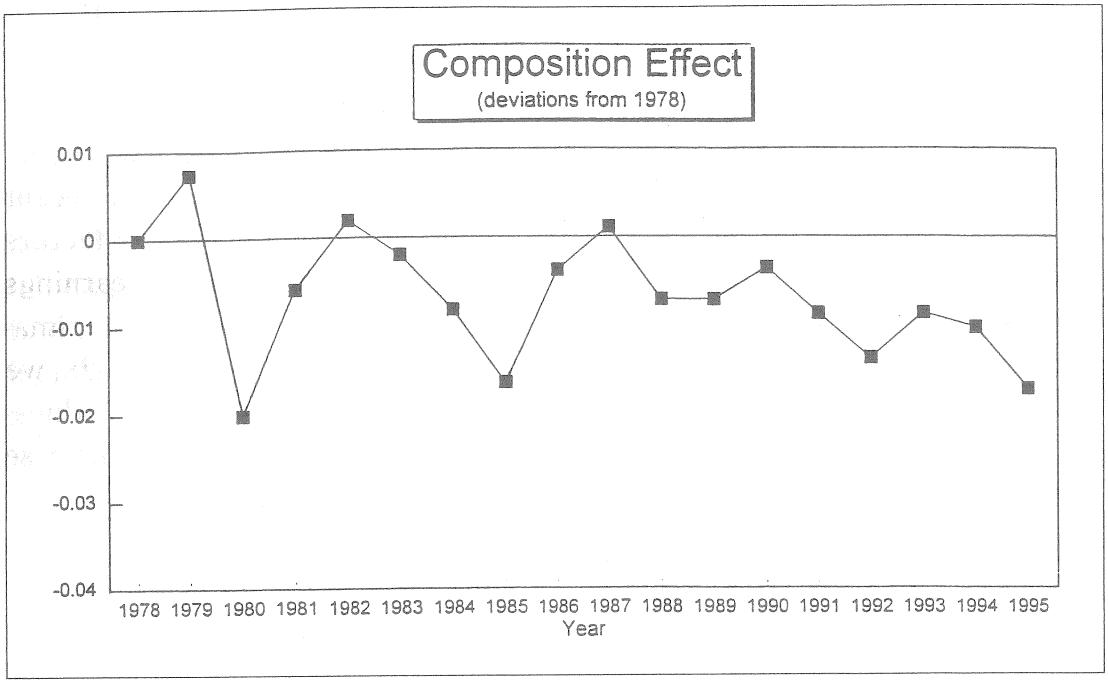
FIGURE A1

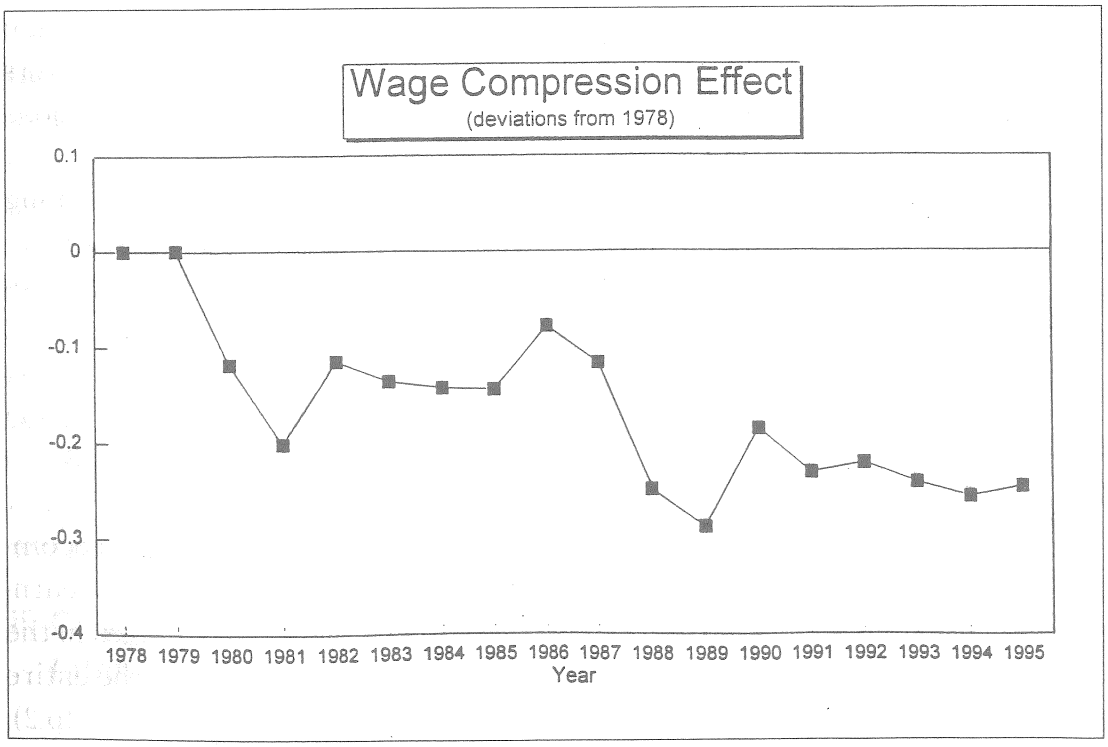
All Workers: Composition and Wage Compression Effects on the Variance of the Log of Real Earnings, 1978-1995



