THE MISMATCH IN THAI LABOR MARKET: OVEREDUCATION

Akkaya Senkrua

A Dissertation Submitted in Partial
Fulfillment of the Requirements for the Degree of
Doctor of Philosophy (Economics)
School of Development Economics
National Institute of Development Administration
2015

THE MISMATCH IN THAI LABOR MARKET: OVEREDUCATION

Akkaya Senkrua

School of Development Economics

Assistant Professor.....Major Advisor

(Suchittra Chamnivickorn, Ph.D.)

Professor.....Co-Advisor

(Nattapong Thongpakde, Ph.D.)

Assistant Professor.....Co-Advisor

(Santi Chaisrisawatsuk, Ph.D.)

The Examining Committee Approved This Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy (Economics).

Associate Professor.....Committee Chairperson

(Yongyuth Chalamwong, Ph.D.)

Assistant Professor.....Committee

(Suchittra Chamnivickorn, Ph.D.)

Professor.....Committee

(Nattapong Thongpakde, Ph.D.)

Assistant Professor.....Committee

(Santi Chaisrisawatsuk, Ph.D.)

Assistant Professor.....Dean

(Nada Chunsom, D.B.A.)

September 2015

ABSTRACT

Title of Dissertation	The Mismatch in Thai Labor Market: Overeducation
Author	Akkaya Senkrua
Degree	Doctor of Philosophy (Economics)
Year	2015

Greater educational accessibility in Thailand has considerably contributed to a collective higher level of educational attainment of the Thai labor force. Nevertheless, with the ease of access, the number of workers with overeducation has significantly risen. Overeducation refers to a situation in which a person's education attainment exceeds the requirements of a job, giving rise to a variety of unfavorable outcomes for individuals, employers and society.

This research examines three research questions: 1) Does the educational mismatch (i.e., overeducation) exist in Thailand's labor market?; 2) Is the overeducation in the Thai labor market demand-driven or supply-driven?; 3) Do overeducated workers suffer any form of wage penalties and, if so, are the penalties identical across the earnings distribution? Quantitative analysis is thus employed using the 2006 and 2011 Labor Force Survey datasets. In addition, the samples are weighted so that they are representative of the entire population.

The classification of mismatched workers in this research work is based on the correspondence between the International Standard Classification of Occupations (ISCO) and the International Standard Classification of Education (ISCED) developed by the Organization of Economic Cooperation and Development (OECD). The workers are thus classified into overeducated, properly matched, and undereducated workers. The analysis reveals that the overeducation situation in the country has gone worse from 6.27% in 2006 to 8.51% in 2011. Workers with a college degree in social sciences accounted for the largest proportion (60%) of the overeducated employees. In addition, the likelihood of overeducation is subject to the chosen fields of study, in which the workers with a tertiary degree in medicine and those with a non-tertiary science degree are least likely to suffer from overeducation.

Additional attempts are also made to determine the plausible causes of overeducation to enable a better understanding of the mechanisms by which the demand and supply forces interacted. The findings identify two determinants of the current state of overeducation among Thai labor force: higher education being synonymous with "buying an insurance" and the education inflation. The former has been responsible for a multitude of workers pursuing college degree with the hope of finding a securing job, not matched job upon graduation, and the latter, i.e., an increase in the supply of college graduates lowers wages and leads to overeducation. Hence, effective management of the supply-side factors is a possible solution to tackle overeducation in the labor market.

The public sector and policymakers should make efforts to combat the overeducation problem due to the adverse effects of the mismatch on the workers' incomes and their employers. This research finds that overeducation induces a negative effect on the employees' earnings (i.e., a 30% underpayment) and that the penalties are different between men and women. Male employees encounter a more severe wage penalty than their female counterparts. Moreover, the overeducated workers with a tertiary degree face more severe wage penalties than the overeducated upper-secondary graduates, inadvertently contributing to the lower between-groups wage inequality.

This research also studies the relationship between overeducation and a lack of unobserved skills through quantile regression. The findings reveal a significantly greater negative effect of overeducation on the more skilled workers who are in the top segment of the wage distribution than those with less skilled of the same educational level, suggesting the absence of the correlation between overeducation and the lack of unobserved skills. Also, the greater accessibility to higher education contribute to an increased within-groups dispersion.

This dissertation concludes with the policy implications for mitigation of the overeducation problem through effective management of the supply-side factors: students and educational institutions. Government may increase private costs of college education in order to reduce the supply of college graduates. To be precise, government may reallocate its educational budget more to vocational education. Educational institutions should provide better guidances to students in making the choices of fields of study in order to reduce the incidence of overeducation. Students should be provided with job experience in college possibly through cooperative programs.

ACKNOWLEDGEMENTS

This dissertation would never have been accomplished without the assistance and guidance of numerous individuals to whom I wish to acknowledge and thank.

First and foremost, I would like to express my deepest appreciation for Assistant Professor Dr. Suchittra Chamnivickorn, my thesis advisor. I would not have been able to complete this dissertation without her timely and insightful guidance and encouragement. I am especially grateful to her reading of many immature drafts, initial results, word by word corrections and comments. I am truely appreciated for her timely appointment because I needed to travel a distant from Phitsanulok in Northern Thailand to the capital city of Bangkok. I could not have imagined having a better advisor and mentor for my doctoral study. This dissertation owes much to her.

Besides my advisor, I would like to thank the rest of my committee members, Associate Professor Dr. Yongyuth Chalamwong from TDRI, Professor Dr. Nattapong Thongpakde and Assistant professor Dr. Santi Chaisrisawatsuk for their constructive comments and suggestions, but also for the hard questions rolled out at me in my thesis defense, which motivated me to further into the depths of my research.

Finally, I would like to express my gratitude to my mother, Benjamas Senkrua, for her understanding, encouragement, support, and love, without which this dissertation would not at all has been possible. No word is enough to express how grateful I am to my husband, Boonake Champunod, for giving me the opportunity to pursue my Ph.D. study, helping me to take care of our two daughters during this long journey and standing by me through good and bad times. My two lovely daughters, Mild and Mim, who are always there in good spirits cheering me up and making me smile with the sentence "Go for it, mom. You can do it."

Akkaya Senkrua

July 2015

TABLE OF CONTENTS

LIST OF TABLES

Tables **Page**

LIST OF FIGURES

Figure **Page**

ABBREVIATIONS

Abbreviation	
ISCO	International Standard Classification of Occupation
ISCED	International Standard Classification of Education
ISIC	International Standard Industrial Classification of all economic activities
OECD	Organization for Economic Co-operation and Development

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.1 Introduction

In the recent decade, the role of education as an instrument in promoting many desirable goals has increasingly been criticized. Once education is seen as the vehicle in promoting national economic growth and more equitable distribution of income. Human capital theory suggests that education enhances worker productivity and is reflected in higher individual earnings. These beliefs have led to an expansion of education. Following the tenth national economic and social development plan (2007-2011), education policy ensures that every Thai citizen has access to no fewer than 12 years of basic education with free of charge. Basic education is divided into six years of primary education and six years of secondary education. In 2009, the government under the Prime Minister Aphisit Vetchachewa has launched 15 year free education policy, kindergarten to upper secondary education. Due to free education, the dropout rate has decreased from 0.7% in 2009 to 0.44% in 2011. The educational structure in Thailand is shown in figure 1.1.

Technical and vocational education (TVE) begins at the senior high school grade where students are divided into either general or vocational education. Today, around 60 per cent of students follow the general education programs. The labor market has faced the problem of labor shortage in vocational education, that is, firms face excess demand for vocational workers. So, the government is endeavouring to achieve an equal balance between general and vocational education. TDRI (2011) has revealed that there will be an increase in demand for labor with vocational education. More than 200,000 workers will be needed, especially in the area of science and technology over the next five years due to expansion in industries such as automotive and parts, where there are plans to double their production capacity in this country.

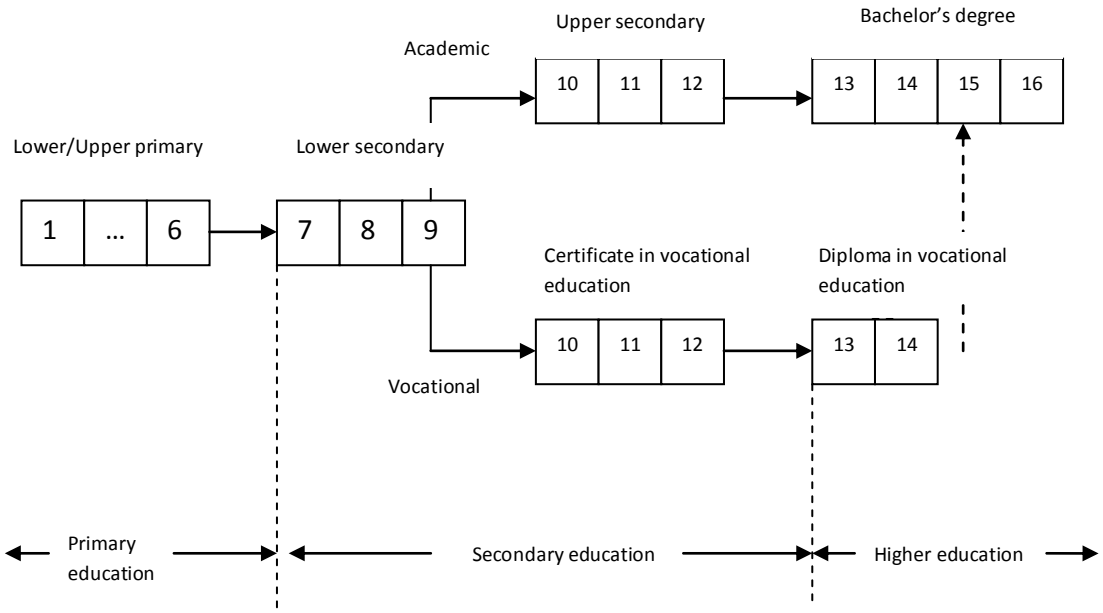


Figure 1.1 Structure of Education systems in Thailand

Source: Somchai Amornthum and Yongyuth Chalamwong, 2001.

The government has realized the importance of this matter and undertook various strategies attempting to improve the number and the quality of vocational education graduates, especially in the field of science and technology. Over the next nine years, the Ministry of Education aims to boost the ratio of vocational education to general education from the current share of 23:77 to 60:40.

In 1990, the government has implemented the first long-term plan for higher education with the aim to make higher education more accessible and more affordable to the Thai public. The move has thus fueled exponential growth in the tertiary education sector following a big jump in the university enrollments. Accordingly, the supply of university graduates entering the labor market has dramatically increased to the point at which the job market is no longer able to absorb such an increased supply of educated workers. As such, many university graduates are unable to secure full time employment and are relegated to jobs formerly filled by high school graduates, giving rise to the emergence of the state of overeducation in the labor market. Individuals are said to be overeducated workers if their years of schooling attained exceed the required years of schooling (Duncan and Hoffman, 1981; Hartog, 2000) This situation is also termed vertical mismatch or education-job mismatch which

occurs when the educational qualification held by a worker differs from those perceived to be required either by the employer or the worker to adequately carry out the tasks associated with his/her job–either in terms of the requirement at the time the worker takes up the job or in terms of the current requirements of the job.

Educational mismatch typically falls into one of the following three categories: overeducation (or over-qualification), undereducation (or under-qualification), and required education (or required-qualification). Different studies have found different degrees of overeducation (undereducation) ranging from 7%(6.9%) to 45%(28%) of the total employed, depending upon region, study period, methodology, and so forth (Hartog, 2000; Sloane and Seaman, 1996; McGuinness, 2003; Sicherman, 1991; Hung, 2008; Alba-Ramirez, 1993) Most of the papers dealing with educational mismatch concentrate on the issue of overeducation. The main reason is that it can be thought as a waste of resources, especially in the wake of a rapidly growing supply of graduates. This study strives to determine whether mismatch exists in the Thai labor market and to point out the traits that are characteristics of overeducated and undereducated workers. A special attention will be given to the extent of mismatch by educational level and field of study which would help individuals to make an optimal decision on years of education and field of study they should attend.

The phenomenon of mismatch is the imbalance between demand for and supply of graduates in each educational level. This study will study which factor (demand or supply factors) is behind the existence of mismatch in Thai labor market in order to give recommendations to policies to reduce the mismatch in the market. Some studies (BOT, 2010; Wieling and Borghans, 2001) have stated that overeducation arises when demand lags behind the growth of supply and its incidence should be proportional to the relative overall excess of the supply of qualified labor. However, some studies (Di Pietro, 2002; Oliveira, Santos and Kiker, 2002; Gottschalk & Hansen, 2000) analyzes that the mismatch can be attributed to a technology and trade explanation. The rapid pace of technological change may require skills higher than those possessed by currently employed workers. At the same time, firms upgrade their new hiring standards and recently hired employees, with higher educational qualifications than their older co-workers, are perceived to be overeducated. The trade hypothesis assumes that an increase in the relative demand for goods and services requiring high skilled workers to make then push the demand for high skilled workers.

Overeducation is potentially costly to the economy: individuals, firms, and society. For individuals, overeducated workers are likely to earn a lower return on their educational investment relative to similarly educated individuals whose jobs match their education (Sicherman, 1991; Duncan and Hoffman, 1981; Daly, Buchel and Duncan, 2000; Hartog and Oosterbeek, 1988; Cohn and Kahn, 1995; Cohn and Ng, 2000; Alba-Ramirez, 1993). It is also possible that previously well-matched workers in the economy will be bumped down in the labor market and, perhaps out of the market entirely, as overeducated workers move into lower level occupations thus raising the mean educational level within these occupations rendering some previously adequately educated individuals undereducated (Battu and Sloane, 2000). From a student's point of view, cost of university education is higher from wage penalties he or she will get if he or she works as overeducated workers. Based on cost-benefit analysis, it may be better for some individuals to study higher vocational education which require 2 years less than bachelor education. Then this thesis will study additional costs to higher education if an individual works in a job which requires lower level of education.

At firm level, there is some evidence to suggest that overeducation is associated with lower productivity. Overeducated workers have lower job satisfaction (Tsang, Rumberger and Levin, 1991; Battu et. al., 2000; Verhaest and Omey, 2009; Veiera, 2005) and poor health (Kornhauser, 1965; House, 1974; Caplan et. al., 1980) which lead to lower output for firms (Tsang et. al., 1996). Moreover, firms may lose investments in training, recruitment, and screening due to higher turnover rate for overeducated workers (Vroom, 1964; Alba-Ramirez, 1993; Hersch, 1991, 1995) At societal level, society wastes resources from underutilizing highly educated workers and tax revenues are being wasted on equipping individuals with non-productive education. Also, inefficient allocation of human capital affects low productivity and growth.

There are 3 research questions in this study:

1) Does the mismatch exist in Thai labor market?

2) What causes the phenomenon of mismatch in Thai labor market: Demand or Supply driven?

3) Are there any pay penalties for overeducated workers? Are the pay penalties same across earning distribution?

Contributions from this study are: 1) Students can decide which level of education and field of study they should attend; 2) Based on cost-benefit analysis, it may not be worth to attend university level if an individual works as an overeducated worker; 3) Government can use this analysis to re-consider subsidy or educational policies for each educational level.

1.2 Background

1.2.1 The Importance of Education in Promoting Growth

In Thailand, the past economic performance was driven primarily by rapid accumulation of physical capital, gains in labor, and favorable institutional and policy environments. With aging population, Thai economy instead has derived its growth from productivity improvement. According to the human capital theory, investment in human capital leads to productivity improvement and eventually economic growth. Besides, there exist many forms of investment in human capital, some of which are formal education, on-the-job training, health, and migration.

Most studies attach great importance to formal education as a major determinant of productivity improvement. Ammar Siamwalla, Dilaka Lathapipat and Somkiat Tangkitvanich (2011) states that education is an important factor in society, economy, and politics. In addition, education is believed to reduce income inequality in the long run. Nipon et al. (2011) state that education embodies both individual and social benefits. Individual benefits are reflected in the form of higher earnings, and on the social benefits education can generate positive externalities in that: 1) there are social connections among employees in the same industry whereby low-educated workers who work in an industry with a large number of high-educated workers would have higher productivity than low-educated workers who work with few high-educated workers; 2) a city with a concentration of high-educated residents will have high economic growth (Lucas, 1988); 3) technology-intensive investment is higher in the city heavily populated by highly educated individuals; and 4) there are non-monetary benefits associated with education, e.g., good health, low poverty, and low crime rate.

