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DIFFERENTIAL RETURNS TO EDUCATION ACROSS COGNITIVE ABILITY LEVELS: EVIDENCE FROM CEBU LONGITUDINAL HEALTH AND NUTRITION SURVEY DATA

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ABSTRACT

This thesis estimates the returns to education in association with childhood cognitive ability for Filipino youth using the Cebu Longituditional Health and Nutrition Survey Data. After reviewing a wide range of literature on returns to education and cognitive ability, we find that limited studies have analyzed the returns to education in conjunction with childhood cognitive ability in the context of developing country. Estimated results using Ordinary Least Square method show that the male returns to education at average cognitive level is 2.5% and for female it is around 8%. The marginal effect of schooling decreases as cognitive ability increases indicating that schooling has the largest impact for low cognitive ability people. Female seems to earn 20% less than males, signaling the need for policy formulation for female empowerment. Employment type has positive and significant impact on earning, mother's education, base level household income, family size and community level characteristics have positive but insignificant impact on earnings.

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CHAPTER 1

Introduction

The relationship between education and development has long been recognized in the development literature. Education is considered an important input for development processes as well as a product of development process. Education is recognized as a crucial input for income generation, behavioral change of an individual, economic well- being of the society and economic growth of the country as a whole by various research works in the contemporary literature of development economics. Although it is considered an important factor in the development literature, there have been limited empirical studies to measure its impact in the context of developing countries. In recent studies, lots of research has been done focusing on different aspects of economic development associated with education, mostly based on the Mincerian framework. Some of the studies are summarized below.

CHAPTER 2

Literature review

Returns to Education and Cognitive Ability

Fang et al. (2012) estimate the returns to education in the context of China using the China Health and Nutrition Survey (CHNS) data collected in 1997, 2000, 2004 and 2006.They use Instrumental variable (IV) approach to estimate the impact of education treating per capita income as the dependent variable and years of schooling, age, gender, ethnicity, marital status, urban residency and health status as explanatory variables. Most existing studies use data from before 1995 which do not include the information regarding educational reform, so the results may not be relevant in present context. The estimated results show that the returns to education in China have increased from less than 5 percent prior to the early 1990s to about 20 percent during the period of 1997 to 2006. The updated returns to education in China reflect a significant increase in returns, converging to levels comparable to or exceeding those in Western countries. The limitation of the study is that the observations included represent only 9 provinces. In this case, the results might not be nationally representative since there exists a vast diversity in terms of geography and household set up. Due to that fact, it fails to capture the effect of diverse characteristics.

Warunsiri & McNown (2010) employ a pseudo-panel approach for estimating returns to education in the context of Thailand treating the endogeneity problem. Estimated results show a downward bias of the returns to education in least squares regressions with individual data, which is confirmed with instrumental variable estimation. The overall rate of return was found to be between 14% and 16%. Females have higher returns than males, and workers in urban areas have higher returns than those in rural areas. As practiced by

numerous studies, they use a wage (hourly) equation for estimation, and includes years of education, experience, age and distance as independent variables. Basically, the model is based on the Mincerian framework which may not be appropriate for developing countries because large population of self-employed people residing in rural area. Blundell et al. (2001) evaluate the returns to education using individual data obtained from a British 1958 National Child Development Study (NCDS) birth cohort employing three estimation methods: matching method, IV method and control function method. The estimated results show strong evidence of heterogeneous returns to education with IV estimator. However; the findings of this study might not appropriate in the context of developing country due to the imperfect market structure.

Brenner & Rubinstein (2011) investigate the returns to education in the U.S. using a sub-sample of white males from the National Longitudinal Survey of Youth (NLSY79) and find that individuals from poorer families exhibit higher marginal returns to education relative to their wealthier counterparts. This finding suggests that higher marginal costs, rather than inability to benefit from education, prevent those individuals from continuing their education. Regarding the methodological case, their results were found to be robust to OLS, IV and fixed-effects specifications. Furthermore, they show that it contains a group of individuals whose cognitive abilities are comparable to those of the most gifted rich, as well as a group of individuals who demonstrated non-cognitive problems and low cognitive abilities. Additionally, they claim that the paper is the first to provide direct evidence that the returns to education decline with family income or with parents' education and that this

result is robust to various estimation methods, functional forms, age, labor market status and data sets.

Trostel et al. (2002) examine the economic return to schooling using comparable micro data from 1985 through 1995 in the context of developed countries worldwide and find considerable variation in rates of return across countries. The authors are not able to find evidence for worldwide rising rate of returns to education from 1985 through 1995. Indeed, estimated results indicate that the worldwide rate of returns declined slightly over the period. They use hourly wage as the dependent variable and education, marital status and some other exogenous explanatory variables as independent variables. Additionally, they use spouse and parent education as instrumental variables in order to address the exogeneity bias during the estimation process. However; parental education are poor instruments as they are unlikely to satisfy the exclusion restriction needed in an IV approach. Conventional OLS estimators suggest a worldwide average rate of returns to schooling of just under 5% for men and a little under 6% for women. Additionally, IV estimator indicates that the OLS estimates are biased downward by 1%. Findings might differ in various aspects compared to developing countries due to geography, community level characteristics, childhood ability and structure of society. Our present study incorporates those information along with childhood ability as explanatory variables which will make this study unique in the sense that childhood cognition would be linked to adulthood earning.

Some literature focuses on uncertainty of educational return in a developing economy, emphasizing gender issues, poverty, inequality and economic growth.