## FIGURE A2
## Alternative Path: Composition and Wage Compression Effects on the Variance of the Log of Real Earnings: 1978-1995



# Appendix 2
# The Full Decomposition Results, Selected Wage Regression Results and Comparison of Our Results With those of Other Decompositions

In this paper, we focus on examining the impact of educational expansion on the distribution of earnings among individuals. Several recent studies have used other inequality decompositions to examine the factors (including educational expansion) which explain recent changes in earnings inequality. All of the techniques reviewed below are based on the estimation of wage or earnings equations for different years. In this appendix, we compare the results presented in this paper regarding the effect of educational expansion on earnings inequality with the results presented in these other recent studies.

## i. Literature Review

a. Chu (1997) shows that the most important factor in explaining falling wage inequality between 1966 and 1977 was falling returns to education (and by extension an equalizing wage compression effect). Chu then notes that between 1980 and 1986 the wage ratio (unadjusted for changes in human capital characteristics) between university- and primary-educated workers fell. However, Chu (1997) does not present a wage inequality decomposition for the post-1977 period.

b. Using the Manpower Utilization Surveys (the same data we use), Jiang (1992) decomposes the log variance of the earnings of paid employees from 1978 to 1986. As we do in our paper, Jiang (1992) finds an equalizing wage-compression effect and disequalizing composition effect of educational expansion from 1978 to 1986. Jiang (1992) also finds that the disequalizing composition effect was greater than the equalizing wage compression effect, causing the overall effect of educational expansion between 1978 and 1986 to be disequalizing.

c. Fields and O'Hara (1996) use the Manpower Utilization Surveys to decompose the change between 1980 and 1993 in the Gini coefficient of labor earnings in Taiwan. They find that disequalizing and equalizing changes in the determinants of earnings counteracted one another, and that over the entire period "the Gini coefficient of labor earnings fell by a trivial amount" (p.2). The most important disequalizing factors were: an increase in the male-

female wage gap and an increase in returns to education. The most important equalizing factors were: reduced inequality in the distribution of education, reduced inequality in the distribution of experience, a fall in returns to experience, and a fall in the earnings premium for married workers (probably because of an increase in married female labor force participation).

d. Bourguignon, Fournier and Gurgand (1998) use the Income and Expenditure Surveys from 1979/80 to 1993/94 to decompose the Gini coefficient of family income, with a focus on the causes of the change in earnings inequality. They note that while income inequality increased, earnings inequality fell slightly. Consistent with the results of Fields and O'Hara (1996), they find that disequalizing and equalizing changes in the determinants of earnings largely counteracted one another. "Overall, it thus appears that the fall in the inequality of individual earnings in Taiwan over the period 1979-1994 results from several strong influences which have not played all in the same direction. On the disequalizing side, there is the increase in the returns to education which increases earnings disparities. On the equalizing side, three phenomena of unequal importance have permitted to overcompensate the preceding evolution. By order of importance they are: (a) the fall in the variance of the unobserved determinants of earnings [the residuals in the earnings equation]; (b) the change in schooling and the distribution of schooling within the population of wage earners; and finally (c) the change in participation and occupational choice behavior which brought more women in the wage labor force and took out some men. Such an evolution is essentially equalizing because of the initial earnings gap in favor of men" (p.25).