Investing in education is crucial to greater productivity, growth, and technological development. Compulsory education, a period of education (9 years)

that is required of every person, is divided into 6 years of primary education (Pratom1-6) followed by 3 years of lower secondary (Matthayom 1-3). Free education is extended to upper secondary education (Mattayom 4-6). Primary education aims to develop basic skills in reading, writing, and arithmetic in young children as well as to assist them in developing an understanding of the world around them, enabling them to live harmoniously and participate as active members in society. So, governments throughout the world should make education compulsory for all children. Secondary education is designed to provide students with knowledge and working skills suitable for their ages, needs, interests, and aptitudes. Students who have completed the lower level of secondary education and wish to continue their studies may do so at the upper secondary level or at vocational schools.

Students at vocational schools typically receive more hands-on, career-minded education than students at traditional schools. Individuals are given the opportunity to explore and identify potential career goals, and are provided with the resources needed to achieve them. University education is available to students who have completed the upper secondary level of education. University education leads to an increase in earning capacity, a broader range of opportunities, and a more rewarding career. Employers prefer university graduates because a higher educational qualification generally demonstrates the skills and qualities valued by them. UNESCO/OECD (2002) states that tertiary education being the best level of education for economic growth even though income inequality will increase in the future. Chaiyuth Panyasawatsut (2008) reports that education has different external effects varying with the level of education. That is, the external benefit of investing in tertiary education is the growth in economy as highly-educated workers are innovative and able to absorb new technology with ease. At the other end, investment in primary education has a poor effect on economic growth but its strongest values lie in non-monetary benefits, e.g., good health and low crime rates.

There is extensive evidence of the economic benefits of investing in higher education. Individuals who attend higher education have higher average earnings, are more employable, and are less likely to experience poverty than individuals without higher education. Moreover, higher education generates economic benefits to society. Countries with a large labor force of individuals with higher education have higher

productivity and higher tax receipts, thereby lowering dependence on public welfare programs. In addition to economic benefits, higher education provides several social benefits. Individuals with higher education tend to have higher standards of living and better well-beings. They also tend to be healthier and are less likely to smoke nor engage in criminal activities. The benefits of higher education extend across generations, i.e., children of parents with higher education are more exposed to reading, have higher cognitive skills, and are better able to concentrate. Finally, higher education promotes nation building because citizens with higher education are more likely to vote, to donate blood, and to participate in community service (World Bank, 2011).

The past Thai government was aware that tertiary education could improve the country's competitiveness and thereby reduce income inequality in the long run. The then Ministry of University Affairs thus in 1992 devised and implemented the national education plan together with the first long-term higher education plan (1990-2004). The emphasis of the two plans was on greater access to higher education by the general public.

1.2.2 Factors Affecting the Mismatch in the Labor Market

It is widely known that not merely the demand for but also the supply of workers as well as the characteristics of labor market play an important role in the labor market adjustment. This section thus aims to investigate the changing nature of the demand for and supply of highly educated workers, which in turn give rise to the mismatch in the labor market.

1.2.2.1 The Supply of Graduates

For the past two and half decades the education system has greatly changed, in particular in 1999 when the National Education Act was promulgated. The act has since then served as a basis for educational reform in the Kingdom of Thailand. The essence of the act is a 9-year compulsory education and a free 12-year basic education whereby individuals can gain access to education without having to pay for school fees and books. After secondary school (Mattayom 3), most students continue to study upper-secondary school, instead of vocational school. The ratio between general graduates and vocational graduates is 65:35 in 2008 (Table 1.1). Few

students continue to study vocational education because of quarrel among vocational students and valuation of degree certificate. The government aims the ratio of vocational students to traditional students at 60:40 in 2016.

Table 1.1 The Number and Ratio of Upper-Secondary Graduates to Vocational Graduates

year	number of graduates			percentage of upper-secondary graduates	percentage of vocational graduates
	upper-secondary	vocational	total		
1992	125,886	117,670	243,556	52	48
1993	136,191	129,011	265,202	51	49
1994	150,083	138,981	289,064	52	48
1995	173,082	153,000	326,082	53	47
1996	197,286	170,202	367,488	54	46
1997	243,526	176,965	420,491	58	42
1998	277,128	193,136	470,264	59	41
1999	295,213	206,145	501,358	59	41
2000	332,028	170,499	502,527	66	34
2001	347,169	145,980	493,149	70	30
2002	352,324	170,104	522,428	67	33
2003	344,860	160,910	505,770	68	32
2004	325,424	142,510	467,934	70	30
2005	319,250	158,943	478,193	67	33
2006	316,277	160,250	476,527	66	34
2007	306,821	163,152	469,973	65	35
2008	308,103	167,994	476,097	65	35

Source: Office of the National Economic and Social Development Board, 2015.

A disproportionate number of Thai secondary school graduates have pursued university study since Thai society places a much greater value on tertiary education

than vocational education. In addition, the private rate of return from investing in university education is higher than that of vocational education (Table 1.2), prompting even greater number of students to pursue university study due to higher earnings.

Table 1.2 The Private Rate of Return Investing in University Education Relative to That of High School Education (Unit: Percent)

Level of education	1985		1990		1995		2000		2005	
	male	female	male	female	Male	female	male	female	male	female
Upper secondary	9.96	4.14	6.59	5.34	7.46	7.08	8.46	7.35	6.98	10.54
Vocational	14.35	10.24	12.14	9.86	13.5	13.79	9.56	11.57	11.65	13.1
Upper vocational	14.91	13.23	15.4	10.94	13	10.61	13.74	11.15	11.68	12.17
University	**15.12**	**14.12**	**18.64**	**11.96**	**20.45**	**15.31**	**17.46**	**13.66**	**17.46**	**20.04**

Source: Chaiyuth Panyasawatsuth, 2008.

Note: The private rate of return is calculated from Mincer earnings equation under the assumption that the labor market is competitive and the cost of education includes only opportunity costs, not the direct costs. Thus, the private rate of return may be overestimated resulting from the use of Ordinary Least Square (OLS) in the regression while neglecting the direct cost of education.

In the last decade of the 1990's (i.e., 1990-2000), rural residents in Thailand found it relatively easier to gain access to higher education after the establishment of six regional universities: Burapa University in the east of Thailand (Chonburi province); Ubonratchatani University; Surnaree University of Technology (Nakorn Rachasrima province); Mahasarakham University in the northeast of Thailand; Naresuan University in the north of Thailand (Phitsanulok province); and Thaksin University in the south of Thailand (Songkhla province).

In 2004, 41 locations of Rajabhat Institute were upgraded to the status of university and renamed Rajabhat University meanwhile 39 locations of Ratchamongkol Institute of Technology were merged into nine, upgraded to the university status, and renamed Ratchamongkol University of Technology. The increase in higher education institutions (Table1.3) associated with the compulsory education leads to greater number of tertiary graduates.

Table 1.3 The Number of Tertiary Educational Institutions, 1992-2010

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Government institution	21	23	19	20	20	21	22	23	23	23
Private institution	26	26	24	26	28	29	32	46	50	47
Total	**47**	**49**	**43**	**46**	**48**	**50**	**54**	**69**	**73**	**70**
	2002	2003	2004	2005	2006	2007	2008	2009	2010	
Government institution	24	24	66	78	78	78	78	78	83	
Private institution	54	54	54	61	63	63	68	63	65	
Total	**78**	**78**	**120**	**139**	**141**	**141**	**146**	**141**	**148**	

Source: Yongyuth Chalanwong, 2011.

The higher education sector in Thailand expanded quickly in the past decade, and one of the driving forces behind the expansion was believed to be the Student Loan Fund (SLF) introduced in 1996. The SLF was introduced following the realization by the government that poor Thai people were unable to acquire higher education due to the lack of financial resources with up to 71% of total secondary school graduates citing the lack of financial resources as the reason for not enrolling in higher education (The Child and Youth Survey, 2002).

Thai governments have provided loans to students under the Student Loans Fund (SLF) program since 1996. The main objective of the SLF is to increase higher education opportunity to students from low-income families. Only high school or tertiary level students with annual household income below 150,000 baht ($4,300) are eligible to apply for the loan. For debt repayment, all borrowers begin repaying their debts within 2 years following their graduation or after they stop borrowing regardless of their income level. The total repayment period is 15 years with no interest charged in the first year of the repayment. During the first 10 years of its operation, the SLF lent to more than 2.6 million students with the loan value totalling nearly 200 billion baht ($5.7 billion).

The SLF scheme nonetheless contains a host of flaws, some of which are that its loan screening system at tertiary institutions is relatively ineffective, that it fails to disburse loans on time, that it has a very poor collection mechanism, and that it is still based on the supply-side financing paradigm since all major decisions rest with the

government committees and school administrators. In addition, the SLF is suffering from a serious financial sustainability problem due to its very low recovery rate. As a consequence, another income contingent student loan scheme was introduced in 2006 by the then Prime Minister Thaksin Shinawatra. Known as the Thailand Income

Table 1.4 The Number of Tertiary Graduates (Unit: Persons)

Year	Bachelor	Above bachelor	Total
1992	85,930	7,538	1,868,808
1993	98,699	8,977	1,944,247
1994	105,478	10,430	2,067,100
1995	109,246	11,225	2,164,834
1996	118,297	13,328	2,288,485
1997	137,080	17,316	2,431,000
1998	145,590	19,706	2,395,549
1999	158,787	22,260	2,459,246
2000	173,588	30,100	2,480,161
2001	193,239	34,117	2,504,311
2002	169,604	40,046	2,653,161
2003	241,608	37,365	2,711,278
2004	257,276	45,274	2,685,509
2005	271,941	48,564	2,773,857
2006	262,703	58,112	2,768,309
2007	304,035	67,947	2,737,121
2008	311,377	78,452	2,711,685

Source: The Ministry of Education. The Office of Education Council, 2013.

Contingent Allowance and Loan (TICAL06) scheme, it replaced the existing Student Loan Fund (SLF), which was more of a mortgage-type loan system in use since 1996. However, the TICAL06 scheme lasted only a year and was replaced with the reintroduction of the SLF in 2007 following a military coup that overthrew the

government on September 19, 2006. However, in 2008 the Income Contingent Loan (ICL) was brought back with the new condition that the lending would be made to students in fields of education which are in demand and supportive of the development of the country.

The first difference between the ICL and SLF is the amount of loans varying by the educational level. The ICL lends to students only tuition fees and education-related expenses excluding living expenses. The second difference is that borrowers of the ICL can borrow for the living expenses if their annual family income does not exceed 300,000 baht, an additional condition which was approved in 2012. The third dissimilarity is in the repayment in that the repayment starts when students can earn a minimum income of 16,000 per month or 192,000 baht per year. The repayment rate is progressive depending on students' income. The final difference is that students pay back the loan to the Revenue Department, not Krung Thai Bank. Additional details on the SLF and the ICL are provided in the appendix A.

Another driving force behind tertiary expansion is the policy of Yingluck's administration that raises the minimum monthly salary of university graduates with a Bachelor's degree to 15,000 baht. The policy provides upper-secondary and vocational graduates incentives to further their study at the university level. In addition, Thai students attach greater value to university education in relation to vocational education. With the launch of such a policy, a larger number of tertiary graduates are anticipated to join the labor market in the coming years. Employers nevertheless postpone hiring university graduates and hire vocational graduates instead, resulting in rising unemployment rate among tertiary graduates.

All of the previously discussed, i.e., increasing numbers of universities; greater value attached to tertiary education; the income contingent loan; the 15,000-baht monthly salary for graduates with a Bachelor's degree, led to a rise in tertiary level enrollment from 1,814,046 persons in 2001 to 2,412,986 persons in 2008 (Yilmaz, 2010) and an increase in university graduates from 85,930 persons in 1992 to 311,377 persons in 2008 (Table 1.4). Moreover, the share of workforce with tertiary education soared from 2.75% in 1986 to 11.79% in 2009 (Table 1.5).

Table 1.5 Share of Workforce by Level of Education (unit: percent)

Year	Primary and below	Upper primary	Some high school	High school	Some college	College and above	Total labor force
1986	67.72	15.88	6.99	4.48	2.17	**2.75**	100
1987	65.75	16.98	7.25	4.78	2.25	**2.99**	100
1988	63.53	18.49	7.22	4.97	2.53	**3.25**	100
1989	61.24	21.36	7.14	4.88	2.18	**3.19**	100
1990	58.97	23.17	7.19	5.06	2.23	**3.38**	100
1991	59.27	22.07	7.54	5.27	2.12	**3.72**	100
1992	57.93	22.3	8.1	5.24	2.37	**4.06**	100
1993	54.73	24.18	8.53	5.67	2.53	**4.37**	100
1994	53.66	23.68	9.55	5.92	2.69	**4.49**	100
1995	54.11	22.42	10.16	5.89	2.78	**4.64**	100
1996	53.37	22.01	11.17	5.82	2.56	**5.07**	100
1997	51.52	22.05	11.45	6.39	2.85	**5.74**	100
1998	47.82	21.62	13.31	7.22	3.53	**6.5**	100
1999	46.81	21.11	13.38	7.68	3.88	**7.13**	100
2000	45.16	21.19	14.02	8.55	3.75	**7.32**	100
2001	42.09	22.36	13.97	9.04	4.33	**8.2**	100
2002	41.04	22.69	14.12	9.73	4.32	**8.1**	100
2003	39.06	22.8	14.85	10.09	4.54	**8.66**	100
2004	37.1	22.47	15.36	11.04	4.64	**9.39**	100
2005	36.94	22.13	15.04	11.19	4.61	**10.08**	100
2006	35.89	21.85	15.27	11.77	4.57	**10.65**	100
2007	33.19	23.37	15.07	12.65	4.78	**10.95**	100
2008	31.92	23.49	15.39	12.94	4.89	**11.37**	100
2009	30.93	23.29	15.55	13.31	5.14	**11.79**	100

Source: Dilaka Lathapipat, 2010.

1.2.2.2 The Demand for Graduates

In the rapidly changing global setting, both the product and service markets and the labor market are forced to adjust in response to the changes. Two principal rationales for the adjustment of demand for high skilled workers are: trade effects and skill-biased technological effects. The first is concerned with the structural

changes of the Thai economy. That is, an increase in the relative demand for goods and services which require high skilled workers to produce pushes up the demand for high skilled workers.

The growth of the Thai economy in the past was driven mainly by unskilled labor in which the proportion of unskilled labor was 88.38% of total workforce while 8.77% for skilled labor[1]. Later, greater emphasis was given to industrial and service sectors as growth engines, together with the education expansion policy. Ease of access to education led to lower number of unskilled laborers entering the labor market, and thereby the proportion of unskilled labor relative to other labor decreased from 88.38% in 1991 to 70.41% in 2009 while that of skilled labor increased from 8.77% in 1991 to 19.15% in 2009 (Figure 1.2). An increase in the proportion of skilled labor is the result of higher demand for skilled labor in certain industries which are skilled-labor intensive, e.g., chemical and energy industry, technological industry, service industry.

During 1991-1993, of the total employment private sector employment in industrial sector accounted for 46.4% (Figure 1.3), the employment of which was mostly by the labor and resource intensive industries, e.g., textiles and clothing, leather, wood and furniture. Following the 1997 economic crisis in Thailand, a multitude of firms had to close down their businesses and employment of every sector of the economy dropped dramatically except for the export-oriented industries which flourished due to the depreciation of Thai baht. As such, employment in the manufacturing sector remained relatively stable at around 46.3%. Then, in 2001 foreign direct investment started to increase with firms in the service sector increasing employment. The same trend was witnessed in the knowledge and technology intensive industry, e.g., automobile and parts, and electronics. There was an increase in the demand for high educated labor, as a result. During 2004-2006, technology intensive industries witnessed a 10% growth rate in employment of university graduates and the service sector, especially banking and finance industry, increased its hiring of the highly educated labor by 10 percent.