In this nexus, Mohapatra & Luckert (2012) examine uncertain educational returns in Indian using a nationally representative survey dataset on labor markets collected in 2005-2006. They consider wage as the dependent variable and educational attainment, gender, age, region of residence, and social and religious affiliation as independent variables. The maximum likelihood estimates show that the wage-education slope parameter across individuals is statistically significant for all levels of education except for women's primary education. Furthermore, the results show that uncertainty in educational returns increases with level of education level .For example the uncertainty in men's returns increases from 19% at the secondary level to 25% and 33% at the higher secondary and university level. Overall, the mean returns to education is consistent with previous studies in India which found it to be higher for women relative to men.

Macro level research, focusing on the impact of educational attainment on economic development has found significant effects which vary depending on the educational level. Gyimah-Brempong (2011) uses panel data to estimate the effects of educational attainment on development outcomes in African countries using random effect (RE), dynamic fixed effect (DFE) and GMM-IV estimation methods. He finds a positive and significant impact of educational attainment on development outcomes. Additionally, he finds that the different levels of education affect development outcomes differently; for some development outcomes, primary and secondary education have found to be more important than tertiary education, while for income growth rate, tertiary education has found to be more important. The study related to African countries is relevant to our present study in some aspects. For example, it focuses on developing

countries and has evaluated the impact of educational attainment on per capita income as the development variable even though it is macro level case.

Michaelowa (2000)studies the issue of returns to education in low income African countries and raises some questions regarding the limitation of the study and conclusions drawn by contemporary empirical work. He argues that the generally agreed and consistent conclusions are not possible due to imperfect market structure and unavailability of relevant information especially for low income countries, whose information on earnings is practically difficult to obtain.

Hu et al. (2014)estimate returns to education in China using optimal instrumental variable selection methods on a simulated annealing algorithm. Employing an instrumental variable regression method and generalized method of moments, they find that the returns to education of Chinese residence are 9.96%.The study includes 1630 samples in which monthly wage is treated as the dependent variable based on Mincer's theoretical framework. In the sample, urban residents account for 70% of the total sample, 45% of the respondents work in government agencies and 55% work in small business. The limitation of the study is that it does not emphasize the rural households and childhood and youth characteristics. In terms of methodology, it is well organized and addressed the issue of endogeneity selecting appropriate instrumental variable.

Most research on this topic is based on Mincerian framework. However; Oostendorp & Doan(2013) uses a different approach to estimate the returns to education. They estimate the returns to education in terms of change in wage rather than employment, effectively ignoring the fact that during globalization

not only wages but also employment patterns were affected. They use four large-scale representative household surveys from the transition economy of Vietnam for the period 1998–2006 to estimate the returns to education taking into account both changes in wages and employment. The results show that the estimated increase in returns to education is lower once changes in employment patterns are taken into account. They consider trade, mining and manufacturing sectors with wage as the dependent variable. One important issue regarding the returns to education is that the educational level may affect regional distribution of labor which has not been incorporated in the study. Likewise, their study has not addressed the issues of migration, liberalization and trade reform. The relevance of this paper for us is that both the countries are developing and have some similarities in the context of household living standard. The difference is that they focused on wage earner households while our focus would be both wage earner and self employed who have reported their tentative earning.

The common belief and findings of the previous study show that the returns to education are highest for primary education and lower for subsequent levels. However; a recent study suggests that the pattern is changing. Colclough et al. (2010) study the changing pattern, its causes and their implication for both education and labor-market policy. They conclude that the returns to primary schooling are decreasing where as returns to secondary and higher education have been increasing. This pattern implies that the expected demand for only primary education is falling and increasing returns to secondary and higher education implies that children are being able to proceed to secondary and beyond that level. (ibid)One explanation for this might be that primary education has lower earnings increments associated with it than in the past,

thereby reducing its direct poverty-mitigating potential. They argue that basic education is valued not only for its economic benefits but also for its non-market benefits in terms of reductions in fertility and mortality, empowerment, better environment, lower crime, and democratic participation..

The issue regarding the wage earner and self employed worker raised above is relevant to our present context in the sense that the self employed and wage earner both are included in our study. This study has slightly different approach for estimating returns to education as compared to contemporary research related to returns to education. Our interest is to examine the returns to education of adults similar in age in conjunction with childhood cognitive ability in addition to other explanatory variables. While much of the literature examining the returns to human capital focuses on education, there is a strand of literature that investigates the returns to individual cognitive ability. This paper adds to that limited literature.

It is generally accepted that output depends on quality of input, technology and the environment for production activities. If we expect productive human resource, they should have gone through effective training to acquire required skills and strength for the concerned production activities. It is true that healthy, skilled and motivated human resources are the key to better production output. My point here is to associate childhood skill formation activities to adulthood output generation and its importance. Youth education, health and employment outcomes are prime concern worldwide as it indicates the future of each nation.

The relationship between education and economic development has been thoroughly studied in the development literature exploring different aspect of impact

and consequences. However; limited research has been done in terms of adulthood earning in association with children cognitive skill. Villa (2014) investigates how health, cognition and specific noncognitive abilities are jointly produced over the different stages of childhood in the context of developing country using CEBU data. Her findings indicate that cognition at age eight has a significant effect on health stock at age eleven; and parental investment has positive effect on health and cognitive development. Additionally, results show that initial health has positive effects on adulthood health stock and positive behavior. Her study has created space for us to estimate differential returns to education across cognitive skill using the latest data.