Chu (1997), Bourguignon, et al. (1998) and Fields and O'Hara (1996) develop decompositions which present a more complete description of the distribution of income than we do in this paper. For example, while we only examine the distribution of earnings among workers, these three papers examine the distribution of total income among households. In this appendix, we restrict our comments to the parts of these papers which examine only the change in the distribution of labor earnings among workers.

### ii. Comparing the Results Presented in the Present Paper with the Literature Reviewed Above

In this sub-section of the appendix we compare our results with the results in the reviewed literature regarding the effects of educational expan-

sion, specifically: the composition effect, the wage-compression effect, and the overall effect of educational expansion. Table A3 presents the full decompositions of earnings inequality for selected periods in Taiwan from 1979 to 1994, reported as 3-year centered averages.

**TABLE A3**

**Paid Employees: Changes in the Contribution of Observable Education and Other Human Capital Quantities and Prices, and Unobserables to the Total Change in the Variance in the Log of Real Earnings (3-year Centered Averages)**

| | 1979-1994 | 1979-1983 | 1983-1989 | 1989-1994 |
|---|---|---|---|---|
| Total Change in Variance | −0.02025 | 0.01814 | −0.02564 | −0.01275 |
| Total Observable Quantities | 0.20663 | 0.09975 | 0.10682 | 0.00005 |
| Education Quantities | 0.014 | 0.042 | 0.008 | −0.035 |
| Other Quantities | 0.192 | 0.058 | 0.099 | 0.035 |
| Total Observable Prices | −0.20854703 | −0.08742274 | −0.1115564 | −0.009563 |
| Education Prices | −0.056 | −0.006 | −0.024 | −0.025 |
| Other Prices | −0.153 | −0.081 | −0.087 | 0.016 |
| Unobservables | −0.018 | 0.006 | −0.021 | −0.003 |

Our results regarding the overall effect of educational expansion are consistent with the reviewed literature. Consistent with Fields and O'Hara (1996) and Bourguignon, et al. (1998), we find that the overall effect of educational expansion between 1978 and 1995 was equalizing. Further, our finding that the overall effect of educational expansion was disequalizing in the late 1970s and early 1980s, and then equalizing in the later 1980s and 1990s is consistent with Jiang (1992); Jiang (1992) calculates the overall effect of educational expansion between 1978 and 1986 to be disequalizing, while we find that the overall effect of educational expansion was disequalizing from 1979 to 1983 (3-year centered averages). Neither Fields and O'Hara (1996) nor Bourguignon, et al. (1998) calculate decompositions for shorter subperiods.

Our results regarding the composition effect of educational expansion are mostly consistent with the literature reviewed above. Consistent with Jiang (1992), we find a disequalizing composition effect from 1978 to 1989 (Jiang finds that the composition effect of educational expansion was dis-

equalizing from 1978 to the last year for which data was available — 1986). Fields and O'Hara (1996) and Bourguignon, et al. (1998) find that over the entire 1978 to 1995 period the composition effect of educational expansion was equalizing. Our results regarding the direction of the composition effect over the entire 1978 to 1995 period are varied: our estimate of the composition effect using data for paid employees only implies that the effect of the composition effect between 1978 and 1995 was slightly disequalizing (table A3), but using data from all workers, or the alternative path (tables A1 and A2), the measured composition effect was equalizing over the entire 1978-1995 period.