---

[1] Unskilled laborers are individuals graduating with primary education or secondary education. Skilled laborers are individuals graduating with vocational, undergraduate, or graduate degree. Others are upper-secondary degree holders and none of the above.

Unit: percent

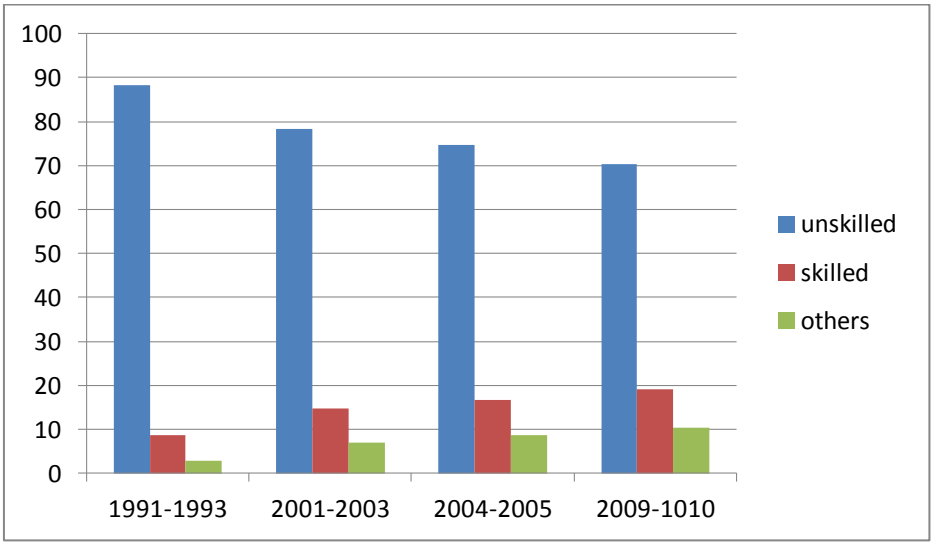


Figure 1.2 The Proportion of Labor by Educational Level

Source: Yongyuth Chalanwong, 2011.

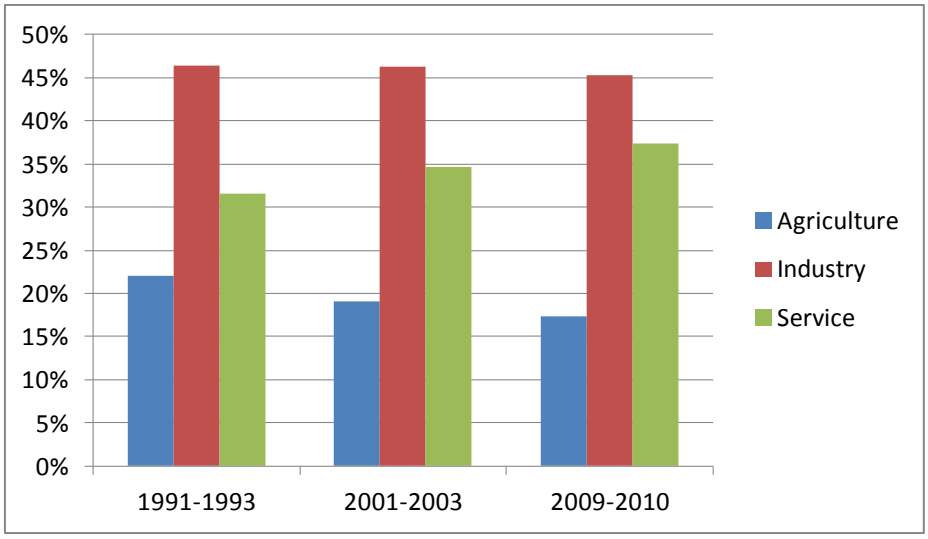


Figure 1.3 The Proportion of Private Employees by Sector

Source: Yongyuth Chalanwong, 2011.

The second rationale of demand adjustment for high-skilled workers is that technological progress has led to changes in the production process. The changes increase the demand for high skilled workers economy-wide as the new and advanced

technologies are biased toward this group of workers. Most studies claim that higher demand for high skilled workers is due to the skill-biased technological change (Berman et. al., 1998; Sasaki and Sakura, 2005). Skilled labor is relatively more complementary to equipment capital than is unskilled labor. Furthermore, more educated, able or experienced labor deals better with technological change. In the Nelson-Phelps model, it is argued that a more educated workforce may make it easier for a firm to adopt and implement new technologies. Firms value workers with education because they are more able to evaluate and adapt to innovations and to learn new functions and routines than less educated ones. From this model, technological changes may stimulate the demand for skilled workers.

Salary premiums[2] received by skilled and professional workers suggest that demand for both types of workers remains strong. Table1.6 depicts the compensation premiums that given types of employees received in 2006 relative to unskilled production workers. Skilled production workers earned approximately twice as much as unskilled production workers with the compensation premium for the former increasing from 1.43 in 2004 to 2.09 in 2006. Increased premiums over time indicate not only the continuing growth in demand but also difficulty in filling the positions.

Table 1.6 Compensation Premiums

Year	Management	Professionals	Skilled production workers	Unskilled production workers	Non-production workers
2006	7.26	3.57	2.09	1.00	1.81
2004	9.35	2.88	1.43	1.00	1.33

Source: Yilmaz, 2010.

[2] Premiums are calculated as the difference between the average compensation across a certain type of employee and the average compensation among unskilled production workers. Compensation amounts include fringe benefits.

Continued expansion among professional and skilled workers and the high compensation premiums received by these two groups of employees suggest that the demand for skilled labor remains robust. In other words, the hiring of skilled labor apparently grew more than the average growth of jobs across all the remaining types of employees (Table1.7)

Table 1.7 Growth in Hiring

Yea	Management	Professionals	Skilled production workers	Unskilled production workers	Non-production workers	Total
2001-2003	5%	20%	13%	7%	8%	8%
2003-2006	9%	21%	9%	5%	17%	7%

Source: Yilmaz, 2010.

CHAPTER 2

LITERATURE REVIEW

Countries, including U.S., Australia, the United Kingdom, Netherlands, Taiwan, and Hong Kong, face an increase in the relative supply of college graduates entering the labor market. This has resulted from both the increase in the college-age population and an increase in the proportion of this population attending tertiary education due to rapid expansion of the educational system. As the average educational attainment of labor force has increased, the job structure cannot absorb the greater supply of educated workers. Many workers cannot secure full-time employment and are relegated to jobs formerly filled by high school graduates. Many workers have more skills than their jobs require. Berg, Freedman, Marcia and Freeman, Michael (1978) find that the underutilization of worker skills has existed in the labor market. This phenomenon has come to be known in the literature as "overeducation."

This chapter reviews empirical studies deem relevant to the scope of this study. The first section provides the definition of mismatch. The second section reviews the existence of mismatch. The next two sections examine the determinants and the causes of educational mismatch. The last section explores the effects of overeducation on wages.

2.1 The Mismatch Defined

Three definitions of mismatch are used: educational (qualification) mismatch or vertical mismatch, horizontal mismatch, and skill mismatch. Educational (vertical) mismatch refers to a situation in which the educational qualifications held by a worker differ from those perceived to be required either by the employer or the worker to carry out adequately the tasks associated with his/her job. Horizontal mismatch moves away from a reliance on the level of education by taking into account the type of

education, namely, the mismatch between an individual's field of education and his/her occupation. Skill mismatch is seen as the discrepancy between the skill--both general and specific--possessed by a worker and the skills required by his/her jobs.

An individual can be grouped into one of three types of the educational mismatch: overeducated, undereducated, or properly matched worker. An individual i can be defined as being overeducated (undereducated) if his or her educational level exceeds (below) the required level of education to do his or her job. Properly matched worker has educational level that matches with educational level which a job requires.

It follows that the operationalization of mismatch requires both a measure for the attained educational level of the worker and the required level of education to the job. Although observed educational levels may be subject to some measurement error, the measurement of required education is much more difficult.

On measuring the required level of schooling, four different measurements are possible. First, workers are asked on the schooling requirement for their jobs; second, information on job descriptions is collected; third, information on required schooling calculated by using mean or mode method. Fourth, required education is considered from the correspondence between ISCO educational level and ISCED occupational level. The main reason for this lack of uniform measurement is the dependency of empirical researchers on the availability of relevant data to measure the mismatch.

First, the self-assessment method asks to specify the minimum education required for their jobs and their response is defined as required schooling. This method is further broken down into direct and indirect self-assessment. The former asks the respondents whether they are over-, under-, or rightly educated for their jobs from the questions like 'Do you have a level of education which is, according to your own opinion, too high, too low, or appropriate to your job?'(Groeneveld and Hartog, 2004). Indirect self-assessment asks respondents the best level for their job. Over- and under-education is then measured by comparing this level with the actual educational level for their job. However, there are large differences in the formulation of the question on which the measure is based. So, this set of measures is divided into two groups. One is based on the question asking the required level to perform the job (Hartog and Oosterbeek, 1988); another is based on the question asking required level to have the job (Duncan and Hoffman, 1981).

A potential advantage of self-assessment is that the worker respondent is in the best position to judge which qualifications are needed for the job he or she performs. But its weakness lies in different answers to different questions. A piece of evidence is reported by Green, Mcintosh and Vignoles (2002). The University of Newcastle alumni were asked how much schooling is needed to get their current job and how much schooling required to do their job. A quarter of their respondents give different answers to these two questions. Clearly, workers' self-assessment of required schooling could be biased as the respondents are likely to overstate the requirements of their jobs and to upgrade the status of their position.

Self-assessment method has been used by Duncan and Hoffman (1981), Hartog and Tsang (1987), Sicherman (1991), Groot and Brink (2000), Lindley (2005), and Korpi and Tahlin (2009). Some variations exist across these studies. Cases in points: How much formal education is required to get a job like yours? (Duncan and Hoffman, 1981); If someone is applying today for the job you are doing now, would they need any schooling beyond compulsory education? If yes, how many years of education beyond compulsory education would they need? (Galasi, 2008); To you, what level of educatin is best prepared for your job? (Hartog and Oosterbeek, 1988); What kind of education does a person need in order to perform in your job? (Alba-Ramirez, 1993).

Second, job Analysis is a systematic evaluation by professional job analysts who spell out the exact required level of education for the job titles in an occupational classification. A well known example is the U.S. Dictionary of Occupational Titles (DOT) which contains an indicator for educational requirement in the form of the General Educational Development (GED) scale. This scale runs from 1 to 6 or the lowest to the highest years of required schooling. These GED categories are then translated into school years equivalents (0-18). GED scale of six is an equivalence of 15-16 years of school by U.S. Department of Labor, while it is 17-18 years of school by Eckaus.

Table 2.1 The Table Below Shows School Year Equivalents for Required Schooling

GED scale	Objective required schooling (in years)	
	Eckaus (1964)	**U.S. department of labor (1971)**
1	0-4	0-3
2	5-7	4-6
3	8-10	7-8
4	11-12	9-12
5	13-16	13-14
6	17-18	15-16

Source: Rumberger, 1981.

Measures based on job analyses are attractive sources for defining job requirements, because of its explicit goal of objectivity, clear definitions, and detailed measurement instructions. But it has some drawbacks. First, a Dictionary of Titles is lengthy to compile, so the information collected might be out of date by the time of release, especially in a rapidly changing work environment. Second, the job analyst definition is impartial but is based on the assumption that all jobs with the same titles have the same educational requirement. In contrary to the fact, there is some difference in job requirements for the same occupational title. Third, there is no consensus on the conversion of the GED scale to years of schooling. Translating the job requirements into a single schooling variable may bring substantial errors. Glebbeek (1993) shows that for the Netherlands, assigning job level codes to survey responses on type of work has a large measurement error.

The DOT information was used to estimate an overeducation earnings function by Hartog (1985), Rumberger (1981), Rubb (2003), and Verhaest and Omey (2009). Kiker, Santos and Oliveira (1997) also used the job analysis method for Portugal study as well as Oosterbeek and Webbink (1996) for Netherlands. Among these studies, the incidences of overeducation have differences in magnitude even they have used job analysis as a measure of required schooling. This is due to the differences in samples used and methodologies.

Third, Realized Match calculates mean and mode of completed schooling of workers as required schooling. The required amount of schooling is calculated from the mean of completed schooling of all workers holding the same occupation (Verdugo and Verdugo, 1988). People are defined to be overeducated (undereducated) if their actual education is greater (less) than one standard deviation above (below) the mean for the specific occupation.

Kiker et. al. (1997) propose a related method by defining the required schooling level in a job as the mode of the completed schooling level for the worker in that job. Workers with years of schooling completed greater than the mode schooling level for their occupation are defined as overschooled. Similarly, individuals whose years of schooling completed is lower than the mode years of schooling for their occupation are underschooled.

Cohn and Ng (2000), Galasi (2005), and Tsai (2010), Bauer (2002) and Lin and Wang(2005) have replaced the mean with the mode to measure required schooling and their finding is that the incidences of overeducation are higher for the mode measure.

Realized matches, however, have a few drawbacks. One, similar to job analysis, it ignores variation in required schooling across jobs within an occupation. Furthermore the cutoff at one standard deviation from the mean is arbitrary. Two, most data set in developing countries collect education data by the level of the schooling completed, rather than by years of schooling. Transforming educational level to years of schooling may be misleading. For example, some individuals may take 4 years to complete bachelor degree, while some may take 5 or 6 years to complete it.

Another variation of measuring required schooling argues that required education may be dynamic due to changes in technology and educational quality Quinn and Rubb (2006)[3]. Required education, then, is allowed to vary with year of

[3] $ED\_ACTUAL = \sum\beta_{occup}\, OCCUP + \beta_{birth}\, BIRTH + \beta_{year}\, YEAR + \epsilon$

where ED_ACTUAL is an individual's actual educational attainment

OCCUP is a vector of occupational dummy variables

BIRTH is an individual's year of birth

YEAR is a time trend variable that captures the year of the survey

Є is an error term

birth and survey year. The level of education required to perform a specific job is acquired from the coefficient on occupation variable from a regression of actual education on occupation dummies, given the individual's year of birth and the year of the survey.

Groeneveld and Hartog (2004) have studied overeducation inside a firm and used the indexes used in hiring by the personnel department of the organization as measure of required schooling. They argue that it seems fair to assume that human resource department has reliable information on technically required qualifications for a particular job.

Different measures of required education certainly affect the incidence of overeducation, but their effects on the returns from schooling via wages are weak. For example, Verhaest and Omey (2009) conclude that the incidence of overeducation differs by measures of required education. Overeducation in the first job ranges from 10.5% based on the realized match to 54.2% for the job analysis. Groot and Brink (2000) conduct a meta analysis on overeducation and find that the average value of incidence of overeducation based on the realized match method is 13.1% while the average value based on the workers' self-assessment method is 28.6%.

The number of years of education is not a fully reliable measure of educational attainment because it is frequently upward biased. Thus, this problem is solved by the fourth measure, called OECD method. The OECD proposes an approximation for an objective and comparable measure of overeducation based on the ISCO (International Standard Classification of Occupations) classification of occupations and the ISCED classification of education and a correspondence between the occupations and the educational level required. The ISCO produced by the ILO (International Labor Organization) can be used to distinguish the different qualifications and skills related to the educational levels required to perform the jobs grouped by this classification (Tables 2.1 and 2.2). The 1-digit educational and occupational groups are classified as high-skilled, intermediate, or low-skilled depending on the capacities and abilities related to them and, finally, a correspondence table between occupations and educational levels results from matching them together (Table 2.3).

Table 2.2 Conversion of ISCO 9 Categories to 3 Categories

Occupational titles	Low-skilled	Intermediate	High-skilled
1. Legislators, senior officials, and managers			X
2. Professionals			X
3. Technicians and associate professionals			X
4. Clerks		X	
5. Services and sales workers		X	
6. Skilled agricultural, forestry, and fishery workers		X	
7. Craft and related trades workers		X	
8. Plant and machine operators, and assemblers		X	
9. Elementary occupations	X		

Source: OECD, 2007.