Lee & Newhouse (2012) provide cross- country evidence on the impact of cognitive skills on youth employment outcomes using the World Bank's cross country data on test scores for OECD countries. Their findings indicate that improvement in cognitive skills reduce unemployment and improves job quality in the medium term. They also find that school enrollment rates rise and rates of working and unemployment ratios drops as test scores for cognitive skill rises. Additionally, their findings indicate increasing job quality, improvement in occupational status and falling agricultural employment as cognitive skill rises. The limitation of the study is that they focus on estimating returns to education using macro level youth cognitive skill as one of the main explanatory variables in their study. Basically, these macro level studies provide evidence in favor of a positive impact of cognitive skill on different aspect of economic transformation at the aggregate level such as decreasing crime rates and increasing economic well-being. It is a true fact that the formation of cognitive skill is not overnight process, it starts form childhood which is influenced by various components such as health formation,

parental inputs, community factors and own characteristics. Consequently, childhood cognitive skills influence youth skill formation which ultimately influences outputs represented by earning, status and economic well beings in adulthood. In this nexus, our study focuses the impact of educational attainment in association with childhood cognitive skills on adulthood earning outcomes in the context of a developing country which has not been well studied in the literature of development economics.

Contemporary studies on returns to education focus on school attainment rather than quality of education and cognitive skills of children and young people. Heckman & Vytlacil (2001) investigate the role of cognitive ability in explaining the level and the change in the rate of returns to schooling using National Longitudinal Survey of Youth (NLSY) data incorporating the possible estimation problems such as identification and ability bias problems. Due to those problems, they used nonparametric methods to estimate identified parameters and find that the college/ high- school premium increased for young person of the fourth quartile of ability but not for a young person in third quartile of ability in which estimates were found to be very fragile. When they stratify on the basis of work experience, they find mild evidence of an increase in the college/ high-school wage differentials for the most-able men with low levels of work experience. They primarily focus on problems associated with estimation techniques to identify the role of cognitive ability to estimate returns to schooling using panel data. However; it is limited to linking youth cognitive skill to estimate the returns to education in the sense that it does not consider childhood characteristics as explanatory variables.

Kerckhoff et al. (2001) study education, cognitive skills and labor force outcomes using National Adult Literacy Survey (NALS) data obtained from

National Center for Education Statistics. They investigate three questions: "Are educational attainment and cognitive skill affected by antecedent influences (background, ethnicity, and native language) in the same or different ways? Do educational attainment and cognitive skills each make independent contributions to an explanation of occupational status and earnings? To what extent do educational attainment and cognitive skill, individually and in combination, mediate the effects of back- ground, ethnicity, and native language on occupational status and earnings?"Their findings indicate that antecedent factors affect educational attainment and cognitive skills in different ways, and separately serve to explain labor force outcomes. Furthermore, estimated results show that both educational attainment and cognitive skills influence labor outcomes independently in different ways and degrees for different ethnic groups. However; they do not fully explain the estimation methodology and are unable to link the childhood effect to labor force outcomes.

Numerous studies have been carried out evaluating the role of cognitive skill in promoting economic well-being. Hanushek & Woessmann (2008) evaluate the role of cognitive skills in economic development with a focus on the role of school quality and quantity and find strong evidence that cognitive skills rather than school attainment are powerful determinants of individual earnings, income distribution and economic development. Additionally, their findings of a larger skill deficit for developing countries signal the need of structural change in schooling institutions in order to close the gap with developed countries. In similar context, Cawley et al. (1998) examine the contribution of the rise in the return to ability to the rise in the economic returns to education using a nonparametric method with panel data as they reject the widely used linearity assumption invoked to identify the contribution of

return to ability on the return to education, and find little evidence to support higher returns to education for people with higher ability.

Gertler et al. (2014) experimentally evaluate the long term impact of an early childhood psychological stimulation intervention on earnings in Jamaica. Twenty years after the intervention was carried out, they find 25% higher earnings in the stimulated group compared to those of the control group. The estimated results show substantially larger effects for Jamaica compared to the US based study and suggest that psychological stimulation intervention in early childhood might be an effective policy tool for improving long- term outcomes of disadvantaged children especially in developing countries. A Similar study by Moll (1998) evaluates the effects of primary schooling and cognitive skills on wage in South Africa and finds computational skills are more influential than comprehension skills for wages. Furthermore, he suggests that costless reallocation of resources in favor of mathematical training could be an effective policy to ensure better long term future earnings.

Heckman (2010) shows that early childhood development directly influences economic, health and social outcomes for individuals and society. Heckman (2011) highlights, argues and justifies the importance of investment in early childhood. Burger (2010) evaluates the effect of preschool programs and care programs, and finds the considerable positive short-term effects on child cognitive development, relatively higher progress in children from economically disadvantaged families compared to their more advanced peers.