An important difference between our results and some of the studies reviewed above is the impact on inequality of changes in prices of (returns to) education. In our work and that of Jiang (1992), we find evidence of falling prices of (returns to) education and an equalizing wage compression effect. Fields and O'Hara (1996) and Bourguignon, et al. (1998) find evidence of increasing prices of (returns to) education and a disequalizing effect of changes in education prices on inequality.[12]

While our result that education prices fell from 1978 to 1995 is not consistent with Fields and O'Hara (1996) and Bourguignon, et al. (1998), it is consistent with other studies which have examined changing returns to education in Taiwan over the period for which we have data. Gindling, Goldfarb and Chang (1995) find that returns to education were remarkable stable between 1978 and 1992 (increasing slightly from 1978 to 1988 and then falling slightly from 1988 to 1992 for men). Gindling and Sun (1998) present changes in the relative wages of workers with higher education to those with a high school education (adjusted for changes in other human capital characteristics), finding that this ratio increased from 1978 to 1987, and then fell from 1987 to 1995 (overall, relative wages in 1995 were lower than in 1978). Table A4 presents selected results from the earnings equation used to calculate the our inequality decompositions. The pattern of the change in relative wages and returns to education described in Gindling, Goldfarb and Chang (1995) and Gindling and Sun (1998) is consistent with the results of the

12 The results of Fields and O'Hara (1996) and Bourguignon, et al. (1998) do not imply that educational expansion resulted in a rise in returns to education in Taiwan. Rather, they argue that the effect of increases in the relative demand for more-educated workers counteracted the wage-compression effect of increases in relative supply.

## TABLE A4
## Results of the Estimation of the Wage Equations: 1978, 1983, 1989, and 1995

| Variable | Coefficient Standard Error | | | |
|---|---|---|---|---|
| | 1978 | 1983 | 1989 | 1995 |
| Constant | 10.96 | 11.25 | 11.76 | 12.11 |
| | 0.013 | 0.012 | 0.012 | 0.012 |
| Junior High | 0.092 | 0.115 | 0.095 | 0.087 |
| | 0.009 | 0.008 | 0.008 | 0.009 |
| Senior High | 0.283 | 0.299 | 0.241 | 0.198 |
| | 0.008 | 0.008 | 0.008 | 0.008 |
| Junior College | 0.455 | 0.504 | 0.442 | 0.397 |
| | 0.014 | 0.011 | 0.010 | 0.010 |
| University | 0.652 | 0.695 | 0.666 | 0.598 |
| | 0.014 | 0.011 | 0.011 | 0.011 |
| exp | 0.087 | 0.070 | 0.052 | 0.045 |
| | 0.003 | 0.002 | 0.002 | 0.002 |
| exp2 | −0.00342 | −0.0031 | −0.0021 | −0.0021 |
| | 0.0002 | 0.0002 | 0.0002 | 0.0001 |
| exp3 | 0.00008 | 0.00006 | 0.000039 | 0.00005 |
| | 0.00000006 | 0.000005 | 0.0000005 | 0.0000004 |
| exp4 | −0.00000006 | −0.00000004 | −0.00000003 | −0.00000004 |
| | 0.000000000 | 0.000000000 | 0.000000005 | 0.0000000004 |
| sex | −0.243 | −0.300 | −0.374 | −0.344 |
| | 0.007 | 0.006 | 0.005 | 0.005 |
| marital status | 0.079 | 0.065 | 0.038 | 0.044 |
| | 0.009 | 0.008 | 0.007 | 0.006 |
| tenure | 0.0069 | 0.0120 | 0.0110 | 0.0138 |
| | 0.0005 | 0.0004 | 0.0004 | 0.0004 |
| R-squared | 0.423 | 0.465 | 0.467 | 0.265 |
| Numer of Observations | 15179 | 18198 | 21061 | 30132 |
| Mean of the Log of Real Earnings | 9.66 | 11.84 | 12.24 | 12.57 |
| Variance of the Log of Real Earnings | 0.237 | 0.242 | 0.224 | 0.200 |

Note: All coefficients are significantly different from zero at 1%.

earnings regressions presented in table A4, where the coefficients on all education dummy variables increase from 1978 to 1983, and then fall back to below 1978 levels by 1995. In the decomposition results presented in this paper, while the effect of changes in education prices is equalizing throughout, the equalizing effect is relatively weak from 1978 to 1988 and stronger from 1988 to 1995.

