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解析台灣教育的效果與功能：個體與總體分析(第 2 年)
研究成果報告(完整版)

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Summary of final report

In this research project, I have tried to identify what's the "true" rate of return to education in Taiwan. Using Instrumental variable method and heterogeneous human capital theory, I had developed three empirical models to estimate and discover the rate of return to education in Taiwan. The main sources of data are from varies years of Taiwan's Manpower Utilization Survey. As education is an important form of human capital accumulation, can education be also an effective means for fostering intergenerational social mobility? Using Taiwan's Panel Study of Family Dynamics data, I also investigate education and intergenerational social mobility in Taiwan.

The major conclusions from my research are that the estimated rates of return to education are relatively higher by the IV method than by the OLS method. The estimated rate of return to education is 5.97% for males and 14.69% for females, higher than that by OLS especially in the female group. Due to the severe influence by family factors on females' education, we also find that the female rate of return to education is significantly underestimated the by OLS. The Taiwan empirical study also shows that significant heterogeneous return to education does exist and the educational choice was made according to the principle of comparative advantage. The estimated rates of return for attaining university were 19% and 15%, much higher than the average rate of return of 11.55 and 6.6%, for 1990 and 2000, respectively. The decline trend of return to university education may be caused by the rapid expansion of the number of colleges and universities and the increasing supply of college graduates in the 1990s. Quantile regression with cohort data also confirms the same result. Moreover, we find that education and ability are complements for the old cohort, while they are substitutes for the young cohort, i.e., education can compensate disadvantage in ability. The important policy implication is that general education

may consolidate and even create social diversity.

Empirical results from PSFD data find that father's social status affects an individual's educational attainment. Offspring whose father is in the upper class have the best advantage of receiving higher education than those whose father is not. Moreover, education has a profound influence on social status. The higher the educational attainment is, especially for university and above, the greater the chance will be in the upper-class and the advantage of education to enter the upper class does not vary among different cohorts. This implies that the upper-class may dominate education to preserve their social status. However, other things being equal, for those with junior college education but their fathers are not in the upper-class, tend to have a greater chance to be in the upper-class than those whose father is in the upper-class. Hence, education can still be an effective means to compensate the disadvantage in one's father's social status. We also find that senior high school and junior college education has the greatest chance to be in the middle class, which is conducive to social stability. Our results confirm that popularization of education is beneficial to intergenerational social mobility. Thus, equal opportunity to attain education and prevention of monopoly in education by the upper class should be the ultimate goal of a government's educational policy as it not only enhances one's earning capability but also fosters social mobility.

The above research has developed into four papers: 1. Endogeneity and Investment in Education: Estimating Rates of Return to Education for Taiwan, 2. Heterogeneity, Comparative Advantage, and Return to Education: The Case of Taiwan, 3. Return to education and ability in Taiwan: an cohort analysis, 4. Education and Social Mobility in Taiwan. The following attachment is the complete version of the four papers. The second paper has been accepted for publication on Economics of Education Review and the rest of the papers are currently submitting to journals.

Endogeneity and Investment in Education: Estimating Rates of Return to Education for Taiwan

Abstract

To avoid the endogenous bias of the education variable in the OLS estimation of return to education, this paper applies the 2SLS instrumental variable method to estimate the rate of return to education using data from the 1990 Taiwan's Manpower Utilization Survey. Instrumental variables include the nine-year compulsory education policy, area of residence, sibling status, and father's education. Tests are also conducted to choose the most effective valid instrument from all combinations of IVs. Consistent with the literature, the estimation results show that the estimated rate of return to education is relatively higher by the IV method than by the OLS method. Due to the severe influence by family factors on females' education, we also find that the female rate of return to education is significantly underestimated by the OLS.

Keywords: Human capital investment, return to education, endogenous bias, ability bias, instrumental variable, local average treatment effect

JEL Classification: J24; I21

Endogeneity and Investment in Education: Estimating Rates of Return to Education for Taiwan

I. Introduction

Human capital investment and accumulation have been identified as one of the important sources for a country's long-run economic growth.[1] For the past four decades, Taiwan, a small island of 36,000 kilometers with limited natural resources, has achieved the so-called "economic miracle" with average annual economic growth rate of 8.45% between 1960 to 2000. Taiwan's remarkable economic performance is consistent with the human capital theory to a large extent due to the development of a well-educated and better-trained labor force, which speeds up industrialization processes and upgrading of technology to sustain the long-run growth of the economy. Chuang (1999) finds that during the 1964-1994 period, 30% of Taiwan's average annual economic growth can be attributed to human capital. Lin (2004) also discovers that higher education had a positive effect on economic growth in Taiwan for the period 1965-2000; one additional percent of higher education stock is estimated to increase real output by approximately 0.19%. Moreover, examining the relation between education and growth, Chuang (2000) finds that unidirectional causality runs from higher education to economic growth in Taiwan over the period 1952-1995. Wu

[1] See, for example, Barro and Sala-i-Martin (1995).

(2003) notices an increasing trend of rates of return to education in Taiwan from 1978 to 2001.

These findings on the education-growth nexus of Taiwan's economic miracle can be described as follows. Since the adoption of an open trade policy in the early 1960s, Taiwan has experienced drastic and rapid structural changes from an agriculture-oriented to an industry-oriented economy. In fact, the output share of industry increased from 23.03% in 1961 to 39.36% in 1978, subsequently remaining relatively stable until the mid 1980s. The structure of exports changed from labor-intensive products in the 1960s, to capital-intensive in the 1970s and technology-intensive in the 1980s. This open trade and rapid industrialization process increased the demand for skilled labor, which increased the return on education, and the increase in the quality of workers facilitated the process of accessing, absorbing, and applying technology upgrades and thus the subsequent economic growth.

The Human capital theory emphasizes education and on-the-job training to enhance labor productivity and hence wage rates of workers.[2] The economic return to education not only influences an individual's educational choice but also affects the labor quality of the whole society. Therefore, from both individual and social points

[2] Card (1999) provides a comprehensive literature survey on empirical studies of the relationship between education and productivity.

of view, the estimation of return to education is an important measure for human capital investment decisions and thus has a profound effect on human development.[3]

For the past forty or more years, investment in education has expanded greatly in Taiwan due to the government's expansionary education policy, the process of rapid industrialization, and the conventional wisdom that "To be a scholar is to be at the top of society." The average years of education for employed workers in Taiwan has increased tremendously from 7.18 years in 1978 to 11.03 years in 2006, while for the same period, the per capita income rose from US$1,461 to US$14,455, a roughly ten-fold increase. According to the human capital theory, education enhances labor productivity and hence increases wage rates. But what is the economic return for an additional year of schooling? Previous empirical studies on returns to education in Taiwan, e.g., Psacharopouls (1985); Gindling, Goldfarb, and Chang (1995); Chuang and Chao (2001); and Wu (2003), among others, have neglected either the endogeneity problem of education or the heterogeneity of unobserved ability, thus tending to encounter the endogeneity bias and ability bias for the estimates of returns to education.[4] Two exceptions are Gurgand (2003) and Spohr (2003), who adopted

[3] Return to education is one of important measures in constructing the human development index, which is considered to be a more inclusive index for measuring human welfare and has been announced every year by the United Nations since 1990.

[4] The former is caused by educational decisions and is endogenous rather than exogenous, and the latter arises as more able people, other things being equal, receive more education according to the human capital theory. See, for example, Heckman, Lochner, and Todd (2003) for a detailed discussion.

the IV method, but with a simple instrumental variable or special attention to specific groups only. Gurgand (2003) estimates the influence of education on a farmer's income, adopting a simple instrumental variable of the share of primary and high school farmers to replace the formal years of education, while Spohr (2003) uses the nine-year compulsory education policy as the instrumental variable and adopts the yearly wage instead of the hourly wage as the dependent variable.[5] Instead of using a single instrumental variable, this paper intends to deal with the problems by using four different instrumental variables, namely the nine-year compulsory education policy, area of residence, sibling status, and father's education, and their combinations, to identify an unbiased and consistent estimate of the rate of return to education for Taiwan. Tests of the validity of various combinations of instruments are conducted. We find that the combination of the compulsory education policy and area of residence is the most efficient valid instrument and may give a better estimation for the rate of return to education.

Due to the heterogeneity of an individual's ability, the conventional OLS estimation of the wage equation will be subject to the ability bias because the intercept of the wage equation by the OLS method reflects personal ability, which is correlated with the marginal cost of receiving education. Moreover, if the

[5] See Card (1999) for the discussion of different interpretations of estimated coefficients of education variable for using the hourly wage and the yearly wage as the dependent variable.

heterogeneity of an individual's ability is revealed by the different slopes of the wage equation, i.e., the greater the return to education, the higher the incentive for educational investment, then under this situation, the estimation results by the OLS method will be further inflated. As there exist heterogeneous returns to education, reflected by the intercept and slope of the wage equation, the adoption of the OLS method to estimate the return to education requires that explanatory variables and the error term be mutually independent. Failure to satisfy this condition will render a bias in estimation by the OLS method. More importantly, educational investment is an endogenous decision process that is heavily influenced by personal characteristics and family background factors. As the education variable is not exogenous, conventional OLS estimation will be subject to bias.[6]

Griliches (1977) proposes to use the instrumental variable method to tackle the problems of ability bias and endogeneity.[7] However, the major difficulty is to find a valid instrumental variable, especially for cross-section data analysis such as the estimation of return to education. Heckman and Vytlacil (1999) point out that the instrumental variable has to be correlated with an individual educational choice and

[6] For discussion of factors that determines an individual's educational choice, see, for example, Haveman and Wolfe (1995).

[7] Griliches (1977) uses the viewpoint of the efficiency unit in the labor market and considers human capital to be homogenous; thus, people choose to have different stocks of human capital. In this regard, to solve for the problems of ability bias and measurement error, an effective estimation method is the instrumental variable method. Sometimes this type of model is also called the common coefficient model.

uncorrelated with an individual's ability. Most of the existing literature has shown that it will be relatively difficult to find a valid instrumental variable from the demand side of education, as we are not quite certain that the demand factor for education has no correlation with an individual's wage rate. Therefore, economists are inclined to use supply factors for education such as family background factors as the instrumental variable. For example, Trostel, Walker and Woolley (2002) use parents and spouse's education as instrumental variables to estimate male and female return to education for 28 countries, finding that the estimated rate of return to education is typically higher when calculated by the IV method than by the OLS method. Other studies, such as Arcand, D'hombers and Gyselnck (2004), Patrinos and Sakellariou (2005), and Sakellariou (2006), adopt the father's years of education as the instrumental variable; all of these find results similar to those of Trostel, Walker and Woolley (2002).[8]

As we are not convinced that family background factors are uncorrelated with an individual's ability, recent studies have switched to supply side factors of the labor market as the instrumental variable.[9] For example, Angrist and Krueger (1991) use

[8] See Card (2001) for a detailed comparison and discussion of the estimation results by OLS and IV methods.

[9] If there is an inter-generational transfer effect, family background factors such as parents' education may be correlated with an individual's ability. From a genetics point of view, an individual's innate ability is inherited through the genes.

birth season as the instrumental variable, as differences in birth season cause different dates of school enrollment and hence different times for completing compulsory education. Apparently, birth season has a correlation with years of schooling, but none with an individual's ability. Harmon and Walker (1997) use the compulsory educational policy in the U.K. as the instrumental variable because the change in educational policy is exogenous but in fact influences people's minimum years of schooling. As the instrumental variable is subject to the educational choice of particular demographic groups, the results estimated by the IV method can be interpreted as the marginal rate of return to education for those particular demographic groups. Likewise, the estimated rate of return to education for the IV method is usually higher than that for the OLS method.[10]

There are other instrumental variables in the literature. For instance, Duflo (1999) chooses birth date before and after institutional change, and personal residential area, as the educational resources may be different under different policies, as instrumental variables. Moretti (2004) uses estimated demographic structure in the city and land-grant university as instrumental variables to estimate estimated spillover effect of education and social rate of return to education.

[10] Card (2001) has an alternative interpretation. He thinks that people with low education tend to have higher rates of return to education because they are the group influenced by the education policy, which reduces their original high marginal cost of education. Thus, low education is not the result of low ability.

Conventionally, under the assumption of mutual independence of the explanatory variables and the error term, estimates from the OLS method are interpreted as the average marginal rate of return to education. However, if it is not the case, as it usually is, the OLS estimates will subject to the endogeneity bias.

Based on the results from the literature, this paper intends to estimate the rates of return to education for Taiwan. The major contributions of the paper are to take the endogeneity of education and the individual's heterogeneity into account to estimate an unbiased and consistent rate of return to education using the IV method. Second, tests are conducted to choose the most effective valid instrument from all combinations of IVs. Third, conducting a case study of Taiwan, a country characterized by an economic miracle with rapid accumulation in education investment, may provide useful implications for other developing countries.

This paper is organized as follows. Section II specifies the empirical model. Section III contains data description, estimation results, and sensitivity analysis. The conclusion follows in Section IV.

II. The empirical model

As in the literature, we use Mincer's (1974) specification of wage equation as the basic model for the estimation of rate of return to education, and an additional educational choice equation is also stated as

$$Y_i = X'\delta + \beta S_i + u_i ,$$

$$S_i = Z_i'\alpha + v_i ,$$

where Y is the real hourly wage in logarithmic form; X is other variables affecting an individual's wage rate, such as work experience, marital status, industry, and firm size; S denotes years of schooling; Z is explanatory variables including instrumental variables that determine one's educational choice; u and v are error terms for wage and educational choice equations, respectively; and the coefficient β represents the average rate of return to education for additional years of schooling.

To cope with the endogeneity problem of investment in education, a 2SLS instrumental variable estimation method is used. Furthermore, as the samples are subject to those who work for a wage payment, the direct estimation of the wage equation will encounter the problem of sample selection bias. Thus, we adopt Heckman's (1976) two-stage selection model to explicitly correct for the problem of selection bias.[11]

[11] See also Johnston and Dinardo (1997, pp. 447-450) for a detailed illustration of Heckman's two-stage selection model.

The selection of instrumental variables

The use of instrumental variables to estimate return to education requires that instrumental variables satisfy the orthogonality condition; i.e., instrumental variables have no correlation with the individual's ability or error term. Furthermore, under the heterogeneous return to education, instrumental variables have to be uncorrelated with one's earning capability in addition to the orthogonality condition; i.e., Z is uncorrelated with β. In other words, allowing for a heterogeneous return to education, the instrumental variable should be correlated with one's educational choice, but uncorrelated with one's wage rate.[12]

We first adopt the nine-year compulsory education policy as our instrumental variable. Numerous studies have shown that the compulsory educational policy has a significant effect on return to education; see, e.g., Angrist and Krueger (1991); Cruz and Moreira (2005); and Sakellariou (2006), among others. From a policy perspective, the implementation of a compulsory educational policy significantly enhances the structure of labor quality of the developing countries, especially for those groups subject to family liquidity constraints.[13] Thus, the use of the compulsory educational

[12] See, for example, Blundell *et al.* (2003) for detailed discussion on this point.

[13] In 1968, developing countries Taiwanese government implemented the nine-year compulsory educational policy, which directly affected the school enrollment rate of children aged 12 to 14. Groups particularly influenced by compulsory education are poor or minority groups, which are usually subject

policy as the instrumental variable not only solves for problem of endogeneity and ability bias caused by the OLS method but also gives us estimates for the rate of return to education for those who are subject to liquidity constraints, an important factor that hinders educational investment for economically disadvantaged people. Most research on return to education in developing countries has proved that using institutional factors as the instrumental variable tends to result in a higher estimated rate of return to education than that found by the OLS method.[14]

Compulsory educational policy is an institutional change that includes the building of new junior high schools and recruitment of new educational staff and teachers, and thus it is closely related to an individual's educational investment but has no direct relationship with an individual's ability. As educational resources are different among different residential areas, it thus has different impacts on individual's educational achievement, while having nothing to do with an individual's ability. From the viewpoint of the life cycle of household income, elder children tend to have less family education resources than their young siblings do, as family income is usually low in the early stage.[15] Moreover, the greater the number of siblings for a

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to credit constraints.

[14] See, for example, Card (2001) for a detailed literature review on this line of research.

[15] Using data from the 1989 Survey of Women's Living Status in the Taiwan Area, Parish and Wills (1993) find that younger siblings tend to have an advantage in receiving better education than their elder siblings.

given family budget constraint, the fewer the educational resources that are given to each child. Thus, both the existence of young siblings and the number of such siblings will be correlated with an individual's educational achievement, but these factors have no correlation with an individual's ability or wage. Therefore, this paper adopts the nine-year compulsory education policy, residential area, and the existence of younger siblings as instrumental variables for educational choice.[16] In the literature, some research, see, e.g., Trostel, Walker and Woolley (2002); Arcand, D'hombers and Gyselnck (2004); Patrinos and Sakellariou (2005); and Sakellariou (2006), among others, use family background variables such as the father's education as the instrumental variable; for comparison, we thus also include father's education as an additional instrumental variable.[17]

Tests of validity for instrumental variables

Econometrically, in the 2SLS estimation, a valid instrumental variable should satisfy two conditions: Instrument relevance and Instrument exogeneity. The relevant tests include using the partial coefficient of determination or F-test to test the explanatory power and sign of the instrumental variable on the endogenous education

[16] We also regard the number of siblings as the instrumental variable; the estimated results are similar to what we have reported here.

[17] The father's education may not be a good instrumental variable, as a father's education may influence an individual's ability or wage through genes or social connections.

variable at the first step of regression.[18] As for the exogeneity test, the over-identifying restrictions test is used on the orthogonality condition for all the instruments.[19] In the second stage of regression, we adopt the Durbin-Wu-Hausman test for exogeneity.[20]

III. Data analysis and estimation results

As the paper uses the nine-year compulsory educational policy, which was implemented in Taiwan in 1968, as one of the instrumental variables for a broader inclusion of samples, we adopt data from the 1990 Taiwan Manpower Utilization Survey conducted by the Directorate-General of Budget, Accounting and Statistics, Executive Yuan, Taiwan, Republic of China.[21] The MPUS data are repeated cross

[18] See Bound, Jaeger, and Baker (1995) and Staiger and Stock (1997) for detailed descriptions of the relevant tests. The F-test can be used to joint test the significance of coefficients of all the instrumental variables. A rule of thumb is that F statistics should be greater than 10, and that any values below 10 imply that the selected instrumental variables have insignificant explanatory power and thus generate estimation bias.

[19] Assume that the number of selected instruments is m and the number of relevant endogenous variables is k. If m=k, the regression coefficients are exactly identified. If m>k, the regression coefficients are over-identified. If m<k, the regression coefficients are under-identified.

[20] The estimation process is similar to test for the omitted variable, as it was first proposed by Durbin (1954), Wu (1973), and Hausman (1978), respectively; hence it is also called the Durbin-Wu-Hausman (DWH) test. For a discussion of DWH test of exogeneity, see, for example, Davidson and MacKinnon (2003).

[21] We also tried the Taiwan Manpower Utilization Survey data for 1995 and 2000. The results are similar to what we report in this paper. However, data for the 1995 and 2000 MPUSs may encounter limited sample problems. For example, the proportion of samples having received nine-year compulsory education is as high as 95% and 99% for 1995 and 2000, respectively. Thus, the use of the nine-year compulsory educational policy as the instrumental variable for 1995 and 2000 data will be subject to insufficient samples of those who were not affected by the compulsory education policy. For the completeness of the data, this paper uses the 1990 Taiwan Manpower Utilization Survey data.

sections and stratified random samples of around 20,300 households (about 60,000 persons aged 15 and above in these sampled households) from about 532 villages and neighborhoods in Taiwan, and they are not panel data. For the use of instrumental variables, we choose samples only with complete intergenerational information, such as father's education and number of siblings. A total of 7,193 samples are obtained.[22] Tables 1 and 2 present all the variable names, definitions, and basic statistics.

[22] As the samples with complete intergenerational information are smaller than the original survey samples, then to ensure the representation property of the selected sample, we further conducted conventional OLS estimation for return to education for our selected sample and the original survey sample, finding that the estimation results for the two samples are similar, which justifies the appropriateness of the selected sample.

Table 1. Variable name and definition

Name	Definition
Wage	Real hourly wage in logarithmic form.
Years of education	Education levels include illiterate and self educated, primary school, junior high school, senior high school, vocational school, junior college, university, graduate school and above. The corresponding years of education are 0, 6, 9, 12, 12, 14, 16, and 18 years, respectively.
Tenure	Years working at current job.
Work experience	Work experience is proxied by age-years of education-6-tenure. As males in Taiwan need to serve two years in the army, an additional 2 years is thus further subtracted for males.
Sex	Dummy variable: 0 for female, 1 for male.
Marital status	Dummy variable: 0 for single, 1 otherwise.
Industry	Industry in which the individual works are dummy variables, which include agriculture, forestry, fishery, and husbandry; manufacturing; water, electricity, fuel, and coal; construction; wholesalers, retailers, and restaurants; transportation, storage, and communications; finance, insurance, and real estate; and public and personal services. Wholesalers, retailers, and restaurants is the reference group.
Firm size	Dummy variables include 1-9 persons, 10-49 persons, 50-99 persons, 100-499 persons, 500 persons and above, and the public sector. 1-9 persons is the reference group.
Residential area	Residential area is classified into urban and rural areas and represented by a dummy variable: 0 for rural area, 1 for urban area. Based on the official classification of Taiwan's Ministry of Interior, cities, towns, or villages with a population of residences of over fifty thousand are classified as urban areas.
Number of siblings	Having younger siblings in the family is represented by a dummy variable: 1 for yes and 0 for no.
Compulsory educational policy	People affected by the nine-year compulsory educational policy implemented in1968. A dummy variable: 0 for those who were born before 1956 (not affected by the policy) and 1 for those who were born after 1956 (affected by the policy).

Table 2. Summery of basic statistics for variables

Variable name	Mean	Standard Deviation	Min. value	Max. value
Age	27.79	6.81	15	64
Years of education	10.83	2.76	0	18
Tenure	3.55	4.17	0.08	41.17
Work experience	6.09	5.70	0	46
Sex	0.66	0.47	0	1
Marital status	0.32	0.47	0	1
Industry				
Agriculture	0.05	0.21	0	1
Manufacturing	0.38	0.49	0	1
Water, electricity, fuel, and coal	0.01	0.07	0	1
Construction	0.11	0.31	0	1
Wholesalers, retailers, and restaurants	0.18	0.39	0	1
Transportation, storage, and communications	0.06	0.23	0	1
Finance, insurance, and real estate	0.05	0.23	0	1
Personal and public services	0.17	0.37	0	1
Firm size				
1-9 persons	0.44	0.50	0	1
10-49 persons	0.26	0.44	0	1
50-99 persons	0.07	0.26	0	1
100-499 persons	0.11	0.31	0	1
500 persons and above	0.04	0.19	0	1
Public sector	0.09	0.28	0	1
Instrumental variable				
Educational policy (IV1)	0.86	0.35	0	1
Residential area (IV2)	0.68	0.47	0	1

Number of Siblings (IV3)	0.26	0.44	0	1
Father's education (IV4)	6.05	3.86	0	18
Observations	7193			

Source: 1990 Manpower Utilization Survey, DGBAS, Taiwan

Industry includes 8 one-digit and 76 two-digit classifications, according to the Standard Classification of Industry of the Republic of China, DGBAS.[23] Residential area is classified into urban and rural areas. Based on the official classification of Taiwan's Ministry of the Interior, cities, towns, or villages with over fifty thousand residences are classified as urban areas. Due to data limitations, it is not possible to acquire residence information for samples during their study period. We use current residence as a proxy for the residence during schooling age.[24]

The total sample is 7,193 persons, average age is 28 years old, average years of education is 10.83 years, with an average tenure of 3.55 years and work experience of 6.09 years. Among them, females comprise 34% and males 66%; 23% are married; 38% work in manufacturing, 18% in wholesalers, retailers, and restaurants; 17% in

[23] The original classification of industry includes 9 one-digit and 85 two-digit industries, for simplicity and research purposes, we had aggregated some industries, which results in 8 one-digit and 76 two-digit industries.

[24] A possible bias from this assumption is that current residence may not be the same as the residence of schooling age, i.e., the residence of schooling age was in a rural (urban) area, but current residence is in an urban (rural) area. However, according to data from Panel Study of Family Dynamics, conducted by Academia Sinica since 1999, for those who were born between 1953 and 1963, the percentage of those living in rural areas during their schooling years but currently living in urban areas is 1.23%, while that for those living in urban areas during their schooling years but currently living in rural areas is only 0.91%. Thus, the bias of using the current residential area for the residence of schooling age is likely to be limited.

personal and public services; 70% worked at small- and medium-size firms (below 50 persons); only 4% worked at large enterprises (500 persons and above); and 9% worked in the public sector; 86% received nine-year compulsory education; 68% lived in urban area and 32% in rural area.

Estimation results

We use the IV method or so-called 2SLS method to estimate rate of return to education for Taiwan. The results of first stage regression for educational choice are presented in Table 3. The four instrumental variables, educational policy (IV1), residence area (IV2), number of siblings (IV3), and father's education (IV4), as expected, all have a positive effect on individual's education achievement. These results imply that those who receive compulsory education, live in urban areas, have no younger siblings, and have fathers with higher education tend to have more education. Moreover, even including all four instrumental variables into the educational choice regression, as in column 5 of Table 3, the estimated coefficients all remain significant and have expected signs.

Table 3. Results of first stage regression on educational choice

	IV1	IV2	IV3	IV4	IV1+IV2+IV3+IV4
Age	0.4908***	0.4883***	0.4809***	0.4473***	0.3958***
	(17.59)	(17.85)	(16.73)	(17.52)	(15.12)
Age^2	-0.0083***	-0.0089***	-0.0088***	-0.0079***	-0.0066***
	(-18.68)	(-21.33)	(-20.10)	(-20.21)	(-15.77)
Educational policy	0.9974***				0.9635***
	(6.75)				(7.17)
Residence area		1.1235***			0.7144***
		(16.47)			(11.15)
Number of siblings			-0.3104***		-0.2150***
			(4.17)		(3.18)
Father's education				0.2764***	0.2592***
				(37.33)	(34.75)
Constant	3.2259***	3.8294***	4.5216***	3.2363***	2.1664***
	(6.98)	(8.93)	(10.29)	(8.09)	(5.09)
Partial R^2	0.0057	0.0327	0.0022	0.1460	0.1647
F-test	19.6***	67.7***	11.4***	579.4***	609.1***
Adj-R^2	0.1063	0.1333	0.1028	0.2466	0.2650
Observations	7193	7193	7193	7193	7193

Notes: 1. Figures in the parentheses are t statistics.
2. *, **, and *** stand for statistical significance levels at 90%, 95%, and 99%, respectively.
3. The F-test is for the instrument relevance condition (the significance of coefficients of all the instrumental variables). A rule of thumb is that F statistics should be greater than 10, and that any values below 10 imply that the selected instrumental variables have insignificant explanatory power and thus generate estimation bias.

To ensure that our instrumental variables are valid instruments, we further test for instrument relevance and exogeneity. From both the partial coefficient of

determination and the F-test of first stage regression in Table 3, all four instrumental variables have significant correlations with years of education. Among them, the father's education has the most explanatory power for an individual's education. As for the exogeneity test, from Table 4, the over-identifying restrictions test shows that the four instruments are not all exogenous, suggesting that potential endogeneity within the four instruments may bias the estimation.[25]

Table 4 lists the estimation results for the rates of return to education for the OLS and IV methods. First, by considering a parsimonious formulation of the Mincerian wage equation, which includes only variables like tenure and work experience in addition to education, the estimated rates of return to education, tenure, and work experience are 5.62%, 3.98%, and 1.45%, respectively. Including additional explanatory variables, which include marital status, industry, and firm size, the estimated rates of return to education, tenure, and work experience drop to 4.95%, 3.59%, and 1.15%, respectively. It should be noted that by construction, a valid instrumental variable should not be correlated with wage or any variable that explains wage; therefore, in the spirit of the IV method for estimating wage equation, the omitted variable bias problem should be negligible. We find that those additional explanatory variables are all significant with the expected signs; in general, those who

[25] To verify the exogeneity of the four instruments, see the next section on the sensitivity analysis for a detailed exogeneity test on various combinations of the four instrumental variables.

are married, work in construction and finance, insurance, and real estate sectors, and work at large enterprises tend to receive higher wages. Note that from Table 4, the result of the conventional OLS estimation rejects the null hypothesis of the DWH test that the education variable is exogenous; hence, this result justifies the use of the IV method for the estimation of return to education

From Table 4, using the nine-year compulsory education policy (IV1) as the instrument, the estimated rate of return to education is 8.57%, higher than that found by the OLS method. This result remains true (7.85% for IV and 4.95% for OLS) even after controlling for additional explanatory variables. Thus, the estimated average rate of return to education by the conventional OLS method will be biased downward because of the endogeneity of education variable. The instrument variable by the compulsory education policy suggests that compulsory education will increase the rate of return to education, as the implementation of compulsory education reduces the marginal cost of education, especially for those children whose families are subject to credit constraints.

The instrument of residence area (IV2) also shows an estimated rate of return to education of 8.01%, higher than the estimate found by the OLS. This result implies that return to education is higher in urban areas than in rural areas, as urban areas tend

to provide more and better educational resources and thus lower marginal costs of education than rural areas do.

As for the instruments of family background variable, the estimated rates of return to education for the number of siblings (IV3) and father's education (IV4) are 8.22% and 7.37, respectively, again higher than that found by the OLS method. This result implies that one with no younger siblings or a father with more education will tend to receive more family educational resources, thus resulting in more education and a higher rate of return to schooling.

However, taking four instrumental variables jointly, the estimated rate of return to education is still higher for the IV method than for the OLS method but lower than estimates by any single instrument. The reason is that an estimate using a single instrumental variable usually represents the rate of return for one particular demographic subgroup, and as we increase the number of instruments in the first stage regression, the estimated educational achievement will in general become closer to the real value and thus approach the average marginal rate of return to education for the whole group.

Comparing the estimates through four instruments, we find that the estimated rate of return to education is highest for compulsory education, followed in order by

residence area, father's education, and number of siblings. This result suggests that institutional factors such as compulsory education have a stronger effect on return to education than do family background factors such as number of siblings or father's education. In other words, as the compulsory education is a comprehensive institutional change which generally reduces the marginal cost of education for people, especially those subject to credit constraints, it is thus the most significant effect on return to education.

Actually, the estimated rate of return to education found by the OLS method is not the average marginal rate of return to education, or so-called average treatment effect (ATE); it also encounters the problems of the endogeneity bias and the ability bias. In contrast, estimates by the IV method not only avoid the problems of the endogeneity and ability biases but also provide an estimate of the marginal rate of return to education for a particular demographic subgroup (Card (1999, P.1855)), an estimate close to the local average treatment effect (LATE) (Heckman, Lalonde, and Smith (1999)).