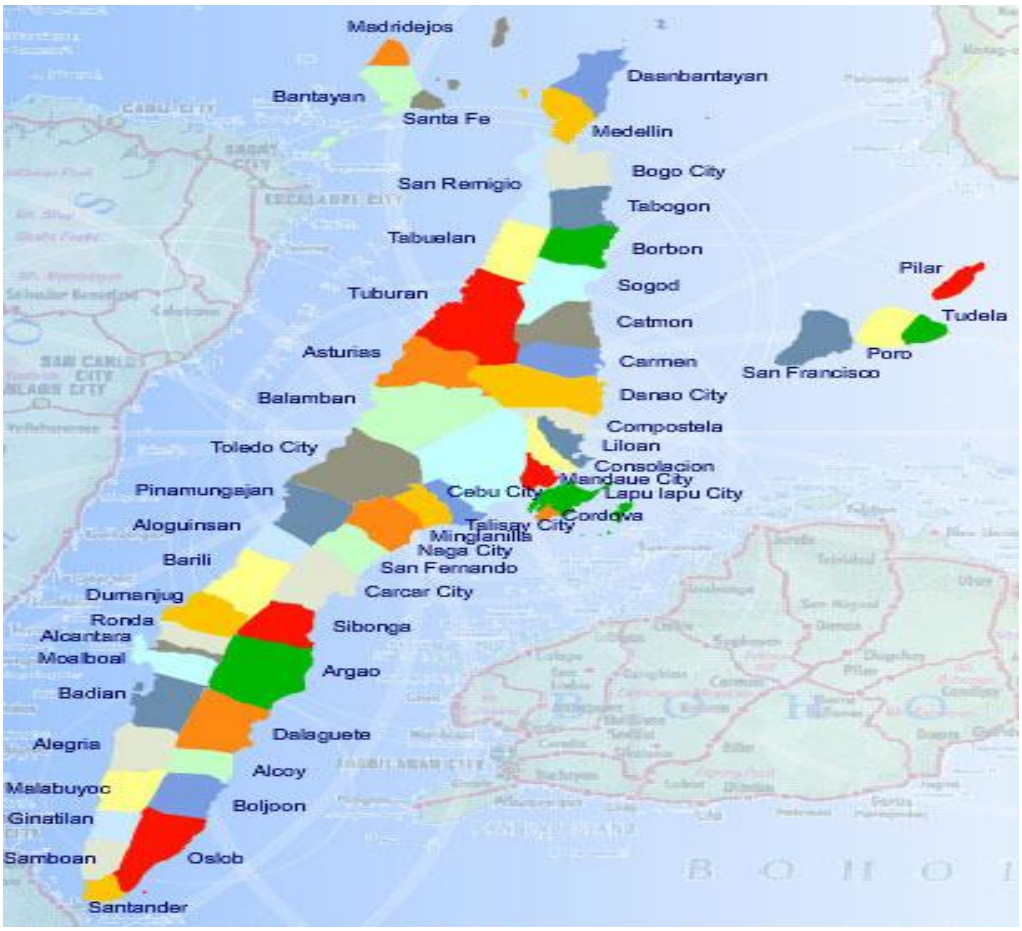
Brief information about study location of CEBU[1]

Cebu is an island province in the Philippines, consisting of the main island itself and 167 surrounding islets. Cebu is one of the most developed provinces in the Philippines, with Cebu City as the capital of Cebu Island and the main center of commerce, trade, education and industry. The Cebu Island is long and narrow stretching 122 miles from north to south and 20 miles across at its widest point. The entire island is about 1,725 sq mile in area and accommodates around 3.5 million people in which 2.3 million live in Cebu metropolitan area. The official language spoken in the Cebu is Cebuano which is spoken by around 93% of people

Regarding the education system, Philippines has three layers of education: elementary school from grade one to grade six, high school from six to twelve and undergraduate and above as higher level. Cebu has several educational institutions including schools and colleges specializing in various courses like Medicine, Engineering, Nursing, Law, Commerce, Education, Computer science and other professions. The country has adopted mandatory high school (K-12 system) and around 16% of the total budget is allocated for education sectors. Student may choose vocational subject after elementary school which might impact the earning level in youth. Since high school is mandatory for all, school enrollment is not the problem of interest but vocational education may impact youth earnings.

[1]: **https://en.wikipedia.org/?title=Cebu**

Map of Cebu


Madridejos
Bantayan
Santa Fe
Daanbantayan
Medellin
Bogo City
San Remigio
Tabogon
Tabuelan
Borbon
Pilar
Sogod
Tuburan
Tudela
Catmon
Asturias
Carmen
Poro
San Francisco
Balamban
Danao City
Compostela
Toledo City
Liloan
Consolacion
Mandaue City
Pinamungajan
Cebu City
Lapu lapu City
Cordova
Aloguinsan
Talisay City
Minglanilla
Naga City
Barili
San Fernando
Carcar City
Dumanjug
Ronda
Sibonga
Alcantara
Moalboal
Argao
Badian
Dalaguete
Alegria
Alcoy
Malabuyoc
Boljoon
Ginatilan
Samboan
Oslob
Santander

CHAPTER 3

Data Description

This study uses the data set from Cebu Longitudinal Health and Nutrition Survey (CLHNS) which is part of an ongoing study of a cohort of Filipino women who gave birth between May 1, 1983 and April 30, 1984. The CLHNS was originally designed as a study of infant feeding patterns and diets. The cohort of children born during that period, their mothers, other caretakers, and selected siblings have been followed through subsequent surveys conducted in 1991-92, 1994, 1999, 2002, and 2005. The baseline survey was conducted from May 1983 through April 1984 in randomly selected 33 communities called barangays[2] (17 urban and 16 rural) from the Cebu Metropolitan area. Approximately 2,600 household were studied intensively collecting detailed health, nutrition, demographic, and socioeconomic data. .The 1991-92 study added information on entry into school, and administered a non-verbal intelligence test (IQ). The 1994-95 follow-up study of women and children from the original CLHNS was undertaken beginning in October of 1994 and was completed in October of 1995. Basic questionnaire modules from the original and 1991 follow-up surveys were administered to ensure continuity with previous rounds of data collection. Additional information on school achievement and non-verbal intelligence were added. The 1994 survey added tests achievements score of Cebuano, English reading and mathematics. In 2005 survey, the CLHNS added schooling, work, and earnings information.

The main focus of this study is to estimate the effect of early childhood cognitive achievement level to educational returns in adulthood. Sticking with the primary goal of our study, we employ required data information influencing indexed child's education and earning such as indexed children's personal information, parental education, community factors, household information and

[2] smallest administrative division in the Philippines for a village, district or ward

employment patterns. We use detailed information on schooling, marital status, sex, employment patterns, community information and earnings of indexed children when they were 22 year old in 2005. We use baseline parental education information from 1983-84 surveys, baseline household income and urban indicators such as access to electricity, telephone, internet, household size, market days, cooking fuel, piped drinking water etc from 1994 surveys. Achievement tests on mathematics, English and Cebu are taken from 1994 surveys when children were eleven years old. Likewise IQ scores are adopted from 1994 when children were eleven years old. We used IQ test and achievement test scores to represent cognitive scores of sample children.