There are several differences between the technique used by Jiang, 1992 and in our paper and the decomposition techniques used by Fields and O'Hara (1996) and Bourguignon, et al. (1998) which might explain our different results. First, we use a different, and more flexible, functional form for the education variables in the wage equations (as does Jiang, 1992). We use dummy variables for each of four education levels, while the other studies use a single variable which measures years of education completed.[13] The functional form we use allows returns to different education levels to change at different rates over time, while using a single years of education variable forces the returns to each additional year of education to be the same in each year. That is, using a single years of education variable in the wage equations forces the change from one year to the next in the returns to one more year of primary education to be the same as the change to one more year of university education. Second, Fields and O'Hara (1996) and Bourguignon, et al. (1998) decompose the Gini coefficient, while we (and Jiang, 1992) decompose the log variance. Third, Bourguignon, et al. (1998) correct the earnings equation estimates for selectivity bias. Finally, the decomposition methodologies used in these papers are different. The techniques used in our present paper, Fields and O'Hara (1996), and Bourguignon, et al. (1998) are compared, and the limitations of each are discussed, in Gindling (1999). In Gindling (1999) we present evidence that the measure of the wage-compression effect presented in our present paper is partly dependent on the change in the variance of education quantities. This is a serious limitation of our technique. However, we think it unlikely that this limitation is driving the result that the wage compression effect is equalizing because: (1) all of the coefficients on the education dummy variables in the earnings equations (table A4) fall from 1978 to 1995; and (2) preliminary estimates using a modification of our technique which does not have this

13 Unlike the three other papers, Jiang (1992) also includes industry, occupation and region dummy variables as right-hand-side variables.

limitation still shows that, on average, the education price effect is equalizing.[14]

14 The technique we use in the present paper allows us to easily compare year-to-year changes in the composition and wage compression effects over a period of many years. This allows us to show clearly the "inverted-U" characteristic of the composition effect (for example, as we do in figure 1). The techniques derived in Fields and O'Hara (1998), Bourguignon, et al. (1998) and Gindling (1999) cannot easily do this. These techniques easily compare only two years at one time (for example, compare 1978 with 1995). Therefore, these other techniques are not well-suited for the analysis we wish to carry out in the present paper, and we do not use them here.

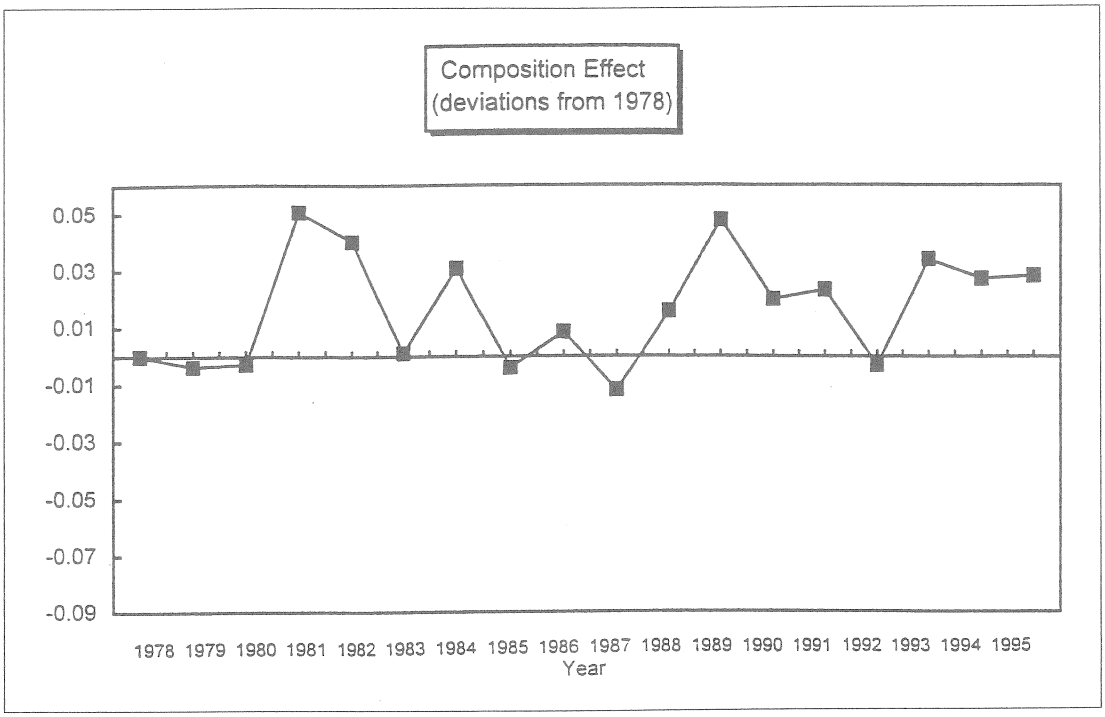
# Appendix 3
# Alternative Specification of the Earnings Equation: Including Industry and Occupation Dummy Variables