Table 2.3 Conversion from ISCED 8 Categories to 3 Categories

Educational level	Low-skilled	Intermediate	High-skilled
1. Pre-school	X		
2. Primary education	X		
3. Lower secondary education	X		
4. Upper secondary education		X	
5. Post-secondary education		X	
6. Bachelor degree			X
7. Master degree			X
8. Doctorate degree			X

Source: OECD, 2007.

Table 2.4 Correspondence Between ISCED Educational Level and ISCO Employment Level

ISCED educational level	**ISCO employment level**		
	Low-skilled	**Intermediate**	**High-skilled**
Low-skilled	Matched	Undereducated	Undereducated
Intermediate	Overeducated	Matched	Undereducated
High-skilled	Overeducated	Overeducated	Matched

Source: OECD, 2007.

There are three different categories from the adjustment between the occupation groups and the educational levels: overeducation, properly match, and undereducation. Overeducation arises when high-and intermediate-educated individuals work in low-skilled occupations and high-educated individuals work in intermediate occupations. Undereducation arises when low-and intermediate-skilled graduates work in high-skilled occupations and low-educated individuals work in intermediate-skilled occupations.

This method improves the understanding of overeducation in three folds. First, it is free of biases which are inherently involved in the years of education. Second, the measure of overeducation makes more sense if it applies to only some categories of occupations, since overeducation does not occur for high skilled occupations. Finally, this method is based on internationally comparable educational and occupational categories, it is applicable across countries and it thus facilitates comparative research.

This OECD method has also some limitations as it relies on the homogeneity of the educational profiles and the occupations between countries. If differences between countries in the requirements of the jobs are important, which is something very likely when working with a high level of aggregation in the definition of the different occupations, and the education systems are different, then the use of a common classification could be misleading. However, it is easy to compare the incidence of mismatch across countries with this approach. Several studies (Serrano

et. al., 2012; Ortriz, 2008; Ortriz, and Kucel, 2008; Stefanik, 2011) have used this method to measure the incidence of overeducation but the percentage of overeducation varies because of different countries and time considered.

2.2 The Existence of Mismatch

The mismatch refers to the imbalance between demand and supply of graduates in each educational level, i.e. the supply of college gradutates is greater than the hiring demand. These graduates accept jobs which require lower level of education than they actually have to avoid being unemployed. In the end, they become overeducated workforce. In the other hands, an individual is said to be undereducated if they have lower level of education than that required by a job. He or she may substitute job experience for low educational level.

Tsang and Levin (1985), Hartog and Oosterbeek (1988) and Sicherman (1987) have found the educational mismatch in U.S. labor market. As a result from an expansion in higher education, higher education is seen as the vehicle in improving skills and promoting economic growth. The relative supply of college graduates entering the labor market has increased dramatically while the job structure has not been able to absorb the increased supply of educated workers and a state of over-education has emerged in labor market.

The labor markets in many countries have experienced the educational mismatch, regardless of measures of required education. Using self-assessment method, Alba-Ramirez (1993) finds the incidence of overeducation in Spain; similarly, using Realized Match method, Cohn and Khan (1995) find the overeducation in the U.S. Table 2.4 summarizes the incidence of overeducation from various measures of required schooling.

Educational mismatch is also found in Thai labor market. Yonyuth Chalamwong (2011) shows that there is excess supply of university educated workers especially in Bangkok due to the fact that Bangkok is the hub of higher learning with a higher concentration of higher education institutions than all other provinces in the kingdom. Gropello, et. al. (2011) have used two indicators to identify the supply of university graduates, namely, tertiary educated workforce and tertiary gross

enrollment ratio. Their finding reveals that Thailand has gaps in the current quantity of tertiary educated workers but not in the tertiary gross enrollment ratios. With a new approach, Mehta, et. al. (2011) have also found overeducation in Thai labor market. Overeducation is confirmed if observed education levels rise in jobs that offer very low returns to education and that undergo little technological change. With a concentration in low skilled jobs which require primary education such as cooks, waitresses, bus drivers, carpenters, and security guards, if workers with more than primary schooling have higher proportion to work in low skilled jobs over time, there is an increase in the incidence of overeducation.

2.3 Determinants of Mismatch

A lot of literatures have studied the determinants of educational mismatch by breaking down into three groups: 1) education characteristics, 2) employment characteristics, 3) individual characteristics.

Education characteristics are among the main determinants of the educational mismatch. There are three concepts to consider: 1) level of education, 2) field of study, 3) educational quality.

The level of education completed by graduates is critical concern to employers. If quality of qualifications is perceived to have been watered down, firms may upgrade their educational requirements to ensure the recruitment of the most able graduates (Screening theory, Spence, 1973). Thus, overeducated workers could be comprised of those who have non-professional qualifications, a low quality of education, or both. As a result of these changes, university graduates may be taking jobs today (requiring less than a university degree) that they would not have in the past. Also as far as academic achievement goes, the higher the postsecondary education, the more likely the match would be (Wolbers, 2003; Robst, 2007; Krahn and Bowlby, 1999). Robst (2007) also finds that the more recent the degree, the more

Table 2.5 Incidence of Overeducation and Undereducation

Authors	country	Measure of required schooling	Incidence of overeducation (male/female) (%)	Incidence of undereducation (male/female) (%)
Sicherman (1987)	U.S.	Self-assessment	40	16
HartogandOosterbeek (1988)	Netherlands	Self-assessment	25.7	20.6
Alba-Ramirez (1993)	Spain	Self-assessment	17	23
CohnandKhan (1995)	U.S.	Realized Match	33	20
DuncanandHoffman (1981)	U.S.	Self-assessment	42	11.9
Tsang et. al. (1991)	U.S.	Job Analysis	40	-
DoltonandSilles (2002)	U.K.	Self-assessment	22	-
Bauer (2002)	Germany	Realized Match	12/10	10/15
Ortriz et. al.(2008)	Spain and Germany	OECD method	15 and 12	-
Stefanik (2011)	Cyprus, Estonia	OECD method	30	-
Serrano et. al.(2012)	Spain	OECD method	25	-

likely the match, which might be attributable to the fact that people most likely would take their most recent degree to find work in the labor market. Some papers (Kiker et al., 1997; McGoldrick and Robst, 1996; Alba-Ramirez, 1993) use years of schooling instead of level of education and find that the higher the years of schooling, the likelihood is greater for being overeducated. In contrast, Buchel and VanHam (2002)

have found that the probability of overeducation decreases with more years of schooling.

Field of study is worth investigating, as there are numerous different programs offered by postsecondary institutions. Employers may value differently the stock of human capital associated to each field of study. These entail a degree of specialization. That is, some programs such as Arts and Humanities, Languages, etc. give individuals general skills that can lead to a wider range of occupations, while some programs like engineering, architecture, or medicine give occupational-specific skills that are aimed at certain occupations. Wolber, 2003; Grayson, 2004; Garcia-Espejo and Ibanez, 2006; Robst, 2007; Krahn and Bowlby, 1999; Storen and Arnesen, 2006; Heijke et al., 2003 find that graduates from occupation-specific programs have a much higher degree of match than those in the more general programs. This is attributable to the fact that these such programs provide specific skills meant for the job market.

Most literatures on overeducation always deal with the incidence of this phenomenon, investigating the effects of educational level (years of schooling) on educational mismatch, and considering impact of overeducation on earnings. Very seldom has it been related to the quality of education because there is no standard approach to define or measure university quality. Studies tend to use either resource-based measures (spending per student, staff-student ratios) or prestige rating. Resource levels will be most closely linked with teaching standards and may have their greatest impact through standard human capital effects associated with the accumulation of skills. The primary function of university prestige may be as a quality signal to employers because university prestige appears to be strongly linked to the quality of university research. McGuinness (2003) uses teaching scores and research scores as proxies for university quality and finds that the effects of attending higher quality institution on the probability of being overeducated are limited. On the other hand, Robst (1995) has found the negative relationship between college quality and the likelihood of being overeducated by using three measures of college quality: 1) aptitude test score, 2) educational and general expenditures per student, 3) prestige rating.

Several studies have found that workers' heterogeneity alone cannot account for the extent of qualification mismatch in the labor market. Jobs also differ widely even when they carry the same occupational code. Hence, workers who are overqualified can hold jobs involving more complex tasks, more decision-making, and more responsibilities than workers who are well-matched by their qualifications and work in the same occupation, while the inverse can be true for under-qualified workers. It is also important to consider job characteristics on the probability of educational mismatch.

The job competition theory (Thurow, 1975) highlights the role of jobs, instead of workers, as the origin of overeducation. Under this theory, workers compete for a job on the basis of their relative training costs. The more education, the less training required and hence the better is the position in the job queue. In such a setup overeducated workers should find themselves in an advantageous position since their relative training costs are smaller than the costs of other workers. Wage is determined by the characteristics of the job, not by worker's marginal productivity. In this view the worker's marginal product is dictated by the job characteristics and not by the stock of worker's human capital. Three main job characteristics are considered: 1) permanent or temporary employment, 2) firm size, 3) private or public sector.

Due to the character of fixed-term contracts as stepping stones toward a better position in the labor market, they might be more closely associated with overeducation than permanent contracts. But the existence of a segmented labor market may modify this logic. Two hypotheses could be formulated in such a scenario. First, permanent workers have higher probability of receiving training and attaining a job match. Moreover, given that many temporary employees are new entrants into the labor market, they are usually more qualified than those in the primary segment. Overeducation might thus be more likely among temporary workers than among those holding permanent contracts. Second, permanent workers are more likely to be overeducated than those with fixed term contracts. With the reason of job security, human capital might be invested not in order to attain a good match but to be well placed in a competition for secure jobs.

The effects of type of contract on overeducation are mixed. Permanent or full time employment is defined as working 35 hours or more per week and the opposite

definition is for part-time employment. Wolbers, 2003; Witte and Kalleberg,1995; Krahn and Bowlby, 1999 have found that having a full time or permanent job is associated with an increased match. The opposite result is found by Garcia-Espejo and Ibanez (2006) who has concluded that having a temporary contract increases the match.

The job competition theory should have higher explanatory power in internal labor markets where accepting a job below the individual's educational requirement could be a way of getting access to an entry port in an organization, from which promotion is possible and, eventually, an alignment with their educational attainment. Internal labor markets are known to be more present in large firms, since a firm must have a certain minimum workforce to offer internal job openings and develop rules and procedures for the allocation and pricing of jobs. Internal mobility (promotion) should work here as a mechanism of adjustment. A lot of literatures (Wolbers, 2003; Witte and Kalleberg, 1995; Ordine and Rose, 2009; Dolton and Silles, 2008) have found that working in larger firm is negatively associated with being overducated because there are more positions available for individuals to find a position that matches their skills. Some authors (Ortriz, 2008; Ortriz and Kucel, 2008; Van der Meer and Wielers, 1996) find that the bigger the company the more likely new employees are expected to occupy jobs below their educational attainment, expecting that promotions will correct this mismatch. Employers would expect that this mechanism acts as an incentive for the newly recruited workers.

Another job characteristic that can affect educational mismatch is the type of sector, private or public sector. Public sector refers to the part of the economy concerned with providing various government services. The private sector is the business sector which is intended to earn profits for the owners of enterprises. Most literaturs (Karakaya, Plasman and Rycx, 2005; Hung, 2008; Ordine and Rose, 2009) have concluded that the public sector, characterized by a less competitive environment and powerful trade unions, has difficulties to effectively use and reward more qualified workers. As a result, the wage penalty of overeducation would be larger in this sector, leading to a lower proportion of overeducated workers. In contrast, private sector firms respond more flexibly, allow overeducated workers to be more fully utilized, and pay wages closer to his/her productivity potential. Thus, we

can find more overeducated workers in private sector than in public sector. The opposite result is found by Dolton and Vignoles (2000) and they have concluded that the relationship between sector and earnings for the overeducated is inconclusive. The overeducated in the public sector may not earn less than their equivalent in the private sector in some labor market.

Individual characteristics are expected to play an important role in a decision to accept a job offer. Gender, age, marital status, having children, and work experience are considered as indiviudal factors that can determine the incidence of educational mismatch. Evidences find mixed results of the relationship between gender and the probability of overeducation. Some literatures (Belfield, 2010; Hung, 2008; Battu et al., 1998) find that men have higher probability to be overeducated than women. The opposite result is found by Omey, (2009), Ordine and Rose (2009), and Ortriz (2008).

Older workers are less likely to be overschooled than their younger colleagues. This fact is consistent with search theory which predicts that workers are increasingly in better matches, but also with the theory of career mobility where workers who are overschooled in their first job have a higher probability to be promoted. A lot of literatures (Krahn and Bowlby, 1999; Ordine and Rose, 2009; Ortriz, 2008) support the above conclusion that older workers have higher match over younger workers. ILO (2013) has grouped age into two groups: the youth (aged 15-29) and the mature (aged 30 and above) and has found that youth are significantly more likely to being exposed overeducation risk than mature workers and are significantly less likely to be undereducated. The opposite result is found by Robst (2007), Wolbers (2003), and Witte and Kalleberg (1995).

Marital status has a differential effect of being overeducated between men and women. The theory of differential overqualification (Frank, 1978) claims that overeducation will be more marked for married women relative to men and single women. Married women in smaller labor markets run a higher risk of working in jobs for which their current qualifications exceed the educational requirements of the job. They are overqualified. This is due to the problem of dual job search for couples which is much more difficult to optimize than a single job search. In this situation, husbands may follow the ‘male chauvinist family location decision rule’ and optimize

their individual job search. Their wives are ‘tied movers’ or ‘tied stayers’, that is, their job search is undertaken under the condition that the job search of their husbands is optimized. This leads especially in smaller local labor markets (with fewer vacancies) to a higher risk of a mismatch between formal qualifications and job requirements. The Frank’s theory is supported by Buchel and Mertens (2000) that married women run a higher risk of working in jobs for which they are overeducated. Opposite result is supported by McGoldrick and Robst (1996); Wirz and Atukeren (2005) and Battu et al (1998) that marital status is not found to have a significant and positive impact on women’s probability to work in a job for which they are overeducated. ILO (2013) has found that having a partner, whatever his or her employment status, decreases the overeducation risk for mature men and women. It also reduces the risk of overeducation for young men. Living with a partner usually raises the risk of undereducation.

Workers having children would try to find the matched jobs to get higher wages so having children decreases the probability to be overeducated. This clearly reflects the greater responsibility parents bear and the greater need to get the highest possible returns on their education. ILO (2013) has concluded that having children makes young people less vulnerable to overeducation. With respect to gender, women with children are restricted in their spatial mobility and face higher risk of overeducation because they are restricted to small regional labor market. Thus, women with a child consistently face a higher risk of overeducation. In contrast, Some literatures (Dolton and Silles, 2003; Buchel and VanHam, 2002; Battu, Seaman, and Sloane, 1998) find that for females with children, there is no discernible impact on overeducation.

Work experience is another factor causing overeducation. The human capital theory (Becker, 1993) states that overeducation is transitory phenomenon that individuals use more years of schooling to compensate for low years of experience to get jobs. After they get more experience, they would move to jobs which matched with their educational level. The career mobility theory of Sicherman and Galor (1990) is built on this argument and states that acquired experience helps to escape from overeducation. So an individual with more years of work experience would less likely to be overeducated rather than adequately educated and more likely to be

undereducated rather than adequately groups (Buchel, 2001; Hartog, 2000; Groot and Brink, 2000; Borghans and de Grip, 2000; Cohn and Ng, 2000).

2.4 Causes of the Mismatch

This section investigates the main causes of educational mismatch which can be broadly divided into 2 groups dealing with labor supply and labor demand. The section is closed with different methods in determining the causes of overeducation.

2.4.1 Labor Supply Characteristics

Widening access to higher education has increased the heterogeneity of graduates through lower ability students accessing higher education and an increase in student-staff ratios. To some extent, the unobserved heterogeneity will relate to differences in the skills that exist among individuals with similar levels of education. Hence, previous studies on overeducation, which implicitly assumed homogeneity of workers, have overestimated the true extent of the phenomenon. Individual heterogeneity is taken into account by assuming that two persons possessing the same years of education can have different skills and/or ability levels. The figure below exhibits methods that take into account individual heterogeneity.