Table 1: Description of variables used in this analysis

Variables	Description
LN(INC)	Log of income per year of indexed child in local currency
FEMALE	Dummy variable for female
EDU	Highest grade completed by indexed child
C94ZZ	Standardized value for achievement and IQ test score
MARRIED	Marital status of indexed child,
MOMEDU	Highest grade attained by indexed child's mother
LN(HHPCINC)	Per capita income of household for base year (1983)
MAINEMPL	Main employment of the indexed child (four types below)
SELF(1)	Self employed and operated by close family members
FAMILYPRIV(2)	Privately owned business by family
PRIVATECO(3)	Private company
GOVNGO(4)	Government and non-profit organization
HAZ94	Height for age- z-score for indexed child

Table 1: Continued...

Variables	Description
HAZ94	Height for age- z-score for indexed child
PIPEWTR94	Household's access to piped water
TOILETFL94	Household toilet flushes or water sealed
GARBG94	Household has designated garbage pickup
ELECTR94	Access of household to electricity
COOKFUEL94	Access of household to clean cooking fuel
EXCRETA94	Access of household to visible excreta
CLFD94	Area where food kept in is clean?
HHSIZE94	Number of person living in household
MRKTDAY	Does this barangay have specific market
TELEPHONE	Access to telephone
INTERNET	Access to internet

Our observations consist of the information from survey 1983, 1994 and 2005. Indexed child's educational attainment, gender, marital status, income employment types and community level characteristics (MRKTDAY, TELEPHONE and INTERNET) are obtained from 2005 survey. The achievement scores, IQ scores and control "variables 94" (includes: HAZ94, PIPEWRT94, TOILETFL94, GARBG94, ELECTR94, COOKFUEL94, EXCRETA94, CLFD94 and HHSIZE) are obtained from survey 94. Here, cognitive ability is obtained by standardizing achievement test scores on English, math, Cebu language and IQ score. Additionally, base level household income and mother's education are obtained from the 1983 base year survey. While extracting the income information

of indexed children, we considered only the income generated by main employment.

The summary statistics of observations used are presented in Table 2.

Table 2: descriptive statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
LN(INC)	973	10.895	0.821	7.272	14.942
FEMALE	973	0.471	0.499	0.000	1.000
EDU	973	10.016	3.216	0.000	16.000
C94ZZ	973	-0.077	1.177	-2.559	3.532
MARRIED	973	0.275	0.447	0.000	1.000
MOMEDU	973	6.856	3.535	0.000	17.000
LN(HHPCINC)	973	7.396	1.069	0.223	11.307
MAINEMPL(SELF)					
FAMILYPRIV	973	0.319	0.466	0.000	1.000
PRIVATECO	973	0.540	0.499	0.000	1.000
GOVNGO	973	0.039	0.194	0.000	1.000
HAZ94	973	-2.036	0.984	-5.250	1.840
PIPEWTR94	973	0.402	0.491	0.000	1.000
TOILETFL94	973	0.553	0.497	0.000	1.000
GARBG94	973	0.333	0.472	0.000	1.000
ELECTR94	973	0.761	0.427	0.000	1.000
COOKFUEL94	973	0.447	0.497	0.000	1.000
EXCRETA94	973	0.556	0.497	0.000	1.000
CLFD94	973	0.147	0.354	0.000	1.000
HHSIZE94	973	7.187	2.393	2.000	18.000
MRKTDAY	973	0.106	0.308	0.000	1.000
TELEPHONE	973	0.931	0.253	0.000	1.000
INTERNET	973	0.693	0.462	0.000	1.000

Of the total observation, there are 47% female and 53% male. On average achievement score in math, English and Cebu are 30, 27 and 13 respectively. Mean IQ score is 68. For occupation, around 54% of indexed children are working in private companies, 31% are working in family owned private firms, only 3% are involved in government and non-profit organizations and around 12% are self employed (operated by indexed child). 80% have access to electricity, 95% have

telephone and 70% have access to internet. Average years of schooling completed by indexed child is 10, whereas average years of schooling for mothers is 7.The average household size for the year 94 is 7, which indicates that most of the household is living as joint family.

CHAPTER 4

Estimation Strategy and Econometric Model

Theoretical Framework

We consider simple functional form explaining the impact of earning of an individual child as:

$$INCOME = f(P, H, X, R, \varepsilon) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

INCOME = yearly earning of an indexed child of year 2005

P = personal characteristics representing educational attainment, cognitive ability, marital status and gender of an indexed child (year 2005).

H= family and household characteristics that includes base level parental education[3], base level household income and main employment type of indexed child for year 2005.

X= vector of control variables from year 1994 when a child took achievement and IQ test (electricity, pipe water, clean food storage, cooking fuel, flush toilet, garbage facility, household size and excreta)

R = community characteristics that includes market day, access to telephone and internet.

ε= individual heterogeneity captured by error term

The functional form explained by (1) clearly shows that the income of an individual is determined by their own characteristics such as educational attainment, cognitive ability level, marital status and gender. These components are not solely

[3] Survey data consist of very few observations on father's education. So we use only mother's education in our regression.

responsible for determining the level of income; there are other components such as family and household characteristics (parent's education, household income level and the occupation type they choose to work) represented by "H" in the functional form. Additionally, there are some other factors such as access to electricity, clean drinking water, garbage facility, household size, food storage facility, height of age index and excreta represented by "X" that may affect the level of earning. Lastly, community level characteristics represented by "R" may influence earning level.

Econometric Model

Most of the empirical studies on returns to education are based on the model developed by Mincer (1974). In the basic Mincer equation, variation in individual's earning is explained by years of schooling and experience, with a linear relationship between schooling and earnings. The basic Mincer equation consists of heteroskedasticity and endogeneity problems which has been widely criticized by many researchers who have suggested modified estimation methods. Among them Card (2000) offers a modified estimation method addressing those issues while estimating returns to education. Nonetheless, Mincer's equation still offers a good starting point for the estimation involving labor market outcome associated to education.