Table 4. Estimated rates of return to education: OLS vs. IV

	OLS		IV1		IV2		IV3		IV4		IV1+IV2+IV3+IV4	
Years of education	0.0562***	0.0495***	0.0857***	0.0785***	0.0801***	0.0722***	0.0822***	0.0750***	0.0737***	0.0659***	0.0625***	0.0539***
	(26.19)	(25.17)	(10.34)	(22.23)	(11.75)	(10.09)	(9.22)	(7.82)	(18.22)	(16.88)	(6.22)	(5.47)
Tenure	0.0398***	0.0359***	0.0401***	0.0366***	0.0422***	0.0364***	0.0443***	0.0365***	0.0419***	0.0374***	0.0433***	0.0391***
	(12.52)	(11.57)	(17.21)	(16.22)	(18.02)	(15.11)	(15.21)	(13.78)	(17.72)	(16.22)	(18.17)	(16.98)
Tenure^2	-0.0015***	-0.0014***	-0.0015***	-0.0011***	-0.0015***	-0.0011***	-0.0015***	-0.0011***	-0.0015***	-0.0011***	-0.0015***	-0.0013***
	(-14.3)	(-11.07)	(-12.62)	(-8.32)	(-12.92)	(-9.68)	(-9.12)	(-7.32)	(-14.11)	(-9.02)	(-14.49)	(-12.24)
Work experience	0.0145***	0.0115***	0.0041***	0.0032**	0.0039***	0.0040**	0.0031*	0.0034*	0.0050***	0.0041***	0.0049***	0.0039**
	(3.51)	(3.15)	(1.98)	(1.65)	(1.90)	(1.84)	(1.62)	(1.60)	(2.62)	(2.41)	(2.17)	(1.99)
Work experience^2	-0.0001	-0.0002	0.0001**	0.0001	0.0001**	0.0001	0.0002***	0.0002*	0.0002**	0.0001	0.0001*	0.0001
	(-0.86)	(-0.62)	(1.83)	(1.29)	(1.75)	(1.13)	(2.17)	(1.68)	(2.10)	(1.12)	(1.71)	(1.11)
Sex	0.3216***	0.2979***	0.3110***	0.2921***	0.3044***	0.2977***	0.3022***	0.2847***	0.3102***	0.2973***	0.3143***	0.2907***
	(33.12)	(28.53)	(29.47)	(27.45)	(29.74)	(28.12)	(28.47)	(26.32)	(30.21)	(28.18)	(31.17)	(27.46)
Marital Status		0.0586***		0.1342***		0.1179***		0.1216***		0.1201***		0.1243***
		(5.02)		(12.39)		(10.21)		(11.12)		(10.92)		(11.25)
Industry												
Agriculture		-0.3142***		-0.4022***		-0.3875***		-0.4004***		-0.3972***		-0.3842***
		(-12.99)		(-15.33)		(-14.63)		(-14.82)		(-15.44)		(-14.77)
Manufacturing		-0.0332***		-0.1032***		-0.1018***		-0.1011***		-0.0981***		-0.0913***
		(-2.99)		(-6.94)		(-7.78)		(-7.92)		(-6.27)		(-8.78)
Water, electricity, fuel and coal		0.1056		0.0913		0.0838		0.0911		0.1001		0.1005
		(1.24)		(1.32)		(0.99)		(1.11)		(1.01)		(1.12)
Construction		0.1621***		0.0763***		0.0746***		0.0776***		0.0812***		0.0932***
		(9.73)		(5.06)		(4.97)		(4.43)		(6.16)		(5.77)

Transportation, storage, and communications		0.0544***		0.0152		0.0151		0.0150		0.0177		0.0163
		(3.14)		(0.64)		(0.75)		(0.66)		(1.09)		(0.95)
Finance, insurance, and real estate		0.1121***		0.1522***		0.1512***		0.1561***		0.1492***		0.1422***
		(4.72)		(6.92)		(7.01)		(7.44)		(6.98)		(6.43)
Personal and public services		-0.0251*		-0.0438***		-0.0427***		-0.0387**		-0.0412***		-0.0402***
		(-1.68)		(-2.77)		(-2.53)		(-2.42)		(-2.67)		(-2.51)
Firm size												
10-49 persons		0.0441***		0.0901***		0.0888***		0.0909***		0.0878***		0.0776***
		(3.92)		(7.82)		(7.44)		(7.27)		(7.44)		(6.32)
50-99 persons		0.0511***		0.1165***		0.1167***		0.1201***		0.1125***		0.1088***
		(3.41)		(6.27)		(6.45)		(6.21)		(5.93)		(5.87)
100-499 persons		0.0542***		0.1322***		0.1307***		0.1409***		0.1324***		0.1228***
		(3.19)		(9.39)		(8.93)		(7.93)		(7.74)		(7.21)
500 persons and above		0.0817***		0.1698***		0.1622***		0.1711***		0.1544***		0.1412***
		(3.69)		(6.66)		(6.37)		(7.02)		(6.02)		(5.93)
Public sector		0.1176***		0.2501***		0.2498***		0.2488***		0.2341***		0.2219***
		(6.82)		(12.66)		(12.47)		(11.87)		(12.21)		(11.43)
Correction term λ	-1.1700***	-1.012***	-0.5598***	-0.4445***	-0.5300***	-0.4112***	-0.5217***	-0.4266***	-0.4655***	-0.3676***	-0.4688***	-0.3617***
	(-6.04)	(-5.09)	(21.79)	(-17.08)	(-20.64)	(-16.04)	(-19.76)	(-15.71)	(-17.91)	(-13.77)	(-18.20)	(-14.04)
Constant	3.8071***	3.6191***	3.5583***	3.6048***	3.5713***	3.6807***	3.4428***	3.4165***	3.4614***	3.5245***	3.4225***	3.5128***
	(72.71)	(122.65)	(34.36)	(33.27)	(41.18)	(44.22)	(26.48)	(27.12)	(71.00)	(73.86)	(70.45)	(74.29)
Observations	7193	7193	7193	7193	7193	7193	6376	6376	7193	7193	7193	7193

Adj-R^2	0.3020	0.3494	0.1962	0.2889	0.209	0.2975	0.1928	0.286	0.2335	0.3115	0.2313	0.3100
DWH test for exogeneity	-8.07***	-7.68***										
Over-identifying restrictions test											12.48***	10.68**

Notes: 1. Figures in the parenthesis are t statistics; *, **, *** represent statistical significance levels at 90%, 95%, and 99%, respectively.

2. Reference group: wholesalers, retailers, and restaurants for industry; 1-9 persons for firm size.

3. Instrumental variables: IV1 for compulsory educational policy, IV2 for residence area; IV3 for number of siblings, and IV4 for father's education.

4. Heckman's (1979) two-stage selection method is used for correcting selection bias. Variables in the Probit model include years of education, marital status, number of children, and residency area, and λ is the sample selection-corrected term (or the inverse Mills ratio).

5. Null hypothesis of DWH test for exogeneity is that education variable is exogenous.

6. Null hypothesis of over-identifying restriction is that all the including instrumental variables are jointly exogenous.

Sensitivity Analysis

Previous analysis shows that the estimated rate of return to education found by the conventional OLS method will be biased downward, as the education variable is endogenous. The IV method not only solves the endogeneity problem but also provides an estimated rate of return to education for a particular demographic subgroup. Theoretically, a valid instrument needs to satisfy both the instrument relevance and instrument exogeneity conditions. However, Donald and Newey (2001) point out that the most difficult task is to choose the most suitable instrumental variable from a set of IVs.[26] Likewise, for sensitivity analysis, we further perform tests for relevance and exogeneity conditions for all the possible combinations of our four instrumental variables to verify the most appropriate instruments. The results are shown in Table 5.

[26] See Donald and Newey (2001) for a detailed discussion on the selection and combinations of instrumental variables.

Table 5. Estimated rates of return to education for various combinations of IVs

Combination of IVs	ROR to education	Adj-R^2	F-test for relevance	Over-identifying restrictions test
IV1	0.0857	0.1962	19.61	
IV2	0.0801	0.2090	67.75	
IV3	0.0822	0.1928	11.42	
IV4	0.0737	0.2335	579.40	
IV1+IV2	0.0791	0.2112	25.17	1.44
IV1 +IV3	0.0844	0.2097	66.24	1.23
IV1+IV4	0.0762	0.2366	591.73	6.85**
IV2+IV3	0.0810	0.2097	17.82	1.02
IV2+ IV4	0.0721	0.2311	403.42	7.33**
IV3+IV4	0.0784	0.2341	225.70	7.52**
IV1+IV2+IV3	0.0814	0.2110	81.49	2.88
IV1+IV2 +IV4	0.0673	0.2201	499.15	10.21***
IV1+IV3+IV4	0.0651	0.2197	392.42	9.44***
IV2+IV3+IV4	0.0694	0.2307	552.83	9.07***
ALL	0.0625	0.2313	609.18	13.52***

Notes: 1. IV1 for compulsory educational policy; IV2 for residence area; IV3 for number of siblings; and IV4 for father's education.
2. If F-statistic is smaller than 10, it implies that the selected IV has no explanatory power and will cause an estimation bias for return to education.
3. Null hypothesis of over-identifying restriction is that all the including instrumental variables are jointly exogenous.
4. *, **, and *** represent the statistical significance levels at 90%, 95%, and 99%, respectively.

From Table 5, we find that the inclusion of more IVs will reduce the estimated rate of return to education, as the result from one single IV represents one particular demographic subgroup. The inclusion of further IVs will increase the explanatory power for education achievement at the first stage; therefore, the estimated rate of

return to education will conceptually approach the real average marginal rate of return to education at the second stage wage regression.

However, the two conditions of instrument relevance and exogeneity still need to be satisfied as valid instruments. Moreover, the criterion for the most effective valid instrument among the IVs is the one that provides the minimum mean square error (MSE) for the estimation of rate of return to education at the second stage wage regression. From Table 5, we find that any single instrumental variable satisfies the instrument relevance condition; however, every IV combination that includes the father's education (IV4) will reject the null hypothesis of the over-identifying restrictions test, suggesting that the father's education fails to satisfy the instrument exogeneity condition and thus is not a valid instrument for education. Among all the IV combinations, the combination of compulsory education policy (IV1) and residence area (IV2) not only satisfies both the relevance and exogeneity conditions but also has the lowest MSE value. Thus, the combination of IV1 and IV2 is the most effective valid instrument for education variable. Table 6 shows the estimated rates of return to education for both males and females using IV1+IV2 as the instrument for education.

Table 6. Estimated rates of return to education for males and females

	OLS				IV1+IV2			
Explanatory variable	Male		Female		Male		Female	
Years of education	0.0531***	0.0465***	0.0771***	0.0621***	0.0572***	0.0480***	0.1407***	0.1009***
	(21.21)	(18.66)	(26.96)	(21.01)	(7.33)	(7.05)	(13.07)	(11.25)
Tenure	0.0471***	0.0401***	0.0566***	0.0551***	0.0410***	0.0312***	0.0363***	0.0302***
	(16.88)	(13.28)	(11.32)	(10.98)	(13.65)	(11.95)	(4.11)	(4.95)
$Tenure^2$	-0.0017** *	-0.0015** *	-0.0015** *	-0.0017** *	-0.0015** *	-0.0011** *	0.0005	-0.0005
	(-14.46)	(-11.78)	(-4.66)	(-3.87)	(-12.62)	(-10.13)	(1.12)	(-0.77)
Work experience	0.0209***	0.0178***	0.0266***	0.0243***	0.0015	-0.0014	-0.0069*	0.0054
	(9.13)	(7.42)	(8.98)	(8.22)	(0.77)	(-0.98)	(-1.66)	(0.77)
Work $experience^2$	-0.0003** *	-0.0003**	-0.0005** *	-0.0004** *	0.0002**	0.0002**	0.0005***	0.0002
	(-4.11)	(-3.07)	(-3.16)	(-2.96)	(2.66)	(2.17)	(2.43)	(0.98)
Marital status		0.0868***		0.0092		0.1212***		0.0081
		(8.21)		(0.29)		(9.95)		(0.44)
Industry								
Agriculture		-0.3672** *		-0.0941		-0.4166** *		-0.0883
		(-11.45)		(-0.74)		(-15.11)		(-0.76)
Manufacturing		-0.0086		-0.0642** *		-0.0583** *		-0.1744** *
		(-0.67)		(-2.71)		(-3.07)		(-9.12)
Water, electricity, fuel, and coal		0.1862**		0.1177		0.1566**		0.2256
		(3.23)		(0.41)		(1.82)		(0.17)
Construction		0.1544***		0.0011		0.0849***		0.0064
		(8.03)		(0.21)		(3.93)		(0.08)
Transportation, storage, and communications		0.0569***		0.0476		0.0432		0.0481
		(2.66)		(1.33)		(1.50)		(0.87)

Finance, insurance, and real estate		0.1369***		0.0612**		0.1897***		0.0668***
		(3.98)		(2.78)		(5.93)		(2.62)
Personal and public services		-0.0054		-0.0671**		-0.0107		-0.0763**
		(0.56)		(-3.34)		(-0.43)		(-3.77)
Firm size								
10-49 persons		0.0393**		0.0887***		0.0497***		0.1043***
		(2.91)		(4.07)		(3.21)		(6.44)
50-99 persons		-0.0072		0.1487***		0.0526*		0.2284***
		(-0.43)		(6.01)		(1.79)		(9.93)
100-499 persons		0.0104		0.1266***		0.0796***		0.2088***
		(0.66)		(5.88)		(2.99)		(8.12)
500 persons and above		0.0388		0.1702***		0.1203***		0.2227***
		(1.12)		(6.33)		(4.41)		(6.77)
Public sector		0.0533**		0.2875***		0.1621***		0.3605***
		(2.66)		(10.43)		(7.12)		(14.94)
Correction term λ	-0.5321**	-0.4817**	0.3144***	0.2907***	-1.4532**	-1.3783**	0.7328***	0.5568***
	(-20.62)	(-19.11)	(11.25)	(9.69)	(-9.93)	(-8.45)	(7.76)	(6.94)
Constant	3.8622***	3.9328***	3.2918***	3.1084***	4.0221***	3.9029***	2.6891***	3.1209***
	(111.73)	(101.45)	(78.66)	(69.33)	(43.45)	(40.19)	(21.12)	(26.43)
Observations	4769	4769	2424	2424	4769	4769	2424	2424
Adj-R^2	0.1483	0.2203	0.2750	0.3164	0.1046	0.1715	0.1302	0.2401

Notes: See Notes in Table 3.

Results from Table 6 suggest that the estimated rate of return to education is higher for females than for males for both the OLS and IV methods, and that the estimated return to education is higher for the IV method than for the OLS method for both males and females, suggesting a downward bias estimation through the OLS

method. For the parsimonious formation of wage equation with only education, tenure, and work experience as the explanatory variables, the estimated rate of return to education is 5.31% for males and 7.71% for females by the OLS, and that of the IV method is 5.72% for males and 14.07% for females.[27] Including additional explanatory variables of marital status, affiliated industry, and firm size, the estimated rate of return to education is 4.65% for males and 6.21% for females by the OLS, and that of the IV method is 4.80% for males and 10.09% for females. These results imply that the downward bias by OLS estimation is greater for females than for males, as females are likely to be underinvested in or discriminated against in education due to family background factors. Thus, for those whose educational choice is critically influenced by family factors, such as females, the IV method will mitigate the endogenous downward bias and provide a better estimate for their marginal rates of return to education.

IV. Conclusion

Conventional OLS estimation of rate of return to education by the Mincerian wage equation has its statistical simplicity in empirical studies, provided that the education variable is uncorrelated with the error term. If this basic statistical

[27] These results are similar to those in Spohr (2003).

assumption is not true, as is indeed the case in educational choice, the endogeneity of the education variable will cause the estimated rate of return to education to be biased downward by the OLS method. To solve for the endogeneity problem, this paper uses the IV method to estimate rate of return to education using data from the 1990 Taiwan Manpower Utilization Survey. Instrumental variables include the nine-year compulsory education policy, residence area, number of siblings, and father's education. Except the father's education, the other three IVs satisfy both the instrument relevance and exogeneity conditions.

The results show that the estimated rate of return to education is higher for the IV method than for the OLS method. Among them, the highest estimated rate of return to education (8.57%) is for the instrument of compulsory education policy, implying that a comprehensive institutional change such as a nationwide compulsory educational policy significantly reduces the marginal cost of education for the people, especially those who are subject to family credit constraints. Thus, the impact on education is greater for the compulsory educational policy than for residence area or family factor.

As there is more than one instrument, any combination of IVs can be a valid instrument. We further perform tests of relevance and exogeneity for all the possible combinations of four IVs and choose the one with the minimum MSE in the second

stage wage regression as the most effective valid instrument. The result shows that the combination of compulsory education policy (IV1) and residence area (IV2) is the most efficient valid instrument, which may give a better estimation for the rate of return to education. Using this instrument, we further estimate rates of return to education for both males and females, finding that the estimated rate of return to education is 5.72% for males and 14.09% for females, which is higher than that found by OLS, especially in the female group. As females are likely to be underinvested or discriminated against in education due to family credit constraints, this paper shows that the downward bias will become more serious for females than for males through OLS estimation.

References

Angrist, J. D. and A. B. Krueger (1991), "Does Compulsory Schooling Attendance After Schooling and Earning?" Quarterly Journal of Economics, 106(4), 979-1014.

Arcand, J. L., B. D'hombres and P. Gyselinck (2004), "Instrument Choice and the Returns to Education: New Evidence from Vietnam," Economics Working Paper Archive at WUSTL, 0510011.

Barro, R. J., and X. Sala-i-Martin (1995), Economic Growth, Cambridge, MA: MIT Press.

Bound J., Jaeger D. A. and R. Baker (1995), "Problems with Instrumental Variables Estimation When the Correlation between the Instruments and the Endogenous Explanatory Variable is Weak," Journal of the American Statistical Association, 90, 443-450.

Card, D. (1999), "The Causal Effect of Education on Earnings," In Ashenfelter, O. and D. Card, (eds) Handbook of Labor Economics, Vol. 3A, Amsterdam: Elsevier.

Card, D. (2001), "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems," Econometrica, 69(5), 1127-1160.

Chuang, Y. C. (1999), "The Role of Human Capital in Economic Development: Evidence from Taiwan," Asian Economic Journal, 13, 117-144.

Chuang, Y. C. (2000), "Human Capital, Exports, and Economic Growth: A Causality Analysis for Taiwan, 1952-1995," Review of International Economics, 8, 712-720.

Chuang, Y. C. and C. Y. Chao (2001), "Educational Choice, Wage Determination, and Rates of Return to Education in Taiwan," International Advances in Economic Research, 7, 479-504.

Cruz, L. M. and M. J. Moreira (2005), "On the Validity of Econometric Techniques with Weak Instruments: Inference on Returns to Education Using Compulsory School Attendance Laws," Journal of Human Resources, 40 (2), 393–410.

Davidson R. and J. G. MacKinnon (2003), Econometric Theory and Methods, Oxford, UK: Oxford University Press.

Donald, S. and W. Newey (2001), "Choosing the Number of Instruments," Econometrica, 69(5), 1161-1191.

Duflo, E. (1999), "Schooling and Labor Market Consequences of Schooling in Indonesia: Evidence from an Unusual Policy Experiment," Mimeo, Department of Economics, MIT

Durbin, J. (1954), "Errors in Variables," International Statistical Review, 22, 23-32.

Gindling, T. H., M. Goldfarb and C.C. Chang (1995), "Changing Return to Education in Taiwan," World Development, 23(2), 343-356.

Griliches, Z. (1977), "Estimating the Return to Schooling: Some Econometric Problems," Econometrica, 45(1), 1-22.

Gurgand, M. (2003), "Farmer Education and the Weather: Evidence from Taiwan (1976–1992)," Journal of Development Economics, 71, 51–70.

Hansen L. P. (1982), "Large Sample Properties of Generalized Method of Moments Estimators," Econometrica, 45, 1-22.

Harmon, C. and I. Walker (1995). "Estimates of the Economic Return to Schooling for the UK," American Economic Review, 85, 1279-1286.

Hausman J. (1978), "Specification Test in Econometrics," Econometrica, 46(3), 262-280.

Haveman, R. and B. Wolfe (1995), "The Determinants of Children's Attainments: A Review of Methods and Findings," Journal of Economic Literature, 33, 1829-1878.

Heckman J. J. (1976), "The Common Structure of Statistical Models of Truncation, Sample Selection, and Limited Dependent Variables and a Simple Estimator for Such Models" Annals of Economic and Social Measurement,5, 475-492.

Heckman, J. J., R. J. Lalonde, and J. A. Smith (1999), "The Economics and Econometrics of Active Labor Market Programs," In Ashenfelter, O. and D. Card, (eds) Handbook of Labor Economics, Vol. 3A, Amsterdam: Elsevier.

Heckman, J. J., L. J. Lochner, and P. E. Todd (2003), "Fifty Teatrs of Mincer Earnings Regressions," Working Paper 9732, National Bureau of Economic Research, Cambridge, MA.

Heckman J. J. and E. Vytlacil (1999), "Local Instrumental Variable and Latent Variable Models for Identifying and Bounding Treatment Effects," Proceedings of the National Academy of Sciences, 96, 4730-4734.

Johnston, J. and J. Dinardo (1997), Econometrics Methods, 4th edition, Macraw-Hill.

Lin, T. C. (2004), "The Role of Higher Education in Economic Development: An Empirical Study of Taiwan Case," Journal of Asian Economics, 15, 355–371

Mincer, J. (1974), Schooling Experience and Earning, New York: Columbia University Press.

Moretti, E. (2004), "Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data," Journal of Econometrics, 121(1-2), 175-212.

Patrinos, H. and C. Sakellariou (2005), "Schooling and Labor Market Impacts of a Natural Policy Experiment," Labour, 19(4), 705-719.

Psacharopouls, G. (1985), "Return to Education: A Further International Update and Implications," Journal of Human Resources, 20(4), 583-604.

Sakellariou C. (2006), "Education Policy Reform, Local Average Treatment Effect and Returns to Schooling from Instrumental Variables in the Philippines," Applied Economics, 38, 473-481.

Sargen J. (1958), "The Estimation of Economic Relationships Using Instrumental Variables," Econometrica, 26(3), 393-415.

Spohr, C.A. (2003), "Formal Schooling and Workforce Participation in a Rapidly Developing Economy: evidence from 'Compulsory' Junior High School in Taiwan," Journal of Development Economics, 70, 291–327.

Steiger D. and J. H. Stock (1997), "Instrumental Variables Regression with Weak Instruments," Econometrica, 65(3), 557-586.

Trostel P., I. Walker and P. Woolley (2002), "Estimates of the Economic Return to Schooling for 28 Countries," Labour Economics, 9(1), 1-16**.**

Wu, D. (1973), "Alternative Tests of Independence Between Stochastic Regressors and Disturbances," Econometrica, 41, 733-750.

Wu, H. Y. (2003), "An Economic Evaluation of Taiwan's Educational Development: 1978-2001," Taiwan's Economic Forecast and Policy, 33(2), 97-130. (in Chinese)

Heterogeneity, Comparative Advantage, and Return to Education: The Case of Taiwan

Abstract

By considering heterogeneity in abilities and self-selection in educational choice, this paper adopts the heterogeneous human capital model to estimate rate of return to university education using data from the 1990 and 2000 Taiwan's Manpower Utilization Surveys. The Taiwan empirical study shows that significant heterogeneous return to education does exist, and that the educational choice was made according to the principle of comparative advantage. The estimated rates of return for attaining university were 19% and 15%, much higher than the average rate of return of 11.55 and 6.6%, for 1990 and 2000, respectively. The declining trend of return to university education may have been caused by the rapid expansion of the number of colleges and universities and the increasing supply of college graduates in the 1990s.

Keywords: Heterogeneous human capital; Sorting gain; Selection bias; Return to education; Marginal treatment effect; Average treatment effect

JEL: I21, I28, C23

Heterogeneity, Comparative Advantage, and Return to Education: The Case of Taiwan

I. Introduction

According to human capital theory, people invest in education to accumulate human capital, enhance personal productivity, and in return receive higher life-cycle earnings profiles.[28] The economic return to education not only affects the individual's educational choice and hence his life-cycle earnings but also influences the labor quality of the whole society, an important factor for the aggregate performance of the economy and for the planning of government educational policy. Thus, the estimation of the return to education has become one of the most essential issues in modern labor economics.

What is the "true" rate of return to education? Education is a form of human capital investment and accumulation; however, the formulation and identification of human capital may be quite diverse and usually result in different estimation methods for the rate of return to education. There are two viewpoints on the formulation of human capital. One is, human capital is homogenous, and people may choose to have different units of human capital through investment like education and on-the-job training, ending up with different stocks of human capital by themselves.[29] Following

[28] See, for example, Card (1999) for a complete theoretical and empirical survey on the relationship between education and earnings.

[29] The practice of labor in homogenous efficiency unit can be dated back to neoclassical tradition of

this line of view, researchers use the common coefficient model to estimate the return to education from the Mincerian wage equation and emphasize the problems of ability bias and measurement error. The OLS or instrumental variables methods are usually employed. Another opinion, as in Roy (1951),Willis and Rosen (1979), and Willis (1986), views human capitals as heterogeneous multidimensional attributes, and people choose their educational attainment based on the comparative advantage of their different attributes of abilities. In the case of heterogeneous human capital, the random coefficient model is usually adopted to estimate the returns on education.

A major problem in the estimation is that education is an investment decision, and thus the schooling variable is endogenous, which is against the basic exogeneity assumption of explanatory variables in OLS estimation. Moreover, education is a self-selection process. In the real world, the data that we observe are results after selection, and thus not a random sample. For example, it is not possible to find the wages for those who have received college and university education if instead they enter the labor market right after they graduate from high school. As a result, the error term in the regression equation is truncated, and it renders selection bias for the estimator. If human capital is heterogeneous, as in the Roy model, then heterogeneity

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labor economics, see, for example, Clack (1899) and Stigler (1941). Griliches (1977) also points out that human quality can be measured based on the efficiency units,

in abilities will reinforce the process of self-selection and thus exacerbate the effect of selection bias.

Following Roy's (1951) heterogeneous human capital model and Bjorklund and Moffitt's (1987) concept of marginal treatment effect (MTE), Heckman and Vytlacil (1999, 2000), and Carneiro, Heckman, and Vytlacil (2001) develop a model to estimate the return to education with heterogeneous human capital.[30] The main features of the model are that the estimation results can be used to test the hypothesis of heterogeneous human capital and further estimate the average treatment effect (ATE) and trace the selection bias.

For the past four decades, Taiwan, a small island of 36,000 kilometers with limited natural resources, has achieved a so-called "economic miracle," with an average annual economic growth rate of 8.45% between 1960 and 2000. The investment in education has expanded greatly in Taiwan. The average years of education for employed workers in Taiwan have increased tremendously from 7.18 years in 1978 to 11.03 years in 2006, while for the same period, the per capita income rose from US$1,461 to US$14,455, a roughly ten-fold increase. Thus, the estimation of the economic return from education is especially relevant. Using data from the

[30] The marginal treatment effect is the average return for those who are at the critical status of receiving or not receiving education but eventually decide to take the education. The selection process is based on the characteristics of the individual's unobserved abilities. For a detailed description, see, for example, Heckman and Li (2004) and Heckman, Urzua and Vytlacil (2006).

1990 and 2000 Taiwan's Manpower Utilization Surveys, this paper adopts the heterogeneous human capital model to estimate the rate of return to college and university education in Taiwan and compares the estimation results with that from the conventional OLS or IV estimation methods.

This paper is organized as follows. Section 2 lays out the theoretical framework and empirical method for the heterogeneous human capital model. Section 3 contains data description and analysis. Section 4 presents estimation results of Taiwan's empirical study. The conclusion follows in Section 5.

2. An empirical model for heterogeneous human capital

Heterogeneous return on education

In the conventional Mincerian earning equation with the assumption of homogeneous human capital, the common coefficient model can be expressed as

$$\ln Y_i = \beta S_i + \gamma X_i + U_i, \tag{1}$$

where i is an index for the individual; $\ln Y_i$ is the worker's average hourly real wage in logarithmic form; S_i is years of schooling; X_i represents other variables that influence an individual's real wage, including tenure, work experience, sex, marital status, affiliated industry, and firm size; and U_i is random error. The coefficient β is the rate of return to an additional year of education.

Due to ability bias and selection bias, OLS estimation for equation (1) will result in the estimation of the average marginal rate of return to education being biased. A useful tool to deal with the problem is the instrumental variable method, that is, to find a set of relevant instruments which is correlated with the schooling variable but uncorrelated with the real wage or error term; see, for example, Angrist and Krueger(1991), Trostel, Walker, and Woolley(2002), Patrinos and Sakellariou (2005), and Sakellariou (2006).

Empirically, it is very difficult to find relevant instruments. Carneiro and Heckman (2002) point out that most empirical studies on return to education in the literature used invalid instruments which tend to have high correlation with the omitted personal unobserved abilities.[31]

If human capital is heterogeneous, the empirical earning equation allowing for heterogeneous return to education can be specified as

$$\ln Y_i = \beta_i S_i + \gamma X_i + U_i , \tag{2}$$

where β_i stands for heterogeneous rate of return to education. Suppose the educational choice is whether to attain a university education or not. If $S_i = 1$ denotes to attain university and $S_i = 0$ is not to do so, and earn only a high school diploma, then after selection into different educational attainments, the wage profiles for the two statuses will be different and can be expressed as

$$\ln Y_{0i} = \gamma_0 X_i + U_{0i} , \text{ if } S_1 = 0 ; \tag{3a}$$

$$\ln Y_{1i} = \gamma_1 X_i + U_{1i} , \text{ if } S_i = 1 ; \tag{3b}$$

where $E(U_{0i} \mid X_i) = 0$ and $E(U_{1i} \mid X_i) = 0$. After selection, it is not possible for any cross-sectional data to have both $\ln Y_{0i}$ and $\ln Y_{1i}$ for the same individual. Therefore,

[31] Heckman (1997) and Heckman and Navarro-Lozano (2004) prove that only when individual unobserved heterogeneity does not exist or does exist but is uncorrelated with an individual's schooling choice, the estimated rate of return to education using the IV method can be identified as a consistent estimator.

in the case of heterogeneous human capital, estimation using the conventional OLS or IV methods is not valid.

Further rearranging equations (3a) and (3b) yields

$$\begin{aligned} \ln Y_i &= S_i \ln Y_{1i} + (1 - S_i) \ln Y_{0i} \\ &= [(\gamma_1 - \gamma_0) X_i + (U_{1i} - U_{0i})] S_i + \gamma_0 X_i + U_{0i} \\ &= \beta_i S_i + \gamma_0 X_i + U_{0i} \end{aligned} \tag{4}$$

where

$$\beta_i = (\gamma_1 - \gamma_0) X_i + (U_{1i} - U_{0i}) . \tag{5}$$

The term β_i represents heterogeneous return to education for individual i. From equation (5), the term β_i includes observed heterogeneity $(\gamma_1 - \gamma_0) X_i$ and unobserved heterogeneity $(U_{1i} - U_{0i})$. As these two components are different among people, thus the heterogeneous return β_i will be a random variable following certain distribution. For a given X_i, the mean value of β_i is:

$$\overline{\beta} = E(\beta_i \mid X_i) = E[(\gamma_1 - \gamma_0) X_i] . \tag{6}$$

Suppose people decide whether to go or not to go to university based on the following rule:

$$S_i^* = P_i(Z_i) - U_{si},$$

$$S_i = \begin{cases} 1 & if\ S_i^* \geq 0 \\ 0 & if\ S_i^* < 0 \end{cases} \tag{7}$$

where S_i^* is a latent variable which stands for the net return from receiving university education, Z_i is a vector of observable variables that affect the individual's schooling decision, $P_i = P_i(Z_i)$ is the probability of receiving a university education for individual i, and U_{si} represents all the individual's unobservable heterogeneity which influences the schooling decision.[32] For any individual, whether he or she will receive a university education or not is mainly determined by the observable heterogeneity, $P_i = P_i(Z_i)$, and unobservable heterogeneity, U_{si}. The smaller the U_{si} is, the greater the probability of entering a university will be.

Selection bias and marginal policy effect

First, according to the study of Carneiro et al. (2001) and Heckman and Vytlacil (1999, 2000), we define selection bias= $E(U_{01} \mid S_i = 1) - E(U_{01} \mid S_i = 0)$ as the difference of mean value of unobserved attributes for not receiving university education between those who do undertake university education and those who do not.

[32] By definition, U_{si} follows a uniform distribution between [0,1], see Heckman and Vytlacil (1999).

Further defining treatment on the treated (TT) as the average policy effect for those who participate in the program ($S_i = 1$), i.e., the average return to university for those who receive university education. Treatment on treated can also be expressed as

$$TT = E(\beta_i \mid X_i, S_i = 1) = ATE + E(U_{1i} - U_{0i} \mid S_i = 1), \tag{8}$$

where the average treatment effect ($ATE = E(\beta_i \mid X_i) = \overline{\beta}$) as the mean value of the sample with particular characteristics X , and $E(U_{1i} - U_{0i} \mid S_i = 1)$ is defined as sorting gain, the mean difference of the unobserved heterogeneity between going to university and not going to university for those who choose to have university education. Thus, from equation (8), we have sorting gain (=$TT - ATE$) is equal to the rate of return to university for those receiving university education minus the average rate of return to university education from a random sample with similar observable attributes X_i .