To date, the studies have attempted to control for heterogeneous skill effects by using fixed or random effect models that allow for some variability in worker characteristics by controlling for unobserved effects. These studies have concluded that when taking into account skill differences across individuals with similar levels of education, the wage penalty associated with overeducation largely disappears (Bauer, 2002; Frenette, 2004; McGuinness, 2006; Quintini, 2011).

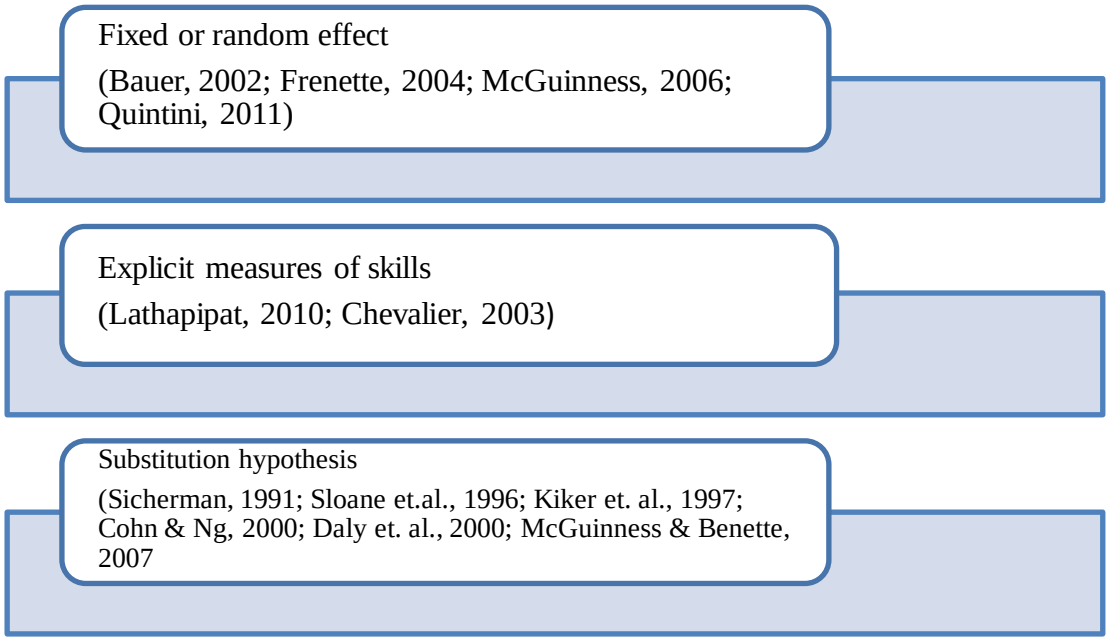


Figure 2.1 Three Methods in Controlling for Individual Heterogeneity

Other authors introduce into the analysis explicit measure of skills related to job performance. Chavalier (2003) has introduced the variable 'unobserved skill' into the analysis and found that the effect of overeducation on wage is reduced by 8% when the measure of skills is included. The deviation between the expected and observed earnings is used to be a proxy for the unobservable characteristics affecting workers' productivity. Chevalier and Lindley (2007) have used both observable and unobservable skills and found that including all measures of skills reduces the wage penalty for overeducated workers but does not eliminate it.

From the other point of view, the observed discrepancies between job skill requirement and educational attainment may be temporary. Discrepancies can result from substitution among the various forms of human capital endowment. Indeed, overeducated workers may substitute education for the lack of previous job experience, accepting jobs requiring less education than they actually possess in order to acquire the necessary experience for the job mobility. Under this view, the phenomenon of overeducation will be a transitory situation, with workers accumulating human capital that allows them to improve their job situation. Undereducated workers may substitutes experience for the lack of education, or undereducation may reflect a

situation where workers and employers believe that the actual mix of schooling and experience is adequate. Undereducation would thus be a long lasting situation.

Another reason which causes the differences among graduates is field of study. While education is of great use to creating human capital (i.e., formal education, on-the-job training, and experience), the fields of study are of greater use to the job market due to the occupationally specific skills acquired. Frenette (2004) has studied the role of academic program in the incidence of overqualification and found that overqualification rates vary considerably by major field of study at the college and bachelor's levels, but not at the master's level.

The relation between overeducation and other forms of human capital is especially relevant from public policy point of view. If formal education and other form of human capital are substitutes, overeducated workers will invest less in other forms of human capital than workers who are correctly educated. By extension, undereducated workers will invest relatively more in other human capital. If overeducated workers have to invest less in other forms of human capital, the social waste of overeducation will be less, as the lower investment cost in other human capital (partially) compensates the higher investment costs in formal education. Substitution between overeducation and other forms of human capital can also explain the persistence of overeducation, particularly if education is subsidized by the government.

A related argument can be found in Thurow's job competition model (Thurow, 1975). In the job competition model, it is argued that employers use observable characteristics of individuals, such as education, as selection device for hiring new workers. Education is seen as a proxy for other forms of human capital which the employer needs to invest in workers. Higher educated workers need less other human capital. For this reason, employers hire the highest educated workers, irrespective of the requirements of the job. In that case, skills of workers are underutilized and workers are overeducated. In short, the job competition model predicts a negative relation between overeducation and other forms of human capital.

The alternative hypothesis is that overeducation and other forms of human capital are complements. If education has an allocative effect and general human capital emhances the ability and reduces costs to acquire specific human capital,

overeducation and other human capital may be complements. Evidence for this hypothesis can be found in OECD (2007) which concludes that '……education and post school training seem to be complements.'

Most literatures (Daly, et. al., 2000; Buchel and Schult, 2001; Quinn and Rubb, 2006; Alba-Ramirez, 1993; Sicherman, 1987; Kiker, et. al., 1997; Cohn and Ng, 2000; Korpi and Tahlin, 2009) have used job experience as other form of human capital and examined whether overeducated workers substitute formal education for experience they don't have. Their result shows that overeducated workers tend to have lower work experience than adequately educated workers. Variation among these studies is the definition of experience. Because of no years of experience collected, most studies use work life immediately after school as a proxy for work experience. It is defined as the total number of full time or regular part time years an individual has worked since the age of 18 (Daly, et. al., 2000) or an individual's age minus years of education minus five (Quinn and Rubb, 2006) or age minus education minus tenure minus six (Kiker, et. al., 1997) and age minus school minus six (Cohn and Ng, 2000).

Another form of human capital frequently used is training (Verhaest and Omey, 2004; Sicherman, 1987). Individuals spend a quarter of their lives at school, but learning does not stop when they leave. For firms and individuals, education is becoming the normal state of affairs. In some cases, work offers plenty of opportunities to learn. Training can have various functions: complete retraining as a result of changing occupations, further training because of obsolete skills, and training for newcomers to enter the labor market.

A different strand of literature highlighted the role of educational quality as a crucial element in determining the mismatch. Student- faculty ratio, scores from standardized tests, and quality of institutions are indexes used to measure educational quality.

The increase in the student-faculty ratio reflects the shift from higher education reserved mostly for selected few to something within the reach of the general public. This may be one of the factors contributing to the perceived decline in the quality of higher education despite the difficulty in quantifying the quality of university graduates. The labor market is similar to product market (i.e., high quality

products command high prices) in that high-quality graduates receive high wages and vice versa. Some research works have studied the quality of graduates using the variance of wage residuals and found that the variance of residuals in the wage equation differs greatly among the tertiary graduates. In Dilaka's work (2010), using the same method earlier, university graduates have been found to be diverse in quality.

Another factor affecting the quality of university graduates is the quality of their secondary education. Secondary education has a strong influence on tertiary education. Hence, if secondary school graduates are of low quality, this likely leads to low quality in tertiary graduates (World Bank, 2011). V-NET, ONET, PISA and TIMSS scores can reflect the quality of secondary education. V-NET is Vocational National Education Test for vocational students in their third year of study. ONET is Ordinary National Educational test for primary and secondary students. PISA is international test among OECD member countries for primary and secondary students. TIMSS is also international test for mathematics and science for both primary and secondary students. Thai students have poor performances in all tests and scores continue to decline over time.

Still another factor affecting the quality of graduates is the quality of university per se. Individuals who graduate from low-quality universities are expected to have less human capital in comparison with those graduating from high-quality universities. Robst (1995) found a negative relationship between college quality and the likelihood of being overeducated. Institutional quality can be measured by evaluation scores from Office of National Education Standard and Quality Assessment (ONESQA), university ranking, and academic publications.

Evaluation of higher education institutions in Thailand is undertaken by the Office of National Education Standard and Quality Assessment (ONESQA). On the level of vocational education, ONESQA evaluates 6 indexes: internal quality assessment, the quality of graduates, teaching, management, knowledge service, and innovative knowledge of students and teachers. The second quality assessment (2006-2010) finds that public institutions are better than private institutions and institutions located outside Bangkok have no differences in quality relative to those in Bangkok.

On the level of higher education, ONESQA divides universities into 6 types, i.e., government university, autonomy university, Rajamangala University of Technology, open university, Rajabhat university, and private university; and evaluates the university by 14 indexes, i.e., 7 student indexes, 2 teaching indexes, and 5 administrative indexes. A university is evaluated every 5 years and the first round of evaluation was undertaken during 2001-2005 and the second round in 2006-2010. The National Institute of Development Administration (NIDA) was one of eight universities nationwide with the best qualified graduates and Mahanakorn University of Technology (MUT) was the best university in research.

Whether a university is of world class is judged by its ranking on the international indexes. Currently two of the most respected rankings are the Shanghai Jiao Tong University (SJTU) rankings and the Times Higher Education (THE) rankings. The SJTU ranking methodology focuses on research-related activity of the university, and its criteria include the numbers of Nobel laureates among the university's faculty members and alumni, the number of articles published in the journals, performance on the academic citation index, and university size. The THE's ranking criteria encompass measures of quality of teaching, skill provision, and number of international faculty members. In 2012, King Mongkut's University of Technology Thonburi is ranked 26th among Asian universities and has the highest ratio of research to faculty members among Thai universities.

Academic publication is another index which can indicate the quality of a university. The World Bank (2011) has reported that Thailand has only 2,059 scholarly publications per year compared to China of 48,552 and Korea of 21,471. Academic faculty members play a crucial role in skill provision. First, they train future primary, secondary, and tertiary teachers who in turn shape the quality and relevance of the entire national education system. Second, they provide skills to future high-level research, technical, managerial, and administrative workforce who will later become leaders in various sectors. Third, they are key incubators of the innovation and creativity that will enhance national productivity and competitiveness. Currently, Thailand is suffering from two main faculty-related constraints: higher and growing student-to-faculty ratio, and low share of faculty with graduate degrees. High student-to-faculty ratios affect teaching by leading to disproportionally high teaching

loads and to less time for personal interaction with students and for professional development. The World Bank (2011) has reported that Thailand has the student-to-faculty ratio of 37:1 in 2007, which was quite high relative to other countries, e.g., Malaysia 20:1, Lao 25:1, and Philippines 23:1. Furthermore, Thailand has high proportion of faculty with a master's degree but low proportion with doctorate degrees. In public higher education institutions in 2008 the share of faculty with Ph.D. and Master's degree was respectively 26% and 59%.

Diverse education standards are a major cause of concerns for a number of employers when it comes to recruitment. If the quality of graduates is perceived to have been poorer, firms may increase their educational requirements to ensure the recruitment of the most able graduates, and thereby those with low education quality could end up as overeducated workers. Following such changes, university graduates of today may be working in jobs that require less than a university degree.

2.4.2 Labor Demand Characteristics

Two principal explanations for the adjustment of demand for labor are technological change effect and trade effect (Figure 2.2). One explanation is that a technological progress leads to a change in production process and organizational changes. Another reason that firms adopt new technologies is the problem of labor shortage especially unskilled labor because new technologies are associated with reduced labor input of manual and cognitive task routines and increased labor input of non-routine cognitive tasks.

The problem of labor shortage is found across educational level especially in secondary education or lower. The most serious problem of labor shortage lies in secondary education for about 64.9 percent of the total shortages (Table 2.5). The main causes are free education allowing students to continue their studies longer and delaying their entry into the labor market and aging society which reduces the supply of working-age population.

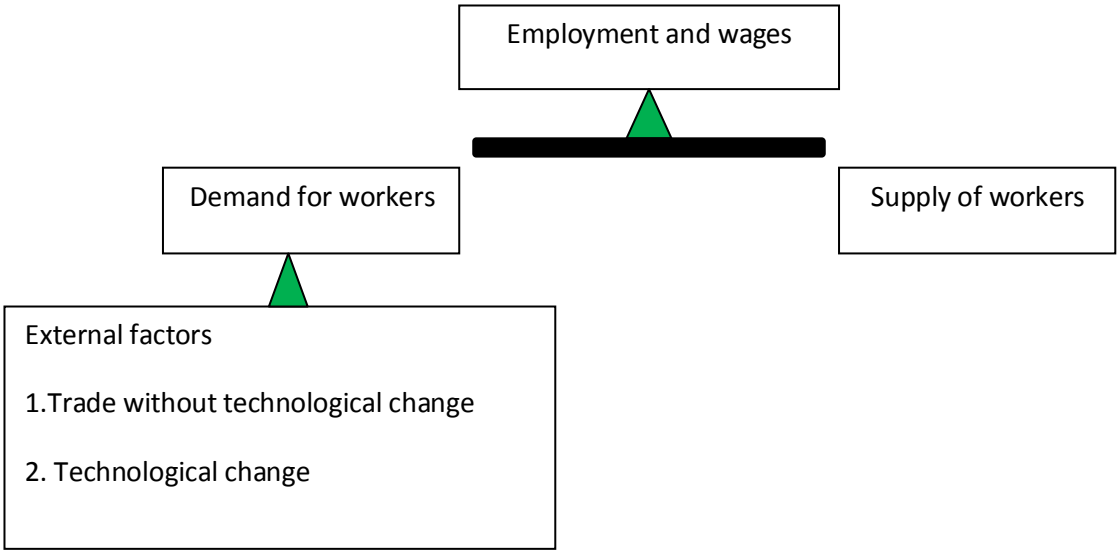


Figure 2.2 Demand for Labor

Labor shortage is also found at vocational level, that is, there is excess demand in vocational labor market especially in machine shop mechanics, electrical technology, and auto mechanics (The Federation of Thai Industries, 2010). Their main causes are many folds. One is government policy which guarantees the monthly salary for college graduates at 15,000 baht (by 2014). This policy induces vocational graduates to continue for college education. Two is 300 baht minimum wage which encourages secondary school graduates to seek employment rather than entering college. Three is requirement to continue studying in upper secondary school. That is, the Office of Basic Education Commission has changed its admission requirement for students who will continue their study to upper secondary level in the same school. For example, GPA requirement is just 1.5-2.0 on 4.0 scale while the old requirement would accept own students to continue studying no more than 40% of total students. Four is that Thai people value degree certificate because it serves as a screening device for employers which would enable them to get good jobs and pays. Five is the problem of fight outbreak among vocational students. Parents disproportionately are not happy to send their children into vocational institutions because of their fear that they might be victims of these awful outbreaks.

Firms who need to hire college graduates also face the problem in both quality and quantity. Firms also face the problem of labor shortage of educated workers in terms of quality, not quantity shortage. That is, college graduates rose from 2.75 percent in 1986 to 11.79 percent in 2009 (Table 2.6), while unemployment rate for educated labor force was very high at 13.79 percent in 2010 (Table 2.7). This evidence shows that higher education cannot deliver skills that firms need.