For our estimation purpose, we consider two basic models as follows:

$$\ln(INC) = \beta_0 + \beta_1 EDU + \beta_2 C94ZZ + \beta_3 FEMALE + \beta_4 MARRIED + \beta_5 (EDU * C94ZZ) + \beta_6 H + \beta_7 X + \beta_8 R + \varepsilon_0 \quad \ldots\ldots(2)$$

Where, H,X and R are the vectors of household-family characteristics, control variables 94 and community level characteristics as explained in equation (1).

To allow for the possibility that returns to education likely vary according to cognitive ability, we also include an interaction term between educational attainment and cognitive achievement.

We standardized factor score for cognitive ability, C94ZZ, using confirmatory factor analysis on four achievement test scores: math, Cebuano, English, and IQ. Individual and family background controls included in the model are marital status, gender, occupation type, maternal education, per capita household income when the index child is born and height-for-age z score when the index child is 11 years old. We also include a number of household and environmental controls from when the child is 11 to control for childhood conditions. These controls include indicator variables indicating whether or not the household has access to piped water, electricity, a clean food storage area, clean cooking fuel, a flushable toilet, garbage facilities, and whether excreta is visible around the household. Finally, we include 2005 community controls indicating access to telephone services. Internet and a market.

It is likely that there are differential returns to education and cognitive skills depending whether the individual is male or female. We therefore modify (2) to include interactions with a female indicator variable to allow for differential returns according to gender. When we introduce female interaction with education and cognitive ability, equation (2) becomes as shown below:

$$\ln(INC) = \alpha_0 + \alpha_1 EDU + \alpha_2 C94ZZ + \alpha_3 FEMALE + \alpha_4 MARRIED + \alpha_5 (FEMALE * EDU) + \alpha_6 (FEMALE * C94ZZ) + \alpha_7 (EDU * C94ZZ) + \alpha_8 (FEMALE * EDU * C94ZZ) + \alpha_9 H + \alpha_{10} X + \alpha_{11} R + \mu_0 \ldots\ldots\ldots\ldots\beta)$$

Equation (3) consists of four interaction terms that make this equation different from equation (2) and the interpretation of the coefficients of those terms would be slightly different compared to equation (2). We can evaluate the marginal rate of returns to education for both males and females using the following mathematical derivation.

To find the marginal returns to education in the case of interaction term is obtained by differentiating equation (2) with respect to "EDU" as:

$$\frac{\partial(INC)}{\partial(EDU)} = \beta_1 + \beta_5 C94ZZ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

In the case of "FEMALE" interaction, marginal rate of returns to education is obtained by differentiating equation (3) with respect to "EDU" as:

$$\frac{\partial(INC)}{\partial(EDU)} = \alpha_1 + \alpha_5 FEMALE + \alpha_7 C94ZZ + \alpha_8 (FEMALE * C94ZZ) \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

From equation (4), the returns to education at average cognitive level (Z94ZZ=0) without "FEMALE" interaction term is $\boldsymbol{\beta_1}$. From equation (5), the returns to education for male is evaluated when FEMALE=0 and C94ZZ=0; and the returns to education at average cognitive level for "FEMALE" is evaluated when FEMALE=1 and C94ZZ=0. Therefore, Male returns to education= α_1, and Female returns to education= $\alpha_1 + \alpha_5$

CHAPTER 5

Empirical Results

Tables 3 and 4 report estimates from equations (2) and (3), respectively. In each of these tables we estimate the model with and without added controls. Incrementally adding controls at the individual-, household- and community-level has little effect on our main estimates of interest. This alleviates concern that unobserved characteristics correlated with our control variables are contaminating our results

Table 3: parameter estimation results for equation (2) using OLS estimator

Dep Var:LN(INC) VARIABLES	Scenario I	Scenario II	Scenario III	Scenario IV
EDU	0.0436***	0.0278**	0.0270**	0.0305**
	(0.0103)	(0.0111)	(0.0114)	(0.012)
C94ZZ	0.197***	0.103	0.103	0.0663
	(0.0727)	(0.0740)	(0.0754)	(0.0841)
EDU*C94ZZ	-0.0125**	-0.0074	-0.00778	-0.0034
	(0.0059)	(0.0060)	(0.0061)	(0.0068)
FEMALE	-0.201***	-0.273***	-0.265***	-0.303***
	(0.0453)	(0.0466)	(0.0472)	(0.0528)
MARRIED	0.0342	0.0389	0.0425	0.0386
	(0.0504)	(0.0511)	(0.0514)	(0.0575)
MOMEDU		0.0064	0.0061	0.0089
		(0.0073)	(0.0077)	(0.0088)
LN(HHPCINC)		0.0290	0.0291	0.00848
		(0.0224)	(0.0232)	(0.0256)
FAMILYPRIV		0.183**	0.190**	0.191**
		(0.0779)	(0.0787)	(0.0882)
PRIVATE		0.620***	0.621***	0.635***
		(0.0768)	(0.0774)	(0.0864)
GOVIGO		0.300**	0.296**	0.326**
		(0.138)	(0.139)	(0.152)
HAZ94			0.0206	0.0317
			(0.0237)	(0.0269)
PIPEWTR94			-0.0209	-0.0219
			(0.0494)	(0.0580)
TOILETFL94			-0.0335	-0.0200
			(0.0547)	(0.0626)
GARBG94			0.0203	0.0554
			(0.0526)	(0.0625)

Table 3: Continued...