The rate of return to education under OLS can be expressed as

$$p\,lim(\hat{\beta}_{OLS}) = E(\ln Y_{1i} \mid X_i, S_i = 1) - E(\ln Y_{0i} \mid X_i, S_i = 0)$$

$$= E(\beta_i \mid X_i, S_i = 1) + [E(U_{0i} \mid S_i = 1) - E(U_{0i} \mid S_i = 0)].$$

By the definitions above, we have

β_{OLS} = TT + Selection bias

=ATE + Sorting gain + Selection bias.

Therefore, the bias between β_{OLS} and treatment on the treated (TT) is selection bias, and the bias between β_{OLS} and average treatment effect (ATE) is sorting gain plus selection bias. If policy adoption is made with partial or full knowledge of the idiosyncratic gain to policy adoption, then neither can the IV method identify the mean effect of the policy.[33]

Likewise, treatment on the untreated ($\text{TUT} = \overline{\beta} + E(U_{1i} - U_{0i} \mid S_i = 0)$) is the average policy effect for those who do not attend the program, i.e., the average return to university for those who do not receive university education ($S_i = 0$).

Under certain assumptions it is possible using the local instrument variables (LIV) method to derive the marginal treatment effect (MTE) and estimate heterogeneous rate of return to education.[34] Marginal treatment effect is defined as given personal characteristics (X_i) and unobservable heterogeneity (U_{si}) the marginal gain of an individual who is indifferent to choose university education and not to choose it. Thus, the marginal treatment effect is the marginal price for an individual who is willingly to pay for university education.[35] From MTE, we can

[33] See Heckman, Urzua and Vytlacil (2006) for a detailed proof.

[34] For a detailed discussion of how to use the local instrumental variable method to estimate marginal treatment effect, see, for example, Heckman and Vytlacil (1999, 2000), and Carneiro, Heckman and Vytlacil (2001).

[35] The marginal treatment effect may change as the unobservable heterogeneity (Us) changes. Carneiro, Heckman, and Vytlacil (2000) proves that if MTE does not change as Us changes, in this case

further identify all other policy effects as weighted averages of MTE. Therefore, the empirical strategy is to test whether the model of heterogenous human capital hypothesis generates the data.

3. Data Analysis

This paper adopts data from the 1990 and 2000 Taiwan Manpower Surveys. Table 1 shows all the variables used in the paper and their definitions. Table 2 presents basic statistics of the variables. The samples for 1990 and 2000 are 7,193 persons and 7,626 persons, respectively.[36] Among them, 6% and 12.5% received university education, respectively, implying that the number of workers receiving university education doubled between 1990 and 2000. The tenure is 3.55 years and 4.30 years, and previous work experience is 6.09 years and 6.56 years for 1990 and 2000, respectively. The percentages of females in the sample are 34% and 31%, and the percentages of married individuals are 31% and 35% for 1990 and 2000, respectively. For the same period, the percentages of those working in manufacturing

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TT = ATE = MTE = LATE.

[36] For the purposes of comparison between the conventional OLS and IV models and our heterogeneous human capital model, we only choose samples with completely intergenerational information such as the number of siblings, which can only be obtained from the sample's mother and is used as an instrumental variable for education. However, we also do the estimation on return to education for all models by using the large samples without restrictions on intergenerational information and the estimated results are similar to what we report here.

are 38% and 30%, respectively, followed by wholesale, retail, and restaurant, 18% and 23%, and public and personal services, 17% and 16%. As for the firm size, most of the workers work in small and medium enterprises (below 50 persons) with percentages of 70% and 72% for 1990 and 2000, respectively, while the percentages of those who work in large enterprises (above 500 persons) are 3.7% and 4.6%, respectively. There were respectively 8.7% and 7.2% of workers in the public sector in 1990 and 2000.

Table 1. Variable names and definitions

Name	Definition
Wage	Real hourly wage in logarithmic form.
University education	Schooling dummy: 1 for receiving university education and zero otherwise.
Work experience	Age-years of education-6 as the proxy for work experience. As males in Taiwan have to attend military service for two years, an additional two years will be further subtracted for the male sample. In some cases, we further separate work experience as tenure (work experience in current job) plus general work experience (experience before current job).
Sex	Gender dummy: 1 for male and zero for female.
Marital status	Dummy variable: zero for not married and 1 for others.
Industry	Industry dummies: The eight industries include agriculture, forestry, fishery, and husbandry; manufacturing; water, electricity, and coal; construction; wholesale, retail, and restaurant; transportation, storage, and communication; financial, insurance, and real estate; personal and public services; with wholesale, retailer, and restaurant as the reference group.
Firm size	Firm size dummies: firm size is classified by the number of employees, 1-9 persons, 10-49 persons, 50-99 persons, 100-499 persons, above 500 persons, and work in the public sector, with 1-9 persons as the reference group.

Table 2. Basic statistics of the variables

	1990		2000	
Variable name	Mean	S.D.	Mean	S.D.
Wage	4.684	0.441	4.995	0.506
University education	0.060	0.238	0.125	0.331
Tenure	3.548	4.172	4.299	4.728
Work experience	6.087	5.703	6.565	6.069
Sex	0.663	0.473	0.690	0.463
Marital status	0.318	0.466	0.354	0.478
Industry				
Agriculture	0.046	0.210	0.035	0.184

Manufacturing	0.381	0.486	0.295	0.456
Water, electricity, and coal	0.005	0.072	0.002	0.044
Construction	0.105	0.307	0.121	0.326
Wholesale, retail, and, restaurant	0.183	0.387	0.227	0.419
Transport, storage, and communication	0.059	0.235	0.049	0.215
Finance, insurance, and real estate	0.054	0.227	0.041	0.198
Personal and Public services	0.167	0.373	0.155	0.362
Firm size				
1-9 persons	0.439	0.496	0.448	0.497
10-49 persons	0.258	0.438	0.273	0.445
50-99 persons	0.073	0.261	0.065	0.247
100-499 persons	0.105	0.307	0.096	0.295
Above 500 persons	0.037	0.189	0.046	0.208
Public sector	0.087	0.281	0.072	0.259
Samples	7193		7626	

Source: Taiwan Manpower Utilization Survey, 1990 and 2000.

4. Estimation results

For comparison, we first estimate the rates of return to university education for 1990 and 2000, respectively, by using the conventional OLS and IV methods. The results are shown in Table 3. As expected, the Durbin-Wu-Hausman test suggests that the education variable is endogenous and thus the estimated return to education by OLS will be biased and inconsistent. If the education variable is not exogenous, Griliches (1977) proposes the use of the instrumental variable method to tackle the

problems of ability bias and endogeneity. The use of instrumental variables to estimate return to education requires that instrumental variables satisfy the instrument relevance and instrument exogeneity conditions; i.e., the instrumental variable should be correlated with one's educational choice, but uncorrelated with one's wage rate.[37]

From a policy perspective, the implementation of a compulsory educational policy significantly enhances the structure of labor quality of the developing countries, especially for those groups that are subject to family liquidity constraints. Compulsory educational policy is an institutional change which includes building of new junior high schools and recruiting new educational staff and teachers, and thus it is closely related to an individual's educational investment.[38] As educational resources are different among different residential areas, they thus have different impacts on individual's educational achievement.[39] Moreover, given family budget constraints, the greater the number of siblings there are, the smaller the educational resources that are available to each child. We therefore use the nine-year compulsory education policy, residential area, and the number of siblings as instrumental variables for

[37] See, for example, Heckman and Vytlacil (1999) and Blundell et al. (2003) for detailed discussion on this point.

[38] Numerous studies have shown that a compulsory educational policy has a significant effect on return to education, see, e.g., Angrist and Krueger (1991); Cruz and Moreira (2005); and Sakellariou (2006), among others.

[39] For example, Duflo (2001) chooses personal residential area as an instrument, since the educational resources may be different among regions under different policies. Moretti (2004) uses demographic structure in the city and land-grant university as instrumental variables to estimate the spillover effect of education and social rate of return to education.

educational choice, as they will be correlated with an individual's educational achievement but have no correlation with an individual's ability or wage.

For the validity of the IV method, the relevant tests include using the partial coefficient of determination or F-test to test the explanatory power and sign of the instrumental variable on the endogenous education variable at the first step of regression. As for the exogeneity test, to ensure that the selected instruments have no relationship with the unobserved error term, the over-identifying restrictions test is used as the orthogonality condition for all the instruments. The results in Table 3 show that the instrumental variables we choose satisfy both the instrument relevance and instrument exogeneity conditions.[40]

The estimated wage premiums for university education for OLS and IV methods are 39.27% and 82.14% (corresponding to average annual rate of return at 9.82% and 20.54%) in 1990 and 33.33% and 69.12%（corresponding to average annual rate of return at 8.33% and 17.28%）in 2000. Annual rates of return to tenure for the two methods are 4.02% and 3.83% in 1999 and 4.59% and 4.46% in 2000, while those to previous work experience are 1.12% and 0.85% in 1990 and 1.24% and 0.99% in

[40] We also conducted separate tests for each instrument; they all satisfied the required conditions for a valid instrument. However, we find that the inclusion of further IVs will increase the explanatory power for education achievement at the first stage; moreover, the inclusion of all three variables provides the minimum mean square error (MSE) for the estimation of rate of return to education at the second stage wage regression. It means that the combination of the three IVs is the most effective valid instrument. We thus adopt the nine-year compulsory education policy, residential area, and the number of siblings as our instrumental variables.

2000. The results in Table 3 show that the estimated rate of return to university education is higher, about double, in the IV method than in the OLS; moreover, the rate of return is higher in 1990 than in 2000. The decline in the rate of return may reflect the large expansion of university education, which has increased the supply of college graduates since 1990.[41] As for other explanatory variables, marital status, industry, and firm size all significantly affect the worker's wage. In general, workers who are married, work in construction, transportation, storage, communication, finance, insurance, or real estate, and work in large enterprises, tend to receive high wages. These results are consistent with the literature.

Table 3. Rate of return to education—OLS and IV methods

	1990		2000	
	OLS	IV	OLS	IV
University education	0.3927***	0.8214***	0.3333***	0.6912***
	(22.20)	(18.25)	(21.66)	(15.38)
Tenure	0.0402***	0.0383***	0.0459***	0.0446***
	(17.03)	(15.21)	(17.98)	(15.35)
(Tenure)^2	-0.0015***	-0.0015***	-0.0013***	-0.0013***
	(-15.27)	(-14.75)	(-11.70)	(-9.32)
Work experience	0.0112***	0.0085***	0.0124***	0.0099***
	(5.68)	(2.80)	(5.66)	(4.42)
(Work experience)^2	-0.0003***	-0.0002***	-0.0004***	-0.0003***

[41] Due to government policy on expanding higher education facilities, the number of colleges and universities in Taiwan has increased from 46 in 1990 to 127 in 2000. As a result, the enrollment rate of colleges and universities has increased tremendously, climbing from about 40% in 1990 to 57.7% in 2000, implying easy access to college and university education. It should be mentioned that in 2007, the college and university enrollment rate had soared to nearly 100%.

	(-4.23)	(-2.92)	(-4.30)	(-3.28)
Sex	0.2870***	0.2837***	0.1778***	0.1689***
	(27.40)	(26.75)	(14.87)	(13.88)
Marital Status	0.1047***	0.1215***	0.1064***	0.1058***
	(9.12)	(10.50)	(8.16)	(7.99)
Industry				
Agriculture	-0.3989***	-0.3595***	-0.4828***	-0.4667***
	(-15.99)	(-14.18)	(-14.99)	(-14.27)
Manufacturing	-0.0819***	-0.0736***	-0.0533***	-0.0546***
	(-6.26)	(-5.55)	(-3.85)	(-3.87)
Water, electricity, and coal	0.1094	0.1030	-0.0172	-0.0473
	(1.41)	(1.31)	(-0.12)	(-0.33)
Construction	0.0904***	0.1152***	0.1080***	0.1216***
	(5.32)	(6.68)	(6.05)	(6.69)
Transport, storage, and communication	0.0418**	0.0379*	0.0550**	0.0443*
	(2.02)	(1.81)	(2.32)	(1.84)
Finance, insurance, and real estate	0.1119***	0.1257***	0.0480*	0.0631**
	(5.38)	(5.99)	(1.94)	(2.51)
Personal and public services	-0.0657***	-0.0456***	-0.0004	0.0252
	(-4.26)	(-2.93)	(-0.03)	(1.61)
Firm size				
10-49 persons	0.0733***	0.0738***	0.0817***	0.0891***
	(6.51)	(6.48)	(6.48)	(6.96)
50-99 persons	0.0784***	0.0935***	0.1242***	0.1529***
	(4.38)	(5.18)	(5.88)	(7.16)
100-499 persons	0.0982***	0.1096***	0.1635***	0.1925***
	(6.23)	(6.89)	(8.82)	(10.28)
500+ persons	0.1230***	0.1188***	0.1744***	0.2093***
	(5.25)	(5.01)	(6.89)	(8.180)
Public sector	0.1922***	0.2090***	0.2115***	0.2814***
	(10.80)	(11.65)	(9.92)	(13.31)
Constant	4.2783***	4.2605***	4.5538***	4.5380***
	(295.00)	(287.98)	(292.63)	(281.90)
Validity test of instruments for				

education				
F-test		81.24***		66.49***
Over-identifying restrictions test		3.12 [0.2101]		2.79 [0.2478]
Durbin-Wu-Hausman (DWH) endogeneity test	-6.22***		-7.45***	
Observations	7193	7193	7626	7626
Adj-R^2	0.3316	0.3174	0.2332	0.2105

Notes: 1. Figures in the parentheses and square bracket are t-statistics and p-value, respectively; and *, **, and *** stand for statistical significance levels at 90%, 95%, 99%, respectively.

2. Reference groups: wholesale, retail, and restaurant for industry; 1-9 persons for firm size.

3. Instrumental variables for education include nine-year compulsory educational policy, urban and rural regions, and number of siblings.

4. The F-test is for the instrument relevance condition (the significance of coefficients of all the instrumental variables). A rule of thumb is that F statistics should be greater than 10 and any values below 10 imply that the selected instrumental variables have insignificant explanatory power and thus generate estimation bias.

5. The Null hypothesis of over-identifying restrictions test is that all the including instrumental variables are jointly exogenous.

6. The Null hypothesis of the Durbin-Wu-Hausman test is that the potential endogeneity of the variable does not bias the estimated coefficients.

Under heterogeneous human capital, figures 1 and 2 show estimated marginal treatment effects for 1990 and 2000. The marginal treatment effect measures the average price that an individual is willing to pay for university education under given personal characteristics and unobserved heterogeneity. From figures 1 and 2, MTE declines as individual's unobservable heterogeneity (Us) increases, but at a decreasing rate. Suppose that individuals choose to have university education according to

equation (7). Results in figures 1 and 2 imply those who are likely to have university education (with smaller Us) are willing to pay a higher price, i.e., higher MTE; while those who are less likely to have university education (with greater Us) tend to pay a lower price, i.e., smaller MTE. In other words, those who receive university education tend to have a higher marginal rate of return to education. Thus, the selection process of schooling undertaken is based on the principle of comparative advantage.[42] Those who are suitable for university education choose to enter university, and those who are better suited to solely having a high school education choose not to enter university and instead go into the labor market after graduating from high school. This phenomenon is consistent with the saying that "Every trade has its master." For example, if individuals who acquire more schooling become lawyers and those who do not become cooks, then the former are better lawyers than the average cooks would be if they became lawyers; the latter are better cooks than the average lawyers would be if they became cooks. Hence, the policy implication derived from the analysis supports the education system that separates vocational and technical education from the general educational track, as not all people are suitable to receive a college or university education.

[42] See also Willis and Rosen (1979) for the similar results of selection according to comparative advantage.

Comparing the estimated MTE in 1990 and 2000 from Figures 1 and 2, we find that though the shape looks the same, MTE is greater in 1990 than in 2000, implying that for equal probability of entering university, the marginal rate of return to university education is higher in 1990 than in 2000. It should be reasonable to infer that easy access to colleges and universities under the college expansion policy in the 1990s and the increased supply of college and university graduates caused the decline in marginal return to education.

The estimation results from the Taiwan study firmly support the theory of heterogeneous human capital and hence heterogeneous return to education. Unobserved heterogeneity (Us) determines heterogeneous MTE and hence heterogeneous marginal rate of return to education, and the declining trend of MTE curve justifies the selection on the unobservable heterogeneity.[43] Therefore, the estimated results from the conventional OLS and IV methods do not consider the unobserved heterogeneity among individuals and thus fail to correctly infer the "true" rate of return to education.

[43] We perform test on MTE function to see if it is statistically different from zero by log linear regression analysis. The result does show that the estimated slope is significant different from zero with values -1.499 and -0.928 for 1990 and 2000. Therefore the MTE is not flat but downward sloping.

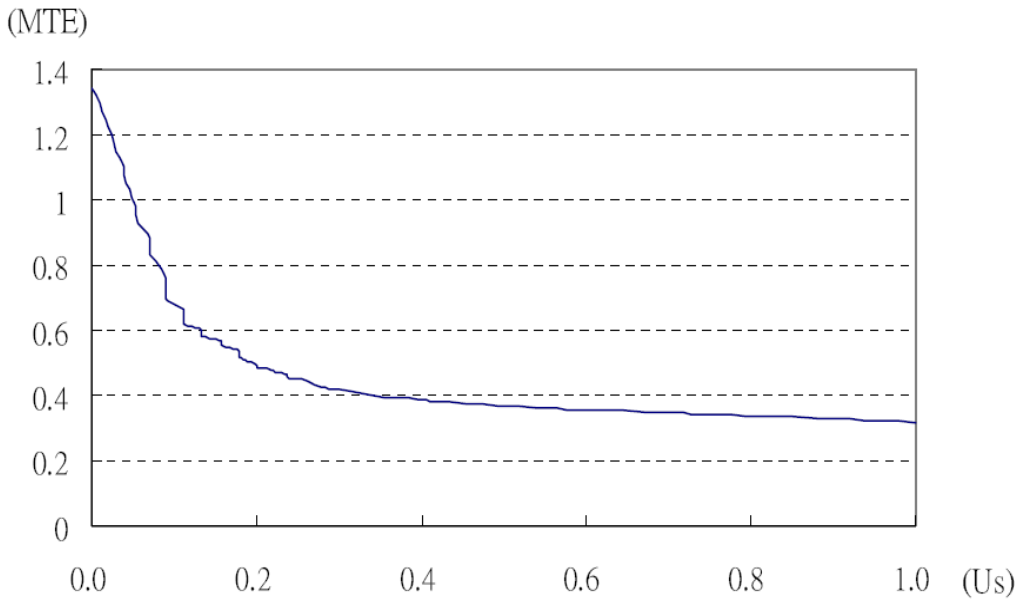

Figure 1. The estimated marginal treatment effect (MTE) for 1990

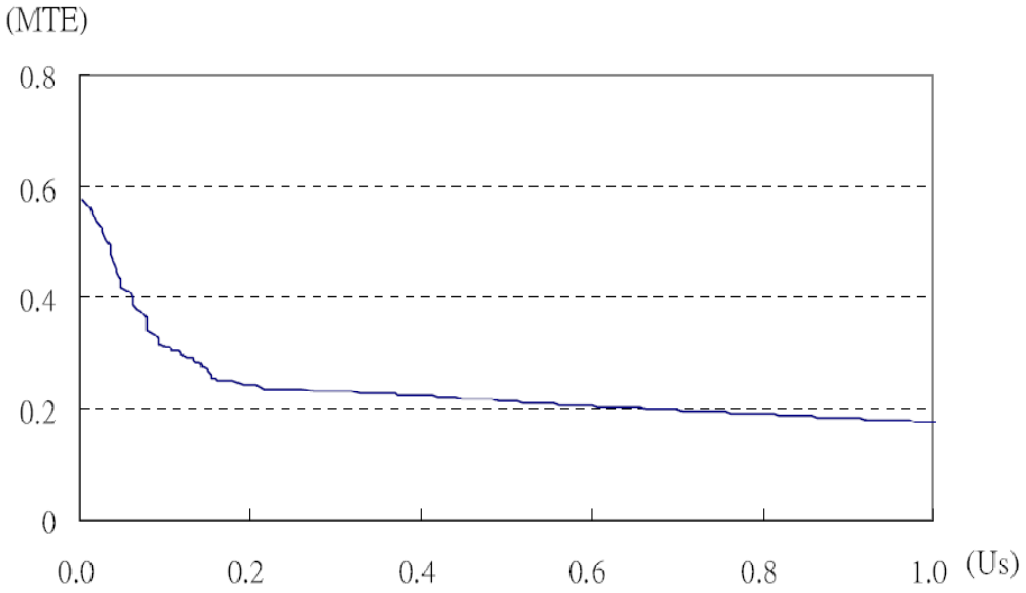

Figure 2. The estimated marginal treatment effect (MTE) for 2000

The estimation bias can be further calculated. Table 4 lists various estimated policy effects for 1990 and 2000. The average treatment effect (ATE) is 45.99% for 1990, implying that given individual personal characteristics, the average annual rate

of return for four years university education is 11.5%. Using the conventional OLS method, the estimated coefficient is 39.27% (9.82% annually), implying an underestimation for OLS; while the estimated value for the IV method is 82.14% (20.54% annually), implying an overestimation for the IV method.[44] Comparing the estimation results, we have $\beta_{IV} > ATE > \beta_{OLS}$ for 1990 and $\beta_{IV} > \beta_{OLS} > ATE$ for 2000, and in all cases, the estimated coefficients are always larger in 1990 than in 2000. The difference between estimates is attributed to selection bias and sorting gain.

The treatment effect on the treated (TT) is 77.45% (19.36% annually) in 1990, implying that the annual wage for those who have university education is 19.36% higher than what they will get provided that they do not enter university and go to labor market after graduating from high school. The treatment effect of the untreated (TUT) is 64.7% (16.18% annually), implying that for those who do not go to university, their annual wage would be 16.18% higher if they did enter university after graduating from high school. Comparing the results of TT and TUT in Table 4, we again find that the selection process works according to the principle of comparative advantage, for the wage premium for those who receive university education is indeed higher than for those who receive high school education but instead choose to enter university. Thus, under self-selection, those who receive

[44] Depending on the choice of instruments, the estimation results of the IV method may likely represent the rate of return to schooling for a specific group, i.e., a local average treatment effect. See, for example, the discussion in Griliches (1977) and Card (2001).

university education are indeed more suitable to enter university, as their rate of return to education is higher than those who do not enter university.

The treatment effects on the treated and on the untreated are 59.87% and 47.14% (14.97% and 11.79% annually), respectively, in 2000. Similar implications are for the selection but smaller in estimated value than that in 1990, implying a declining trend of rate of return to education in the 1990s. However, on average, the difference between TT and TUT remains stable, at about 3.2 percentage points annually.

Table 4. Comparison of estimated coefficients for different methods

	Estimated value (1990)	Estimated value (2000)
OLS	0.3927 (0.0982)	0.3333 (0.0833)
IV	0.8214 (0.2054)	0.6912 (0.1728)
ATE	0.4599 (0.1150)	0.2655 (0.0664)
TT	0.7745 (0.1936)	0.5987 (0.1497)
TUT	0.6470 (0.1618)	0.4714 (0.1179)
Bias	-0.0672 (-0.0168)	0.0678 (0.0170)
Selection bias	-0.3818 (-0.0955)	-0.2654 (-0.0664)
Sorting gain	0.3146 (0.0786)	0.3332 (0.0833)

Notes: 1. Figures in the parentheses are the annual rate of return.

2. Selection bias = OLS – TT.
3. Sorting gain = TT – ATE.
4. Bias = OLS – ATE = selection bias + sorting gain.

The discrepancy between the estimated rate of return to education by OLS and average treatment effect is the bias caused by selection bias and sorting gain. From Figure 4, selection bias is significantly negative, 38.18% (9.55% annually), in 1990, implying sorting on the unobservable heterogeneity, and the selection process is significant in Taiwan. The sorting gain is 31.46% (7.86% annually) in 1990, implying that the rate of return to university education is much higher than the average treatment effect, i.e., average rate of return to university education ($\overline{\beta}$). These results reconfirm the sorting on the heterogeneous attributes according to the principle of comparative advantage in making the individual's educational decision. Comparing the results from 1990 and 2000, we find that selection bias tends to decline while sorting gain tends to increase, though at a moderate scale, in the 1990s. The persistent magnitude of sizable sorting gain in both 1990 and 2000 confirms the existence of essential heterogeneity among individuals.

In sum, due to selection bias and sorting gain, the estimated rate of return to education by the conventional OLS and IV methods are subject to bias, though the

bias is not sizable, at around 1.7 percentage points, because of the offsetting consequence by selection and sorting.

We further conduct a numerical analysis to estimate the heterogeneous returns to education in Taiwan in 1990 and 2000.[45] The results are shown in Figures 3 and 4. We find the expected rates of return to education in 1990 and 2000 are a random variable that follows certain distribution, representing the distribution of underlying heterogeneity in human capital. The expected rate of return to education in 2000 is skewed to the left and less dispersed than that in 1990.

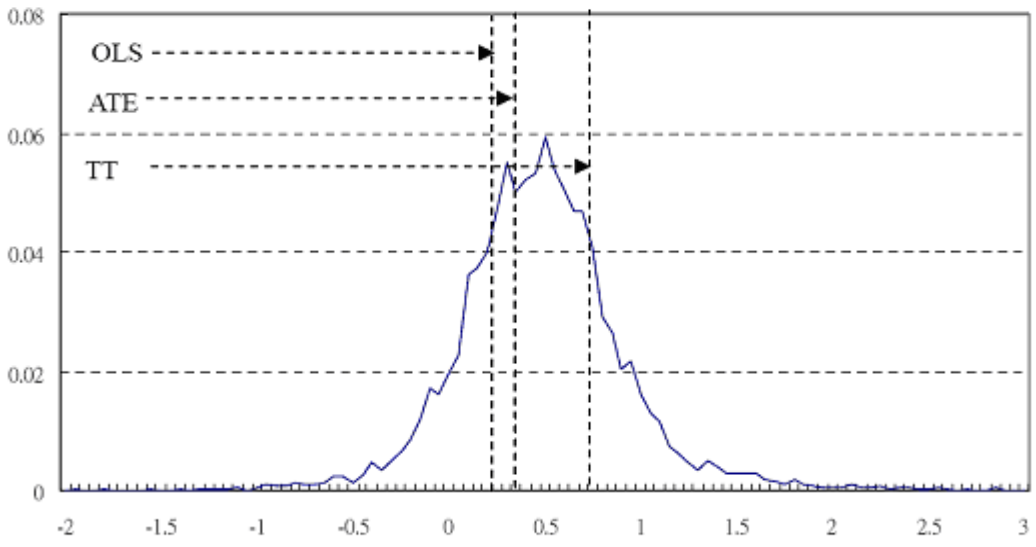

Figure 3. The distribution of the expected rate of return to education, 1990

[45] Applying equation (5), the estimated returns to education is calculated by $\hat{\beta}_i = (\hat{\gamma}_1 - \hat{\gamma}_0)X_i + (\hat{U}_{1i} - \hat{U}_{0i})$, where $\hat{U}_{ji} = lnY_{ji} - ln\hat{Y}_{ji}, j = 0,1$.

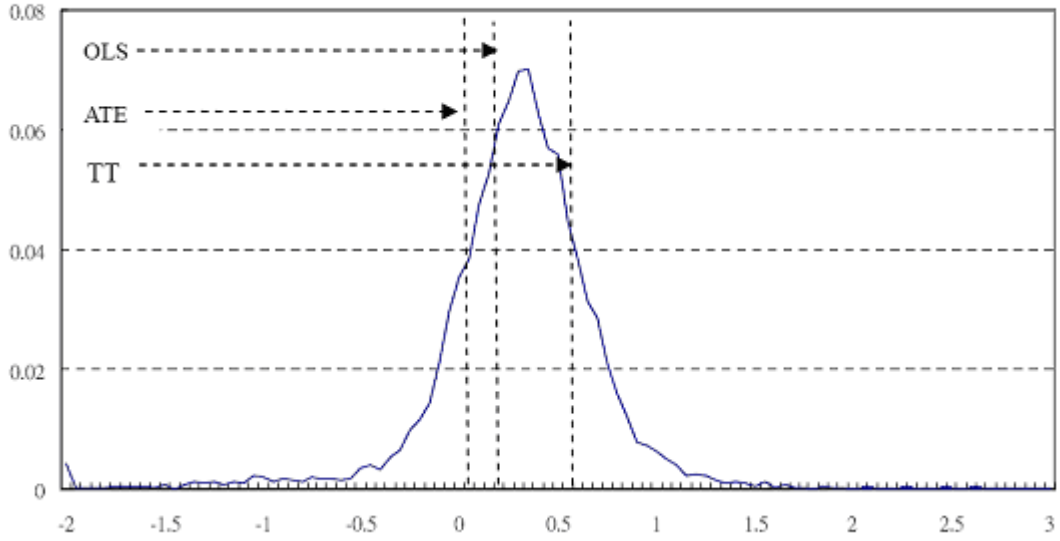

Figure 4. The distribution of the expected rate of return to education, 2000

5. Concluding remarks

Due to heterogeneity in human capital, the individual will self select his or her educational attainment. In this situation, sorting and selection on unobserved heterogeneity results in a bias estimator for rate of return to education using the conventional OLS and IV methods. The OLS tends to underestimate, while the IV method tends to overestimate. By considering heterogeneity in an individual's abilities and self selection in education, this paper estimates the rate of return to university education in Taiwan using Manpower Utilization survey data for 1990 and 2000.

Estimation results show that without considering an individual's heterogeneity in abilities and selection in educational choice, the OLS and IV methods will generate bias and inconsistent estimators for the effect of treatment on the treated. The estimated marginal treatment effect confirms the heterogeneous human capital hypothesis, that there is a heterogeneous rate of return to education among individuals. The declining trend of the MTE curve further justifies the self selection on unobserved heterogeneity according to the principle of comparative advantage, that those who attain university are more willing to pay a higher price for schooling and hence tend to obtain a higher return on education.

The estimated average annual rates of return to university education are 11.5% and 6.64% in 1990 and 2000, respectively, higher than the coefficients estimated by OLS. However, for those who receive university education, their marginal rates of return to education are 19% and 15% for 1990 and 2000, respectively, higher than the average rate of return. Moreover, the expected rates of return to education in 1990 and 2000 are a random variable that follows certain distribution. These results are all consistent with the theory of self selection on unobserved heterogeneous abilities. As for the declining trend of rate of return to university education, it may be caused by the rapid expansion of colleges and universities and the increasing supply of college graduates in the 1990s.

Thus, major implications of our findings are that as heterogeneity creates sorting gain among individuals, the finding of very significant and persistent sorting gains for those who choose to have university supports the heterogeneous human capital hypothesis. Moreover, the estimated average treatment effect will significantly different from the effect of treatment on the treated, i.e., the average rate of return to education will be significantly less than the rate of return to those choose to have university. However, the implementation of college expansion policy in the 1990s tends to reduce the average rate of return to education over time, and at the mean time the magnitude of selection bias will also decline too as more and more high school graduates start to enter the university under college expansion policy. As a result, the the bias between the estimated effect by OLS and the effect of treatment on treated will shrink.

References

Angrist, J. D. and A. B. Krueger (1991), "Does Compulsory Schooling Attendance Affect Schooling and Earning?" Quarterly Journal of Economics, 106(4), 979-1014.

Arias, O., K. F. Hallock and W. Sosa-Escudero (2001), "Individual Heterogeneity in the Returns to Schooling: Instrumental Variables Quantile Regression Using Twins Data," Empirical Economics, 26(1), 7-40.

Ashenfelter, O. and A. B. Krueger (1994), "Estimates of the Economic return to Schooling from a New Sample of Twins," American Economic Review 84(5), 1157-1173.

Bjorklund, A. and R. Moffitt (1987), "The Estimation of Wage Gains and Welfare Gains in Self-Selection Model?" Review of Economics and Statistics, 69, 42-49.

Bronars, S. G. and G. S. Oettinger (2006), "Estimates of the Return to Schooling and Ability: Evidence from Sibling Data," Labour Economics, 13(1), 19-34.

Card, D. (1999), "The Causal Effect of Education on Earnings," In Ashenfelter, O. and D. Card, (eds) Handbook of Labor Economics, Volume 3A, Amsterdam: Elsevier.

Card, D. (2001), "Estimating the Return to Schooling: Progress on Some Persistent Econometric Problems," Econometrica, 69(5), 1127-1160.