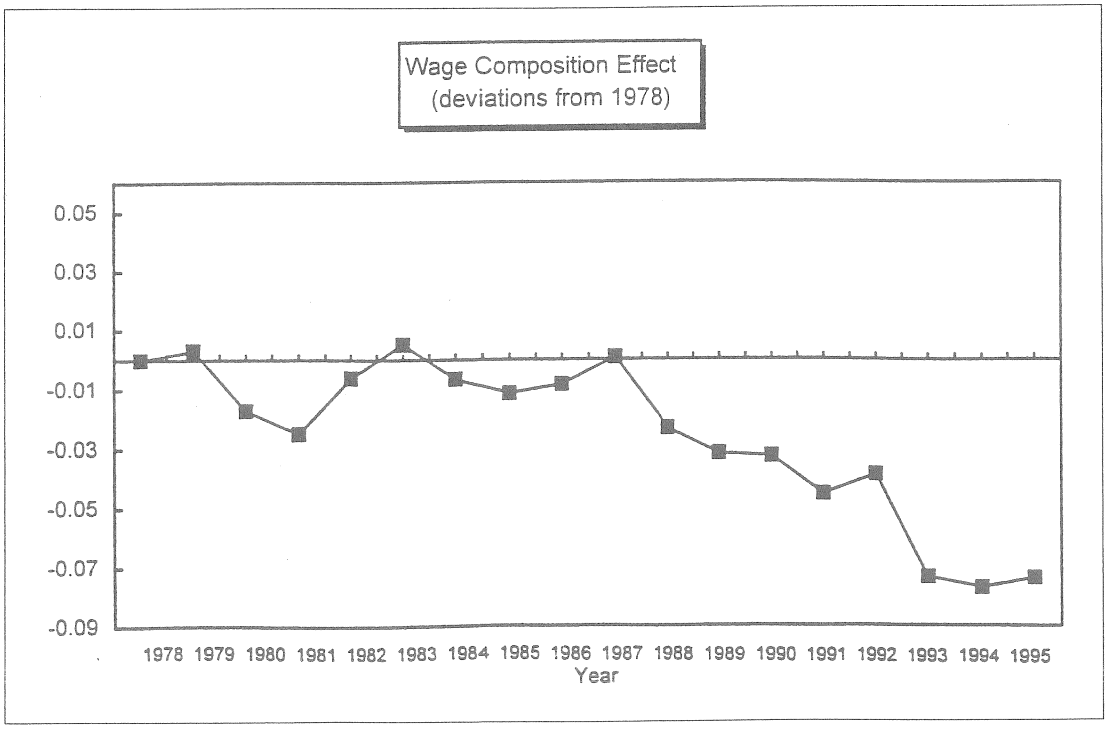
In this appendix we present the results of the inequality decompositions based on earnings regressions which include industry and occupation dummy variables on the right-hand-side. Whether or not to include industry and occupation dummy variables in the estimation of earnings equations designed to estimate the rate of return to education depends on what one believes about the cause of earnings differences between occupations and industries. Broadly, we can identify two views.

a. In the first view, earnings differences between occupations and industries occur because of compensating differentials; workers in some industries and occupations are paid more because the working conditions in those industries and occupations are worse than in other industries and occupations. In that case, workers in the least-desirable industries must be paid more than workers in other industries. In this case, earnings differences between occupations and industries are due to the unique characteristics of each industry and occupation, and have nothing to do with constraints imposed by other variables in the earnings equations. Therefore, one should include industry and occupation dummy variables in the earnings equations to control for these compensating differentials.