Table 2.6 Labor Demand, Labor Shortage, and Unemployed Persons, 2013

Educational level	Labor demand		Labor shortage		Unemployed persons	
	(persons)	(percent)	(persons)	(percent)	(persons)	(percent)
Secondary level or lower	99,804	32.6	57,275	31.5	119,800	56.52
Vocational	57,249	18.7	31,456	17.3	39,900	18.83
Upper vocational	26,022	8.5	15,818	8.7	43,600	20.57
Bachelor or higher	45,616	14.9	27,637	15.2	7,950	3.75
Other education	2,449	0.8	2,363	1.3	700	0.33
No requirement	75,006	24.5	47,275	26	-	-
Total	306,148	100	181,827	100	211,950	100

Source: National Statistical Office, 2013

Due to technological change, the significant shifts in labor demand have favored more skilled and educated workers, called skill-biased technological change. Skill-biased technological change (SBTC) means technological progress that shifts demand toward more highly skilled workers relative to the less skilled. Most studies have claimed that higher demand for high skilled workers is due to SBTC (Berman, Bound, and Griliches, 1994; Berman, Bound, and Machin, 1998; Berman and Machin, 2000; Sasaki and Sakura, 2005). The capital skill complementarity with technological change is one of the essential tools to show the existing of the SBTC. By skill, it means higher levels of education, ability, or job training. When the term of capital-

skill or technology-skill complementarity is used, it means that skilled or more educated worker is more complementary with new technology or physical capital than is unskilled or less-educated workers. The relative utilization of more skilled workers is positively correlated with capital intensity and the implementation of new technologies both across industries and across plants within industries. These patterns strongly suggest that physical capital and new technologies currently appear to be relative complements with more skilled workers.

A common alternative to RandD based technology measures is some index of computer use across industries. This has the advantage of being a direct measure of the diffusion of a new technology. The diffusion of computers and related technologies is a important measurable source of changes in the relative demand for skills. Computer

Table 2.7 Working Population (Percent) by Educational Level, 1986-2009

Year	Some primary and below	Upper primary	Some high school	High school	Some college	College and above	Total labor force
1986	67.72	15.88	6.99	4.48	2.17	2.75	100
1987	65.75	16.98	7.25	4.78	2.25	2.99	100
1988	63.53	18.49	7.22	4.97	2.53	3.25	100
1989	61.24	21.36	7.14	4.88	2.18	3.19	100
1990	58.97	23.17	7.19	5.06	2.23	3.38	100
1991	59.27	22.07	7.54	5.27	2.12	3.72	100
1992	57.93	22.3	8.1	5.24	2.37	4.06	100
1993	54.73	24.18	8.53	5.67	2.53	4.37	100
1994	53.66	23.68	9.55	5.92	2.69	4.49	100
1995	54.11	22.42	10.16	5.89	2.78	4.64	100
1996	53.37	22.01	11.17	5.82	2.56	5.07	100
1997	51.52	22.05	11.45	6.39	2.85	5.74	100
1998	47.82	21.62	13.31	7.22	3.53	6.5	100

Table 2.7 (Continued)

Year	Some primary and below	Upper primary	Some high school	High school	Some college	College and above	Total labor force
1999	46.81	21.11	13.38	7.68	3.88	7.13	100
2000	45.16	21.19	14.02	8.55	3.75	7.32	100
2001	42.09	22.36	13.97	9.04	4.33	8.2	100
2002	41.04	22.69	14.12	9.73	4.32	8.1	100
2003	39.06	22.8	14.85	10.09	4.54	8.66	100
2004	37.1	22.47	15.36	11.04	4.64	9.39	100
2005	36.94	22.13	15.04	11.19	4.61	10.08	100
2006	35.89	21.85	15.27	11.77	4.57	10.65	100
2007	33.19	23.37	15.07	12.65	4.78	10.95	100
2008	31.92	23.49	15.39	12.94	4.89	11.37	100
2009	30.93	23.29	15.55	13.31	5.14	11.79	100

Source: Yongyuth Chalamwong, 2011.

capital substitutes for workers in performing routine tasks that can be readily described with programmed rules, while it complements workers in executing nonroutine tasks demanding flexibility, creativity, generalized problem solving capabilities, and complex communications. These two mechanisms, substitution and complementarity, have raised relative demand for workers who hold a comparative advantage in nonroutine tasks, typically college educated workers (Bresnahan et.al., 1998; Autor, Katz and Krueger, 1998; 2003).

One explanation for mismatch (overeducation) emphasizes the role of technological change. The rapid pace of technological change may require skills and qualifications higher than those possessed by a large number of currently employed

Table 2.8 Unemployment Rate (Percent) of New Graduates by Educational Level, 2007-2010

Educational level	**2007**	**2008**	**2009**	**2010**
Secondary	5.05	6.01	4.96	3.60
Upper-secondary	6.22	9.19	7.13	2.71
Vocational	8.62	5.45	4.24	12.16
Upper-vocational	10.28	15.18	22.63	10.55
Undergraduate	12.37	10.52	10.32	13.79
-(Academic) social science	11.26	11.44	12.11	10.58
-(Vocational) social science	12.39	8.46	8.01	18.03
-(Academic) science	16.94	13.88	13.03	10.35
-(Vocational) science	7.22	8.23	3.15	4.11
-engineering	11.95	16.65	20.38	12.42
Graduate	2.02	2.36	2.65	4.27
-(Academic) social science	-	-	-	-
-(Vocational) social science	1.59	3.10	2.88	1.13
-(Academic) science	9.72	-	0.00	33.70
-(Vocational) science	-	-	2.47	6.08
-engineering	-	5.62	6.89	1.34

Source: Nipon, et. al.

workers. Under complementarity between new technologies and human capital, firms are willing to adopt new technologies only if they have a sufficient number of highly educated employees. A crucial characteristic of skilled workers is their adaptability. Skilled workers are regarded as being more flexible than unskilled workers, in the sense that they can adapt to new technologies at a lower cost relative to the unskilled workers. A crucial assumption behind the technology-related explanation for the mismatch (overeducation) is that firms have strong disincentives to provide training to their less skilled workers since they may not get fully rewarded for the training costs they have to bear. That is, when workers are willing to change employers, the

potential benefits from training accrue not only to the firm providing it and the worker acquiring it, but also to other firms that could make use of it without shouldering any of the cost.

Most literatures (Acemoglu, 1998; Albrecht and Vroman, 2002; Dolado et. al., 2009) shows that skill-biased change in technology (SBTC) should cause overeducation to decrease because SBTC increased the demand for educated workers and educated workers become more likely to reject low quality jobs and wait until finding a better one. There is, however, growing evidence that an increase in overeducation has coincided with a period of rapid SBTC. Following a SBTC, firms searching for educated workers become more selective in their hiring policies, rejecting candidates who, in spite of their credentials, turn out to be poorly skilled. Low ability educated workers will then seek employment in jobs that do not require a qualification and become overeducated (Pryor and Schaffer, 1997; Wolff, 2000; Layne, 2010; Morato and Planas, 2011).

The additional factor that has received most attention to date is rising international trade or trade liberalization. Based on the Hecksher-Ohlin and Stolper-Samuelson theorems, trade liberalization leads to growth in sectors where countries have comparative advantages, causing factor prices to converge internationally. It argues that for less developed countries, (LDCs) comparative advantage generally lies in their stocks of unskilled labor, while protectionism distorts prices in favor of capital. Because capital and skill are complements, protectionism raises the demand for skilled versus unskilled labor. Therefore, moving from protectionism to trade liberalism should shift the composition of output and employment toward sectors intensive in unskilled labor, raising the relative demand for unskilled labor, versus skilled labor, and increasing their wages relative to the wages of skilled workers.

New trade model has concluded that trade liberalization increases the demand for educated workers for many reasons. One is that trade liberalization leads to larger markets, which in turn induces greater research and development (RandD), increases the stock of technological knowledge, and reallocates employment toward innovative activities requiring more education (Stockey, 1994). Two is that trade opening links such change to foreign direct investment and imports of technology intensive goods which require skilled workers (Davis, 1996; Xu, 2003). Third explanation internalize

some of the complexities of modern production processes by assuming that the production of goods comprises the combinations of activities like various manufacturing tasks, marketing, distribution, foreign trade activities and exporting services. These tasks differ in their skill intensity so that the act of exporting becomes a skilled intensive activity, even when the act of manufacturing is unskilled intensive. Moreover, the act of exporting to high income destinations may require technologies and tasks that are yet more skill intensive. Consequently, economies that trade with high income countries will utilize relatively higher levels of skills than economies that are either closed or specialize in trade with middle- or low-income countries (Feenstra and Hanson, 1996; Matsuyama, 2007; Verhoogen, 2008; Grossman and Rossi-Hansberg, 2008 and 2009).

Since exporting is associated with other plant characteristics, such as size and technology uses, which are also potential sources of labor demand shifts. Most literatures (Bernard and Jensen, 1997; Verhoogen, 2008) find that demand variables, particularly export sales, are strongly correlated with increases in the demand for skilled labor. One explanation is explained by Verhoogen (2008) who developed a model where exports require quality upgrading-an activity that demands skilled labor. This idea can be extended to accommodate models where exporting requires associated services such as labeling or customer support and where the provision of these services is a skilled intensive activity. The second explanation (Matsuyama, 2007) is stressed on the export destination. Exporting to high income countries (e.g., the U.S.) does require higher quality and more skills. The third explanation is about the relationship between skill upgrading and the use of imported materials, and foreign technical assistance is likely to continue to be an important topic. An increasing number of developing countries embarked on trade liberalization process and trade barriers between developed and developing countries declined after WTO negotiations. These trade developments might encourage more technology transfers that favor relatively skilled labor as the relative price of imported technology decreases and firms are pressured to improve their productivity when faced by increased foreign competition.

Heterogeneous firm trade theories view exporting as an investment activities requiring sunk entry costs on the part of firms. Thus, more productive firms self-select

themselves into exporting and become larger in size compared with less productive non-exporters. Bustos (2005) allows for the interaction between exporting and skill mix choice and shows that less productive firms produce for domestic market and choose less skill intensive technology, while more productive firms choose to export using the same technology, and even more productive firms choose to export and use more skill intensive technology. It is expected that exporting is likely to be associated with an increase in a firm's employment, particularly skilled employment. A lot of indicators used to proxy for trade liberalization are export status (exporter dummy), the ratio of total firm exports to total firm sales, expenditures on foreign technical assistance, imported material, and the share of imports from all countries.

Most studies (Grossman, 2013; Egger and Koch, 2012) states that trade, especially in exporting firms, will improve the matches that workers achieve in an industry, resulting in these workers finding employment with either better managers or better technologies than before, then within industry wage inequalities will increase. Upgraded matching tends to benefit all workers in an industry, but especially those at the higher end of the ability and wage distribution. Highly productive firms expand production due to exporting and, therefore, find it attractive to install a better (more expensive) screening technology than in the closed economy. Koch (2012) shows that the average mismatch between worker-specific abilities and task-specific skill requirements unambiguously shrinks in the open economy. However, Zhu et. al. (2012) finds no correlation between trade openness and degree of matching. One reason is that they use the reduction of foreign tariff as a measure of openness.

2.4.3 Methods in Determining the Causes of Overeducation

Studies in the causes of overeducation can be divided by three methods of analysis: individual-level, aggregate-level, and mixed (individual and aggregate-levels) but all methods break down the causes of overeducation into demand-side and supply-side factors (Figure 2.3).

Literatures using individual-level analysis have two methods to determine the causes of overeducation: direct and indirect methods. For direct method, variables representing causes of overeducation are estimated on the probability of being overeducated. Stefanik (2011) finds 4 explanations for overeducation. First is

overeducation as a career strategy. He has used age as a proxy and hypothesized that younger individuals in earlier stages of their career are much likely to be overeducated. A university graduate entering an overeducated working position to compensate the lack of working experience. After some experience is gathered, he or she will look for more suitable job. Second is education as an insurance. He has used unemployment experience as a proxy and hypothesized that experienced unemployment increases the likelihood of overeducation. Third is overeducation due to upgrading theory. He has used wage as representing variable and hypothesized that overeducated workers earn more than the rest of their educational groups. New technology makes higher educated workers more productive in existing jobs so the growth of productivity has to be visible in the rise of wages (assumption of classical economic theory). Fourth is overeducation due to education inflation. This explanation is controversial to earlier one, that is, employers adjust hiring standards following an increase in supply of university graduates so overeducated workers would receive lower wages than the rest of educational groups. The results from binary logistic regression on 10 EU countries show that in Italy, overeducation can be explained more as career strategy, in Belgium more as a result of using education as insurance. In case of Spain, all explanations discussed are valid.

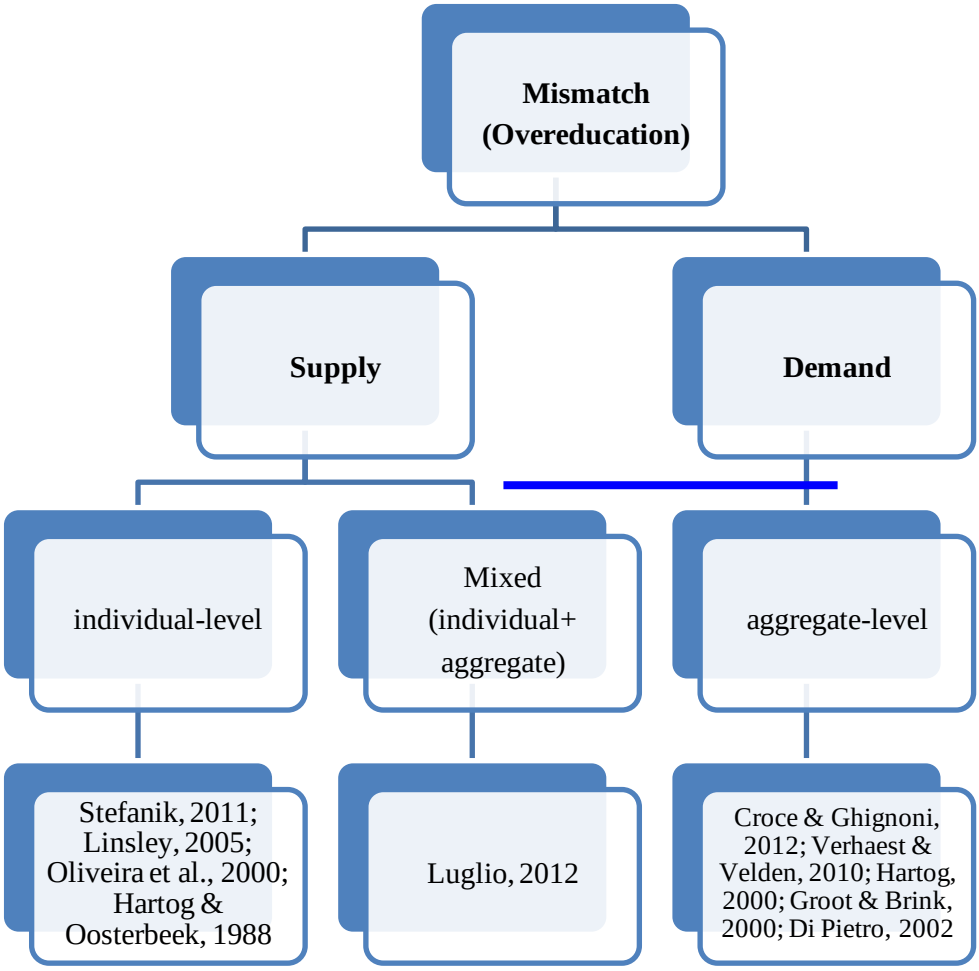


Figure 2.3 Three Methods in Determining Causes of Overeducation

For indirect method, the causes of overeducation are determined by using earning function. The earning function is called the over-required-undereducation (ORU) earnings function which is an adaptation of Mincerian wage equation. The equation is given by:

$$lnY_i = \alpha_0 + \alpha_1 q_i^r + \alpha_2 q_i^o + \alpha_3 q_i^u + X_i\beta + \mu_i$$

where Y_i is income

X_i is a vector of other characteristics for individual i

q_i^o is surplus educational qualifications or the education in excess of that which is required for the job

q_i^u is deficit education

Actual education is given by:

$$q_i = q_i^r + q_i^s - q_i^d$$

The causes of overeducation are broken down into three factors: worker characteristics, job characteristics, and both. Human capital theory (Becker, 1993) is based on the assumption that productivity is an increasing function of the human capital level of the worker. In this model, labor is paid the value of its marginal product, and consequently wages are determined by the workers' educational attainment, experience, and training. Indeed, the human capital model implies that worker characteristics, or the supply-side, determine earnings. Overeducation arises when there is an increase in the educational attainment of workers. Employers, faced with a cheaper supply of educated labor, substitute away from low-skilled workers towards the more highly skilled. Educated workers are placed in positions previously filled by low-skilled workers. The hypothesis to test for human capital theory is $\alpha_1 = \alpha_2 = -\alpha_3$ which implies that education attainment alone determines earnings.