Carneiro, P. and J. Heckman (2002), "The Evidence on Credit Constraints in Post-Secondary Schooling," Economic Journal, 112, 705-734.

Carneiro, P., J. Heckman and E. Vytlacil (2001), "Estimating the Return to Education When It Varies Among Individuals," Working Paper, University of Chicago.

Clark, J. B. (1899), The Distribution of Wealth, New York: Macmillan.

Cruz, L. M. and M. J. Moreira (2005), "On the Validity of Econometric Techniques with Weak Instruments: Inference on Returns to Education Using Compulsory School Attendance Laws," Journal of Human Resources, 40 (2), 393–410.

Duflo, E. (2001), "Schooling and Labor Market Consequences of Schooling in Indonesia: Evidence from an Unusual Policy Experiment," American Economic Review, 91(4), 795-813.

Griliches, Z. (1977), "Estimating the Return to Schooling: Some Econometric Problems," Econometrica, 45(1), 1-22.

Heckman, J. (1997), "Instrumental Variables: A Study of Implicit Behavioral Assumptions Used in Making Program Evaluations," Journal of Human Resources, 32(3), 441-462.

Heckman, J. and E. Vytlacil (1999), "Local Instrumental Variable and Latent Variable Models for Identifying and Bounding Treatment Effects," Preceedings of the National Academy of Sciences, 96, 4730-4734.

Heckman, J. and E. Vytlacil (2000), "Local Instrumental Variables," in C. Hsiao, K. Morimune, and J. Powells, (eds), Nonlinear Statistical Modeling: Proceedings of the Thirteenth International Symposium in Economic Theory and Econometrics: Essays in Honor of Takeshi Amemiya, Cambridge: Cambridge University Press, 1-46.

Heckman, J. and S. Navarro-Lozano (2004), "Using Matching, Instrumental Variables and Control Functions to Estimate Economic Choice Models," Review of Economics and Statistics, 86(1), 30-57.

Heckman, J. and X. Li (2004), "Selection Bias, Comparative Advantage and Heterogeneous Return to Education," *Pacific Economic Review*, 9(3), 155-171.

Heckman, J. S. Urzua, and E. Vytlacil (2006), "Understanding Instrumental Variables in Models with Essential Heterogeneity," Review of Economics and Statistics, 88(3), 389-432.

Mincer, J. (1974), Schooling Experience and Earning, New York: Columbia University Press.

Moretti, E. (2004), "Estimating the Social Return to Higher Education: Evidence from Longitudinal and Repeated Cross-Sectional Data," Journal of Econometrics, 121(1-2), 175-212.

Patrinos, H. and C. Sakellariou (2005), "Schooling and Labor Market Impacts of a Natural Policy Experiment," Labour, 19(4), 705-719.

Roy, A. (1951), "Some Thoughts on the Distribution of Earnings," Oxford Economic Papers, 31, 831-880.

Sakellariou C. (2006), "Education Policy Reform, Local Average Treatment Effect and Returns to Schooling from Instrumental Variables in the Philippines," Applied Economics, 38, 473-481.

Stigler, G. (1941), Production and Distribution Theories, New York: Macmillan.

Stock, J. H. and M. W. Watson (2007), Introduction to Econometrics, 2nd ed., Boston: Person Education.

Trostel P., I. Walker and P. Woolley (2002), "Estimates of the Economic Return to Schooling for 28 Countries," Labour Economics, 9(1), 1-16**.**

Willis, R. (1986), "Wage Determinants: A Survey and Reinterpretation of Human Capital Earnings Function," In Ashenfelter, O. and D. Card, (eds) Handbook of Labor Economics, Amsterdam: North-Holland.

Willis, R. and S. Rosen (1979), "Education and Self-Selection," Journal of Political Economy, 87(5), S7-S36.

不同世代下之教育報酬與能力差異

摘要

本文採用 1978 年至 2004 年的行政院主計處「人力運用調查」原始資料將時間序列的橫斷面資料(time series of cross section data)，整理出依不同世代(cohort)區分的世代資料，再以能夠體現個人特質之異質性的分量迴歸(quantile regression)模型，依據不同年群資料分析不同工資條件分配下的邊際教育報酬率。估計結果支持個人能力的異質性將反應在工資分配上，因此傳統以 OLS 模型估計的平均教育報酬率並不適當，且個人能力的異質性在較年輕世代中最為明顯。本文亦發現在較年長的世代，教育投資對個人能力呈現強化效果(strengthened effect)，即接受教育的結果能強化個人的能力；而較年輕的世代，教育對個人能力則呈現彌補效果(supplementary effect)，即教育可補個人能力之不足，且愈年輕的世代，其教育對個人能力的彌補性也愈強。本研究的重要政策意涵為教育與能力可能是強化亦可能是彌補關係，端視教育的內涵與產業對人才需求的特質而定，且經由教育可創造出更多元化與具異質性內涵的社會。

關鍵字：個人能力異質性、世代效果、教育報酬、強化效果、彌補效果

一、 前言

過去國內外文獻中對工資函數的研究與描述，一直是勞動經濟學的主要議題之一。而工資的重要決定因素即為教育。正如人力資本理論所強調的，透過教育的投資可以累積個人之人力資本、提高技術水準、增進生產力，進而使工資水準得到提升。而經由教育程度之提昇對於個人經濟報酬的影響效果，即為教育報酬率(return to education)。教育的投資報酬率不僅左右個人的就學意願，亦影響社會勞動力的品質，也是政府教育政策之成本效益分析的重要依據，因此教育報酬率的高低對個人和社會的人力資本投資決策影響至為深遠。

以往國內外對工資函數的估計與教育報酬率的研究中，大多採用年度橫斷面(cross section)資料並以傳統的最小平方 (OLS)法估計之。然而根據最小平方法模型的基本假設與定義，傳統 OLS 估計法所估計的乃是被解釋變數(工資)的條件平均數，其估計結果所得之參數所代表的是「平均」的解釋變數(如教育、經驗年數等)對被解釋變數(工資)的影響，並無法解釋於工資之條件分配(conditional distribution)中可能出現的因個人非可觀測之特質的異質性(heterogeneity)所造成之教育報酬率的差異。除此之外，若以台灣地區之年度橫斷面資料來估計教育的邊際報酬率，更強烈地假設此橫斷面資料的樣本均具有相同的年齡所得面相(age-earning profile)，如此不但忽略特定環境下的年群效果(cohort effect)，致使估計結果令人感到懷疑；且於現今台灣地區所展現之經濟快速成長，社會快速變遷的狀況下，不同年群的個體亦將因教育體制的不同或產業結構的快速轉變而造成之勞動需求的變動，使其教育投資的邊際報酬率亦不盡相同，故使用橫斷面資料的估計結果將易產生偏誤及不一致性。

本文一方面透過將時間序列的橫斷面資料(time series of cross section data)重新整理出依不同年群(cohort)區分的年群資料，避免上述因採用橫

斷面資料進行估計時所可能產生之估計結果的偏誤及不一致性問題。另一方面，有別於傳統 OLS 模型僅能估計「平均」的教育邊際報酬率，本文另以 Koenker and Bassett (1978)所提出的分量迴歸(quantile regression, QR)模型，依不同年群資料分析不同工資條件分配下的邊際教育報酬率，如此不但能擴大教育分析的觀察維度(dimension)，體現個人能力的異質性。且經由比較 QR 模型與傳統 OLS 模型的估計結果，除了能夠提供更完整的人力資本投資的內涵，亦可得出更具經濟意義的新發現和解釋。

本文共分成五節，第一節為前言，主要闡述研究動機與目的。第二節為文獻回顧。第三節理論模型，說明 QR 模型的理論依據。第四節資料分析與實證結果，說明年群的區分方式與台灣地區的實證結果。第五節為結論。

二、 文獻回顧

在過去研究勞動經濟學的文獻中，許多國內外學者皆相當重視對於工資函數的描述，經由這些文獻對工資函數的分析我們可以觀察勞工的教育或經驗如何影響工資水準，從而掌握工資變異的成因以做為教育與人力政策的依據。以往國外的文獻中對教育報酬率與工資函數的估計已有長久且完整的發展，如 Willis (1986)整合早期有關之文獻的回顧，而 Card (1999)也提供了相當完整的文獻比較及說明。而以國內資料為對象探討教育報酬率的研究文獻中，較具代表性的研究如 Psacharopoulos (1985)、Gindling, Goldfarb and Chang (1995)、Chuang and Chao (2001)、符碧真(1996)與吳慧瑛(2002)等。雖然因國內外實證研究的資料來源不同而造成估計的結果有些許差異，但在選擇以傳統最小平方法估計 Mincer 人力資本模型(Mincer, 1974)時，大致上皆可得到教育的報酬率為正且隨教育程度的提升而增加，與經驗報酬率為正且經驗平方的報酬率為負之結論。

然而，在工資函數描述與個人教育報酬率估計的國內外實證文獻中，現有的研究大多是建立在以傳統 OLS 模型為基礎的估計方法上。然眾所周知，傳統的 OLS 模型所估計的係數所代表乃是「平均」概念的教育報酬率，亦即係數所代表為每多受一年的教育對平均薪資的影響效果，無法呈現工資的條件分配中可能出現的教育報酬率異質性。事實上，傳統 OLS 模型雖然可以估計教育投資報酬率的平均概念，但卻無法對於工資分配與教育或經驗報酬率之間的關係給予完整地描述。因為受限於傳統 OLS 的計量方法，自 1990 年代開始，許多國內外學者開始採用 Koenker and Bassett (1978)的 QR 模型來估計工資函數(如 Buchinsky (1998)、Machado and Mata (2001)、Hartog et al. (2001)及陳建良與管中閔(2006)等)。有別於傳統 OLS 模型的估計方法，QR 模型延伸解釋被解釋變數(工資)之條件分配中各不同分量的行為，且 QR 模型的估計係數則進一步描述解釋變數(如教育年數與經驗年數)對不同被解釋變數分量的影響程度。因此以 QR 模型估計工資函數，將得以呈現教育或經驗的報酬率在不同工資水準下的異質性。

隨著 QR 在實證經濟學上的應用逐漸受到重視，文獻上採用 QR 模型進行的研究亦廣泛擴展許多與人力資本相關的主題，以 QR 模型針對人力資本投資報酬率的研究中，Mwabu and Schultz (1996)研究發現南非的教育投資報酬率隨著人種與所得高低分配而不同，並以此推論放寬黑人接受高等教育的機會對工資結構的可能影響；Eide and Showalter (1998)研究美國學校品質與學生表現亦發現公立學校的品質高低對學生的表現有不同程度的效果；而 Hartog et al. (2001)則比較葡萄牙在 1980 年代與 1990 年代初期教育報酬率的發展過程，結果顯示教育報酬率對不同工資的勞工有不同影響，並可由此推論在 1980 年代期間，葡萄牙工資差距的擴大，教育報酬率實扮演重要的影響因素。這些工資分配區間教育報酬率的研究，都是有別於傳統 OLS 模型所能觀察到的新面向。

除了以 QR 模型來估計工資函數及教育報酬率，得以完整描述教育與工作經驗對工資不同分量下的影響效果之外，以往國內外實證研究文獻於估計教育報酬率時所採取的資料，多利用單一年度之橫斷面資料來進行估計，若研究長期教育報酬率的時間變化時，則通常選擇以連續或不連續的多年期資料，並依據所設定的模型對每一年的資料進行估計，最後再進行跨年度的比較分析。然而這樣的做法並無法窺得所欲探討之經濟問題的全貌，依據鄭保志(2004a, 2004b)的觀點，若以年度橫斷面資料進行分析時，不同年度之橫斷面資料所估計的教育報酬率，所代表的意義為單一年度不同生命週期階段的勞動者之平均教育報酬率，在進行跨年度比較分析時，由於勞動市場之勞動者進出、人口結構與景氣波動等因素的影響，其比較基礎會有所變動，而使估計結果受到質疑。

事實上，若以年度橫斷面資料估計教育投資的報酬率時，其背後隱含此橫斷面的樣本均具有相同的年齡所得面相的強烈假設，因此估計係數並無法完整表現出人力資本投資上所可能發生之「質」的變化，[46]亦忽略年群差異所可能產生的效果，將無法有效的掌握所欲衡量之教育報酬的概念。國內外文獻中對人力資本投資與年群因素的研究，主要集中在探討工資不均度的影響因素(如 Juhn et al. (1993)、Jappelli (1999)、Card and Lemieux (2001)及鄭保志(2004a, 2004b)等)，較少見諸於探討教育報酬率的文獻中。本文將採取類似張宏基與朱敬一(1996)、吳慧瑛(1996)與黃台心(2000)等對年群區分的觀點，將同一世代年群出生的樣本視為一代表性個人於工作生命週期(life cycle)之行為，依據此觀點，本文選擇以 1978-2004 年行政院「人

[46] 舉例來說，在單一年度橫斷面資料中，於 1930 世代出生與 1940 世代出生之同樣擁有大學學歷的勞動者，兩者所面對的大學教育在品質上必有所差異（如所使用的教科書，教學硬體及軟體的更新等），但以年度橫斷面資料進行教育報酬率的係數估計時，卻將兩者所接受之大學教育視爲相同。

力運用調查」資料，將之區分為不同世代年群（1920 年代出生至 1970 年代出生者），並以 QR 模型估計不同世代的教育報酬率。[47]

三、 理論背景與實證模型

考慮一個對數工資函數表示為

$$\ln W_i = X_i\beta + \varepsilon_i \quad i = 1,2,...,n \tag{1}$$

其中 $\ln W_i$ 為樣本 i 之平均時薪的自然對數值，X_i 為解釋變數向量（如教育年數、現職前經驗、在職年資等），ε_i 為殘差項。傳統 OLS 模型是以解釋變數 X 的線性模型求取殘差項平方和的最小值，說明教育年數與工作經驗如何影響實質工資 $\ln W_i$ 的平均期望值的行為，若最小平方估計值為 $\hat{\beta}$，則估計的模型 $X_i\hat{\beta}$ 為 $\ln W_i$ 之條件逼近，即 OLS 模型的最適解就是被解釋變數的平均值。但是，如果被解釋變數的累積機率分配不是常態的，亦即此隨機變數的分配型態偏向尾端或是有極端值存在時，則 OLS 估計式對這些在尾端的樣本資料行為的估計將會產生誤差。

針對 OLS 模型的限制，Koenker and Bassett (1978)首先提出 QR 模型。[48] 相對於傳統 OLS 模型乃以被解釋變數的平均值為基準的估計，QR 模型則可以任意選擇被解釋變數的分配區間上任何一個特定位置為基準進行估計，進而描繪出被解釋變數的條件機率分配如何受到解釋變數分配變化的影響。考慮被解釋變數分量所在位置的區位模型，在分量迴歸的架構下，(1)式可表示為

[47] 年群可以單年、五年或十年分類，爲考量有效樣本數，本文採十年分類，惟經比較其估計結果發現與單年或五年分類所得之結果頗爲相近。

[48] 有關分量迴歸模型的詳細說明亦可參閱 Buchinsky (1994, 1998)、Garcia et al. (2001)、Machado and Mata (2001)等。

$$\ln W_i = X_i \beta_\theta + \varepsilon_{i\theta} \quad i = 1,2,...,n \tag{2}$$

其中 β_θ 為參數向量，$\varepsilon_{i\theta}$ 為對應的殘差項，$0 < \theta < 1$ 代表特定的機率值。若 $\hat{\beta}_\theta$ 為 QR 係數估計式，則 $X_i \hat{\beta}_\theta$ 為 $\ln W_i$ 的第 θ 個條件分量(conditional quantile)的逼近。

相較於 OLS 以被解釋變數的平均值為估計基準，在研究變數彼此關係時，只能觀測變數與變數之間交互影響的平均趨勢，而忽略了變數在其他分配位置的行為，可能無法完整描述變數間的關係，這個問題尤其在變異數不齊一(heterogeneous variance)的情況下更為明顯。Koenker and Hallock (2001)與 Koenker (2005)認為如果變異數的異質性與應變數的分配之間呈某種特殊關係，則自變數影響應變數的邊際效果在整個分配區間將不是固定常數，此時以平均趨勢來刻畫整個分配的行為也就不完整。[49]

傳統 OLS 模型的估計係數 $\hat{\beta}$ 與 QR 模型的估計係數 $\hat{\beta}_\theta$ 代表工資函數中特性變數在兩種估計方法下的報酬率，其中 $\hat{\beta}$ 是特性變數對工資「平均」而言的影響，而 $\hat{\beta}_\theta$ 則可能隨工資的分量的變化而改變。當工資的條件分配為異質時，QR 所估計的報酬率通常和最小平方法所估計者不同，尤其在左右兩尾下的報酬率更可能出現相當大的差異。由於 QR 的估計係數會隨 θ 改變而有所不同，我們可據此觀察在不同工資下之教育報酬率進而推究其個別報酬率的異質性。除此之外，我們亦可進一步觀測人力資本投資與能力之間是否存在強化(strengthened)或彌補(supplementary)關係，以正確描繪出教育投資在不同世代年群所產生的效果。這些都是傳統以 OLS 法估計的工資模型所無法提供的觀察面向。

[49] 有關分量迴歸模型的詳細說明及估計求解方法可參閱陳建良與管中閔(2006)。

四、 資料分析與實證結果

資料分析

本文採用 1978 年至 2004 年的行政院主計處「人力運用調查」原始資料，因為人力運用調查的資料是針對十五歲以上，不包括武裝勞動力與監管人口，自由從事經濟活動之民間人口，並登錄其個人的年齡、性別、教育程度、從業身分，行職業等人口、家庭、社會與經濟背景資料，所以在選擇資料方面，我們參考國內外文獻的做法，選擇公私部門受雇人員，排除失業者(每週工時不足 15 小時者)、雇主、自營作業者及無酬家屬工作者的樣本。

另外，本文將同一段年分出生的人視為同一個世代。舉例來說若出生年份為 1920 年至 1929 年，則將之表示為 1920 世代出生的人，以 1920s 標記之。因此 1920 世代出生的人，於 1978 年度的橫斷面資料上為 48 歲至 57 歲者、於 1979 年度的橫斷面資料為 49 歲至 58 歲者…2004 年度為 74 歲至 83 歲者。以此類推，我們可將 1978 年度至 2004 年度的所有橫斷面資料區分為 1920s 至 1970s 六個不同的世代，[50]若我們將每一個世代中的樣本點，視為代表性的個人，[51]則每一世代中的樣本點，將可視為此代表性個人在勞動市場上生命週期中所能觀測到的樣本點。例如，1920s 的樣本點為 1920 世代出生的代表性個人 48 歲至 65 歲之生命週期的樣本點，而 1930s、1940s、1950s、1960s 與 1970s 分別以相同的方式推估之。表 1 為區分不同世代及不同性別後，變數的基本統計資料。

表 1、變數基本資料分析

[50] 1920s 之前與 1970s 之後的資料，由於資料的樣本數太少，迴歸估計的結果均不顯著，在實證上並不具太大意義，故將之省略。

[51] 國內外的文獻上對世代（年群）問題的處理上，Deaton and Paxson (1994)與鄭保志(2004a)將同一年群的每一個樣本點，視爲同一群人，而張宏基與朱敬一(1996)、吳慧瑛(1996)與黃台心(2000)則進一步將之視爲一個代表性個人。

	全體樣本					
	1920s	1930s	1940s	1950s	1960s	1970s
實質月薪	17233,59	21744.00	27529.28	28823.14	27054.85	26790.78
	(14713.77)	(21588.49)	(26576.14)	(23773.17)	(20534.37)	(12567.29)
教育年數	6.29	6.39	7.97	9.96	11.15	12.20
	(4.67)	(4.05)	(4.08)	(3.58)	(2.79)	(2.34)
潛在工作經驗年數	42.89	37.56	28.95	18.30	10.30	5.40
	(8.20)	(8.89)	(9.74)	(9.20)	(6.88)	(3.87)
現職前經驗年數	24.40	21.17	17.45	11.27	6.15	2.85
	(14.18)	(12.68)	(10.61)	(8.37)	(5.69)	(3.14)
在職年資年數	18.49	16.39	11.49	7.03	4.15	2.55
	(13.86)	(12.09)	(9.25)	(6.34)	(4.07)	(2.30)
教育層級比例						
不識字與自修	0.2540	0.1810	0.0826	0.0108	0.0007	0
國小	0.4376	0.5631	0.5112	0.3240	0.0917	0.0159
國中	0.1104	0.0920	0.1236	0.1825	0.3067	0.2047
高中	0.0646	0.0423	0.0614	0.0925	0.0940	0.0964
高職	0.0401	0.0522	0.0969	0.1968	0.2960	0.3676
專科	0.0387	0.0337	0.0545	0.1050	0.1251	0.1955
大學	0.0547	0.0357	0.0697	0.0885	0.0858	0.1200
樣本數	31634	78677	118234	213946	202499	88541
	男性樣本					
實質月薪	18021.48	23379.69	30555.40	32422.21	31709.92	29565.72
	(14950.98)	22108.63	(29136.39)	(25869.85)	(23194.08)	(13438.27)
教育年數	6.73	6.82	8.40	10.12	11.20	11.94
	(4.52)	3.91	(3.85)	(3.45)	(2.71)	(2.39)
潛在工作經驗年數	42.69	37.38	28.50	17.89	10.63	5.41
	(6.84)	7.71	(8.93)	(8.62)	(6.55)	(3.81)
現職前經驗年數	23.70	19.96	16.22	10.46	6.15	2.82
	(13.71)	12.01	(9.74)	(7.55)	(5.29)	(3.05)
在職年資年數	18.98	17.42	12.27	7.42	4.47	2.59
	(13.91)	12.12	(9.38)	(6.47)	(4.27)	(2.36)
教育層級比例						
不識字與自修	0.2038	0.1338	0.0438	0.0036	0.0002	0

國小	0.4633	0.5870	0.5168	0.3039	0.0671	0.0156
國中	0.1213	0.0981	0.1354	0.2029	0.3475	0.2582
高中	0.0682	0.0458	0.0677	0.1014	0.0952	0.0988
高職	0.0440	0.0602	0.1056	0.1912	0.2772	0.3498
專科	0.0402	0.0337	0.0529	0.1086	0.1286	0.1737
大學	0.0592	0.0415	0.0779	0.0885	0.0842	0.1039
樣本數	27546	63242	86828	145121	117228	45550
	女性樣本					
實質月薪	11924.61	15042.04	19162.98	21234.34	20655.18	23850.67
	(11693.82)	(17806.77)	(14718.69)	(16149.23)	(13821.17)	(10823.05)
教育年數	3.35	4.63	6.78	9.63	11.10	12.47
	(4.56)	(4.16)	(4.46)	(3.81)	(2.88)	(2.25)
潛在工作經驗年數	44.31	38.29	30.19	19.17	9.86	5.40
	(14.23)	(12.62)	(11.59)	(10.28)	(7.27)	(3.94)
現職前經驗年數	29.14	26.11	20.86	12.97	6.15	2.88
	(16.20)	(14.09)	(12.06)	(9.65)	(6.21)	(3.24)
在職年資年數	15.18	12.18	9.33	6.20	3.71	2.52
	(13.01)	(10.99)	(8.50)	(5.96)	(3.75)	(2.24)
教育層級比例						
不識字與自修	0.5922	0.3743	0.1900	0.0260	0.0013	0
國小	0.2649	0.4654	0.4956	0.3664	0.1254	0.0161
國中	0.0364	0.0674	0.0912	0.1394	0.2506	0.1480
高中	0.0401	0.0280	0.0441	0.0736	0.0923	0.0938
高職	0.0139	0.0193	0.0731	0.2087	0.3220	0.3865
專科	0.0284	0.0338	0.0587	0.0975	0.1204	0.2185
大學	0.0240	0.0119	0.0472	0.0884	0.0880	0.1370
樣本數	4088	15435	31406	68825	85271	42991

資料來源：行政院主計處「人力運用調查」1978-2004 年原始資料。

括號內數字為標準差。

由表 1 的結果發現，平均實質月薪以 1950 世代出生者最高為 28,823 元，而以 1920 世代出生者最低僅 17,234 元，其中男性樣本的實質月薪均高於女性樣本。在教育年數方面，愈年輕的世代，其教育年數愈大，1920

世代出生的樣本，其教育年數僅 6.29 年，而 1970 世代出生的樣本，其教育年數則為 12.2 年；除此之外，愈年輕的世代，受高等教育（專科與大學以上者）的比例也相對愈高，例如 1920 世代出生的樣本，受高等教育者僅占 9.3%，而 1970 世代出生的樣本，受高等教育的比例則超過 30%。且男性樣本的教育年數與受高等教育的比例亦高於女性樣本。至於個人的經驗年數，則與樣本進入職場的長短相關，[52]故較年長世代樣本的經驗年數將高於較年輕世代的樣本，1920 世代出生的樣本，其平均經驗年數為 42.89 年（其中現職前經驗年數與在職年資年數分別為 24.4 年與 18.49 年），而 1970 世代出生的樣本，其平均經驗年數僅 5.4 年（其中現職前經驗年數與在職年資年數分別為 2.85 年與 2.55 年）。除此之外，由各世代的男女樣本數亦可看出，在較年長的世代中，勞動市場的組成以男性占主要比例，而在較年輕的世代中，男女在勞動市場所占的比例幾無差異。

估計結果

1、勞動參與的選擇

在工資函數的估計中，Heckman (1979)認為勞動參與率的「樣本選擇性」(sample selection)是一個重要的問題。因為只有參與勞動市場者才能觀測到其工資，當估計工資函數時，如果忽略勞動供給的「選擇性」，直接選擇有工資的樣本來估計，可能會帶來人力資本變數的報酬率估計偏誤。因此，針對樣本選擇性的問題，標準 Heckman 兩階段選擇模型，第一階段先估計勞動參與機率，經由選擇的機率計算其 inverse Mill's ratio，再加入

[52] 本文的工作經驗所指爲潛在工作經驗，乃由下列方式推算而出：就女性而言，工作經驗=年齡-教育年數-6；就男性而言，工作經驗=年齡-教育年數-8，這是因爲絕大多數的男性至少必須服役 2 年，而工作經驗包括在職年資與現職前經驗，其中在職年資可直接由原始資料中取得，而現職前經驗=工作經驗-在職年資。由於以往女性的教育年數相對較低，依照上述方式所推算的女性潛在工作經驗將高於男性。

第二階段工資函數的 OLS 或 QR 的估計模型中，第一階段的勞動參與機率的估計式為

$$z_i^* = w_i\gamma + u_i \tag{3}$$

且 $$z_i = \begin{cases} 1 & if\ z_i^* > 0 \\ 0 & if\ z_i^* \le 0 \end{cases} \tag{4}$$

其中 w_i 為影響選擇工作與否的個人或家庭背景因素，個人因素包括性別(男性為 1，女性為 0)、年齡與教育年數，而家庭因素則包括有無子女(有子女為 1，沒有子女為 0)、[53]居住地為城市或鄉村(城市為 1，鄉村為 0)等，[54]

則(2)式 Mincer 工資方程式將改寫為

$$\ln W_i = \begin{cases} x_i\beta + \varepsilon_i & if\ z_i^* > 0 \\ - & if\ z_i^* \le 0 \end{cases} \tag{5}$$

因此，(6)式的條件期望值可表示為

$$E(\ln W_i | W_i\ is\ observed) = E(\ln W_i | z_i^* > 0)$$

$$= E(x_i\beta + \varepsilon_i | w_i\gamma + u_i > 0)$$

$$= x_i\beta + E(\varepsilon_i | w_i\gamma + u_i > 0)$$

$$= x_i\beta + \beta_\lambda\lambda_i \tag{6}$$

[53] 由於「人力運用調查」對子女的問項僅限於有偶婦女，因此本文將「人力運用調查」原始資料還原爲家計單位，並以此判斷男性是否有子女。

[54] 城市與鄉村的區分乃根據經濟建設委員會都市及住宅發展處所發表之「都市及區域發展統計彙編」的分類標準，並按照內政部戶政司發佈的資料區分之。

其中 λ_i 即為 inverse Mill's ratio。另依據 Buchinsky (1998)的建議，本文在考慮勞動參與選擇性的校正之後，在 QR 模型中同時加入一階和二階的 inverse Mill's ratio。[55]

除此之外，在以全體樣本估計教育報酬率時，因考慮到也會受到選擇工作與否的影響，故就全體樣本也進行第一階段選擇工作與否的估計，[56]但因考量男、女有別，故加入性別與婚姻的交乘項以及性別與子女的交乘項，來控制男女在已、未婚以及男女在有、無子女的情況下對勞動參與的可能不同影響。

表 2、選擇工作與否-Probit 模型

	1920s	1930s	1940s	1950s	1960s	1970s
教育年數	0.0128***	0.0169***	0.0290***	0.0313***	-0.0523***	-0.1316***
	(0.0013)	(0.0010)	(0.0009)	(0.0008)	(0.0009)	(0.0015)
年齡	-0.1039***	-0.0718***	-0.0393***	0.0100***	0.0747***	0.1955***
	(0.0014)	(0.0006)	(0.0004)	(0.0004)	(0.0005)	(0.0009)
子女	-0.4346***	-0.3827***	-0.3764***	-0.3053***	-0.2457***	-0.1224***
	(0.0201)	(0.0120)	(0.0099)	(0.0085)	(0.0123)	(0.0224)
城鄉	-0.2179***	-0.2361***	-0.0982***	0.2439***	0.5654***	0.6551***
	(0.0122)	(0.0085)	(0.0081)	(0.0067)	(0.0061)	(0.0087)
性別	0.4260***	0.4975***	0.2975***	0.0330***	-0.1161***	-0.1846***
	(0.0914)	(0.0635)	(0.0377)	(0.0124)	(0.0065)	(0.0075)
婚姻	-0.4597***	-0.3937***	-0.3826***	-0.6786***	-0.6502***	-0.6105***
	(0.0906)	(0.0597)	(0.0323)	(0.0129)	(0.0127)	(0.0212)
性別*婚姻	1.0142***	1.0245***	1.1365***	1.5185***	1.3920***	1.1266***
	(0.0930)	(0.0644)	(0.0392)	(0.0157)	(0.0156)	(0.0284)
性別*子女	0.5505***	0.3393***	0.4017***	0.5799***	0.5661***	0.4194***

[55] 若同時加入一階與二階之 inverse Mill's ratio，則二階之 inverse Mill's ratio 的估計結果並不顯著，因此本文在 QR 模型之處理上與 OLS 模型一致，僅加入一階之 inverse Mill's ratio。

[56] 一般在兩階段選擇模型上通常是男性與女性樣本分別估計，在本文後段以 OLS 及分量迴歸進行估計時，亦均將男性與女性樣本分別以選擇模型進行校正估計。

	(0.0335)	(0.0217)	(0.0294)	(0.0312)	(0.0289)	(0.0217)
截距項	5.7826***	3.7794***	1.9633***	-0.0946***	-1.2028***	-3.0220***
	(0.1228)	(0.0682)	(0.0379)	(0.0170)	(0.0141)	(0.0223)
Pseudo R^2	0.2962	0.3346	0.3039	0.2635	0.2137	0.2873
樣本數	68438	144558	184728	304577	319976	181998

註：子女、城鄉、性別及婚姻為虛擬變數，有子女為 1，沒有為 0；城市為 1，鄉村為 0；男性為 1，女性為 0；已婚為 1，未婚為 0。

城市與鄉村的區分乃根據經濟建設委員會都市及住宅發展處所發表之「都市及區域發展統計彙編」的分類標準，並按照內政部戶政司發佈的資料區分之。

括號內數字為標準差。

第一階段 6 個不同世代之勞動參與估計結果如表 2 所示。由表 2 結果可以發現教育年數在年長世代對勞動參與有正向效果，但在年輕世代(1960 與 1970 世代)則呈現負向效果，推測可能原因是在年輕世代中，由於高等教育普及，有許多人尚在就學階段(如研究所與博士班)，使教育年數對勞動參與呈現負向效果，特別在愈年輕的世代，如 1970 世代，教育年數的負向效果更高於 1960 世代；而年齡對勞動參與的影響，年長世代為負，而年輕世代為正，這是因為年長世代樣本年齡相對較大，因此隨著年紀愈大，該世代勞動者愈有可能因為屆齡退休而退出職場，反之在年輕世代中由於樣本年齡相對較小，因此隨著年紀的增口，該世代勞動者對進入職場的壓力也愈大。