b. In the second view, access to higher paying industries and occupations is one of the benefits, or returns, to higher education. That is, some industries and occupations pay higher wages than others because those industries require workers to be more educated — education is a necessary pre-requisite for entry into these higher-paying industries and occupations. In this case, the premium paid to workers in higher-paying industries is part of the return to education. Including industry and occupation dummy variables in the earnings equation will cause the coefficients on the education variable(s) to be biased estimates of the true rate of return to education. Therefore, one should not include industry and occupation dummy variables in the earnings equations. We hold this view when we present the results in the body of this paper, which are based on earnings regressions which not include the industry and occupation variables in the estimation of the earnings equations.

## FIGURE A3
## Alternative Specification: Including Occupation and Industry Dummies Composition and Wage Compression Effects on the Variance of the Log of Real Earnings: 1978-1995



Both of the above views are well-represented in the literature. For example, of the papers which present inequality decompositions that we discuss in appendix 2, one (Jiang, 1992) includes industry and occupation dummy variables, while two (Bourguignon, et al., 1998 and Fields and O'Hara, 1996) do not include occupation and industry dummy variables.

Figure A3 and table A5 present the results of the decompositions based on earnings regressions which include industry and occupation dummy variables. The results using this alternative specification regarding the wage compression effect of educational expansion are very similar to the results presented in the body of our paper. Specifically, the wage compression effect is largely neutral from 1978 to 1987, and then strongly equalizing from 1987 to 1995.

**TABLE A5**

**Alternative Specification — including Occupation and Industry Dummie**
**Changes in the Contribution of Observable Education and Other Human Capital Quantities and Prices, and Unobservables to the Total Change in the Variance in the Log of Real Earnings**
**(3-year Centered Averages)**

| | 1979-1994 | 1979-1983 | 1983-1989 | 1989-1994 |
|---|---|---|---|---|
| Total Change in Variance | −0.01983 | 0.01814 | −0.02561 | −0.01236 |
| Total Observable Quantities | 0.20586 | 0.07718 | 0.09268 | 0.03600 |
| Education Quantities | 0.032 | 0.026 | 0.004 | 0.002 |
| Other Quantities | 0.174 | 0.051 | 0.089 | 0.034 |
| Total Observable Prices | −0.203987 | −0.065637 | −0.0967289 | −0.0416211 |
| Education Prices | −0.070 | 0.002 | −0.027 | −0.046 |
| Other Prices | −0.134 | −0.068 | −0.070 | 0.004 |
| Unobservables | −0.022 | 0.007 | −0.022 | −0.007 |

The results regarding the composition effect of education expansion are similar to those presented in the body of our paper with one important exception; the change from 1992 to 1993 (see figure 1). When using earnings regressions that do not include industry and occupation dummy variables, there is a small disequalizing measured education composition effect between 1992 and 1993 (see figure A3). When using earnings regressions

that do include industry and education dummy variables, there is a large disequalizing measured education composition effect between 1992 and 1993 (see table A5). As a result of this difference, when using the industry and occupation dummy variable specification, the measured composition effect of educational expansion over the 1989 to 1995 period is not equalizing (see figure A3). Therefore, when using the industry and occupation dummy variable specification, the measured education composition effect does not exhibit the "inverted-U" pattern.

We believe the estimates which do not include the industry and occupation dummy variables are more likely to be correct than the estimates presented in this appendix. We believe that the results which include industry and occupation dummy variables suffer from a serious data problem. Specifically, the codes used to record the occupation of workers in the Manpower Utilization Survey data changed between 1992 and 1993. This change makes it impossible to construct occupation dummy variables for the 1993-1995 period that are precisely comparable to the occupation dummy variables that we can construct for the 1978-1992 period. As noted above, the biggest difference in the decomposition results presented in the body of our paper and in appendix 3 occurs between 1992 and 1993. If we do not consider the 1992-1993 change, the results of the decompositions presented in the body of our paper and those presented in appendix 3 are very similar. The fact that the occupation codes also changed between 1992 and 1993 strongly suggests that the large disequalizing measured education composition effect reported between 1992 and 1993 in appendix 3 occurred because of this data problem. This data problem does not affect the results presented in the body of our paper.