Dep Var:LN(INC) VARIABLES	Scenario I	Scenario II	Scenario III	Scenario IV
ELECTR94			0.0142	-0.00412
			(0.0628)	(0.0709)
COOKFUEL94			0.0129	-0.0516
			(0.0534)	(0.0624)
EXCRETA94			-0.0420	-0.0147
			(0.0475)	(0.0540)
CLFD94			-0.0034	0.0967
			(0.0667)	(0.0764)
HHSIZE94			0.0032	-0.0005
			(0.0094)	(0.0106)
MRKTDAY				0.0429
				(0.0851)
TELEPHONE				0.0711
				(0.110)
INTERNET				0.0332
				(0.0649)
Constant	10.58***	10.08***	10.14***	10.19***
	(0.117)	(0.201)	(0.238)	(0.277)
Observations	1,410	1,292	1,288	973
R-squared	0.065	0.141	0.144	0.171

From Table 3, in all four scenarios, effect of educational attainment to earning is highly significant and the sign of the coefficient is consistent with the findings of previous literature. The estimated results show that, at average cognitive level (C94ZZ=0) the returns to education is 0.043 in the first scenario and 0.30 in the fourth scenario. It implies that at average cognitive ability, one more additional years of schooling causes an increase in earnings by 4.3% (from scenario I) and from scenario IV, it is 3%. In the case of cognitive ability, the estimated coefficient is significant implying one point change in average cognitive level leads to increase earnings by 19.7% (from scenario I) and from scenario IV, it seems to be 6.6%. Estimated coefficient of cognitive index in scenario II, III and IV seem to be

insignificant but the sign patterns are consistent. The impact of gender to earning is significant at 1% significance level. The coefficient can be interpreted as the earning decreases by 20% (from scenario I) when the gender is female, implying a 20% wage difference between male and female. From the policy perspective, this result indicates the need of appropriate policy formulation in favor of female empowerment so as to ensure equality in terms of earning.

The coefficient associated with interaction term (EDU* C94ZZ94) seems to be negative which is not counter intuitive. It implies that the marginal effect of schooling decreases as cognitive ability increases. ,or that the effect of cognitive ability decreases as schooling increases. This would indicate that schooling has the largest impact for low cognitive ability people. Regarding the impact of marriage, it shows that the earning difference is 3% if a person is married. It is probably due to the fact that both husband and wife are able to work and earn more. In association with mother's education, most of the literature indicates that mother's education has a significant impact on children's educational attainment. However; in our estimation results, mother's education has a very small but positive effect on the earnings of children. Likewise, the occupation types exert significant impact on earnings in different degrees. Our results show that occupation category "FAMILYPRIV" and "PRIVATE" are statistically significant at 5% and 1% significance level respectively. It indicates that the indexed children working in private company are earning the highest income compared to the elf employed category. Additionally, in association with base level household income, one percent rise in the base household income leads to an increase in earnings of indexed children by 2%. The implication of this result is that the family with a higher level of

income is able to provide the required facilities for their children enabling them a favorable environment for study.

Model 2 as explained by equation (3) is estimated under four different scenarios and presented the values in the table (4). As similar to model 1, the first scenario includes the indexed children's own characteristics, the second scenario includes family and household characteristics, the third scenario includes "control 94" variables and the fourth scenario includes community controls. Four scenarios are different only due to the inclusion of independent variables.

Table 4: Parameter estimation with OLS when female interaction is introduced

Dep Var: ln(inc) VARIABLES	Scenario I	Scenario II	Scenario III	Scenario IV
EDU	0.0257*	0.0038	0.0039	0.0006
	(0.014)	(0.0146)	(0.0150)	(0.0170)
C94ZZ	0.147	0.107	0.104	0.0981
	(0.098)	(0.0986)	(0.101)	(0.111)
FEMALE	-0.730***	-0.916***	-0.888***	-1.031***
	(0.229)	(0.231)	(0.234)	(0.260)
FEMALE*EDU	0.056***	0.065***	0.063***	0.074***
	(0.020)	(0.0208)	(0.0210)	(0.0233)
FEMALE*C94ZZ	0.375**	0.239	0.254	0.259
	(0.151)	(0.153)	(0.154)	(0.170)
EDU*C94ZZ	-0.0093	-0.00827	-0.0082	-0.0089
	(0.0082)	(0.0084)	(0.0085)	(0.0092)
FEMALE*EDU*C94ZZ	-0.0310**	-0.0212*	-0.0222*	-0.0180
	(0.0125)	(0.0127)	(0.012)	(0.0139)
MARRIED	0.0522	0.0597	0.0634	0.0719
	(0.050)	(0.0508)	(0.051)	(0.0569)
MOMEDU		0.0071	0.0068	0.0108
		(0.0072)	(0.0076)	(0.0086)
LN(HHPCINC)		0.0357	0.0365	0.0155
		(0.0222)	(0.0230)	(0.0252)
FAMILYPRIV		0.195**	0.201***	0.216**
		(0.0773)	(0.0780)	(0.0869)
PRIVATE		0.619***	0.620***	0.631***
		(0.0762)	(0.076)	(0.0852)
GOVIGO		0.290**	0.286**	0.301**
		(0.137)	(0.138)	(0.150)

Table 4: Continued...