在子女方面，男性或女性有無子女對勞動者進入職場的影響有所不同，以 1920 世代為例，女性無子女為基準，有子女的女性估計參數為-0.4346，顯示有子女的女性勞動者，通常會為了照顧子女而選擇退出職場，但有子女的男性勞動者其估計參數為 0.5419(=0.5505-0.4346+0.4260), 表示有子女

的男性，會因為有子女而必須積極進入職場工作以負擔子女的教養費用。[57]

另外，若居住地為城市，在年長的世代中(1920、1930 與 1940 世代)對勞動參與的影響呈現負向效果，且此負向效果隨世代呈遞減現象；而在年輕世代中(1950、1960 與 1970 世代)，對勞動參與的影響則呈現正向效果，且此正向效果隨世代年輕化有遞增的現象。可能的原因是較早期世代中居住在城市的人，通常經濟狀況較鄉村優渥，對就業與否的壓力相對較小，而居住在鄉村的人，可能因為家庭生計或經濟壓力而必須進入職場以貼補家用。而較年輕的世代，由於城鄉差異擴大，都市的工作機會遠高於鄉村的工作機會，因此居住城市對勞動參與的影響轉變為正向效果，且效果隨世代而遞增。

在性別與婚姻方面，由表 2 第 1 欄的 1920 世代出生之勞動者為例，若以未婚女性為基準，未婚男性的估計參數為 0.4260，顯示同樣在未婚的狀態下，1920 世代之男性相對女性有就業的壓力，對勞動參與有正向影響；已婚女性估計參數為-0.4346，顯示同樣為女性勞動者，已婚婦女通常會選擇退出職場成為家庭主婦，因此對勞動參與呈負向影響；而已婚男性之估計參數為 1.0926(=1.1012+0.4260-0.4346)，顯示較年長的世代受傳統「男主外、女主內」的觀念所影響，已婚男性必須負擔家庭生計，對就業的壓力更甚於未婚男性，因此必須積極進入職場，對勞動參與的正向影響較未婚男性為高。

除此之外，值得注意的是，由表 2 發現相對於未婚女性而言，年長世代未婚男性對勞動參與的影響為正，但年輕世代(1960 及 1970 世代)之未婚

[57]有關子女變數定義因有子女、有未成年子女，和有年幼子女，對於男性和女性的勞動參與的效果，可能都有不同的效果，我們另依此不同子女變數定義估計，惟其結果並不影響第二階段的估計結果，因此非本文主題且限於篇幅有興趣讀者可另行向作者索取。感謝一位匿名評審對不同子女變數定義的寶貴意見。

男性對勞動參與的影響則為負，可能的原因是由於國內教育普及與經濟因素的改變，使就業市場已漸泯除性別限制，[58]年輕世代女性在職場的表現與貢獻，再加上兩性平權意識的抬頭，亦促使性別歧視的偏見逐步消失，[59]愈年輕世代的未婚女性，對進入職場就業以養活自己的情況甚至高於未婚男性。

2、傳統 OLS 模型基準估計

教育的規模與結構乃為影響勞動力市場供給的重要因素，因為按所受之不同教育程度能養成不同的勞動技能和不同的勞動生產力，從而提供不同技術層級的勞動供給。而不同世代的勞動力，更由於所面對之不同的勞動市場需求，因而影響不同世代的教育報酬。

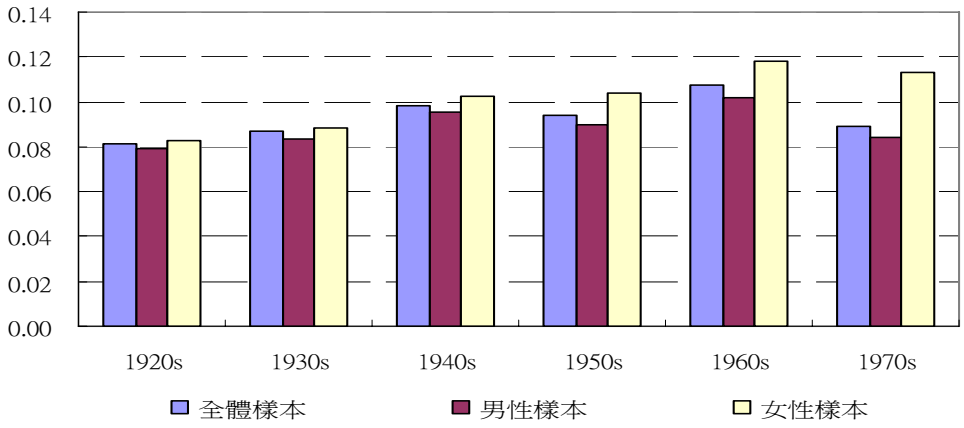

圖 1、不同年群下教育報酬率

[58] 由行政院主計處之「人力運用調查」原始資料發現，台灣地區年輕世代未婚男、女之勞動參與率，1960 年代分別爲 59.1%及 59.3%，而 1970 年代則分別爲 44.8%與 45.6%顯示年輕世代未婚女性的勞動參與率均高於未婚男性。

[59] 根據行政院主計處公布資料顯示，台灣地區從事白領工作的女性，自 2004 年起已經超過男性，告別了過去女性主要擔任藍領工作的生產程序工和人事服務的時代，而取得在職場上與男性平等競爭的地位。女性白領階級的人數近年來持續攀升，2006 年已達 218 萬人，占全部白領階級就業人數的 50.5%，已高於男性。

為避免選擇性估計偏誤，我們將前述 probit 模型計算出來的 inverse Mill's ratio 代入後續的 OLS 與 QR 模型迴歸分析中，圖 1 為經選擇性調整後以傳統 OLS 估計法對不同世代(1920s 至 1970s)的資料所估計的教育報酬率，由圖 1 我們可以發現不同世代（由年長至年輕世代）的教育報酬率乃呈現先上升而後下降的趨勢，即相對上較年長世代的人其教育報酬率較年輕世代的人為低，其中以 1920 世代出生之樣本教育報酬率最低為 8.12% ，而以 1960 世代出生之樣本報酬率最高為 10.76% ，但 1970 世代出生的勞動者，其教育報酬率反而呈現下降的趨勢。這個結果可由勞動供需兩方面來看，在勞動需求面上，隨著經濟發展與產業結構的轉變，勞動需求由早期的勞力密集型的產業所需要的低技術勞工偏向資本和技術密集型生產所需的之高技術勞工，[60]對具有中、高教育水準的年輕世代的勞動需求較高；而在勞動供給面上，年輕世代之高技術勞工供給雖然也較年長世代為高。但當勞動需求增加高於勞動供給增加，將使年輕世代的報酬率相對較年長世代為高。[61]至於 1960 世代之後的勞動力，由於這些年輕世代的勞動者(特別是 1970 世代)，因教育的普及和高等教育的擴充，其所接受之教育規模和教育水準均提高，將使受較高等教育程度的勞動供給相對較為充足，因此，雖然是較年輕的世代，但所表現出的教育報酬率卻呈現微幅減少的狀況。

若區分不同性別，如圖 1 所示，不同世代的男女教育報酬率亦呈相同的世代年群趨勢形態，惟女性的教育報酬率均高於男性的教育報酬率。這

[60] 根據主計處公布之各年度就業者人數的的資料顯示，受雇用的勞工者教育程度的百分比，1978 年低、中、高教育程度者分別占 77.79%、16.71%與 8.51%，至 2000 年時，該比例分別轉變爲 37.09%、35.56%與 27.35%，顯示我國產業結構對低技術勞工需求在持續下降，而中、高技術勞工需求則持續上升。

[61] 根據主計處「人力運用調查資料」，1960 世代之高技術勞工其雇用量由 1990 年的 48.6 萬人的提高至 2000 年的 87 萬人，而實質薪資則由 1990 年的 27983.82 元增加至 2000 年的 46907.09 元，1960 世代者的勞動雇用量與薪資均同時上漲，表示在勞動需求與勞動供給同時增加時，勞動需求增加幅度大於勞動供給的增加。

樣的結果也與一般國內外的文獻的結果相同。[62]其可能的原因可由勞動市場的供需來看：在勞動供給方面，傳統台灣家庭普遍存在「重男輕女」且家中的女兒易受到家庭財務信用限制而放棄入學，[63]造成女性的教育成就偏低，因此勞動市場上女性高教育程度者之勞動供給遠小於低教育程度者；在勞動需求方面，因為女性勞工可能因結婚或養育小孩而退出勞動市場，造成技能的養成不易，市場對女性勞動需求較低，尤其是低技能女性勞工，致使低技能之女性勞工薪資偏低[64]。若果將造成高、低技能女性勞工之薪資差異擴大，故相對提高女性的教育報酬率。惟此一推論仍需要進一步實證檢測。

圖 2 表示在區分不同教育水準下，不同世代下的教育報酬率，[65]由圖 2a 的結果發現，台灣地區的教育報酬率不論在那一個世代，教育報酬率均呈現遞增的現象，其中又以大學程度之教育報酬率最高，而以國小教育程度之教育報酬率最低。這種遞增的教育報酬率可能來自需求面，經濟發展產業結構轉變造成廠商對高技能勞工的需求明顯增加，因而使學歷愈高的勞動者，其教育報酬也愈高。

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[62] 以往的研究如符碧真(1996)、吳慧瑛(2003)及 Torstel, Walker and Woolley(2002)等，均發現女性的教育報酬率均高於男性。

[63] Parish and Willis (1993)使用 1989 年內政部、台灣大學與美國芝加哥大學合作之「台灣地區婦女生活狀況調查」的資料，探討家庭中出生排序、兄弟姊妹、性別、組成人數等因素對個人教育成就的影響，他們發現由於家庭預算限制，較早出生的女兒，常必須犧牲自己的婚姻與受教育機會，提早離家結婚或工作，以減輕家中負擔，將家中資源留給弟妹使用，因此個人的教育成就相對較低。其他如陳建良(2002)、Chu, Tsay and Yu (2005)、Chu, Xie and Yu (2005)與莊奕琦和賴偉文(2008)等以「華人家庭動態調查資料庫」(PSFD)的資料也得到與 Parish and Willis (1993)相同的結果。

[64] 類似推論參見如 Mincer and Polachek (1974) and Polachek (1981)。

[65] 本文以傳統 OLS 模型估計不同世代下不同教育層級的教育報酬率，乃以不識字與自修爲參考組(reference group)，定義國小、國中、高中、高職、專科及大學以上 6 個虛擬變數，並估計其薪資溢酬，再由薪資溢酬計算教育報酬率，如國小程度之教育報酬率=國小薪資溢酬/國小教育年數，而國中程度之教育報酬率=(國中薪資溢酬-國小薪資溢酬)/(國中教育年數-國小教育年數)，其他以此類推。

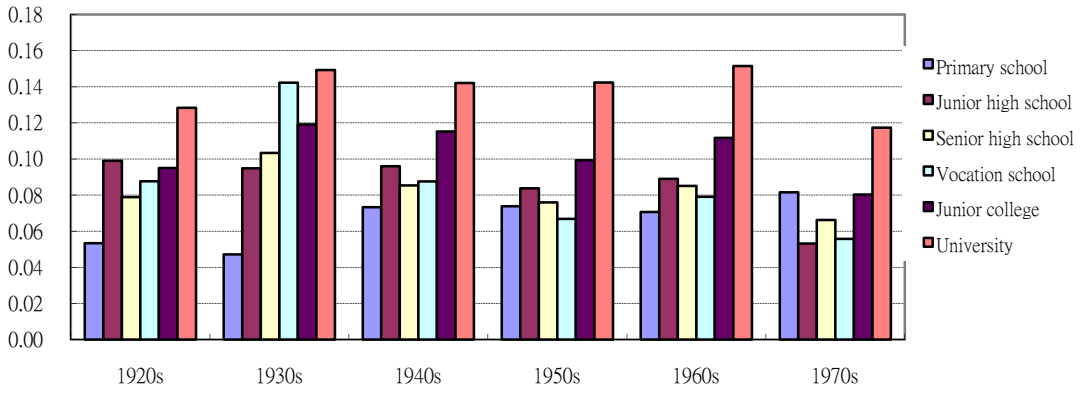


圖 2a、不同教育層級下之教育報酬率(全體樣本)

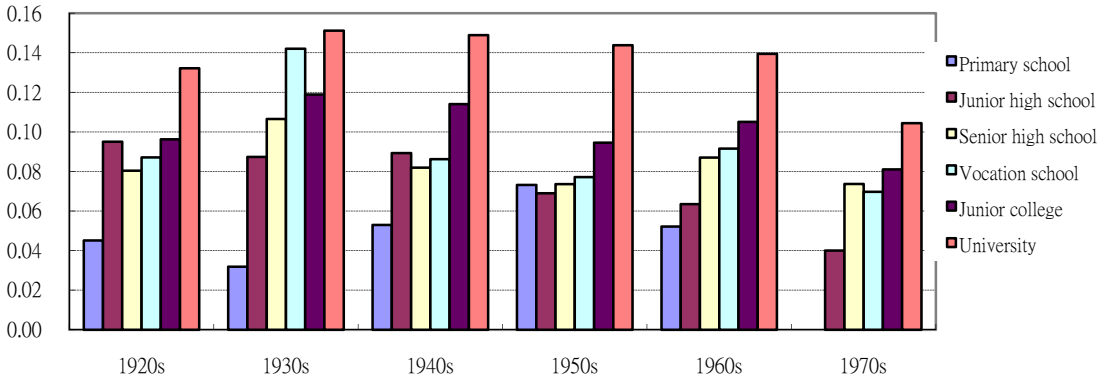


圖 2b、不同教育層級下之教育報酬率(男性樣本)

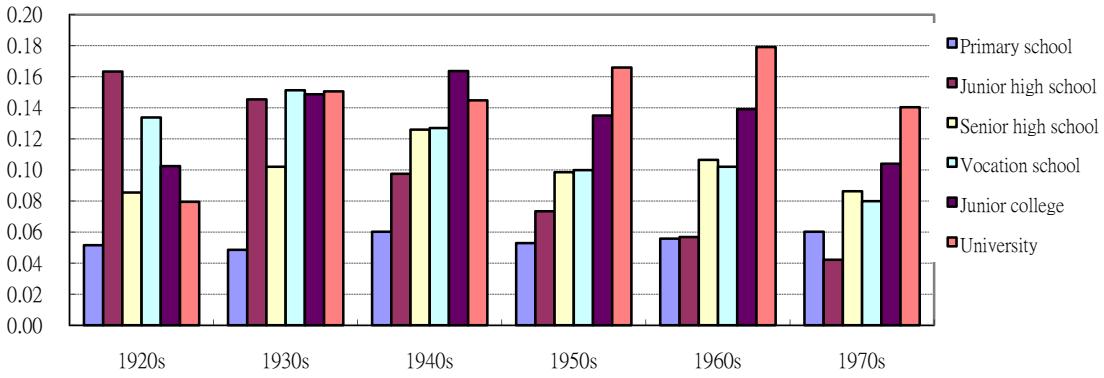


圖 2c、不同教育層級下之教育報酬率(女性樣本)

由圖 2a 的結果也可以發現，在經濟發展的過程中，台灣地區勞動市場對不同教育程度之勞動力的需求程度亦有所不同。舉例來說，在 1930 世代出生的勞動者，當其開始進入職場時正值台灣地區由農業轉型為初級工業時，根據主計處公布的資料顯示，台灣地區自 1961 年至 1980 年止，工業產值佔 GDP 的比例，由 23.03%增加至 39.16%，而此時期正為 1930 世代出生者進入職場之時，快速工業化的初期對技職體系（如高職與專科）出身的勞動力需求自然較高。而由勞動供給面來看，1930 世代出生者，技職教育程度的比例僅占 6.01%，而 1940 世代以後出生者為技職體系出身的比例均在 14%以上，因而造成 1930 世代技職體系出身者之教育報酬率相對較高；對 1960 世代出生的勞動者而言，其進入職場時恰為 1980 年代產業轉型為高科技工業時期，根據主計處公布資料顯示，自 1990 年至 2004 年止，高科技產業(如電腦、電子零組件及精密、光學等製造業)產值佔 GDP 的比例，由 7.47%增加至 12.42%，而此時期對具大學教育程度之高技能勞動需求自然較高。而就勞動供給而言，大學程度者所占比例，1960 世代出生者僅 8.73% ，相較 1970 世代出生者之 13.28%為低。因此 1960 世代大學程度者的教育報酬率相對也較高。

值得注意的是，由圖 2 的結果我們發現在年輕世代中國小教育程度的教育報酬率較年長世代國小教育程度的教育報酬率高，尤其是 1970 世代出生的工作者，其教育報酬率甚至高於中等教育程度之工作者的報酬率，主要的原因，可能由於年輕世代的工作者，因基礎教育的普及，使國小教育程度之勞動者的供給大幅減少，[66]雖然因為經濟發展使該教育程度勞動力的需求也減少，但仍需要維持一定數量的低技能工作者，供給減少的程

[66] 民國五十七年政府實行九年國民義務教育，強制入學方案使國小畢業之教育程度的勞動力供給大幅減少，而減少的部分轉變爲其他較高教育程度的勞動力的增加，其中國小教育程度的勞動力供給減少的幅度，由 1950 世代的 32.4%下降至 1960 世代的 9.17%，到 1970 世代時則僅占 1.59% (詳見本文表 1)。

度遠大於需求減少的程度，因而使國小程度的教育報酬率高於其他教育程度的報酬率。

除此之外，就教育分流的目的而言，高中教育以預備升大學為其目的，而高職教育則以準備就業為目的。因此，由直覺上來看，高職程度的勞動者在就業市場上應較高中程度勞動者有優勢，其教育報酬率也應較高，但由圖 2a 的結果來看，卻發現雖然在較年長的世代中高職程度的報酬率的確高於高中的報酬率，但年輕世代的教育報酬率，卻沒有這樣的現象。這是因為自 1970 至 1980 年間，產業生產結構傾向技術密集產業為主，勞動市場對高技能勞工的需求持續增加，不論就讀高中或高職，學生在畢業後選擇繼續升學的比例皆明顯上揚，特別是 1970 世代出生的工作者，其大專程度以上工作者比例較 1960 世代提高 10%。表示學生雖分流為高中、高職，但莫不希望能繼續升學來提升自己的能力，另一方面，高中與高職畢業生繼續受教育的機會大增，[67]高職程度者投入職場相較於高中程度者並無太大優勢，[68]因而造成高職教育的教育報酬率並不見得比高中教育來得高。[69]但就男性樣本而言，1960 世代以前的各世代高職教育的報酬率仍然略高於高中教育的報酬率。

若區分不同性別下，不同世代之不同教育程度之報酬率如圖 2b 與圖 2c 所示，發現男性勞動者的教育報酬率的形態和全體勞動者的教育報酬率的形態大致相同，而女性勞動者的教育報酬率形態則明顯有所差異，尤其

[67] 自 1980 年代開始，政府亦強調技職教育養成，故先後成立技術學院與科技大學，自 1985 至 2004 年的二十年間，台灣地區大學校院數量增加 117 所（成長 5.2 倍），由原來的 28 所大學院校（其中大學 16 所、學院 12 所）、專科 77 所，成長爲 145 所大學院校（其中大學 75 所、學院 70 所，另有空大 2 所，軍警校院 7 所未計算在內），專科則因改制爲技術學院與科技大學之關係，而僅剩 14 所。

[68] 另一可能原因爲大家競相以進大學爲優先，故在聯考制度下，或由入學志願和分發分數來看，一般進入高中者其成績比進入高職者高，顯示高中生能力普遍比高職生強，在接受相同教育年數下，高中生自然比高職生來得能力優秀，故其教育報酬率也較高。

[69] 除此之外，若由勞動供給面來看，由本文表 1 可以發現，高中程度者所占比例在 1950、1960 及 1970 世代均無變化，但高職程度則呈遞增現象，而勞動需求在年輕世代傾向高技能勞工，反應對高中職的勞動需求降低，亦會造成高職程度之教育報酬率降低，甚至低於高中程度之教育報酬率。

在大學教育程度方面，由圖 2b 中可清楚看出，男性大學畢業的教育報酬有隨世代而下降趨勢，這是因為較年輕的世代，面對的市場愈開放，對勞動需求雖然增加，但另一方面由於教育普及與高等教育供給的不斷擴張，也就是大學生的數目隨著世代而增加，導致男性大學生的教育報酬隨世代而下降。

然而，這種趨勢卻沒有反映在女性樣本上，從圖 2c 來看，女性的大學教育其報酬率並沒有隨世代而有下降趨勢，這是因為由勞動需求方面來看，1920 世代至 1970 世代大學程度就業者中女性相對於男性的比例分別為 0.06、0.12、0.22、0.47、0.76 與 1.24，顯示勞動市場對女性大學生的需求程度相對於男性逐代增高，1970 世代女性大學程度就業者甚至高於男性大學程度就業者。因此雖然男性大學畢業的教育報酬率因勞動供給的擴張而隨著世代有下降的趨勢，但女性大學畢業者卻因勞動需求擴張得更快而並沒有類似的下降趨勢。

除此之外，年長世代的女性的教育報酬率較年輕世代的女性低，推究其原因，一方面除了過去傳統勞動密集產業中適合高教育高技能的女性工作職缺較少外，另外也可能因為過去雇主對所雇用之勞工較存在性別歧視的影響，即使是接受高等教育程度之女性勞動者，亦可能會被迫接受較不合理的薪資，[70]使其教育報酬率相對較低；而較年輕世代的女性工作者，所面對的是更適合女性工作的服務業導向的經濟體系和較不具性別歧視的勞動市場，因此其教育報酬率相對較高。[71]

[70] 比較 1950、1960、1970 世代之男女平均教育年數與實質薪資可以發現，在 1950 與 1960 世代，男女間的平均教育年數相差無幾，但實質月薪卻相差超過 1 萬元以上。但 1970 世代工作者，男女實質月薪差異則縮小至 5 千多元。顯示在過去勞動市場可能存在較大的性別歧視。

[71] 1980 年代以前，政府對於禁止就業歧視是採保留態度。除了憲法第七條及第十五條規定人民之工作平等權應受最高位階法律之保障外，在其他法令中並未明文規定禁止就業歧視。然而，隨著政治解嚴與各種弱勢族群要求平等對待的聲浪高漲，政府在這方面的態度轉趨明確。例如民國七十三年所頒行的勞動基準法中第二十五條就明文規定雇主對勞工不得因性別而有差別之待遇。

3、年代虛擬變數估計

由於本文將同一段年分出生的人視為同一個世代，因此各世代樣本的年齡層分配均有所不同，且分組資料的取得亦將包含「人力運用調查」之原始資料的各不同年度。其中 1920 世代出生之世代，其樣本點之年齡層分配為 44 歲至 65 歲，而 1930、1940、1950、1960 與 1970 世代樣本的年齡層分布則分別為 39-65 歲、29-64 歲、19-54 歲、15-44 歲及 15-34 歲。在資料的取得上，除了 1920 世代包含 1978-1994 年及 1970 世代包含 1985-2004 年「人力運用調查」資料，其他 1930、1940、1950 與 1960 世代的樣本，均包含 1978 至 2004 年之「人力運用調查」原始資料。為進一步控制年度對估計係數的影響，我們將各分組資料，依據其包含的不同年度，分別加入年度之虛擬變數，如圖 3 所示。[72]

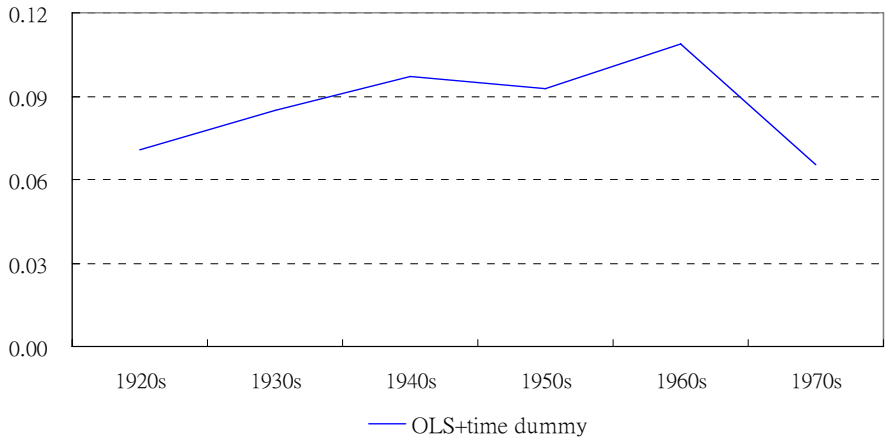


圖 3、加入年代虛擬變數結果

4、內生性偏誤與工具變數法估計

以傳統 OLS 或 QR 模型估計薪資方程式時，其截距項所對應的個人能力與接受教育的邊際成本兩者之間通常存在著相關性，因而將造成估計上

[72] 感謝一位匿名評審對控制年代影響之建議。

有所誤差。而另一方面，若個人能力的異質性存在於所估計之薪資方程式的斜率上時，表示若所估計的教育報酬率愈高者，個人愈有誘因從事教育的投資，將使 OLS 或 QR 模型所估計的結果偏誤進一步擴大。因為教育報酬率存在異質性（影響薪資方程式的截距項與斜率），所以採取 OLS 或 QR 模型估計教育報酬率必須要求解釋變數與個人的能力互相獨立，若無法滿足這個假設，則以 OLS 或 QR 模型所估計的教育報酬率將產生偏誤。尤其甚者，對個人而言，教育並非外生而是一個投資決策，不僅受個人能力亦受家庭環境與家庭背景因素所影響，故教育變數亦為內生變數，而非傳統 OLS 或 QR 模型所假設之外生變數。

當教育變數為一內生變數，則以 OLS 模型所估計之年群差異，我們將無法確定此差異乃來自年群之真實差異，或來自因內生性所產生之估計偏誤。為解決變數內生性所產生的偏誤，Griliches (1977)認為可採用工具變數法解決上述能力偏誤和內生性問題。[73]但若選擇以工具變數的方法來估計橫斷面資料的教育效果時，Heckman and Vytlacil (1999)認為所應考量的是該解釋變數必須對個人教育的選擇具有相關性，但與個人的能力則無相關。因此，本文綜合過去文獻有關工具變數選擇的方式，[74]選擇以教育政策（九年國民義務教育）[75]及區域因素（居住區域為都市或鄉村）作為所選取的

[73] Griliches(1977)採取勞動市場的效率單位觀點，認爲所有的人力資本皆是同質性(Homogeneity)的，但人們可以選擇不同的數量。因此在解決估計教育報酬率時，所產生之個人能力偏誤與衡量誤差(measurement error)的問題，常用的估計方法爲工具變數法，或稱之爲一般係數模型(common coefficient model)。

[74] 如 Harmon and Walker (1997)以英國義務教育政策法規的改變做爲工具變數，認爲教育政策法規改變最低就學的年齡係爲一純粹影響教育的外生變數。而 Duflo (1999)選擇以個人出生時間（制度改革的前後）及個人所居住的區域（政策或制度上對教育的投資可能因區城的不同而有差異）做爲估計教育報酬率的工具變數。

[75] 一般而言，在採用兩階段工具變數估計法過程中，有效的(valid)工具變數必須滿足工具變數相關性(relevance) 以及工具變數外生性(exogeneity)，即所選擇的工具變數必須與內生變數相關，且所選擇工具變數必須具外生性。本文所選擇之工具變數，第一階段相關性 F 檢定爲與過度認定限制檢定(over-identifying restrictions test)分別爲 5518.49 與 4.64，滿足有效工具變數的條件。有關工具變數法的詳細說明請參見 Bound, Jaeger and Baker (1995)與 Staiger and Stock (1997)。

工具變數，經由工具變數法之應用，可避免因內生性誤差而產生的估計偏誤，估計結果如圖 4 所示。[76]

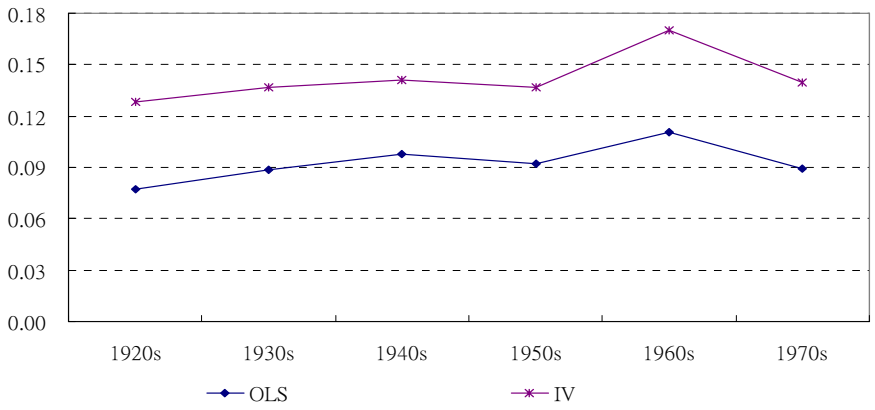


圖 4、工具變數估計

比較由圖 4 之 OLS 法與工具變數法對教育報酬率的估計結果，我們發現以工具變數法所估計的教育報酬率皆明顯高於傳統 OLS 所估計的教育報酬率，[77]但各世代之教育報酬率趨勢則並無太大變化，兩者估計結果差距的標準差僅 0.005。換言之，以兩階段工具變數法估計各年群世代之教育報酬率，僅是傳統 OLS 法估計之結果水平上移，其年群趨勢並未改變，表示既使控制內生性偏誤後各世代之間的教育報酬率之差異仍然存在。

[76] 若選擇九年國民義務教育做爲工具變數，以各分組資料進行第一階段教育方程式的估計時，較年長世代(1920、1930 及 1940 世代)樣本皆爲未受九年國民義務政策影響者，而較年輕世代(1960 與 1970 世代)樣本則皆爲受九年國民義務政策影響者，以該變數做爲在第一階段教育方程式的估計的工具變數將不具意義。因此本文的方式爲將所有世代之分組資料組合(pooling)，以全體樣本估計第一階段之教育方程式，並推估其教育估計值，再依據本文之世代分組方式，以教育估計值做爲教育變數的替代變數，估計第二階段的教育報酬率。因此，九年國教工具變數所呈現的效果極可能是新世代的效果，爲了檢測該工具變數的有效性，本文另比較單獨採用區域因素和單獨採用九年國教的教育報酬率差距，兩組教育報酬率差距之 t 檢定爲 0.4137，顯示兩組係數不存在明顯差異，而變異數的 F 檢定爲 0.9618，亦不顯著。顯示本文以義務教育作爲工具變數具一定的有效性。感謝一位匿名評審之建議。

[77] 有關工具變數法的估計係數高於 OLS 估計的解釋，Card (1999)認爲可能的原因是低教育程度的人受到政府義務教育政策的影響較大，致降低其原本較高之邊際教育成本而使邊際報酬率相對較高。

5、QR 模型估計

在估計了選擇性 probit 模型之後，我們將其計算出來的 inverse Mill's ratio 代入後續的 QR 模型迴歸分析中，並進一步觀察不同薪資所得階層的異質性教育報酬率，[78]如圖 5 所示為 QR 模型估計不同分量下的教育報酬率。比較傳統 OLS 模型與 QR 模型之估計係數的差異，由圖 5a 至圖 5f 的結果可以發現傳統 OLS 模型與 QR 模型的估計結果存在顯著差異(特別在工資分配的左右兩端)，若我們比較在不同分量下的 QR 模型估計係數及其 95%的信賴區間，並觀察其與傳統 OLS 模型估計係數之 95%信賴區間的重疊部分，[79]由圖 5a 至圖 5f 的結果可以發現較年長的世代(如 1920 世代)，其 QR 估計值的 95%信賴區間與 OLS 模型估計值的 95%信賴區間重疊的部分較多，顯示 OLS 模型在估計傳統工資結構較於緊縮的經濟體系上較為適宜且誤差亦較小。以圖 5a 為例，1920 世代出生之勞動者，OLS 與 QR 模型估計值之 95%信賴區間重疊的部分包括 0.1 至 0.6 分量的估計均涵蓋在 OLS 模型估計值的 95%信賴區間，表示以 OLS 模型估計 1920 世代 10%至 60%之工資分配中勞動者的教育報酬率，並無太大的差異，但若以 OLS 模型解釋工資分配右端的行為則仍有所不足，無法正確描述教育年數對工資分配在右側端點變異行為的影響。而愈年輕的世代(如圖 5f 的 1970 世代出生者)除了中位數(0.5 分量)估計值的 95%信賴區間與 OLS 模型估計值的 95%信賴區間相重疊之外，其餘分量的估計值與 95%信賴區間均與 OLS 模型估計值的 95%信賴區間互不重疊，表示傳統 OLS 模型僅能有效估計年輕世代(1970 世代)之中央 40%至 50%工資分配下的教育報酬率，對其他分量下變數的影響行為，