# References

F. Bourguignon, M. Fournier and M. Gurgand
1998 "Distribution, Development and Education: Taiwan, 1979-1994," mimeo, DELTA, Paris, May.

Chu, Yun-Peng
1997 "Employment Expansion and Equitable Growth: Taiwan's Postwar Experience," mimeo, Sun Yat-Sen Institute for Social Science and Philosophy, Academica Sinica, Taipei.

Fei, John, Gustav Ranis and Shirley Kuo
1979 *Growth with Equity: The Taiwan Case*, Oxford University Press for the World Bank, 1979.

Fei, John, Gustav Ranis and Shirley Kuo
1978 "Growth and the Family Distribution of Income by Factor Components", *Quarterly Journal of Economics*, February, pp. 17-53.

Fields, Gary and Jennifer O'Hara
1996 "Changing Income Inequality in Taiwan: A Decomposition Analysis," mimeo, Cornell University, May.

Gindling, T. H.
1999 "A Technique for Decomposing Earnings Inequality Into Individual Human Capital Price and Quantity Effects," mimeo, June.

Gindling, T. H., Marsha Goldfarb and Chun-chig Chang
1995 "Changing Returns to Education in Taiwan: 1978-1991," *World Development* vol. 23, pp. 343-356.

Gindling, T. H. and Way Sun
1998 "Higher Education Planning and the Wages of Workers with Higher Education in Taiwan," *Economics of Education Review*, forthcoming.

Gindling, T. H. and Donald Robbins
1999 "Patterns and Sources of Changing Wage Inequality in Chile and Costa Rica During Structural Adjustment," *World Development*, forthcoming.

Jiang, F. F.
1992 "The Role of Educational Expansion in Taiwan's Economic Development," *Industry of Free China*, Vol. LXVII, no. 2, pp. 434-456.

Juhn, Chinhui, Kevin Murphy and Brooks Pierce
1993 "Wage Inequality and the Rise in Returns to Skill," *Journal of Political Economy*, Vol. 101, No. 3, pp. 410-442.

Knight, J. B. and R. H. Sabot
1983 "Educational Expansion and the Kuznets Effect," *American Economic Review*, Vol. 73, no. 5, pp. 1132-1136.

Kuznets, Simon
1955 "Economic Growth and Income Inequality," *American Economic Review*, March, 45, pp.1-28

Robbins, Donald and Joseph Zveglich
1996 "Trade Liberalization and Wage Structure in Taiwan: 1978-1992," mimeo, Harvard University.

Robinson, Sherman
1976 "A Note on the U-Hypothesis Relating Income Inequality and Economic Development," *American Economic Review*, 1976, 66, pp. 437-440.

# 台灣的教育擴張與收入不平等：1978 年至 1995 年

孫煒
國立中央大學通識教育中心助理教授

T. H. Gindling
美國馬里蘭大學經濟系副教授

## 摘　要

在這篇論文之中我們度量了台灣在 1978 年至 1995 年之間，教育擴張對於眞實收入變動所產生的工資混合效果與壓縮效果。我們發現教育擴張的壓縮效果在 1979 年至 1994 年之間是相等的，我們也發現教育擴張的混合效果在 1970 年代後期和 1980 年代早期是不相等的，但在 1980 年代後期以及 1990 年代卻是相等的。詳言之，在 1978 年至 1983 年之間不平等化的混合效果大於平等化的價格效果，因此在此時期教育擴張增加了收入不平等的現象。在 1983 年至 1989 年之間平等化的壓縮效果大於不平等化的混合效果，因此在此時期教育擴張減少了收入不平等的現象。在 1989 年至 1995 年之間混合效果與壓縮效果是相等的，因此在此時期教育擴張對於收入不平等並無明顯的影響。總的來說，在 1978 年至 1995 年之間台灣教育擴張傾向於減少收入不平等的現象。

關鍵詞：收入不平等、混合效果、壓縮效果、價格效果