Dep Var: ln(inc) VARIABLES	Scenario I	Scenario II	Scenario III	Scenario IV
HAZ94			0.0228	0.0313
			(0.023)	(0.0265)
PIPEWTR94			-0.0212	-0.0270
			(0.0489)	(0.0570)
TOILETFL94			-0.0266	-0.0055
			(0.0543)	(0.0617)
GARBG94			0.0187	0.0575
			(0.0521)	(0.0615)
ELECTR94			-0.0030	-0.0248
			(0.0623)	(0.0699)
COOKFUEL94			0.0153	-0.0569
			(0.0529)	(0.0614)
EXCRETA94			-0.0376	-0.0058
			(0.0470)	(0.0532)
CLFD94			-0.0011	0.0999
			(0.0662)	(0.0752)
HHSIZE94			0.0049	-0.00030
			(0.0093)	(0.0105)
MRKTDAY				0.0372
				(0.0839)
TELEPHONE				0.120
				(0.109)
INTERNET				0.0222
				(0.0640)
Constant	10.73***	10.25***	10.28***	10.36***
	(0.157)	(0.221)	(0.254)	(0.289)
Observations	1,410	1,292	1,288	973
R-squared	0.087	0.159	0.162	0.200

Table (4) represents the estimation results when female interaction terms as shown in the table are introduced. In the First scenario, male returns to education is significant at 10% significance level and the value is 2.5%. But, the estimated values are not significant in scenarios II, III and IV. As explained by equation (5), at average cognitive level (C94ZZ=0), male returns to education is 2.5% from first scenario estimation. Likewise, female returns to education at average cognitive level is (0.0257+0.0562= 0.0819) 0.0819 which is statistically significant at 1%

significance level. We have tested the significance of the parameter separately and are able to confirm its significance as shown in table (5). From table (5), the impact seems to be 7.5% which is statistically significant at 1% significance level. It implies that for females, education has a larger impact on returns to education and this finding indicates the need of appropriate policy formulation in order to empower females. The rate of returns to education is around 6% when indexed child is married. The estimated parameter is positive but not significant.

Table 5: test of significance of female returns to education

Ln(INC)	Coef.	Sd.Err.	t	P>|t|	95% Conf. Interval	
(1)	0.0750	0.0176	4.240	0.000	0.0403	0.109

As we keep on adding more control variables, values of estimated parameters do not change significantly. In association with base level household income, a 1% increase in base level household income leads to rise in earnings by 3% implying that family in good financial condition can provide a favorable environment for education to their kids. However; base level household income is not the main contributor for earning in this case. The effect of mother's education has positive but negligible effect to earnings. Parameters of Occupation categories "FAMILYPRIV" and "PRIVATE" are statistically significant at 5% and 1% significant level. It implies that an indexed child earns around 20% more than base category "SELFEMPLOED" when they work in family owned private category and earns around 60% more than base category when they work in private company "PRIVATE" employment category.

Overall, educational attainment and childhood cognitive ability are able to influence earning in adulthood positively. Community factors also exert some shock

on earnings. Mother's education and family size have positive but very small effect. Occupation type also matters for earning variation especially; people involved in private company earn significantly more income compared to self employed people. The most important finding of this estimation is that the effect of cognitive ability decreases as schooling increases. Additionally, the findings indicate that schooling has the largest impact for low cognitive ability people.

CHAPTER 6

Discussion and Conclusion

This study estimates the rate of returns to education in association with childhood cognitive ability for Filipino children born between May1, 1983 and April 30, 1984 using Cebu Longituditional Health and Nutrition Survey Data. We employ two econometric models to estimate the parameters using OLS method. The estimated results show mixed effects in the sense that some of the coefficients are highly significant, some are properly signed but not statistically significant and the rest are not properly signed. The present topic is a unique and broad subject requiring thorough empirical investigation concerning the estimation methodology. After reviewing the literatures, we find that limited studies have been done concerning the returns to education in conjunction with childhood cognitive ability in the context of developing country. In that sense, this topic is unique and we hope that the findings of this study will contribute to the literature of development economics by filling the research gap suggesting some policy implication in the context of developing country.

Our estimation results indicate that one percent rise in educational attainment contributes to a rise in earnings by around 4% in the case when female interaction term is not included. Females seems to earn 20% less than males implying that appropriate policy formulation is desirable in order to minimize the gender gap in terms of earnings. When the female interaction term is introduced, male returns to education at average cognitive level is 2.5% and female returns to education at average cognitive level is around 8%. Both the results are statistically significant at 1% significance level. It implies that for female, education has larger impact on returns to education and this finding indicates the need of appropriate policy formulation in order to empower females. The negative sign of the interaction term of cognitive level and education implies that the marginal effect of schooling

decreases as cognitive ability increases, or that the effect of cognitive ability decreases and schooling increases. This would indicate that schooling has the largest impact for low cognitive ability people. For better and more secure future, we should invest in child education. More educated societies would be able to innovate new things, creates new opportunity, and higher productivity through higher ability to introduce new technology. So only one suggestion for policy maker- be generous in investing in child education especially female education.

Additionally, our results show that there is positive effect on earning when the indexed child is married implying that married couples are more conscious about earnings. The employment type has positive and significant impact on earnings. In particular, an indexed child can earn 60% more than self employed children when they choose to work in private company, 30% more when they work in government sector and around 19% more when choose to work in family owned private sectors. Mother's education, household size and base level household income seem to have positive but insignificant impact on earnings. Likewise, community level characteristics have positive but insignificant effect on indexed children's earnings.

FUTURE RESEARCH

This study is a broad topic that requires further investigation to provide exhaustive analysis of the topic. Due to time limitation, we are unable to employ all intended methodological approach to evaluate the issue. In the future, we will expand the empirical methods addressing the issue of unobserved biases and occupation selection.

Using the simple Mincerian framework elucidated above, we estimate the joint returns to schooling and cognitive ability. However, any estimates from this framework ignores the indirect effect of these variables on earnings through occupation selection. To address this issue, we plan to use a Multinomial Logistic (MNL) approach to model selection into occupation types as used by Glick & Sahn (1997). Using the MNL model we will then estimate the probability that each individual is employed in each occupation type and apply the approach in Dubin & McFadden (1984) to calculate an inverse mill's ratio for each occupation. We use these calculations to correct for selection into different occupations and estimate the joint returns to schooling and cognitive ability within each occupational category.

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