[78] 本文的 QR 模型乃以任意選擇薪資的分配區間上任何一個特定位置爲基準進行估計，描繪薪資的條件機率分配如何受到教育年數分配變化的影響，與傳統 OLS 估計法之「平均」薪資受「平均」教育年數影響不同。因此，若依照兩階段工具變數法的設定方法，在推估第一階段教育方程式之教育年數估計值，並以 QR 模型估計第二階段之教育報酬率，在模型的設定並不合理，相關文獻上未見類似討論，故本文在 QR 模型估計時，仍以原始調查之樣本資料進行 QR 模型之估計。

[79] 由於 OLS 的平均值估計在整個薪資分配區間都相同，所以圖 5 中三條水平線中間一條爲 OLS 的估計值，上下兩條虛線分別代表 95%的信賴區間。因外三條隨著分位點而變化的線段，則是 QR 模型在各分位點下的估計值與 95%信賴區間。重疊部分愈小則表示以 OLS 估計偏誤亦愈大。

無法根據 OLS 模型來進行有效的估計。由圖 5a 至圖 5f 的結果可以推論教育年數對不同工資分配(薪資水準)的影響效果有顯著差異，隱含個人教育報酬率具有明顯的異質性，尤其在愈年輕的世代中，其異質性的情況愈為明顯。因此就年輕的世代而言，傳統 OLS 估計的平均教育報酬率無法有效表現薪資分配兩端的影響行為，亦無法得知異質性的內涵。

圖 6a 乃以 QR 模型估計樣本在不同世代與不同分量下之教育報酬率，由圖 6a 的結果發現特別是 1960 世代的教育報酬在每個分量上均高於 1950 世代，也高於 1970 世代，這是因為 1960 世代的工作者，其進入職場的時期，正值台灣的產業形態由以農業為主順利轉型為以製造業與商業服務業為主的 1980 年代，此時臺灣經濟發展迅速，勞動需求相對提昇，因此 1960 世代的工作者，其教育報酬率較 1950 世代者高，至於 1970 世代的工作者，則由於教育的擴充和普及，勞動供給大幅的增加，造成該世代之教育報酬率的下降，因此 1960 世代者的教育報酬率，在各分量上亦均高於 1970 世代。

除此之外，在較年長的世代(如 1920 世代與 1930 世代)中，教育報酬率與樣本薪資分配呈顯著正相關，即薪資所得階級愈高(低)者，多受一年的教育，其教育報酬也愈高(低)。而在較年輕的世代中(1940 世代之後)，教育報酬率與樣本薪資分配則呈顯著負相關，即薪資所得階級愈高(低)者，多受一年的教育，其教育報酬也愈低(高)。

若由效率工資(efficiency wage)假說來看，個人勞動生產力與薪資呈正相關，而個人的勞動生產力亦取決於個人能力的高低，因此當個人能力無法被觀察到時，通常廠商會選擇採取支付較高的薪資以確定所雇用之人員為高能力者，依據效率工資理論的觀點，個人薪資高低反映個人能力的高低，薪資愈高者，其能力也愈高。

據此，則上述年長世代之正相關隱含對這些世代而言，教育程度與個人能力之間呈現某種強化關係—高(低)能力者之教育報酬率較高(低)。如 Blackburn and Neumark (1993)、Ashenfelter and Rouse (1998)、Pereira and Silva-Martins (2002)等均發現類似的結果，而其政策意涵 De Fraja (2002)認為若教育與能力為強化關係時，普遍的公共教育將更擴大工資的差距，因此最適的社會公共教育政策應該是更精英化，而非更普及化。而較年輕的世代(40 年代以後)中，報酬率與薪資分配則呈現顯著負相關，即薪資所得階級愈低(高)，其教育報酬將愈高(低)，表示年輕世代者之教育程度與個人能力之間存在彌補關係，即受教育可以彌補個人先天能力的不足，低(高)能力者之教育報酬率反而較高(低)。相似的結果如 Brunello, Fort and Weber(2008)以 12 個歐洲國家的資料，發現因義務教育的變化，將導致個人教育成就的提高也使薪資水準的差異變得較小，以此推論教育與個人能力為彌補關係，即接受教育能有效彌補個人能力不足，縮小薪資差異。另外 Denny and O'Sullivan (2007) 分析英國的資料也發現教育的確可替代可觀察與不可觀察能力之不足。因此教育實扮演重要彌補能力不足之功能，在政策意涵上普及化的教育則有其必要性。

由圖 6a 各世代 QR 曲線的斜率亦可發現，在愈年輕的世代中，教育與能力間的彌補效果愈大。總而言之，由 1920 年代出生的勞工，至 1970 年代出生的勞工，其受教育與個人能力之間的關係，逐漸由強化效果轉變為彌補效果，且兩者之彌補效果隨著愈年輕世代愈來愈強。[80]

[80] 感謝匿名評審對此現象提出三種可能原因：第一、越高教育程度的報酬率越低，可能與估計模型採教育年數有關；第二、單就薪資所得可能無法反應個人工作所得；第三、由於不同行業可能重視教育的程度不同。作者也一一加以進行估計檢測。首先，若以教育年數與年數平方加以估計，各世代之趨勢與原估計結果均一致且穩定，但在年數平方的估計參數並不顯著；其次，在文獻上一般均採用薪資所得來做爲自變數，若要以足以反應個人工作所得的資料(如評審所指加入股票所得)，在取得上相當困難，且台灣也未見類似的調查(家庭收支調查雖有相關資料，但與本文使用之人力運用調查在資料聯結上有所困難)；最後，本文亦區分各世代不同行業進行分量迴歸估計，結果發現大部分的行業亦都符合本文的原估計結論，即教育與能力在年長世代爲強化效果，在年輕世代爲彌補效果。(本文區分 10 個不同產業，分別是農林漁牧業、礦業、製造業、水

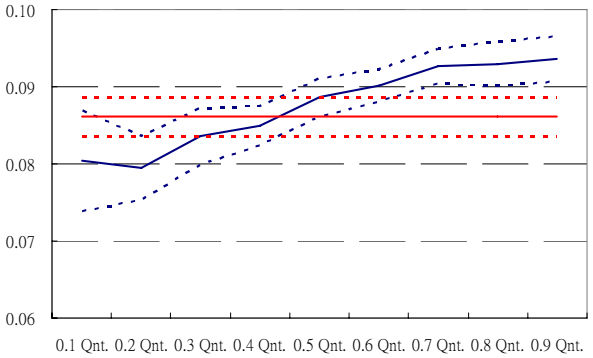
這個結果我們可由幾個面向進行討論並可做為未來進一步的研究議題。首先在教育內涵方面，過去在升學主義之教育體制下，經由聯考方式的篩選使先天能力較強的人優先選擇進入學校就學，而專才式的學校教育內容則進一步加強個人的專業能力，因此先天能力較強的人可透過教育投資獲致較高的教育報酬率。即過去制式且專才型教育能使勞動者經由教育的投資更加強化個人能力。而與過去的教育相比，現代的教育有著較為多元化的入學方式，高等教育也著重在通才性的課程，這類的學制和課程也較能彌補個人先天能力的不足。即多元而通才型教育正可補充個人基本能力之不足。

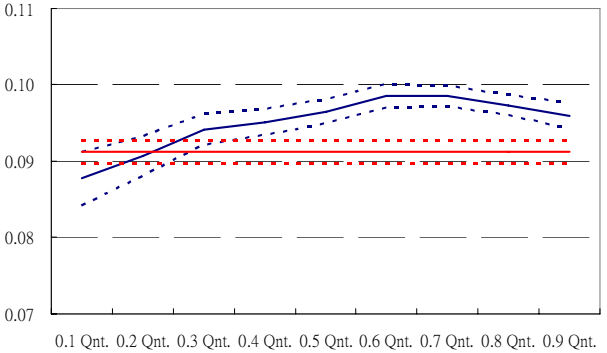
其次，在產業需求與工作內涵方面，過去台灣地區的產業結構傾向於以初級技術為主的勞力密集產業，較年長世代的勞工所面對的產業結構，對工作專長的需要較為單純且直接，亦即在初級技術產業就業的勞工，僅僅要求其在工作上的專業，不需具備其他通才性（如人文、藝術等）的知識內涵，早期的制式學校教育正可以加強勞工在這方面的能力，使高能力者有較高的報酬率。而較年輕世代勞工所面對的產業結構，則屬於技術（或知識）密集型的產業或服務業，這些產業除了要求勞工個人的專業技術之外，亦要求勞工多方面涉獵其他通才性的知識，尤其是服務業的勞工相較於製造業更為需要，此時學校教育正可以補足勞工先天上能力不足之處，因此教育與能力呈現彌補關係。

除此之外，本文另估計在不同性別下 QR 的結果，如圖 6b 與圖 6c 所示，我們可以發現男性在不同世代下之教育報酬率和全體樣本的結果類似，較年長世代的男性，薪資愈高者報酬率愈高；而較年輕世代的男性，高薪資者的教育報酬率反而較低。至於女性工作者在年長的世代中，亦是存在

電燃煤業、營造業、商業、運輸倉儲通信業、工商服務業、個人服務業、社會與公共服務業等，尤其在製造業、商業、工商服務業與個人服務業有特別明顯相似的結果)。

高薪資高報酬的強化效果；但在較年輕的世代中，教育報酬率和薪資分配的彌補效果則不如男性工作者來得明顯。





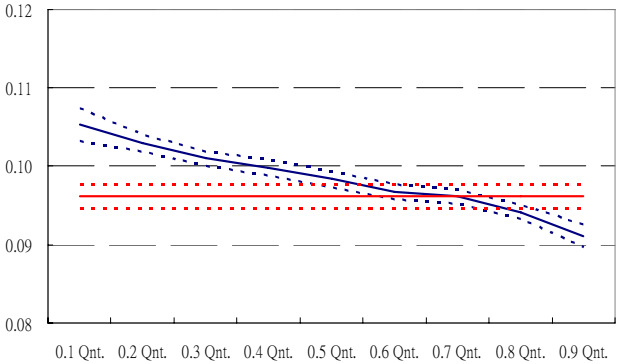


圖 5a、QR 估計值與 OLS 估計值及 95%信賴區(1920 世代) 圖 5b、QR 估計值與 OLS 估計值及 95%信賴區(1930 世代) 圖 5c、QR 估計值與 OLS 估計值及 95%信賴區(1940 世代)

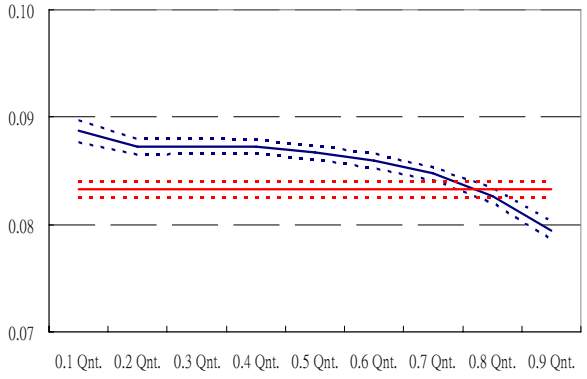


圖 5d、QR 估計值與 OLS 估計值及 95%信賴區(1950 世代)

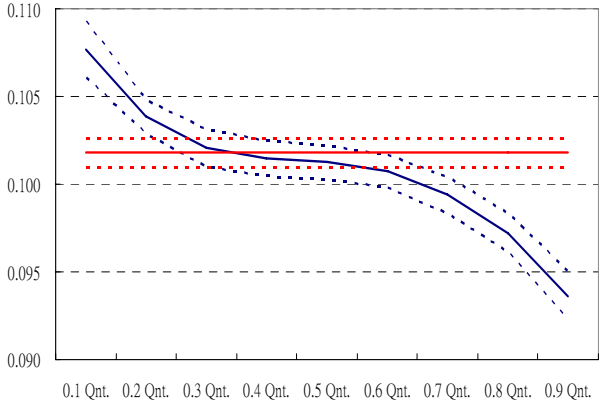


圖 5e、QR 估計值與 OLS 估計值及 95%信賴區(1960 世代)

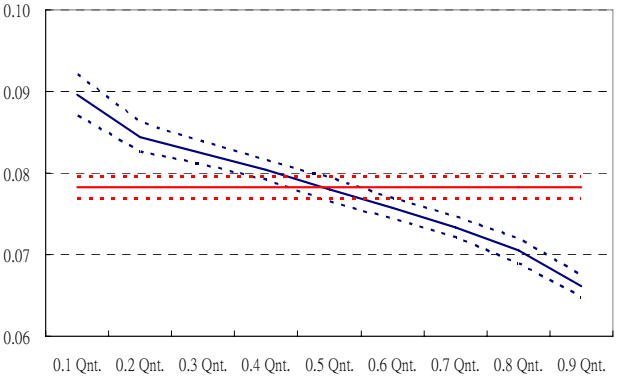
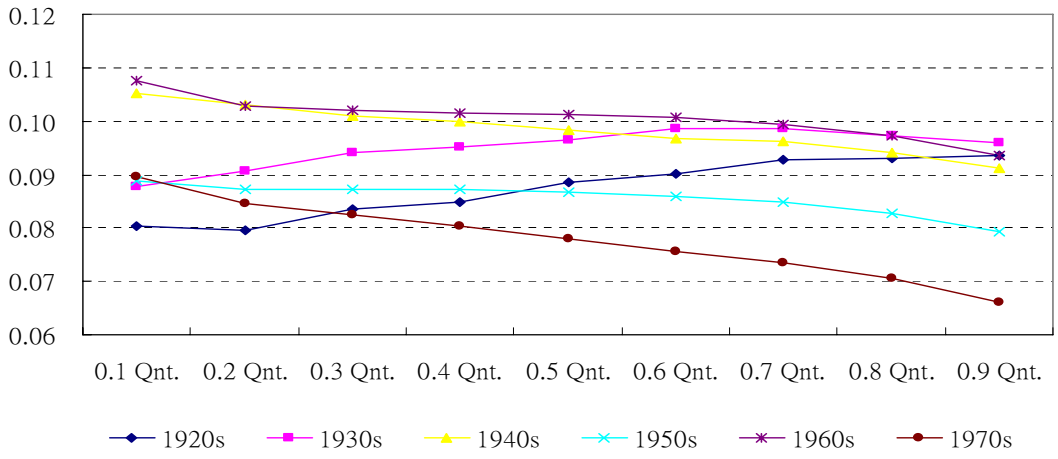


圖 5f、QR 估計值與 OLS 估計值及 95%信賴區(1970 世代)



圖

6a. 教育報酬率-全體樣本

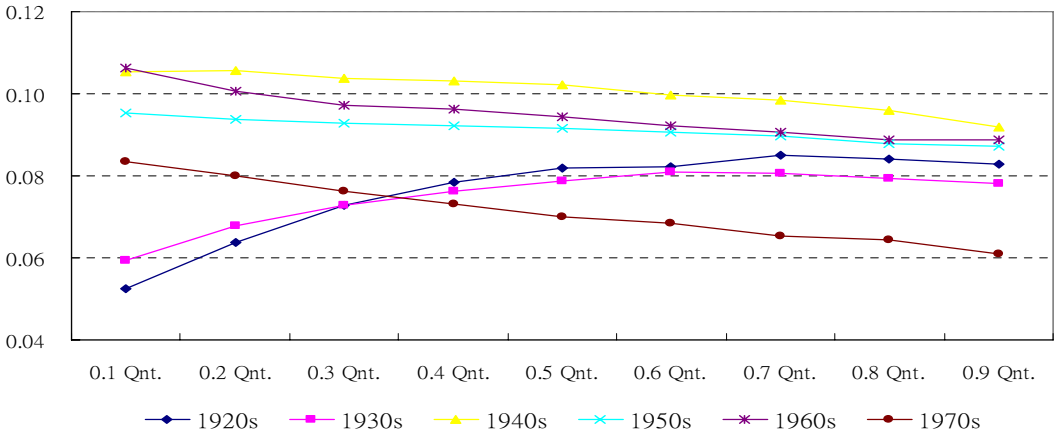


圖 6b. 教育報酬率-男性樣本

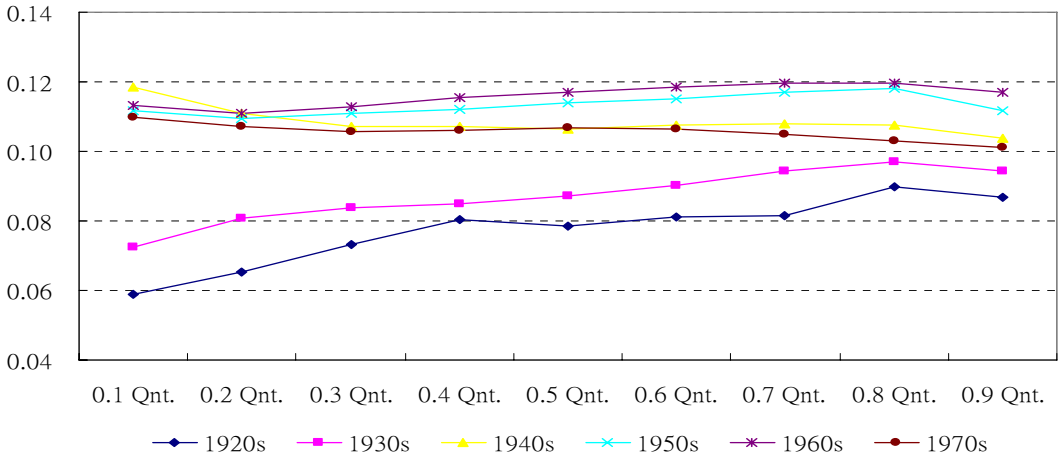


圖 6c. 教育報酬率-女性樣本

五、 結論

不同於過去的文獻中採用年度橫斷面資料,依傳統OLS模型估計「平均」的教育邊際報酬率的方式，本文選擇將時間序列橫斷面的資料重新組合為不同年群資料並採用 QR 模型來估計在不同年群之條件薪資分配下的教育報酬率。一方面透過不同年群的區分，避免因採用橫斷面資料時所強烈假設之相同的個人年齡所得面相，而造成的估計偏誤。另一方面，經由 QR 模型估計結果的分析，不但可擴大教育報酬率的觀察面向，體現個人特質存在異質性的情況下所呈現之工資條件分配中可出現不同的報酬率差異外，更可進一步分析教育投資與個人無法觀測之能力兩者間的可能關係。

由本文的估計結果發現，不同世代的教育報酬率存在相當程度的年群效果，因為不同世代所面對的勞動市場均有所不同，可能來自需求面或供給面甚至兩者同時影響而造成各世代不同的教育報酬率。本文也嘗試提出解釋：在勞動需求上，由於經濟發展與產業結構的轉變，造成對不同技能的需求改變；在勞動供給上，由於教育制度的改變(如九年國教、教育分流、大學擴增等)，影響個人的教育成就，造成勞工教育結構的改變。但因所採取的調查資料無法完整表現個人工作生命週期的行為，且所選擇之調查資料未臻詳盡等限制，故本文並未將制度面與非制度面的因素完全納入模型考量，僅能有限度的解釋不同世代教育報酬的年群效果。如何進一步釐清造成年群效果的原因，似可作為未來研究的方向。

除此之外，本文進一步比較傳統 OLS 模型與 QR 模型之估計結果可以發現，以 QR 模型所估計的係數在不同工資分配中有極大比例落在傳統 OLS 模型的估計係數的 95%信賴區之外，表示不同的個人在先天上即具有能力的異質性而表現出不同的教育報酬率，我們並發現個人能力的異質性在年輕世代中最為明顯，顯示個別能力差異在年輕族群的重要性，因此以傳統 OLS 模型所估計（平均概念）的教育報酬率並不適用。

另一方面，由 QR 模型的估計結果亦發現在較年長的世代，教育與個人

能力呈現強化關係，而較年輕的世代，教育與個人能力則呈現彌補關係，且愈年輕的世代，其彌補性也愈強。顯示過去較年長世代所接受之較為制式的教育，目的乃在於加強個人的能力，深化個人專業能力進而表現在工資水準的提高上；而年輕世代所接受為較多元和通才式的現代教育，則可補足個人能力不足之處，亦即在年輕的世代中，教育乃做為培養多元或多樣化能力的途徑，彌補先天能力之不足。換句話說，不同於傳統制式化的單元價值與著重專業技能教育，現代教育一方面可彌補先天能力的弱勢，但另一方面透過多元化教育訓練，也培養出更多樣化的能力，也豐富了異質性的內涵，體現在愈年輕的世代其異質性也愈大。故本文的重要政策意涵為：教育除了一方面能補充個人能力之不足外，另一方面亦可創造出具更多元化與具異質性內涵的社會。台灣的經驗顯示，教育與能力可能是強化亦可能是彌補關係，端視教育的內涵與產業對人才需求的特質而定。此結果更突顯出教育於二十一世紀人力資本投資的重要性。

參考文獻

行政院主計處，《中華民國台灣地區人力運用調查報告》，台北，行政院主計處。

吳慧瑛 (2002)，「二十年來教育發展之經濟評估, 1978-2001」，《台灣經濟預測與政策》33，97-130。

張宏基與朱敬一 (1996)，「用 Pseudo Panel Data 估計台灣男性跨期勞動替代彈性」，《經濟論文叢刊》，24(3)，313-337。

符碧真 (1996)，「教育投資報酬率長期變化之剖析-以我國發展個案為例」，《教育研究資訊》，4，82-99。

莊奕琦與賴偉文(2008)，「影響教育成就的因素及九年國民義務教育政策效果評析：台灣實證」，《人文及社會科學集刊》，20(1)，25-65。

陳建良 (2002)，「手足組成、出生序與教育年數-以台灣家庭為對象的實證分析」，第六屆經濟發展學術研討會論文，國立台北大學。

陳建良與管中閔 (2006)，「台灣工資函數與工資性別歧視的分量迴歸分析」，《經濟論文》，34(4)，435-468。

黃台心 (2000)，「我國已婚婦女勞動供給的生命循環分析」，《經濟論文叢刊》28(1)，1-24。

鄭保志 (2004a)，「教育擴張與工資不均度：台灣男性全職受雇者之年群分析」，《經濟論文叢刊》，32(2)，233-265。

鄭保志 (2004b)，「工資流動性與終身不均度的年群分析」，《經濟論文叢刊》，32(3)，369-393。

Ashenfelter, O. and C. Rouse (1998), "Income, Schooling and Ability: Evidence from a New Sample of Identical twins," Quarterly Journal of Economics, 113(1), 253–84.

Blackburn, M. L. and D. Neumark (1993), "Omitted-Ability Bias and the Increase in the Return to Schooling," Journal of Labor Economics, 11(3), 521-44.

Bound, J., D. A. Jaeger and R. Baker (1995), "Problems with Instrumental Variables Estimation When the Correlation between the Instruments and the Endogenous Explanatory Variable is Weak", Journal of the American Statistical Association, 90, 443-450.

Brunello, G., M. Ford and G. Weber (2009), "Changes in Compulsory Schooling, Education and the Distribution of Wage in Europe," Economic Journal, 119, 516-5393.

Buchinsky, M. (1994), "Changes in the U.S. Wage Structure 1963-1987: Application of Quantile Regression," Econometrica, 62, 405-458.

Buchinsky, M. (1998), "The Dynamics of Changes in the Female Wage Distribution in the USA: A Quantile Regression Approach," Journal of Applied Econometrics, 13, 1-30.

Card, D. (1999), "The Causal Effect of Education on Earnings," In Ashenfelter, O. and D. Card, (eds) Handbook of Labor Economics, Volume 3A, Amsterdam: Elsevier.

Card, D. and T. Lemieux (2001), "Can Falling Supply Explain the Rising Return to College for Younger Men? A Chort-based Analysis", Quarterly Journal of Economics, 116(2), 705–746.

Chu, C. Y., R. S. Tsay and R. R. Yu (2005), "Intergenerational Transmission of Sex-specific Differential Treatments: The Allocation of Education Resources among Siblings," 2005 Conference on Panel Study of Family Dynamics, Institute of Economics, Academia Sinica.

Chu, C. Y., Y. Xie and R. R. Yu (2005), "Effects of Sibship Structure Revisited : Evidence from Intra-Family Resource Transfer in Taiwan," 2005 Conference on Panel Study of Family Dynamics, Institute of Economics, Academia Sinica.

Chuang, Y. C. and C. Y. Chao (2001), "Educational Choice, Wage Determination, and Rates of Return to Education in Taiwan," International Advances in Economic Research**,** 7, 479-504.

De Fraja, G. (2002), "The Design of Optimal Education Policies," Review of Economic Studies, 69, 437–66.

Deaton, A. S. and C. H. Paxon (1994), "Saving, Growth and Aging in Taiwan," in David A. Wise (ed.), Studies in the Economics of Aging, 331-361, Chicago: University of Chicago Press

Denny, K. and V. O'Sullivan (2007), "Can Education Compensate for Low Ability? Evidence from British Data," Applied Economics Letters, 14, 657-660.

Duflo, E. (1999), "Schooling and Labor Market Consequences of Schooling in Indonesia: Evidence from an Unusual Policy Experiment," Mimeo, Department of Economics, MIT

Eide, E. and M. H. Showalter (1998), "The Effect of School Quality on Student Performance: A Quantile Regression Approach," Economics Letters, 58, 345-350.

Garcia, J., P. Hernandez and A. L'opez-Nicolas (2001), "How Wide Is the Gap? An Investigation of Gender Wage Difference Using Quantile Regression," Empirical Economics, 26, 149-167.

Gindling, T. H., M. Goldfarb and C.C. Chang (1995), "Changing Return to Education in Taiwan," World Development, 23(2), 343-356.

Griliches, Z. (1977), "Estimating the Return to Schooling: Some Econometric Problems," Econometrica, 45(1), 1-22.

Harmon, C. and I. Walker (1995). "Estimates of the Economic Return to Schooling for the UK," American Economic Review, 85, 1279-1286

Hartgo, J., P. T. Pereira, and J. A. Vieira (2001), "Changing Return to Education in Portugal during the 1980s and Early 1990s: OLS and Quantile Regression Estimators," Applied Economics, 33(8), 1021-1037.

Heckman, J. J. and E. Vytlacil (1999), "Local Instrumental Variable and Latent Variable Models for Identifying and Bounding Treatment Effects," Proceedings of the National Academy of Sciences, 96, 4730-4734.

Heckman, J. J. (1979), "Sample Selection Bias as a Specification Error," Econometrica, 47(1), 153-161.

Jappelli, T. (1999), "The Age-wealth Profile and the Life-cycle Hypothesis: A Cohort Analysis with a Time Series of Cross-sections of Italian Households," Review of Income and Wealth, 45(1), 57–75.

Juhn, C., M. M. Kevin and P. Brooks (1993), “Wage Inequality and the Rise in Returns to Skill”, Journal of Political Economy, 101(3), 410–442.

Koenker, R. (2005), Quantile Regression, Cambridge; New York: Cambridge University Press

Koenker, R. and G. J. Bassett (1978), “Regression Quantiles,” Econometrica, 46, 33-50.

Koenker, R. and K. F. Hallock (2001), “Quantile Regression,” Journal of Economic Perspectives, 15, 143-156.

Machado, J. and J. Mata (2005), “Counterfactual Decomposition of Changes in Wage Distributions Using Quantile Regression,” Journal of Applied Economics, 20, 445-465.

Mincer, J. (1974), Schooling, Experience an Earning, New York: Columbia University Press.

Mincer, J. and S. Polachek (1974), “Family Investments in Human Capital: Earnings of Women,” Journal of Political Economy, 82, 76-108

Mwabu, T. and T. P. Schultz (1996), “Education Return Across Quantiles of the Wage Function: Alternative Explanation for Education by South Africa,” American Economic Review, 86(2), 335-339.

Pereira Pedro and Pedro Silva-Martins (2002), “Is there a return-risk relationship in education?” Economics Letters, 75(2), 31-37.

Polachek, S. (1981), "Occupational Self-Selection: A Human Capital Approach to Sex Differences in Occupational Structure," Review of Economics and Statistics, 63(1), 60-69.

Psacharopouls, G. (1985), “Return to Education: A Further International Update and Implications,” Journal of Human Resources, 20(4), 583-604.

Steiger D. and J. H. Stock (1997), “Instrumental Variables Regression with Weak Instruments,” Econometrica, 65(3), 557-586.

Trostel P., I. Walker and P. Woolley (2002), "Estimates of the Economic Return to Schooling for 28 Countries," Labour Economics, 9(1), 1-16**.**

Willis, R. J. (1986), "Wage Determinants: A Survey and Reinterpretation of the Human Capital Earning Function," in O. Ashenfelter and R. Layard (eds), Handbook of Labor Economics, 525-602, Amsterdam, North-Halland: Elsevier.