Job competition theory (Thurow, 1975) offers a demand side explanation for the existence of overeducation. Central to the job competition theory is the assumption that workers compete in the labor market for high wage jobs. Competition between workers creates a job queue. On the demand side, competition between firms for high productivity workers creates a labor queue which is ranked by training costs. As educational level and on-the-job training are assumed to be complements, training costs are lower for individuals with more educational levels. Hence, highly educated persons are matched to high-paying jobs. The model also assumes that productivity and earnings are related to job characteristics, that is, earnings are driven by demand side factors alone and a worker's education has no impact on earnings.

Overeducation arises when there is an increase in the educational attainment of workers. This causes a shift in the distribution of workers in the labor queue, forcing the low-skilled into low-paid jobs or out of the labor market. Furthermore, overeducation reduces the return to education as high-skilled individuals are forced to accept jobs lower in the job queue. Despite lower returns to educational attainment, it is rational for individuals to invest in education as workers need to defend their position in the labor queue. The hypothesis to confirm the job competition model is

$\alpha_2 = \alpha_3 = 0$ which implies that only the educational requirement of the job impacts on earnings.

The assignment model (Sattinger, 1993) is an alternative approach that incorporates both demand and supply side factors into the analysis of overeducation. In this model, the returns associated with additional education depend on the quality of the assignment of heterogeneous workers to heterogeneous jobs. The returns associated with investments in human capital via educational attainment are limited if occupations do not utilize all of the schooling of the workers. That is to say, overeducated individuals earn less than others with their level of educational attainment because of an occupational ceiling on productivity. The hypothesis to test for the assignment model is $\alpha_1 = \alpha_2 = \alpha_3 = 0$. The hypothesis should be rejected to support the model and confirm that both educational attainment and the job education requirements impact on earnings.

A number of literatures have used earning functions to determine the causes of overeducation. Linsley (2005) and Oliveira et al. (2000) have concluded that the demand-side factors explain the existence of overeducation. However, Hartog and Oosterbeek (1988) have concluded that an earning equation containing both supply and demand parameters has been proven to be superior to both the human capital and the job competition specification. Hence, allocation has a significant effect: it does matter where an individual of given education ends up.

Aggregate analysis is to investigate supply and demand-side factors underlying cross-country differences in overeducation, so the estimated model is as follows:

$$Y_{it} = \alpha + \beta_1 S_{it} + \beta_2 D_{it} + \beta_3 X_{it} + \varepsilon_{it}$$

where Y_{it} is the incidence of overeducation by country i and year t

S is measures of labor supply

D is a vector of indicators of labor demand

X is a vector of control variables

Most literatures give an importance in demand-side factors to determine the incidence of overeducation. Di Pietro (2002) states that overeducation is caused by firms' inability to reap the benefits stemming from a high rate of technological progress due to strict employment protection legislation. Croce and Ghignoni (2012)

have concluded that the increase of the supply of qualified labor per se cannot be seen as a factor fuelling overeducation. Cyclical conditions also matter. Verhaest and Velden (2010) have concluded that there is no reason to expect that overeducation increases following supply growth as supply can create its own demand.

Mixed method uses both individual and aggregate-level variables in determining the causes of overeducation. Luglio (2012) has estimated an ordered probit in 13 EU countries. The model is as follows:

$$Y_i = S_i\beta_1 + D_i\beta_2 + X_i\beta_3 + \varepsilon_i$$

Where Y_i = 1 if overeducated

= 2 if properly matched

= 3 if undereducated

S_i is supply-side factors such as age, marital status, educational level, field of study, etc.

D_i is demand-side factors which are regional level variables such as patent application, youth unemployment, gross fixed capital formation, expenditure per worker in RandD sector

X_i is control variables

The conclusion is that the demand-side factors appear to function better in technologically advanced countries (Portugal, Germany, Finland), whereas supply side factors are more efficient in balancing the educational mismatch in countries with lower technological development (Greece, Italy).

2.5 The Effects of Overeducation on Earnings

In a microeconomic framework, overeducation affects workers and firms. Overeducated workers have more skills than their jobs require. Berg, et. al. (1978) finds that the underutilization of worker skills has existed in the labor market for a considerable period. The lower productivity of overqualified employees can be seen in the form of wage penalties. Empirical works have reported the results from estimated functions where an individual's completed schooling is decomposed into the number of years required for his or her current job and the number of years of

surplus or deficit education. The primary interest is in the differences between the estimated coefficients on required education and those for years of surplus or deficit education.

The ORU model[4] as illustrated by Duncan and Hoffman (1981) is a straightforward approach to examine the economic effects of over-(and under-) education. An ORU earnings function is empirically estimated in which an individual's actual educational attainment is decomposed into the number of years of education required on his or her job and any years of surplus or deficit education. This decomposition is expressed by the equation

AE = RE + OE – UE,

where AE is the attained years of education

RE is the required years of education in the job that the worker holds

OE is years of education attained by the worker that is in excess of what the current job requires

UE is years of education required by the job that is in excess of what the worker has attained

OE will be zero for correctly matched and undereducated workers, and UE will be zero for correctly matched and overeducated workers. The equation thus reduces to AE = RE for the correctly matched, to AE = RE+OE for the overeducated, and to AE = RE – UE for the undereducated.

There are two attractive traits of this decomposition. First, it combines the information on attained and required education while fully retaining the continuous character of both dimensions. This allows an assessment of separate payoffs to years of attained education dependent on the nature of the job match as revealed by earnings regressions. Second, the main pattern of results from this model has turned out to be remarkably robust across both time and countries.

[4] An ORU earnings function is a variant of the standard Mincer earnings equation where years of attained education are replaced by years of Overeducation, years of Required education, and years of Undereducation.

The three types of education defined in the equation above have been introduced into a standard Mincerian wage equation producing the ORU wage equation. From the standard Mincerian wage equation:

$$\ln W_i = \sigma_a S_i^a + X_i\beta + \epsilon_i \,, \qquad (2.1)$$

where W_i is individual i's wage

S_i^a is the attained years of schooling

X_i is a vector of control variable including experience and experience squared.

S^a is further divided into three parts: S^r being the years of schooling required for the job, S^o being actual attainment greater than required schooling, S^u being actual schooling less than required schooling. The following identity therefore holds:

$$S_i^a = S_i^r + \underbrace{\max(0, S_i^a - S_i^r)}_{S_i^o} - \underbrace{\max(0, S_i^r - S_i^a)}_{S_i^u} \qquad (2.2)$$

when S^a in the Mincerian wage equation is replaced by these three parts, the wage equation then reads:

$$\ln W_i = \sigma_r S_i^r + \sigma_o S_i^o + \sigma_u S_i^u + X_i\beta + \epsilon_i, \qquad (2.3)$$

where W_i is hourly wage rate

S_i^r is years of required education

S_i^o is years of overeducation

S_i^u is years of undereducation

X is other important variables, e.g., years of experience, experience squared, city size, and a dummy variable for residence in the South

ϵ_i is a standard error term.

From the equation (2.3), the overeducation literatures are concentrated on how overschooling (underschooling) affect wages by looking at the coefficient σ_o (σ_u). The coefficient σ_r represents the returns to years of adequate education, σ_o represents the returns to years of education that exceed those required, and σ_u represents the loss of earnings from a year of undereducation. If the returns to surplus education are found to be lower than those to required education, an implication is that resources are wasted as marginal levels of education received by the overeducated workers cost more than the productivity advantage they have.

Two interesting results are found from cross-sectional wage regressions: 1) the wage effects of both required education and overeducation are positive, while the wage effect of undereducation is negative; 2) the returns to required education exceeds the returns to surplus schooling and deficit schooling. In terms of the above equation, σ_r and σ_o are greater than zero while σ_u is less than zero and σ_r is greater than σ_o and $|\sigma_u|$. Put it differently, overeducated workers earn more than correctly matched workers in the same level of jobs, but less than correctly matched workers with the same level of education. The opposite is true for the undereducated workers.

With ORU model, A number of studies (Sicherman, 1987; Alba-Ramirez, 1993; Cohn and Ng, 2000; Cohn and Khan, 1995; Rubb, 2003; Daly, et. al., 2000) have found that workers who are overeducated get higher wages than their fellow workers (holding other characteristics constant) but lower than workers with similar levels of schooling who work in jobs where their schooling equals that is required. Similar findings have been found in Hong Kong, Portugal, and Taiwan (Hung, 2008; Santos, 1995;Vieira, 2005). These conclusions are not sensitive to the measure of required education, i.e., job analysis, worker assessment, or realized match. Explicit comparisons have only made by Santos (1992, 1995) for Portugal and by Rumberger (1987) for the United States.

To compare the overeducated or undereducated workers to those who are similar in all other observed characteristics (schooling included), but work in jobs that require the level of schooling they actually have, the Verdugo and Verdugo specification is proved to be a good approach. Differences from Duncan and Hoffman's are: 1) the realized match (mean) method is used rather than the workers' self-assessment method to measure required schooling; 2) years of over/

underschooling are replaced by dummies for being over/underschooled; 3) the regression analysis is controlled for the completed years of schooling rather than required years of schooling. Thus, Verdugo and Verdugo model can be expressed as:

$$\ln W_i = X_i\beta + a(E_i) + c(OE)_i + d(UE)_i + e_i , \qquad (2.4)$$

where $\ln W_i$ is the natural log of annual individual wages and salaries

X_i is a row vector of independent variables (e.g., experience, region of residence, sectors of employment, marital status, occupation, etc.)

E_i is years of actual education attainment

OE_i = 1 if overeducated and = 0 if else

UE_i = 1 if undereducated and = 0 if else.

Over- and under-educated workers are compared to those who have similar observed characteristics but work in the jobs that require the years of education they actually possess. If productivity levels and wages are attached to actual level of education, the coefficient on the over- and under-education variables should be zero. Any number of years of education deviating from the required level of education for the job would be unproductive and the reward would be zero. If, on the other hand, productivity levels are flexible and a positive relation exists between educational level and worker productivity, then positive returns to years of overeducation and negative returns to years of undereducation would be expected.

Overeducated workers would earn more than their fellow workers who have the required education in the particular job; however, they will earn less than workers who have the same education but work in jobs that require that higher educational level. Alternatively, undereducated workers would earn less than other workers who possess the required education; they will earn more than those with the same level of education who work in jobs that require the educational level they actually have (Sicherman, 1987; Cohn and Khan, 1995 and Kiker et. al.,1997).

Another earning model used in the overeducation literature is derived from the standard model popularized by Mincer (1974) where log earnings are modeled as the sum of a linear function of years of education and a quadratic function of years of potential experience. It can be shown as:

$$\text{Ln } W = a + b_1E + b_2E^2 + cS + \text{other variables} + \epsilon, \quad (2.5)$$

where ln W is the natural logarithm of wages

E is labor market experience measured by subtracting the age of completion of schooling from reported age

S is years of schooling

Є is error term.

Rumberger (1981) modifies Mincerian equation by breaking years of education into years of required schooling and surplus schooling and estimated the earnings function in the form:

$$\ln W = a + b_1E + b_2E^2 + b_3S_r + b_4S_s, \quad (2.6)$$

where S_r is required schooling

S_s is surplus schooling

E is years of experience

The earnings model is based on the notion that productivity and earning are associated with jobs, not individuals. It assumes that each job consists of a fixed number of tasks that require a certain array of skills to perform them. Hence, the skills and education a worker brings into a job in excess of those required to perform the tasks of the job may not be productive or rewarded through higher earnings.

It is found that schooling in excess of that required in the job is rewarded at a lower rate than required schooling. This suggests that additional schooling is not completely unproductive, but simply that jobs constrain the ability of workers to fully utilize the skills and capabilities they acquire in school. Chavalier and Lindley (2007) also modify the Mincerian earnings equation by adding overeducation dummies into the equation. Their adjusted Mincerian equation becomes:

$$\text{Log } w = \beta_1 + \beta_2X + \beta_3S + \beta_4ex + \beta_5ex^2 + \beta_6D_0 + \mu, \quad (2.7)$$

where W is the log of worker's wage rate

X is explanatory variables (e.g., gender, type of higher education institutions, study programs, etc.)

S is years of schooling

ex is labor market experience (= age-S-6)

D_0 is the dummy variable (= 1 if overeducated and 0, otherwise).

Their conclusion is that overeducated graduates earn less than their peers who are in the matched jobs because overeducated individuals accept a temporary position as a stepping stone for the better job to which they strive for.

Three problems are found in the overeducation studies: unobserved heterogeneity, endogeneity problem, and measurement error.

On the problem of unobserved heterogeneity, OLS results find the wage penalties for the overeducated workers compared to matched workers. An important assumption under the OLS estimation is that workers in the same occupation are homogenous in their ability or skill. On the contrary, workers who work in the same line of job have different abilities.

If unobserved heterogeneity plays an important role, the estimated returns to the years of over- and under-education are misleading, that is, wage penalties to overeducated workers may disappear if the estimation takes unobserved heterogeneity into account. Assume that overeducated (undereducated) workers have less (more) unobserved abilities than correctly matched workers in the same occupations, the estimated returns to years of overeducation (undereducation) will be underestimated (overestimated) when not controlling for unobserved heterogeneity. Hence, it could be expected that the absolute value of the returns to years of required education, overeducation, and undereducation become more similar to each other when controlling for unobserved heterogeneity. In other words, the significant pay penalties associated with overeducated workers in previous studies (Cohn and Khan, 1995; Daly, et. al., 2000; Hartog, 2000, etc) may be due to the failure to control adequately for productivity differences.

One approach to correct for unobserved heterogeneity is the fixed effect model. When estimating the ORU model from equation (2.3),

$$\ln W_i = \sigma_r S_i^r + \sigma_o S_i^o + \sigma_u S_i^u + X_i\beta + \epsilon_i \quad (2.3)$$

The overeducation studies use panel data to estimate the effects of overeducation on earnings, so the equation (2.3) introduces a time factor, t, into the model and has the form:

$$\ln W_{ti} = \sigma_r S_{ti}^r + \sigma_o S_{ti}^o + \sigma_u S_{ti}^u + X_{ti}\beta + \epsilon_{1i} \quad (2.8)$$

Unobserved productivity differences are part of the error term ϵ_{1i}, so

$$\ln W_{ti} = \sigma_r S_{ti}^r + \sigma_o S_{ti}^o + \sigma_u S_{ti}^u + X_{ti}\beta + (\rho_i + \epsilon_{2ti}) \quad (2.9)$$

where ρ_i is ability which is assumed to be fixed over time. With a negative correlation between ρ and S^o and a positive between ρ and S^u, the estimates of the educational effects produced by the OLS analyses of the ORU specification above would be biased. If ρ is a time invariant person specific factor (i.e., $\rho_{ti} = \rho_{t+1i}$), then unbiased estimates could be obtained through the estimation of a standard fixed effects model. One of the fixed effects model is the first difference model, where

$$W_{t+1} - W_t = \sigma_r(S^r_{t+1} - S^r_t) + \sigma_o(S^o_{t+1} - S^0_t) + \sigma_u(S^u_{t+1} - S^u_t) + \beta(X_{t+1} - X_t) + (\rho-\rho) + (\epsilon_{2t+1} - \epsilon_{2t}) \quad (2.10)$$

The individual index i has been dropped to simplify the notation. The ability (productivity) effect has been differenced out from the fixed effect model. Thus the basic idea of the fixed effects estimator is to estimate the pay penalty associated with overeducation controlling for the part that is due to unobserved ability. When fixed effect techniques are applied to investigate the role of unobserved heterogeneity in the analysis of the wage effects of educational mismatch, the results from various studies (Bauer, 2002; Dolton and Silles, 2008; Korpi and Tahlin, 2009; Lindley and McIntosh, 2008; Tsai, 2010) reveal that the estimated differences between adequately and inadequately educated workers become smaller or disappear totally when controlling for unobserved heterogeneity.