紈綺子弟與流氓教授：台灣的教育與階級流動

摘要

本文採用「華人家庭動態資料庫」研究父代與子代間階級流動的情況，並探討教育成就是否為促進代間階級流動的重要管道。實證結果發現父代為上層階級的子代接受高等教育相對最具有優勢，相較於勞工階級與農民階級子代，中產階級的子代也有較高的機會接受高等教育。另一方面，教育成就對社會階級亦有著顯著的影響，愈高的教育成就進入上層階級的相對勝算比也愈高，尤其具大學以上教育成就更有高度的優勢。特別是相對於國小以下教育程度，受專科教育為子代進入上層階級帶來了優勢，而這樣的優勢效果在來自非上層階級的子代又比來自上層階級的子代為大。即先天上家庭環境的不足仍可藉由後天教育成就的提升而改善階級壟斷！而高中與專科教育程度可造就出最有機會進入中產階級的優勢，惟教育成就高低對進入上層階級的相對勝算比不會因為不同的世代而有所不同。整體而言，教育的普及與避免教育壟斷的確有助於社會階級代間的向上流動，故教育政策的首要目標應該避免產生階級壟斷教育的現象，惟有人人教育機會均等的環境，才能真正達到階級的有效流動，讓窮人有真正翻身的機會。

關鍵字：教育成就、社會階級、代間階級流動、相對勝算比。

JEL 分類代號：I21；J24；J62

壹、前言

社會經濟體系中存在各種不同的階級群體，社會成員財富、資源、聲望、權力不一。在現實社會中很明顯地呈現著社會資源分配不均的情況，這是一個地獄與天堂並存的世界。然而生活在地獄者是否永遠只能在地獄？抑或是也有機會上天堂？在現實社會中我們卻也觀察到三級貧戶之子成為一國元首、流氓當教授的實例，而這些窮人翻身的過程中，似乎教育扮演了階級流動的關鍵性角色。

不同社會階級有著截然不同的工作情境、市場情境、生命機會。傳統社會中普遍存在階級世襲的情況，階級代間流動性低，具穩定性。俗話說「龍生龍、鳳生鳳」，愈上層階級愈擁有相對較多的社會資源以鞏固其階級,下層階級很難有出頭的機會。古云「萬般皆下品，惟有讀書高」，科舉制度是打破階級壟斷的途徑；然而在近代民主法治國家中強調人人皆有機會爭取自己更好的生活條件，透過教育的人力資本累積，麻雀也可變鳳凰，階級不再被壟斷。從提升人類生活品質的觀點，階級的流動益發值得重視。

在過去相關文獻中，Heath and McMahon (1999) 運用英國的資料以 logistic regression 模型分析，不同種族進入上層階級、中產階級相較於英國出生的白人之相對風險情況。實證結果顯示種族歧視為子代是否可進入上層階級的重要因素。但就教育來看，程度愈高則愈有優勢進入上層階級，高教育程度提供不同種族一個進入上層階級的公平機會。換言之，先天上爭取進入上層階級的種族不利條件可以藉由後天的教育得到改善。

Iannelli and Paterson (2005) 討論蘇格蘭地區在不同的四個世代下教育因素對於階級流動所扮演的角色。研究發現有愈高階級父代愈有利子代接受高教育，但此項優勢隨世代演進而減緩。另一方面，愈高的教育程度也為進入上層社會階級帶來了更高的勝算，且在控制教育成就變數後父代階級的影響明顯減緩，更也造成某些父代階級變數甚至呈現不顯著的情況。此外，Raffe et al. (2006)比較英格蘭與蘇格蘭地區，不同教育成就對進入高社會階級的影響。Platt (2005)使用英國的資料研究不同種族與家庭背景對於進入高社會階級帶來的影響，但其並未能呈現或突顯階級是否利用對教育的壟斷，以保持階級優勢。Tasiran and Tezic (2006)以瑞典資料研究父母所得及特質影響子代義務教育年限後再繼續升學的情況，著重比較新移民與原住居民的子代教育成就。故了解代間社會階級流動除了考量父代階級外，教育也是重要的解釋變數。

國內相關文獻中，例如僅探討家庭背景或階級對個人升學機率的影響，如蔡淑鈴、瞿海源(1992)、章英華、薛承泰、黃毅志(1996)、孫清山、黃毅志(1996)、黃芳銘

(1998)、駱明慶(2004)、陳正昌(2005)、宋玫玫(2005)和陳婉琪(2005)等均發現家庭背景或階級對個人升學機率有顯著的正面影響；或僅討論跨代階級流動，如謝雨生、余淑宜(1990)、吳乃德(1997)、許嘉猷、黃毅志(2002)等發現上層階級的後代仍維持於上層社會階級具有顯著的優勢。但尚未有著重討論教育在二代間階級流動中扮演之角色的相同研究。[81]

由以上文獻回顧可發現代間的階級向上流動具相當程度的僵固性，但也發現教育程度愈高則愈有優勢進入上層階級。若果如此，上層階級是否傾向壟斷教育？換言之，代間階級向上流動的僵固性，是否經由階級壟斷教育而益形鞏固？教育是否為代間階級向上流動的有效管道？其重要性是否因不同父代階級而不同？教育普及結果是否有助階級向上流動？文獻上尚未有如本文探討代間階級流動並同時考慮教育在其間扮演的角色，這是本文研究的目的和想要釐清的重點。本文使用「華人家庭動態資料庫」（Panel Study of Family Dynamics，簡稱 PSFD）分析社會階級代間流動的情況，並釐清教育成就在代間流動扮演的角色。在研究方法上，首先探討父代階級對子代教育的影響，再討論教育是否影響階級的形成；有了上述二個實證研究的支持再進一步研究代間階級的流動及教育扮演的角色。本文主要結構如下，第二節建構實證模型與採用的估計方法，第三節為資料來源、變數說明與資料特性分析，第四節分析與討論實證估計結果，第五節則為結論。

貳、實證模型與估計方法

為理解自變數對事件機率的發生影響，本文實證使用 logistic regression 模型估算各自變數的相對勝算比(odds ratio)[82]。設 P_i 為成功的機率，則勝算比的對數值可表示為：

$$\text{logit}(P_i) = \ln\left(\frac{P_i}{1-P_i}\right) = \beta_0 + \beta_1 X_{1,i} + \beta_2 X_{2,i} + ...\beta_k X_{k,i}$$

[81]吳乃德(1997)發現外省籍民眾不論父代是那一個階級，他們成爲上層階級的比例都高於相同父代階級的本省籍民眾，顯示本質上階級向上流動性外省籍比本省籍高。文中亦發現不同族群身份對教育成就具顯著的影響力。因此吳乃德(1997)推論階級向上流動機會上的差異主要由教育成就所造成。

[82] 勝算比爲事件發生頻數相對於事件不發生頻數，若勝算比=0.25，說明事件不發生可能性是發生可能性的 4 倍。一個事件相對於另一個事件勝算比，我們稱相對勝算比(odds ratio)。

其中 X 為解釋成功機率的獨立變數，而 $\exp(\beta_k)$ 則代表相對勝算比[83]，故可檢測虛無假設 $H_0 : \exp(\beta_k) \leq 1$。當拒絕虛無假設時表示在其他條件不變下，$X_k$ 每增加一個單位時，勝算比會相對增加。

本文主要探討父代與子代間階級流動情況及教育是否能夠促進階級的流動，故研究方法實證模型主要分為三部分：

2.1 父代階級對子代教育的影響

第一部分模型為各不同父代社會階級對於子代進入高等教育（包含專科及大學以上教育水準）之相對勝算比，以探討愈高的父代階級對子代接受高等教育是否相對較具優勢。主要實證模型為：

模型 1：
$$\ln\left(\frac{\Pr(HEDU_i)=1}{\Pr(HEDU_i)=0}\right)=\alpha_0+\alpha_1 FOCC_i+\alpha X_i+\varepsilon_i$$

其中 i 表示個人，$HEDU$ 為是否接受高等教育之虛擬變數（1 表示接受高等教育，0 表示未接受高等教育），$FOCC$ 為父代階級變數，X 為控制變數，ε 為隨機干擾項，α_1 表示父代階級影響其子代進入高等教育的相對勝算比對數值。另外，由於不同省籍、性別、世代、城鄉、手足個數也為造成教育成就不一的重要因素，故在父代階級對子代教育模型中我們另加入省籍的虛擬變數（1 表示外省籍，0 表示父親非外省籍，）、性別的虛擬變數（1 表示男性，0 表示女性）與世代變數（以第一世代為參照組）、城鄉虛擬變數（1 表示城市，0 表示鄉村）、手足個數等控制變數。

此外，為考量不同省籍於四個世代間對於子代教育成就是否帶來不同的影響，故在實證模型中另加入省籍與世代的交乘項，估計省籍與世代間的交互效果。

2.2 子代教育對子代階級的影響

[83] Feinberg (1985)和 Morgan and Teachman (1988) 認爲以相對勝算比在估測關聯性時具有以下一些好的特性：(1)當相對勝算比大於 1 表示事件發生的可能性會提高，或者說自變數對事件機率有正的作用；相反的，當相對勝算比小於 1 表示事件發生的可能性會降低，或者說自變數對事件機率有負的作用。(2)參考組的選擇發生變化時，相對勝算比仍可互相轉換。(3)對變數的頻數擴大若干倍，並不影響相對勝對比。(4) 相對勝算比還可用於多變量或用於多元模型。有關 Logistic regression 模型的詳細說明可參考 Greene (2003)。

第二部分估算各類教育成就對於進入上層社會階級之相對勝算比，檢測愈高的教育成就是否對進入上層社會階級較具優勢。主要實證模型為：

模型 2：$$\ln\left(\frac{\Pr(UPCL_i)=1}{\Pr(UPCL_i)=0}\right)=\beta_0+\beta_1 EDUC_i+\beta Z_i+\varepsilon_i$$

其中 i 表示個人；$UPCL$ 為是否進入上層階級之虛擬變數（1 表示進入上層階級，0 表示未進入上層階級）；$EDUC$ 為教育程度變數，Z 為控制變數，ε 為隨機干擾項，β_1 表示子代教育影響子代進入上層階級的相對勝算比對數值。另外，為考量不同世代、省籍、性別下對於子代社會階級的影響，故在模型中我們也加入世代變數（以第一個世代為參照組）、省籍的虛擬變數（1 表示外省籍，0 表示父親非外省籍，）、性別的虛擬變數（1 表示男性，0 表示女性）等控制變數。

2.3 父代階級與子代教育對子代階級的影響

透過前述二個 logistic 模型的估計結果，可以釐清父代階級對於子代教育成就之影響及教育成就對於進入上層階級是否帶來優勢。而在第三部分的實證估計中，我們將上述二個模型透過教育成就變數作一連結，進一步討論父代階級與子代教育對於子代階級流動的影響。實證模型設定如下：

模型 3：$$\ln\left(\frac{\Pr(UPCL_i)=1}{\Pr(UPCL_i)=0}\right)=\gamma_0+\gamma_1 FOCC+\varepsilon_i$$

模型 4：$$\ln\left(\frac{\Pr(UPCL_i)=1}{\Pr(UPCL_i)=0}\right)=\theta_0+\theta_1 FOCC+\theta_2 EDUC_i+u_i$$

模型 5：$$\ln\left(\frac{\Pr(UPCL_i)=1}{\Pr(UPCL_i)=0}\right)=\delta_0+\delta_1 FOCC_i+\delta_2 EDUC_i+\delta_3 FOCC_i\times EDUC_i+\upsilon_i$$

模型 6：$$\ln\left(\frac{\Pr(UPCL_i)=1}{\Pr(UPCL_i)=0}\right)=\eta_0+\eta_1 FOCC_i+\eta_2 EDUC_i+\eta_3 FOCC_i\times EDUC_i+\eta_4 COHO_i+\eta_5 PROV_i+\eta_6 GEND_i+\pi_i$$

模型 7：$$\ln\left(\frac{\Pr(UPCL_i)=1}{\Pr(UPCL_i)=0}\right)=\mu_0+\mu_1 FOCC_i+\mu_2 EDUC_i+\mu_3 FOCC_i\times EDUC_i+\mu_4 COHO_i+\mu_5 PROV_i+\mu_6 GEND_i+\mu_7 EDUC\times COHO_i+\tau_i$$

其中 i 表示個人；*UPCL* 為是否進入上層階級之虛擬變數（1 表示進入上層階級，0 表示未進入上層階級）；*FOCC* 為父代階級變數；*EDUC* 為教育程度變數；*FOCC*×*EDUC* 為父代階級與子代教育成就的交乘項；*COHO* 為世代變數；*GEND* 為性別的虛擬變數（1 表示男性，0 表示女性）；*PROV* 為省籍的虛擬變數（1 表示父親外省籍，0 為其他省籍）；*EDUC*×*COHO* 為教育成就與世代的交乘項；ε、u、v、π、τ 為隨機干擾項。

模型 3 首先討論各不同父代社會階級對於子代進入上層社會階級之相對勝算比。考量教育成就對於階級的流動應具一定影響力，故模型 4 中也將此要素納入討論。但因父代階級與子代教育之間可能存在交互影響，如父代為上層階級相對於勞工階級對於子代教育重視程度可能不一，因此，我們進一步在模型 5 中加入父代階級與子代教育之交乘項，藉以釐清子代階級受其父代階級與教育成就間的交互影響效果。模型 6 則加入考量不同世代、省籍、性別等控制變數的影響。隨著教育普及，不同的世代其教育成就的影響亦可能不同，故模型 7 另再加入教育成就與世代的交乘項，以檢測教育成就在不同世代間是否有不同的影響效果。

參、資料來源、變數說明與特性分析

3.1 資料來源與變數說明

本研究採用「華人家庭動態資料庫」進行分析。華人家庭動態資料庫是自 1999 年開始進行的追蹤調查，調查主要對象為成年人樣本。由主樣本延伸，再將其父母、子女、兄弟姊妹納入訪問樣本，以建構追蹤資料庫。本文依據研究主要特性，選擇使用 PSFD 問卷編號 RI1999、RI2000、RI2003 三個主樣本所合併之樣本。其中問卷編號 RI1999 資料庫為 1999 年針對 1953-1964 年（民國 42-53 年）出生之樣本進行問卷訪問，樣本數 999 筆；編號 RI2000 問卷為 2000 年受訪時樣本出生年份為 1935-1954（民國 24-43 年），樣本數為 1,959；編號 RI2003 問卷為 2003 年訪問 1964-1976（民國 53-65 年）出生之樣本，樣本數 1,152。合併後樣本總數為 4,110 筆。

本文所選取之問卷內容除了包括樣本之出生年份、性別、婚姻情況、教育經驗、工作經驗等基本資料以外，尚有父母親職業之相關資料。表 1 為本文實證模型採用之變數說明與各變數分類依據。

表 1-1 變數名稱及說明

變數名稱	變數說明
父代或子代社會階級	分類為第一類專業人員階級、第二類專技人員階級、第三類白領階級、第四類小店主階級、第五類農民階級、第六類技術勞工階級、第七類半／非技術勞工階級。另外，本文將第一類階級與第二類階級稱為整體社會中之「上層階級」；第三類與第四類階級合稱為「中產階級」；第六類與第七類階級合稱為「勞工階級」。
子代教育程度	區分為第一類：國小以下、第二類：國／初中、第三類：高中（含高職普通科）、第四類：高職、第五類：專科（含二專、三專、五專）第六類：大學以上（含技術學院）。
性別	以虛擬變數表示，男性為 1，女性為 0
省籍	以虛擬變數表示，外省籍為 1，非外省籍為 0（即包含原住民、本省閩南、客家人、其他）。
世代	第一世代：民國 34 年前出生 第二世代：民國 35 ~44 年出生 第三世代：民國 45~54 年出生 第四世代：民國 55 年後出生
城鄉	以虛擬變數表示，城市為 1，鄉村為 0
手足個數	兄弟姊妹個數

資料來源：華人家庭動態資料庫(Panel Study of Family Dynamics)，RI1999、RI2000、RI2003 合併資料

表 1-2 階級分類與歸屬

第一類：專業人員階級	包括資本家、大型企業中的經理人員、高級專業人員，如醫生、律師等、高級政府官員、物理科學家、經濟學家等。
第二類：專技人員階級	包括較低層級的專業人員，如政府中級行政人員、教師、作家、作曲家、體育家等。
第三類：白領階級	將一般雖從事專業相關工作但僅擁有較低度專業技術，且工作性質較制式化的職業歸屬於此類階級，例如醫療助理人、保險與房地產或證券銷售人員等。此外，軍警人員也歸於此階級。

第四類：小店主階級	一般小型商店業主。
第五類：農民階級	農、林、漁、牧、狩獵工作人員。
第六類：技術勞工階級	這個階級中本文要強調的是接受過相關專業訓練才適宜從事之工作，非純粹體力工，而是具技術性的，例如家具木工、動力車輛修理工、各類製造工等。
第七類：半/非技術勞工階級	屬於單純體力或操作工，例如貨物搬運工、垃圾收集工等。

註: 本研究將第一類「專業人員階級」與第二類「專技人員階級」視為「上層階級」；第三類「白領階級」與第四類「小店主階級」則合稱為「中產階級」；第六類「技術勞工階級」與第七類「半/非技術勞工階級」合稱為「勞工階級」。

英國學者 Goldthorpe（1987）結合 Weber（1968:302-307）及馬克思主義者等階級架構理論將社會階級分成資本家與高級專業人員、較低級的專業與專技人員、白領勞工、小資產階級、低技能和藍領勞工監督者、技術性勞工、半或非技術性勞工等七大類。在上述階級分類架構中，同一類屬的人，大多有類似的市場情境（market situation）、工作情境(work situation)、和生命的機會(life chance)。

吳乃德(1997)在不違反上述分類邏輯的條件及因應國內特殊環境下，再進一步修改分類為：第一類「資本家、高級專業人員與現代部門的產業擁有者」、第二類「較低級的專業、專技人員與中學和專科教師、小學校長」、第三類「白領勞工階級（含軍警人員）」、第四類「小資產階級」、第五類「農民階級」、第六類「勞工階級」，共計為六大類[84]。其中加入農業階級的理由為：在台灣社會和經濟中，農民和小商店主不論是在收入、思想觀念的刺激和接受、或生活條件及消費型態上，都具有很大的不同。

本研究大致上參照既有文獻和吳乃德(1997)分類標準依職業型態做七大階級分類。將第一類階層稱為專業人員，此階級在整體社會中擁有較多資源及優勢。第二類階層稱為專技人員，雖其不似第一階級掌握了大多的社會資源及工作權威，但仍較其他階級擁有較穩定的職業及生活條件，故本文研究並將第一類階級與第二類階級視為整體社會中之「上層階級」。至於第三、四、五階層分別為「白領勞工」、「小資產階級」、「農民階級」。但為因應時代變遷及整體經濟社會結構的改變，本文將雖從事專業相關工作，但僅擁有較低度專業技術且工作性質較制式化的職業，例

[84] 關於階級分類相關細節請參閱吳乃德(1997)，頁 9~10。

如醫療助理人、保險與房地產或證券銷售人員等也歸於第三類，並稱「白領階級」。此外，第四類稱為「小店主階級」，指小型商店業主。本文將第三類「白領階級」與第四類「小店主階級」則合稱為「中產階級」。另外農、林、漁、牧、狩獵工作人員則納入第五類「農民階級」。

至於勞工階級部分，依 Goldthorpe (1987)階級分類方式將勞工階級細分為第六類「技術性勞工」及第七類「半技術／非技術性勞工」。技術性勞工特別是接受過相關專業訓練才適宜從事之工作，非純粹體力工，而是具技術性的，例如家具木工、動力車輛修理工、各類製造工等。而半技術／非技術性勞工較屬於單純體力或操作工，例如貨物搬運工、垃圾收集工等。本文將上述第六類與第七類階級合稱為「勞工階級」。詳細階級分類和其內容參見表 1-2。

值得一提的是，本文所定義的階級係將相同工作性質、擁有類似生活條件，及相近的工作生命安全屬性的一群人放在同一階層內，以反應不同階級間的上下流動，而非僅是對各職業間的就業選擇。

需特別說明，由於有效樣本需要得知其教育程度、工作職業，與樣本父親從事最久之職業[85]。因資料限制，樣本受訪時其工作職業項目填答屬於職業不能分類之工作者有 1,175 筆。為確保有效樣本數目下，若遇上述無法使用的主樣本時，則以其兄弟姊妹的資料替代之[86]。經過上述取代後，再剔除資料仍不完整的樣本 483 筆[87]，共計總樣本數為 3,625 筆[88]。

因不同經濟環境背景與教育政策變革等因素影響下，造成不同年代出生者的教育成就可能有顯著差異，進而影響階級的流動。故本文依樣本出生年份區分為(1)民國 34 年前出生、(2)民國 35 ~44 年出生、(3)民國 45~54 年出生、(4)民國 55 年後出生等共四個世代以控制可能的不同世代效果[89]。

3.2 資料特性分析

[85]樣本若無填寫父親從事最久職業時，以 16 歲時父親從事的職業取代。

[86]由於本文使用之樣本出生年代涵蓋自民國 23 年～民國 65 年，部分樣本以有效之兄弟姊妹資料取代後出生年代範圍則爲民國 11 年～民國 70 年。

[87]剔除樣本仍無法以工作職業區分社會階級之樣本 367 筆、無父親從事職業者 113 筆，無教育程度資料者 3 筆，

[88]若考量手足個數變數,將再刪除 8 筆缺漏值,樣本數爲 3,617 筆。

[89]我國於民國 57 年起實施九年國民義務教育，故第一、二世代(民國 34 年前出生、民國 35 ~44 年出生)爲未接受九年國民義務教育的世代族群；第三、四個世代爲已接受九年國民義務之樣本。

由表 2 各項變數基本統計特性可知，父代階級以農民階級占比最高；子代階級以技術性勞工樣本數最多；樣本教育程度方面以高職教育成就比率最多。外省籍比例占 9.2%；男性樣本 2,154 筆，占 59.42%；相較原始樣本男性比例 48.51%明顯較高，這可能由於樣本中許多女性受訪者為家庭主婦，因家庭主婦非職業分類之選項，故被剔除之故[90]。而四個世代之樣本比率分別為：20.61%、30.54%、23.17%、25.38%；居住城市者占 52.89%；平均手足個數為 4.24 個。

表 2 變數資料基本統計特性

名稱	樣本數	平均數	標準差
父代階級			
第一類(專業階級)	3625	0.0154	0.123
第二類(專技階級)	3625	0.1159	0.3201
第三類(白領階級)	3625	0.0839	0.275
第四類(小店主階級)	3625	0.0734	0.2608
第五類(農民階級)	3625	0.4124	0.4923
第六類(技術勞工階級)	3625	0.1603	0.3670
第七類(半/非技術勞工階級)	3625	0.1396	0.3466
子代階級			

[90]本文的實證估計主要以職業別區分社會階級，故如同一般文獻(參見如 Heath and Payne (1999)、Iannelli and Paterson (2005)、許嘉猷、黃毅志(2002))剔除了家庭主婦這類不屬社會階級分類的樣本，因家庭主婦並非職業選擇的一個分項，故排除家庭主婦樣本應不致產生選擇性偏誤(selection bias)的情況。

第一類(專業階級)	3625	0.0284	0.1662
第二類(專技階級)	3625	0.1953	0.3963
第三類(白領階級)	3625	0.1694	0.3751
第四類(小店主階級)	3625	0.0726	0.2594
第五類(農民階級)	3625	0.1081	0.3106
第六類(技術勞工階級)	3625	0.3214	0.4671
第七類(半/非技術勞工階級)	3625	0.1051	0.3067
子代教育程度			
國小	3625	0.3148	0.4645
國/初中	3625	0.1393	0.3463
高中	3625	0.0585	0.2347
高職	3625	0.2212	0.4151
專科	3625	0.1297	0.3360
大學以上	3625	0.1362	0.3432
省籍	3625	0.0925	0.2865
性別	3625	0.5942	0.4911

世代			
第一世代(民國 34 年前出生)	3625	0.2061	0.405
第二世代(民國 35 ~44 年出生)	3625	0.3054	0.460
第三世代(民國 45~54 年出生)	3625	0.2317	0.422
第四世代(民國 55 年後出生)	3625	0.2568	0.437
城鄉	3625	0.5289	0.499
手足個數	3617	4.2350	2.166

資料來源：華人家庭動態資料庫(Panel Study of Family Dynamics)，RI1999、RI2000、RI2003 合併資料。

表 3 描繪各類別父代社會階級其子代教育程度分佈情況[91]。子代教育程度分佈情況以國小以下教育成就占 31.48%為最高；其次為高職 22.12%；而擁有大專以上學歷者約有 26%。從各父代階級的子女教育成就分佈來看，父代階級為第一層級的專業人員及第二層級專技人員的子代教育成就在大學以上比例約占三成多，擁有專科以上教育程度者更高達五成左右。但反觀父代為農民階級之子代樣本，其教育程度為國小以下占比為 52.51%，已超越了五成，但接受教育至大專以上程度者僅約一成，遠不及父代處於專技以上層級的子代之教育水準。

觀察父代第六與第七之勞工階級，我們仍可觀察到其子代接受大學以上教育的占比並不高，僅 12.91%、9.88%；而子代擁有專科以上學歷者各約 27%、25%，雖相較於父代在專技以上層級之子代仍有頗大差異，但與父代為農民階級之子代相比，受高等教育比率明顯較高。

[91]樣本父代社會階級以農民階級最多，為 1,495 筆，其次為勞力技術階級，而以專業階級最少僅 56 筆，這樣的情況可能由於本文所使用的樣本出生年代自民國 11 年起，而我國早期為農業結構社會，因此農民在父代樣本中占比最高。

另外，父代階級為白領及小店主之樣本，子代接受大學以上教育占比分別為27.57%、22.93%，雖未達三成以上，惟其子代受專科以上教育則將近五成，顯示父代為白領及小店主這類的中產階級對於子代的教育投資仍十分重視，培育子女至高等教育水準意願頗高。

總之，父代階級與子代教育成就呈現明顯的正相關；即父代階級愈高，其子代接受高教育者之比例也愈高。

表 3 各類父代社會階級的子代教育程度分佈（單位：%）

子代教育程度 / 父代階級	1(國小以下)	2(國/初中)	3(普通高中)	4(高職)	5(專科)	6(大學以上)	合計
1(專業)	10.71	7.14	16.074	19.67	16.0	30.36	100.00
2(專技)	9.29	5.24	6.437	23.55	20.9	34.52	100.00
3(白領)	7.31	7.64	8.645	25.29	23.5	27.57	100.00
4(小店主)	11.65	9.77	8.658	30.02	16.9	22.93	100.00
5(農)	52.512	16.3	4.282	16.3	6.29	4.28	100.00
6(技術勞工)	19.283	18.9	5.349	29.06	14.4	12.91	100.00
7(半/非技術勞工)	28.852	15.0	6.321	24.31	15.6	9.88	100.00
合計	31.483	13.9	5.852	22.17	12.9	13.66	100.00

表 4 為子代教育程度對應其社會階級之分佈情況，其中子代社會階級以技術勞工階層比例最高，為 32.14%，而子代農民階級僅占 10.81%，這是由於台灣以農為主的社會結構漸漸轉型後，子代相較於父代以農民階級為主的情況也漸獲改善。由表 4 所示，當教育成就在大學以上，有 12.53%會成為專業人員、58.79%為專技人員，共計高達七成比例可進入上層社會階級，僅 4%落入勞工階級。若教育成就為專科，則有近四成比例進入白領階級，也約有三成七進入上層社會階級。在高中、職的中等教育成就方面，各有三成多的比例落於技術勞工階級、二成四左右成為白領階級。但教育成就在國/初中以下者約有六成成為勞工階級，僅少數邁入上層階級，尤以國小以下教育成就者，進入上層階級的比例更不到 4%。

值得注意的是，各類教育成就分佈於最高階級的專業人員比例中，除了大學以上教育成就有 12.53%、專科教育成就有 5.74%的比例外，其他教育程度進入專業人員比例皆在 1%以下，顯示進入最上層階級似乎存在一最低教育門檻，必須具有專科以上學歷才比較有機會。另一方面，教育程度在國小以下者卻有 21.12%會落於最低的半/非技術勞工階級，另也有 27.78%成為農民階級。顯示教育程度與社會階級間明顯存在正相關,而高等教育程度者明顯有較高比例進入上層階級;而教育成就愈低者，愈會落於勞工階級、農民階級。

表 4 各類子代教育成就的社會階級分佈（單位：%）

子代社會階級 / 子代教育程度	1(專業)	2(專技)	3(白領)	4(小店主)	5(農民)	6(技術勞工)	7(半/非技術勞工)	合計
1(國小以下)	0.26	3.68	2.72	8.41	27.78	36.02	21.12	100.00
2(國/初中)	0.59	6.93	7.33	10.89	8.71	54.26	11.29	100.00
3(普通高中)	0.47	26.42	24.06	9.91	3.77	31.13	4.25	100.00
4(高職)	0.87	16.58	24.69	8.48	2.37	39.40	7.61	100.00
5(專科)	5.74	31.91	39.79	2.98	0.43	17.02	2.13	100.0

								0
6(大學以上)	12.53	58.79	22.22	1.82	0.40	3.64	0.61	100.00
合計	2.84	19.50	16.94	7.26	10.81	32.14	10.51	100.00

表5分析父代階級與其子代之階級的分佈情況。如前所述父代階級以農業階層居多，而子代社會階級以有技術勞工階級比例最高，最上層專業階級人數在二代中均占比例最少。當父代為專業、專技、白領階級時，其子代皆約有67%左右成為白領以上的階級；若父代為小店主，其子代除了約有55%在白領階級以上，另有18.42%落於小店主階級。此外，父代為農民階級，子代約七成從事農業與勞力部門的職業。再以父代為技術勞工階級來看，其子代仍為技術勞工階級占比42.69%、進入專技以上階級約有23%。在父代為半/非技術勞工階級中，其子代有13.04%仍停留於此階級，另38.54%邁入有技術勞工階級，但僅約18%代進入上層階級。

綜觀而言，普遍存在代間階級流動的僵固性，即父代階級愈高（低）者，其子代也有愈高比例停留於較高（低）之社會階級。例如專技、白領、農民、技術勞工的父代階級，其子代與父代均維持在一同類社會階級的比例也最高。惟值得注意的是，除了父代為農民階級以外，子代似乎皆有一定比例往白領的中產階級集中之趨勢。

表5 各類父代社會階級對應其子代社會階級所占百分比（單位：%）

子代社會階級 / 父代社會階級	1(專業)	2(專技)	3(白領)	4(小店主)	5(農民)	6(技術勞工)	7(半/非技術勞工)	合計
1(專業)	3.57	39.29	25.00	8.93	5.36	10.71	7.14	100.00
2(專技)	7.86	32.38	27.86	4.29	0.95	20.48	6.19	100.00
3(白領)	3.32	31.56	31.89	4.32	1.33	21.93	5.65	100.00

4(小店主)	2.26	30.83	22.18	18.42	0.75	22.56	3.01	100.00
5(農民)	1.54	11.64	8.70	6.62	23.75	33.71	14.05	100.00
6(技術勞工)	2.41	20.31	18.42	6.37	1.20	42.69	8.61	100.00
7(半/非技術勞工)	2.96	15.81	17.98	8.30	3.36	38.54	13.04	100.00
合計	2.84	19.50	16.94	7.26	10.81	32.14	10.51	100.00

肆、實證結果與分析

首先估計不同階級父代對其子代接受教育的影響。表 6 中第(1)欄為不同父代階級下，子代接受高等教育的相對勝算比估計結果。實證結果發現相較於父代為勞工階級者，當父代為上層階級時子代接受高等教育的相對勝算比為 3.31；若父代為中產階級則相對勝算比也有 2.35，這樣的結果顯示上層階級有壟斷教育的傾向，即父代階級愈高，子代愈有接受高等教育的優勢。此外，我們也觀察到農民階級的子代相較於勞工階級的子代受高等教育的相對勝算比小於一，顯示農民子弟接受高等教育的機會相對最小。

接下來我們分別進一步控制省籍、性別、世代、城鄉、手足個數等變數可能產生對是否接受高等教育的影響。由表 6 第(2)欄，我們發現外省籍子代受高等教育的相對勝算比較其他省籍族群來的高，這與吳乃德(1997)、駱明慶(2001)、莊奕琦與賴偉文(2008) 研究發現外省籍比本省籍具有較高的教育成就結論有類似的結果[92]。第(3)欄則再加入性別、城鄉和手足個數，發現在高等教育成就上，男性有較高的相對勝算比率，惟其相對勝算比僅 1.046，故男性相較女性在受高等教育方面雖有優勢但並不大，即性別對於是否能接受高等教育的影響差異不大。而這與 Iannelli and Paterson (2005) 以蘇格蘭資料呈現隨著社會結構變遷與教育水準普遍提高，在義務教育制度實施下男性已失去接受高等教育之優勢，年輕的世代中男女在教育成就

[92]本文另將省籍區分成外省、原住民、本省閩南、本省客家與其他，並以外省族群作爲參照組，估計結果顯示外省族群相較於原住民與閩南族群的子代接受高等教育均具優勢，與表 6 僅區分是否爲外省族群，而外省族群相對較有優勢的結論相似。因省籍細分結果並無特別額外發現，故本文乃採本省與外省籍兩種分類。

上之差異幾乎不存在的結果相似。結果並顯示居住城市接受高等教育的機會也較高，主要原因為城市教育資源相對於鄉村較豐富；而手足個數愈多接受高等教育的機會也較低，因在給定家庭資源下手足個數愈多競爭也愈大，故較為不利。此結果亦和既有文獻相似。

因不同世代的整體教育環境可能改變，故第(4)欄再加入了世代變數的考量，發現愈後面的世代接受高等教育有著愈高的相對勝算比，且呈現隨年輕的世代而遞增的趨勢。甚至最年輕的民國 55 年後出生之第四世代其相對勝算比高達 8.158，近代受高等教育機會能夠提升，政府普及中、高級教育政策是個相當大的關鍵因素。我國於民國 57 年起實施九年國民義務教育，三年內小學畢業生的升學率由原本 60%提高至 80%，十年後更超過九成，九年義務教育政策大幅提升了整體教育水準及人力素質，更為台灣的經濟起飛與產業結構轉換奠定下良好的基礎。另外，在政府對高中、中等技職與專科學校教育的積極推動下，大幅提升了民眾完成九年義務教育後升學的機會，1963 年至 1972 年的十年間，高中、中等技職學校由 254 所增至 374 所，專科學校由 15 所增至的 76 所。民國 80 年代以來則開放普遍設立大學院校，大學院校由 1993 年的 51 所增至 2002 年的 139 所，促使國民接受高等教育的機會大幅提升，故愈年輕世代接受高等教育相對勝算比也愈大。

最後，考量省籍在不同的世代間是否對於子代教育成就帶來不同的影響，故在第(5)欄加入省籍與世代的交乘項。估計結果顯示外省籍與第三世代、第四世代的交乘項係數顯著的小於一，並且呈遞減，表示外省籍族群隨著世代演進，其子代接受高等教育的優勢已逐漸減弱。這可能由於民國 57 年九年國民義務教育的推動後，接下來一連串技職教育、大專院校的成立，普及了教育水準，提升了每一個人接受高等教育的機會，高等教育不再是早期外省子弟的專利，其他族群一樣有機會。此估計結果與莊奕琦和賴偉文(2008) 發現相類似。

比較第(1)欄與第(6)欄的估計結果，加入相關的控制變數後，不同父代階級對於子代受高等教育的影響仍然維持一致的顯著結果，即父代上層階級壟斷子代教育的傾向至為明顯。

表 6 影響子代接受高等教育的相對勝算比估計 結果

	(1)	(2)	(3)	(4)	(5)
父代階級					

上層階級	3.311***	3.129***	3.134***	3.650***	3.639***
	(0.380)	(0.362)	(0.373)	(0.454)	(0.455)
中產階級	2.35***	2.014***	2.116***	2.411***	2.452***
	(0.256)	0.229)	(0.247)	(0.293)	(0.299)
農業階級	0.328***	0.340***	0.449***	0.615***	0.638***
	(0.036)	(0.037)	(0.052)	(0.074)	(0.077)
省籍		1.928***	1.505***	1.551***	8.059***
		(0.249)	(0.200)	(0.212)	(4.573)
性別			1.003	1.087	1.088
			(0.085)	(0.095)	(0.095)
城鄉			1.436***	1.408***	1.472***
			(0.128)	(0.128)	(0.136)
手足個數			0.789***	0.881***	0.883***
			(0.178)	(0.022)	(0.022)
世代					
第二世代				2.234***	2.350***
				(0.368)	(0.414)
第三世代				3.065***	3.455***
				(0.517)	(0.623)
第四世代				6.199**	7.390**

				*	*
				(1.042)	(1.316)
外省籍*第二世代					0.290**
					(0.179)
外省籍*第三個世代					0.183***
					(0.111)
外省籍*第四世代					0.110***
					(0.067)
Pseudo R^2	0.1183	0.1245	0.1572	0.1946	0.1987
樣本數	3625	3625	3617	3617	3617

註 1:括號中為標準差。*、**、***各表示 10%、5%、1%統計檢定顯著水準。

註 2:父代階級參照組為第六類及第七類(勞工階級)。上層階級包括第一類及第二類；中產階級包括第三類及第四類。

註 3:省籍參照組為非外省籍族群、性別參照組為女性。

註 4:世代參照組為第一世代，第一世代於民國 34 年前出生、第二世代於民國 35~44 年出生、第三世代於民國 45~54 年出生、第四世代於民國 55 年後出生。

註 5:城市虛擬變數參照組為鄉村，城市與鄉村的區別按內政部戶政司資料區分之。

註 6:手足個數為兄、弟、姊、妹的個數。

綜觀而言，我們可以推論父代為擁有較多社會資源的上層階級時，其子女接受高等教育的機會最大，特別是大學以上的教育程度，這可能由於上層階級往往掌控較多的政治、社會與經濟資源，故較有能力支援子女的教育投資。雖然政府實施九年國民義務教育及普設高等教育學校，但似乎不能改變父代社會階級愈高其子代接受教育程度愈高的壟斷傾向，只是在政府推動九年義務教育下普遍提升了全民整體教育水準，進而愈後面的世代接受高等教育的機會也較高。

為何利用階級優勢來壟斷教育？是否因為教育可以延伸和維持階級的壟斷？表 7 為估計教育成就高低對於進入社會上層階級的相對勝算比估計結果。第(1)欄分析結果顯示愈高的教育成就的確為進入上層階級帶來了更高的相對勝算比。換言之，若要進入上層階級，高教育成就是重要的先決條件，這也解釋為何發現愈上層階級要愈要壟斷教育。表 7 第(2)欄控制世代變數後，發現愈後面世代其進入上層階級的相對勝算比逐漸降低，民國 55 年後出生的第四世代僅 0.267，亦即愈晚出生的世代進入上層階級的機會有愈來愈不容易之趨勢。而控制了世代變數後，專科及大學以上教育成就進入上層階級的相對勝算比皆大幅提高，尤以大學以上教育程度，其相對勝算比高達 113。表 7 第(3)、(4)欄則分別再加入了性別與省籍的變數。性別變數方面，男性相對於女性進入上層階級有較大的相對勝算比，這有可能是因為女性職業要兼顧家庭、孩童的照料在職場的發揮較易受限，故傾向選擇較穩定和安全屬性的工作，如例行事務、行政性質工作，故升遷機會可能相對較少，抑或是工作上性別的歧視[93]。而在省籍變數方面，外省籍相較其他族群進入上層階級則居於劣勢，可能的解釋是外省籍在台灣乃屬於較少數的族群，故相對而言在進入上層階級方面較為不利。

控制世代、性別和省籍後，教育對進入上層階級的相對勝算比仍然維持同樣的顯著，此估計結果證實教育成就的確為進入上層階級的重要因素。

既然前面分析發現父代階級可壟斷子代的教育，顯然教育投資可帶來某種利得。古代由於係階級世襲制，故階級可因世代相承而繼續維持。然而在民主自由的現代社會，階級已無法由法律確保，故如何可確保某種程度的階級世代相承？如果教育可以做為上層階級維持的工具，則階級壟斷教育就有了合理的解釋。但是既便如此，中、下階級的子代是否仍可透過教育投資作為階級向上流動的有效管道？故我們接著檢測教育與代間階級流動的關係。

表 7 不同教育程度進入上層階級的相對勝算比估計結果

	(1)	(2)	(3)	(4)
教育成就				
國/初中	1.982***	2.818***	2.544***	2.538***

[93]Kunze and Troske(2007) 研究發現男女在工作搜尋行爲與選擇工作結果中，其差異來自非市場因素(例如:男女本質上的不同)，而非歧視造成之結果。故男女可能因爲先天上比較利益的不同，從而選擇不同屬性的工作，不必然由歧視造成。

	(0.450)	(0.668)	(0.607)	(0.606)
高中	8.957***	12.881***	11.792***	12.332***
	(1.944)	(2.938)	(2.705)	(2.839)
高職	5.151***	8.831***	8.399***	8.568***
	(0.918)	(1.759)	(1.678)	(1.711)
專科	14.713***	29.000***	27.537***	28.667***
	(2.640)	(5.999)	(5.715)	(5.967)
大學以上	60.546***	113.39***	109.46***	117.60***
	(11.000)	(23.590)	(22.850)	(24.838)
世代				
第二世代		0.592***	0.630***	0.640***
		(0.010)	(0.107)	(0.109)
第三世代		0.517***	0.565***	0.584***
		(0.091)	(0.100)	(0.104)
第四世代		0.267***	0.290***	0.290***
		(0.048)	(0.052)	(0.052)
性別			1.513***	1.502***
			(0.154)	(0.153)
省籍				0.704**
				(0.107)
Pseudo R^2	0.2589	0.2768	0.2811	0.2826
樣本數	3625	3625	3625	3625

註 1:括號中為標準差。*、**、***各表示 10%、5%、1%統計檢定顯著水準。
註 2:教育成就參照組為「國小以下」。
註 3:省籍參照組為非外省籍族群、性別參照組為女性。

註 4:世代參照組為第一世代，第一世代於民國 34 年前出生、第二世代於民國 35~44 年出生、第三世代於民國 45~54 年出生、第四世代於民國 55 年後出生。

既然教育程度和進入上層階級有正的相關，由前面估計結果又顯示父代階級愈高，其子代接受高等教育的相對勝算比也愈高，因此父代可以藉由子代教育投資以助階級的維持。然而更重要的是，透過教育成就的改善是否有助於帶來代間階級的流動？亦即父代為非上層階級，子代就無法邁入上層階級，上層階級永遠壟斷著階級地位！亦或是透過教育投資仍然可以為父代非上層階級的子代帶來往上層階級流動的機會？

表 8 第(1)欄估計各父代階級對於其子代進入上層階級之相對勝算比，實證結果顯示父代階級愈高，其子代進入上層階級之相對勝算比愈大，即存在階級僵固性。惟此模型之 Pseudo R^2 僅 0.0525，僅以父代階級變數單獨解釋其子代是否進入上層階級可能並不充分，因教育為影響階級的另一重要因素，故於第(2)欄再加入子代教育成就變數，結果顯示教育成就變數顯著，且愈高教育成就對於進入上層階級之相對勝算比愈大，但父代階級變數卻呈現皆不顯著的情況。這可能是由於尚未考量父代階級亦可能影響子代教育成就的關係(參見表 6)而造成無法看出父代階級、教育成就對子代進入上層階級真正的影響。故於表 8 第(3)欄我們加入父代階級與教育成就的交乘項，控制交乘項的估計結果顯示父代為上層階級時具有顯著效果，相對勝算比為 2.882，即父代為上層階級，其子代進入上層階級的可能性較父代為勞工階級者來的高，的確存在有父代階級高，子代階級也高的情況。換言之，父代為上層階級對其子代維持在上層階級具相對上的優勢！而教育成就變數方面，各教育成就變數相對勝算比數值仍維持顯著但相對於第(2)欄的幅度則皆減少，顯示在未控制父代階級對子代教育成就的影響下，可能造成高估教育成就變數的影響。

值得注意的是，在交乘項上，父代非上層階級與專科教育成就的交乘項相對勝算比顯著且大於一，比值為 3.227。這意謂著相對於國小以下教育程度，受專科教育為子代進入上層階級帶來了優勢，而這樣的優勢效果在來自非上層階級的子代又比來自上層階級的子代為大。父代非上層階級之子代，專科教育將可帶給其進入上層階級的好處。由於父代非上層階級的子代，生活條件與求學環境相對較差，而這樣的情況下能夠接受到高等教育的子代可能比同是受高等教育的上層階級子弟有著更高的抗壓性與克服困境的毅力，而進入職場後向上爭取晉升的決心也可能較為強烈。亦即，父代非上層階級，仍然可藉由教育成就改善而增加進入上層階級的機會，下

層階級的子代利用教育成就提升可彌補本身父代階級的不利，可見得透過高等教育的達成，提供了窮人一個階級翻身的機會！

至於為何僅在專科教育者為顯著，在大學以上學歷者卻不顯著，可能與樣本特性有關，因下層階級相對擁有的社會資源較少，子代進入高等教育的選擇較傾向為就讀專科(因就學年限較短且畢業後有一技之長較有利於就業)而非大學所致。由樣本資料可發現，接受專科教育樣本中有近八成父代為非上層階級，而在受大學以上教育者中父代為非上層階級的只占 67%，顯示來自非上層階級家庭背景的樣本在接受高等教育時有較多的比例就讀專科而非大學，以致造成估計結果僅在父代非上層階級而子代受專科教育者呈現顯著。

接下來，加入一些控制變數，第(4)欄加入世代因素的控制後，估計結果呈現愈後面的世代進入上層階級的相對勝算比愈低，顯示其他條件不變下，愈年輕世代似乎愈來愈不易進入上層階級，即愈不易白手起家，這樣的結果反應了進入上層階級的條件愈來愈嚴峻。另一個可能的原因，乃因資料特性所致，由於近期的世代資料，多屬年齡在 35 歲以下的年輕族群，故通常社會階級也相對較低，但等其年長後，則可能進入上層階級[94]。另外在控制省籍與性別方面的估計結果，亦發現如表 7 所示外省籍進入上層階級居於劣勢。相較吳乃德(1997)外省籍具較高勝算比結果相異，這可能是本文控制了世代的變數[95]，再加上由表 6 得知隨著時代變遷外省族群子代先天上接受高教育優勢已因義務教育的施行而喪失，且外省籍在台灣乃屬於較少數的族群，故相對而言在進入上層階級方面較為不利[96]。在性別方面，如同表 7 結果所示男性進入上層社會階級的確較女性有較高的勝算比。

由於不同世代的教育效果可能不同，表 8 第(5)欄則加入高等教育成就與世代的交乘項，試圖控制教育成就在不同世代間的影響效果。其估計結果皆不顯著，表示接受高等教育者，世代變遷對於其是否能進入上層階級的影響無顯著的差異。惟直覺上，近代產業結構已由勞力密集轉變為高技術知識密集社會，在技術知識更加重視的前提下，對於高等教育人才需求情況應更加提高，理所當然地，高等教育對於愈後面世代進入上層階級的重要性也應較早期世代來的高，換句話說，愈年輕世代接受了

[94] 感謝一位匿名評審之建議。

[95] 吳乃德(1997)資料來自國家科學發展委員會民國 83 年的「社會意向調查研究計劃」，樣本屬於較早的世代。

[96]此結果是否也可能代表外省族群的能力較差？我們試著將表 8 中教育成就控制變數拿掉，檢測外省族群進入上層階級之相對勝算比是否仍顯著小於一？估計結果顯示在控制父代階級後，外省籍相對非外省族群進入上層階級的相對勝算比雖大於一，但不顯著，即並不支持外省族群能力顯著較差的假設。另外，再加入世代、性別變數控制後亦不支持外省族群能力顯著較差的假設。感謝一位匿名評審對此假設檢測之建議。

高等教育理應能帶來邁入上層階級的助益，甚至是先決門檻。惟在本文實證結果呈現其相對勝算比雖大於一但並不顯著！換言之，教育成就影響進入上層階級的相對勝算比不會因為年輕的世代而佔有優勢。這樣的結果可能是由於政府高等教育普及政策，使得近代整體教育水準不僅普及而且提升，於是在高等教育人材方面的供給也相對增加許多（可對應表 7 結論），在需求面、供給面皆增加的情況下，使得較年輕世代雖然擁有高學歷，但對於進入上層階級卻沒有造成相對上之優勢。

表 8 影響子代進入上層階級的相對勝算比估計結果

	(1)	(2)	(3)	(4)	(5)
父代階級					
上層階級	2.584***	1.241	2.882*	2.610*	2.619*
	(0.309)	(1.127)	(1.603)	(1.458)	(1.464)
中產階級	1.955***	1.126	1.122	1.099	1.098
	(0.227)	(0.152)	(0.152)	(0.157)	(0.158)
農業階級	0.575***	1.182	1.199	0.964	0.964
	(0.061)	(0.149)	(0.153)	(0.127)	(0.127)
教育成就					
國/初中		2.032***	0.41	0.446	0.445
		(0.464)	(0.470)	(0.513)	(0.513)
高中		9.093***	3.942**	5.181**	5.200**
		(2.020)	(2.533)	(3.376)	(3.392)
高職		5.283***	3.173**	4.783***	4.821***
		(0.971)	(1.808)	(2.767)	(2.800)
專科		15.056***	5.286***	9.503***	8.578***
		(2.840)	(2.991)	(5.495)	(5.705)
大學以上		60.899***	28.366***	51.265***	46.284***

	(11.860)	(15.693)	(29.002)	(30.197)
父代非上層階級*國/初中		5.419	6.150	6.200
		(6.341)	(7.227)	(7.288)
父代非上層階級*高中		2.472	2.419	2.430
		(1.693)	(1.680)	(1.689)
父代非上層階級*高職		1.675	1.734	1.740
		(1.009)	(1.051)	(1.056)
父代非上層階級*專科		3.238**	3.227**	3.238*
		(1.944)	(1.952)	(1.960)
父代非上層階級*大學以上		2.264	2.22	2.231
		(1.341)	(1.326)	(1.331)
世代				
第二世代			0.634***	0.616**
			(0.108)	(0.119)
第三世代			0.586***	0.579***
			(0.106)	(0.122)
第四世代			0.289***	0.279***
			(0.053)	(0.662)
省籍			0.683**	0.684**
			(0.108)	(0.109)
性別			1.518***	1.520***
			(0.156)	(0.156)
專科以上教育成就*第二世代				1.143
				(0.472)

專科以上教育成就*第三世代					1.093
					(0.455)
專科以上教育成就*第四世代					1.141
					(0.479)
Pseudo R^2	0.0525	0.2597	0.2614	0.2846	0.2846
樣本數	3625	3625	3625	3625	3625

註 1:括號中為標準差。*、**、***各表示 10%、5%、1%統計檢定顯著水準。

註 2:父代階級參照組為第六類及第七類(勞工階級)。上層階級包括第一類及第二類；中產階級包括第三類及第四類。

註 3:教育成就參照組為「國小以下」。

註 4:世代參照組為第一世代，第一世代於民國 34 年前出生、第二世代於民國 35~44 年出生、第三世代於民國 45~54 年出生、第四世代於民國 55 年後出生。

註 5:省籍參照組為非外省籍族群、性別參照組為女性。

中產階級是支撐社會結構的重要穩定力量，因此本文繼探討子代能否流動至上層階級的議題後，再進一步探討中產階級的代間流動情況。表 9 為影響子代進入中產階級的實證結果，在控制教育成就、世代、性別等變數後，父代為中產階級者對於子代進入中產階級有顯著且最高之相對勝算比，即要進入中產階級以父代也為中產階級的族群是最具優勢的。而在教育成就變數方面，我們發現高中與專科最有進入中產階級的優勢。惟在世代變數方面，近二個最年輕世代要成為中產階級反而較前面世代來的不容易，這可能由於在其他條件控制後，近期的世代若要進入中產階級需要具備更高之資格，即本質上相對於較早時期成為中產階級的門檻提高了。

由於不同世代背景的教育效果可能不同，特別是九年義務教育實行後影響了不同世代的教育成就。台灣民國 57 起施行九年國民教育，三年內小學畢業生的升學率由原本60%提高至80%,十年後更超過九成;70 年代初期國中畢業生升高中比率約為67%，80 年代突破 80%、邁入 90 年代後更高達 95%以上；而在高中升大學比率方面，70 年代約 40%、80 年代增加至約 50%、至民國 96 年為止已達 87%。故加入中等以上教育成就與受九年國民義務世代之交乘項[97],以檢測義務教育的世代接受中等以上教育

[97] 第一與第二世代爲未受九年國民義務世代；第三與第四世代爲已受九年國民義務教育世代。

者是否較容易進入中產階級。其估計結果顯著且相對勝算比為 3.056，表示九年義務教育施行後教育成就在中等教育以上者具更大優勢。這也意謂著，九年義務教育政策有助於中產階級的產生，從而有助於社會的穩定。

本文實證結果顯示教育成就變數的相對勝算比遠高於父代階級變數，即教育成就對於是否進入中產階級有著相對較大的影響力[98]。而 Heath and McMahon（1999）以英國資料探討子代進入中產階級的機會，發現教育成就的影響力不如父代階級來的重要。此與本文的結果相異，可能原因為本文中，農民非屬中產階級，而 Heath and McMahon（1999）在階級分類上將農民、佃農歸屬於中產階級，其中農民與佃農二代間職業相關程度較高，故產生父代階級成為影響子代是否進入中產階級的最重要因素。

另外，以性別變數而言，男性較女性進入中產階級的相對勝算比小於一，即女性在這個方面反而佔有優勢。我們在觀察原始樣本分配比例上發現，總樣本中男性比率占 59.42%，惟於男、女在中產階級的分佈情況，男性比例僅佔 45.72%，女性樣本有相對集中於中產階級的情況，這可能是實證結果呈現女性在進入中產階級有較高相對勝算比的原因之一。推測此結果的可能原因有：一、中產階級工作性質可能本質上較適合女性從事，例如行政事務或服務性質銷售工作需要女性體貼及有耐心的特質；二、女性背負的家庭照顧責任一般來的較高，為了兼顧家庭較無法全心全力投入職場衝刺，造成在職場上停留於中等層級職位的機會較男性來的普遍。

綜上所述，父代階級、教育成就、世代、性別對於子代進入中產階級皆有顯著的影響。

表 9 影響子代進入中產階級的相對勝算比估計結果

父代階級	
上層階級	1.286*
	(0.167)
中產階級	1.533***
	(0.183)
農業階級	0.711***
	(0.078)

[98] 本文實證中父代階級變數以勞工階級作爲參考組，而教育成就變數以國小以下作爲參考組，由於勞工階級的教育程度以國小教育居多，因此兩參考組的基準相近，故階級與教育成就變數之相對勝算比（係數）可相互比較。

教育成就	
國/初中	2.745***
	(0.481)
高中	3.197***
	(0.625)
高職	2.671***
	(0.421)
專科	3.821***
	(0.664)
大學以上	1.481**
	(0.267)
世代	
第二世代	1.229
	(0.171)
第三世代	0.433***
	(0.101)
第四世代	0.466***
	(0.114)
性別	0.440***
	(0.372)
高中、職以上教育成就*已受九年國教世代	3.056***
	(0.733)
Pseudo R^2	0.1077
樣本數	3625

註 1:括號中為標準差，*表示 10%、**表示 5%、***表示 1%統計檢定顯著水準。

註 2:父代階級參照組為第六類及第七類(勞工階級)。上層階級包括第一類及第二類；中產階級包括第三類及第四類。

註 3:教育成就參照組為「國小以下」。

註 4:世代參照組為第一世代，第一世代於民國 34 年前出生、第二世代於民國 35~44 年出生、第三世代於民國 45~54 年出生、第四世代於民國 55 年後出生。

註 5:已受九年國教世代係指第三與第四世代。

伍、結論

本文採用「華人家庭動態資料庫」研究父代與子代間階級流動的情況，並探討教育成就是否為促進代間階級流動的重要關鍵因素。研究方法以分析父代階級對子代教

育成就的影響與子代教育成就對於階級選擇的影響，再進一步推論教育做為代間階級流動所扮演的角色。

實證結果發現父代為上層階級的子代接受高等教育相對最具有優勢，相較於勞工階級與農民階級子代，中產階級的子代也有較高的機會接受高等教育。另一方面，教育成就對社會階級有著顯著的影響，愈高的教育成就進入上層階級的相對勝算比也愈高，尤其具大學以上教育成就更有高度的優勢。毫無疑問地，高教育水準確實為個人階級提升帶來了助益，在上層階級的父代因擁有相對較多的社會資源，故更有優勢培育子代接受良好的教育,藉由教育的壟斷則更有機會將子代維持在上層階級。惟近四十年來，隨著九年國民義務教育的實施，在普設中、高級學校的教育政策變革下，愈後面的世代也有著愈高的勝算能接受高等教育，緩和了高等教育被壟斷的情況。

更重要的是，當父代為非上層階級時，其子代是否能夠藉由教育成就的提升以彌補本身父代階級條件的不足呢？本文實證結果顯示，相對於國小以下教育程度，受專科教育為子代進入上層階級帶來了優勢，而這樣的優勢效果在來自非上層階級的子代又比來自上層階級的子代為大。代表縱然父代非上層階級，子代一旦接受了高等教育，是可以藉由教育成就的改善彌補先天階級上的不利，來增加進入上層階級的優勢，窮人是有翻身的機會！惟實證結果也呈現，教育成就高低對進入上層階級的相對勝算比不會因為不同的世代而有所不同，對於較多接受高等教育的年輕世代，教育似乎沒有帶來進入上層階級的更多助益，顯示教育成就在現代知識技術密集的社會並無造就出想像中的優勢，除了可能因高等教育人才近年來因廣設大學確有大幅增加而造成高等教育人才過甚，從而競爭加劇外，值得我們注意的是高等教育人才的素質是否亦存在著下降的疑慮？惟整體而言，教育的普及與避免教育壟斷的確有助於社會階級代間的向上流動，給予窮人改善生活的機會，先天上家庭環境的不足仍可藉由後天教育成就的提升而改善階級壟斷！

中產階級在整體經濟結構的穩定上，一直扮演著舉足輕重的角色，本文發現高中與專科教育程度可造就出最有機會進入中產階級的優勢。我國於民國 57 年起實施九年國民義務教育後，接續普遍設立高中、職等中等技職教育及專科院所，大幅提升了國中生升學的機會，也為台灣經濟社會創造了一批優秀的中產階級族群。而這批中流抵柱對於七、八十年代台灣的榮景也功不可沒。此結果更突顯出教育作為促進階級流動和社會穩定的核心價值。本文亦發現農民階級子代向上流動至上層或中產階級，都是處於最劣勢的情況，這主要是由於農民子代在接受中、高等教育的機會也居於劣勢，以致不易造就出代間階級向上流動的情況。

本文研究結果證實教育為促進階級流動的重要管道，故教育政策的首要目標應該避免產生階級壟斷教育的現象，惟有人人教育機會均等的環境，才能真正達到階級的有效流動，讓窮人有真正翻身的機會。另外，政策上大幅開放高等教育應有正面意義,惟開放之餘更應著重教育品質的同等提升。若教育品質未隨開放數量同等提升，則非上層階級的子代雖更有機會進入大學但可能進入的都是低品質的大學，如此則對階級流動未必有實質幫助。

參考資料

吳乃德（1997),“檳榔和拖鞋，西裝及皮鞋”,《台灣社會學研究》,1, 137-167。

宋玫玫（2005),“公私立大專院校學生背景之差異”, 台灣高等教育資料庫第一次議題分析成果研討會。

孫清山、黃毅志（1996),“補習教育、文化資本與教育取得”,《台灣社會學刊》, 19, 95-139。

莊奕琦與賴偉文（2008),“影響教育成就的因素及九年國民義務教育政策效果評析台灣實證”,《人文及社會科學集刊》, 20(1), 25-65。

許嘉猷（1982), 出身與成就, 台灣地區的實證研究, 陳昭南、江玉龍與陳寬政主編社會科學整合論文集, 265-299。

許嘉猷（1994),“階級結構的分類、定位與估計：台灣與美國的實證研究之比較”,《階級結構與階級意識比較研究論文集》, 21-72, 台北：中研院歐美研究所。

許嘉猷（1992),《社會階層化與社會流動》，台北：三民。

許嘉猷、黃毅志,（2002),“跨越階級界限？兼論「黑手變頭家」的實證研究結果及與歐美社會之一些比較”,《台灣社會學刊》, 27,1-59。

陳正昌（2005),“社會階層背景與大學入學機會”, 屏東教育大學社會理論與教育研討會。

陳建州（2003),“從多元入學方案談教育機會均等”, 2003 台灣社會學會年會。

陳婉琪（2005),“族群、性別與階級：再探教育成就的省籍差異”,《台灣社會學》 ,10,1-40。

陳寬政與劉正（2004),“台灣的教育發展與教育流動：結構流動的分析”,《人口學刊》, 9, 71-94。

章英華、薛承泰、黃毅志（1996),“教育分流與社經地位兼論對技職教育革的政策意涵”,《教改叢刊》, AB09。

曾天韻（2004），“台灣地區出身背景對大學及研究所入學機會之影響”，《教育與心理研究》，27(2)，255-281。

華人家庭研究計畫（1999、2000、2003），《華人家庭動態資料庫》，台北：中央研究院人文社會科學研究中心。

黃芳銘（1998），“社會階級在家庭教育中控制結構與資源分配差異的探究”，《中大社會文化學報》，6，43-77。

黃毅志（1992），“結構變遷與地位取得之關係：以教育擴充為例”，《中國社會學刊》，16，89-105。

蔡淑鈴、瞿海源（1992），“教育階層化的變遷”，國家科學委員會研究彙刊：人文及社會科學，2(1)，98-118。

駱明慶（2001），“教育成就的省籍與性別差異”，《經濟論文叢刊》，30(1)，113-147。

駱明慶（2004），“升學機會與家庭背景”，《經濟論文叢刊》，32(4)，417-445。

謝雨生、余淑宜（1990），“台灣的社會階級結構及其流動”，《中國社會學刊》，14，31-63。

Feinberg, Stephen (1985), The Analysis of Cross-classified Categorical Data, 2nd ed., Cambridge, MA: MIT Press.

Goldthorpe, John H. (1987), Social Mobility and Class Structure in Modern Britain, 2nd ed., Oxford: Clarendon Press.

Greene, William H. (2003), Econometric Analysis, 5th ed., Prentice Hall.

Hauser, Robert M., John Robert Warren, Min-Hsiung Huang, and Wendy Y. Carter (1996), “Occupation Status, Education, and Social Mobility in the Meritocracy”, CDE Working Paper No.96-18, Center for Demography and Ecology, University of Wisconsin-Madison.

Heath, Anthony and Clive Payne (1999), “Twentieth Century Trend in Social Mobility in Britain”, CREST Working Paper No.70, Center for Research into Elections and Social Treads, University of Strathclyde.

Heath, Anthony and Dorren McMahon (1999), "Ethnic Differences in the Labour Market: the role of education and social class origins", CREST Working Paper No.69, Center for Research into Elections and Social Treads, University of Strathclyde.

Iannelli, Cristina and Lindsay Paterson (2005), "Education and Social Mobility in Scotland in the Twentieth Century", ESRC Research Project Working Paper No.5, Centre for Educational Sociology, University of Edinburgh.

Kunze, Astrid and Kenneth R. Troske (2007), "Comparative Advantage or Discrimination? Studying Male-Female Wage Differentials Using Displaced Workers", IZA Discussion Papers No.305, Institute for the Study of Labor.

Philip, Morgan S. and Jay D. Teachman (1988), "Logistic Regression: Description, Examples, and Comparison", Journal of Marriage and the Family, 50, 925-936.

Platt, Lucinda (1999), "Making Education Count: the Effects of Ethnicity and Qualifications on Intergenerational Social Class Mobility", Sociological Review, 55(3), 485-508.

Raffe, David, Linda Croxford, Cristina Iannelli, Marina Shapira, and Cathy Howieson, (2006), "Social-Class Inequalities in Education in England and Scotland", Special CES Briefing No.40, Center for Educational Sociology, University of Edinburgh.

Tasiran, Ali and Kerem Tezic (2006), "Parental Income and Continuing Education of Second Generation Immigrants in Sweden", International Review of Applied Economics, 20(4), 491-514.

Weber, Max (1968), Economy and Society, Edited by Guenther Roth and Claus Wittich, Berkeley: University of California Press.

行政院國家科學委員會補助國內專家學者出席國際學術會議報告

98 年 6 月 5 日

附件三

報告人姓名	莊奕琦	服務機構及職稱	國立政治大學 經濟學系
會議時間地點	98.5.28—98.5.31 University of Toronto, Toronto, Canada.	本會核定補助文號	96-2415-H-004-002-MY2
會議名稱	(中文) (英文) 2009 Annual Conference of Canadian Economic Association		
發表論文題目	(中文) (英文) Education and Social Mobility in Taiwan		

報告內容應包括下列各項：

一、參加會議經過

This is my first time to attend the Annual Conference of Canadian Economic Association, which is held this year for 43rd Anniversary at University of Toronto, Toronto, Canada. Over 1,000 scholars attending the conference this year from economics related field such as Macroeconomics, Labor Economics, International Economics, Development Economics, Financial Economics, Regional Economics, Health Issues, Labor and Demographics, Industrial Organization., and Women's and Gender Studies, etc., get together to discuss their research interests, findings, and relevant experiences and policy implications. . The major difference of CEA conference is that besides the presidential address there are also several keynote speeches and state of the art lectures from various research groups, which bring up most updated issues such as financial crisis, intellectual property right, poverty and inequality, Neuroeconomics, challenges in Macroeconomic policy, etc. This year's conference venue is at University of Toronto, where the meeting facility is excellent for academic presentation and better than in hotel as the traditional conference does, and moreover the university bookstore is just next door to the conference site providing a great convenience to access for all participants.

二、與會心得

This is indeed a great pleasure and opportunity for me to be able to joint the conference, to exchange research results, and to share the experiences with distinguished scholars from different concentrations. The Canadian experience is also very unique in the sense that a market economy with a great interaction by government and unions. The keynote speech by Prof. Jeffrey Williamson from Harvard University on "Trade and Poverty," highlighted the importance of culture, geography, and institutions in shaping the process of globalization. There are several topics and presentations that take current issues of financial and environmental crises seriously which stimulate and render fruitful discussion. My paper on education and social mobility in Taiwan provides an empirical method to estimate and test the investment in education and its role on social mobility using Taiwan's PSFD data, which received a harm discussion (about ten questions being raised) from the paper discussant and participants. I had benefited very much from their suggestions. I also commented a paper on the effect of cognitive ability and grades on post-secondary educational achievement in another session. After three and half days of academic exchange and discussion, I had learned a lot on technical modeling and new perspectives on research topics and agenda especially related to education. Discussion with scholars from Canadian universities also helps me in understanding the organizational structure and functioning of the Canadian higher education.

三、建議

I strongly recommend domestic scholars to joint a comprehensive and international conference such as CEA's annual conference to learn more multicultural experience and at the mean time to enhance Taiwan's visibility on the international arena. Of course, to organize a

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