Another avenue that can manage unobserved skills is quantile regression. In it, the estimates at different quantiles represent the effects of a given covariate for individuals that have the same observable characteristics but, due to unobserved characteristics, are located at different quantiles of the conditional distribution. Therefore, those workers that end up in high pay jobs (located at the upper part of the wage distribution) are those who have more productive skill where they are ability, better academic credentials, motivation, etc., to earn a higher wage given a vector of observable characteristics. Having the labor market segmented by skill deciles, with individual skills indexed by the individual's position in the conditional wage distribution, then differences in the wage effects of overeducation across conditional quantiles can be interpreted as differences between skill groups. That is, differences in the overeducation wage effect between workers at high-pay and low-pay jobs can be interpreted as differences between workers with high and low unobserved skills. The quantile regression model can be written as:

$$lnw_i = X_i\beta_\theta + e_{\theta i} \qquad \text{with } Quant_\theta(lnw_i|X_i) = X_i\beta_\theta$$

where X_i is the vector of exogenous variables and β_θ is the vector of parameters. $Quant_\theta(lnw_i|X_i)$ denotes the Θth conditional quantile of ln w given X. The Θth regression quantile, 0<Θ<1, is defined as a solution to the problem

$$\min_{\beta \in R^k}\{\sum_{i:lnw_i \geq X_i\beta_\theta} \theta|lnw_i - X_i\beta_\theta| + \sum_{i:lnw_i < X_i\beta_\theta}(1-\theta)|lnw_i - X_i\beta_\theta|\}$$

which, after defining the check function $\rho_\theta(z) = \theta_z \; if \; z \geq 0 \; or \; \rho_\theta(z) = (\theta - 1)z \; if \; z < 0$ can be written as

$$\min_{\beta \in R^k}\{\sum_i \rho_\theta(lnw_i - X_i\beta_\theta)\}$$

This problem is solved using linear programming methods, where standard errors for the vector of coefficients are obtained using the bootstrap method described in Buchinsky (1998). It must be noted that if the underlying model is a location model,

that is, changes in the explanatory variables producing changes only in the location, not in the shape, of the conditional wage distribution, then all the slope coefficients would be the same for all Θ.

The relationship between overeducation and wage penalties among various quantiles is not clear. Some studies (Budria and Moro-Egilo, 2004; 2006; Motellon et al., 2013) have concluded that overeducation pay penalty is found to be increasing when moving up along the wage distribution. Wage penalties are higher among high-skilled groups. Some studies (McGuinness, 2003) support the human capital theory that overeducation always exists among low-ability segments so wage penalties would be higher among the lower part of wage distribution.

On endogeneity problem, from the standard Mincerian wage equation:

$$\text{Ln } w_i = \sigma_a S_i^a + X_i\beta + \epsilon_i$$

where w_i is individual i's wage

S_i^a is the attained years of schooling

X_i is a vector of control variables including experience and experience squared.

Clearly, the above equation faces the problem of endogeneity problem because the attained years of schooling can affect wages and they, in turn, affects education. The endogeneity problem is much more complex in the Duncan and Hoffman (ORU) model because it includes required education, surplus education, and deficit education.

One approach to correct for the endogeneity problem is instrumental variable method (IV). It will yield acceptable estimates, if these instruments satisfy two conditions, namely relevance and exogeneity. Relevance implies a correlation between the instrument and the endogenous regressors, while exogeneity implies no correlation between the instrument and the error term in the main regression. Korpi and Tahlin (2009) instrument the three schooling parameters in Duncan and Hoffman's model using the number of siblings, place of residence during childhood, economic problems in the family of origin, and disruption in family of origin. They conclude that years of overeducation have no effect on pay.

An alternative approach to address endogeneity problems is propensity score matching (PSM). It assesses the impacts of overeducation relative to a group of nonovereducated graduates with similar overeducation probabilities. The estimation conditions for the technique are that observations with the same probability to be overeducated workers must have the same distribution of characteristics (both observable and unobservable). McGuinness (2008) concludes that the overeducation phenomenon has imposed real and significant wage and productivity costs on individuals.

On the problem of measurement error, it may lie in measuring required schooling. Required schooling varies within occupation. Say, the required education for a secretary in a large professional company might differ from that in a small business. Therefore, it is likely that required schooling is measured with error and so are the educational mismatch variables in the wage equation. If so, OLS estimates will be biased. Accordingly, the small wage differential between well-matched and mismatched workers obtained from the fixed effect model is due to measurement error bias.

Suppose the true model takes the form:

$$\ln W_{it} = X_{it}\beta_x + \beta_o Z^o_{it} + \beta_u Z^u_{it} + \epsilon_{it},$$

where $Z^o_{it} = Edu_{it} - Z^R_{it}$

$Z^u_{it} = Z^R_{it} - Edu_{it}$

Edu_{it} is years of schooling completed

Z^o_{it} is years of surplus schooling

Z^u_{it} is years of deficit schooling

Z^R_{it} is actual years of required schooling

X_{it} is all of the other explanatory variables in the wage equation

ϵ_{it} is error term

When required schooling is observed with errors, S^R_{it} is observed instead of the true value Z^R_{it}.

$$S^{R}_{it} = Z^{R}_{it} + v_{it},$$

where v_{it} is measurement error with $E(v_{it}) = 0$ and $var(v_{it}) = \sigma^{2}_{v}$

Accordingly, the observed years of surplus and deficit schooling are also incorrectly measured:

$$S^{o}_{it} = Edu_{it} - Z^{R}_{it} - v_{it}$$
$$S^{u}_{it} = Z^{R}_{it} - Edu_{it} + v_{it}$$

This type of bias is expected to induce the coefficient on overeducation toward zero in cross- sectional model.

The standard method to correct for bias resulting from classical measurement error is instrumental variables (IV). Only a few studies have made attempts to address the issue of measurement error explicitly in the context of returns to required, overschooling, and underschooling. With instrumental variable methods, Dolton and Silles (2008) have defined overeducation into overeducation (get) and overeducation (do). The former means that individuals have attained education over education required for entering the job. The latter means that individuals have attained education eover education needed to do the job. The IV estimates give larger wage penalties than OLS estimates.

Tsai (2010) argues that analytical method (IV method) to correct for measurement error is inappropriate. He states that assumptions in a classical errors-in-variables model do not apply for study in overeducation. Assumptions used in classical errors-in-variables model are violated when studying in overeducation. One, in classical errors-in-variables model, measurement errors are uncorrelated with the true value (i.e., cov (Z^{R}_{it} ,v_{it}) = 0). Actually, a negative correlation between measurement error and the true value is found, cov (Z^{R}_{it} ,v_{it}) < 0. Two, the explanatory variables in the wage equation are uncorrelated. In fact, years of schooling completed are included in the wage equation as an explanatory variable and years of surplus and deficit schooling have years of schooling completed as one component. Accordingly, the no-correlation assumption among explanatory variables is inappropriate. Three, years of surplus and deficit schooling are not continuous

variables. If educational level is higher than level of required education, years of surplus schooling is equal to years of schooling completed minus years of schooling required. This means that years of surplus schooling is a maximization function equal to Max{0, Edu – Edu^R} where Edu is years of education attained and Edu^R is years of required education. Similarly, years of deficit schooling is equal to Max {0, Edu^R – Edu}.

The non-continuous property of the educational mismatched variables makes it impossible to solve the measurement error problem analytically. Therefore, a numerical approach is used to obtain the true estimates of overeducation and undereducation in the presence of non-classical measurement error. After correcting for measurement error bias, overeducated workers receive wage premiums, instead of wage penalty in other methods, in comparison with their equally educated counterparts.

CHAPTER 3

THEORETICAL FRAMEWORK

As discussed in Chapter 1, the mismatch is the imbalance between demand and supply of graduates so this chapter discusses conceptual frameworks related to supply factors, demand factors, and the matching between supply and demand, including Human capital theory and job competition model as well as assignment model.

3.1 Supply-Side Theories

3.1.1 Human Capital Theory

Human capital theory has been proposed by Schultz (1961) and developed extensively by Becker (1993). Schultz (1961) observes that increases in national output have been large compared with the increases of land, man-hours, and physical reproducible capital while there is unexplained large increase in real earnings of workers. Investment in human capital is probably the major explanation for this difference.

Both Schultz (1961) and Becker (1993) argue that formal education is the main activity which can improve human capital. Other activities which can also improve human capital are on-the-job training, emotional or physical health, migration, etc. Education raises an individual's productivity in the workplace and higher productivity leads to higher earnings. Education has little direct effect on earnings; it operates primarily indirectly through the effect on knowledge and skills. Education develops skills. Skills can be either general or specific (Becker, 1993). Schultz (1975) explained that education enhances a worker's ability to deal with disequilibria and eventually increases productivity.

This section will consider how education affects earnings and rate of returns. Becker (1993) has defined net earnings as the difference between actual earnings and direct school costs.

$$W = MP - k \quad (3.1.1)$$

where MP is the actual marginal product

k is direct costs such as tuitions, fees, books, etc

If MP_0 is the marginal product that could have been received, equation (3.1.1) can be written as

$$W = MP_0 - (MP_0 - MP + k) \quad (3.1.2)$$

$$W = MP_0 - C \quad (3.1.3)$$

where C is the sum of direct and forgone costs

How much individuals invest in education depends on rate of return from investing in education. When considering the rate of return, earning and costs will involve. Becker initially assumes that investment is restricted to a single known period and returns to all remaining periods so the present value of the net earnings stream is

$$V(Y) = \sum_{j=0}^{n} \frac{Y_j}{(1+i)^{j+1}} \quad (3.1.4)$$

where Y is education providing a person entering at a particular age with real net earnings stream of Y_0 in the first period, $Y_1,\ldots,Y_n$; n = last period

i is market discount rate, assumed for simplicity to be the same in each period

If X is another activity providing a net earnings stream from the first period to the last period (X_0, $X_1,\ldots, X_n$) with a present value of V(X) then the present value of the gain from choosing to study in school (Y) would be given by

$$V(Y) - V(X) = \sum_{j=0}^{n} \frac{Y_j - X_j}{(1+i)^{j+1}} \quad (3.1.5)$$

From the above equation, the cost of investing in education equals the net earnings foregone by choosing to invest rather than choosing an activity requiring no investment. If education requires an investment only in initial period, cost of choosing to study in school rather than other activities is $C = X_0 - Y_0$. Returns from education will be received in period 2 (j=1), so the present value of gain from investing in education is

$$\sum_{j=1}^{n} \frac{Y_j - X_j}{(1+i)^j} - C = R - C \quad (3.1.6)$$

The internal rate of return is a rate of discount equating the present value of returns to the present value of costs: R – C = 0. In other words, the internal rate r is defined as

$$\sum_{j=1}^{n} \frac{k_j}{(1+r)^j} = C \qquad (3.1.7)$$

where $k_j = Y_j - X_j$

If returns are the same in each period, equation (3.1.7) becomes

$$C = \frac{k}{r}[1 - (1+r)^{-n}] \qquad (3.1.8)$$

where $(1+r)^{-n}$ is a correction for the finiteness of life that tends toward zeor as people live longer.

If investment is restricted to a single known period, costs and rate of return are easily determined from information on net earnings alone. However, investment in education is distributed over many periods; it takes more than ten years in the U.S., so the analysis must be generalized to cover distributed investment. If investment in education is made during each of the first m period, investment cost in each period is the difference in net earning between education and other activities, total investment cost as the present value of these differences, and the internal rate would equate total costs and returns. The total investment costs as the present value of the earnings difference between education and other activity. It can be expressed as:

$$C_j = X_j - Y_j \,, j = 0, \ldots\ldots, \text{m-1}$$

$$C^1 = \sum_{0}^{m-1} \frac{C_j^1}{(1+r)^j} \qquad (3.1.9)$$

If these difference between X and Y is same in all periods, then

$$C^1 = \frac{k}{r} \frac{[1-(1+r)^{m-1-n}]}{(1+r)^{m-1}} \qquad (3.1.10)$$

Equation (3.1.10) represents costs of education when considering over long periods. The main problem with the above approach is that differences between net earnings in education and other activities do not correctly measure the cost of investing in education since they do not correctly measure earnings forgone. Schultz (1963) states that the total costs of education to students are the sum of tuition, books, living expenses and opportunity costs. Opportunity costs in attending schools are earnings student forego. Forgone earnings are the main costs of students to decide whether they will go to school. Although tuition is free or scholarships are provided to

cover tuition, many children from low income do not avail themselves of the additional educational opportunities. Estimates of rate of return to investment in schooling would be too high if foregone earnings were not included as a cost of schooling.

The true cost of investing in period 1 would be the total earnings forgone, or the difference between what could have been received and what is received. The difference between earnings from education and other activities could underestimate true costs. If the cost of an investment is defined as the earnings foregone, quite different estimates of total costs emerge.

let C_j is forgone earnings in the j th period

r_j is the rate of return on C_j

k_j is the return per period on C_j be a constant.

If the number of period were indefinitely large and investment occurred in the first m periods, so investment in period j would yield a return of the amount $k_j = r_jC_j$. The returns were the same in each period. Total return is the sum of individual returns,

$$k = \sum_0^{m-1} k_j = \sum_0^{m-1} r_j C_j = C \sum_0^{m-1} \frac{r_j C_j}{C} = rC \qquad (3.1.11)$$

k = rC

$$C = \sum_0^{m-1} C_j = \frac{k}{r} \qquad (3.1.12)$$

where $r = \sum_0^{m-1} w_j r_j$, $w_j = \frac{C_j}{C}$ and $\sum_0^{m-1} w_j = 1$

Total costs are defined as the sum of costs during each period which would equal the capitalized value of returns, the rate of capitalization being a weighted average of the rates of return on the individual investments. For the internal rate, r could be determined from the condition that the present value of net earnings must be the same in X and Y and the amount invested in each period seriatim from the relations.

$$C_0 = X_0 - Y_0$$

$$C_1 = X_1 - Y_1 + rC_0$$

$$C_j = X_j - Y_j + r \sum_{k=0}^{j-1} C_k \quad , \; 0 \le j \le m-1 \qquad (3.1.13)$$

Regardless of known investment period, costs and the rate of return can be estimated from net earnings information. If activity X were known to have no

investment (a zero investment period), the amount invested in Y during any period would be defined by

$$C_j = X_j - Y_j + r\sum_{k=0}^{j-1} C_k \quad \text{for all j} \tag{3.1.14}$$

and total cost by

$$C = \sum_0^{\infty} C_j \tag{3.1.15}$$

The internal rate could be determined in a straightforward manner from the equality between present values in X and Y, costs in each period from equation (3.1.14) and total costs from equation (3.1.15).

Mincer (1974) stresses the importance of education on earnings. Investments in people are time consuming. Each additional period of schooling postpones the time of the individual's receipt of earnings and reduces the span of his working life if he retires at a fixed age. The deferral of earnings and the possible reduction of earning life are costly. These time costs plus direct money outlays make up the total cost of investment.

There are four assumptions under the Mincer's schooling model. One, all investment costs are time costs. Two, each additional year of schooling reduces earning life by exactly one year. Three, there exists no depreciation. Four, no further human capital investments are undertaken after completion of schooling so the flow of individual earnings is constant throughout the working life. The present value of an individual's lifetime earnings at start of schooling is

$$V_s = Y_s \sum_{t=s+1}^{n} [\frac{1}{1+r}]^t \tag{3.1.16}$$

where V_s is the present value of an individual's lifetime earnings at start of schooling

Y_s is annual earnings of an individual with s years of schooling

n is the length of working life plus length of schooling or the length of working life for persons without schooling

t is time in years = 0,1,2,….,n

d is the difference in the amount of schooling, in years

e is the base of natural logarithms

r is the discount rate

When the discounting process is discrete and the process is continuous:

$$V_s = Y_s \int_s^n e^{-rt}\, dt = \frac{Y_s(e^{-rs} - e^{-rn})}{r} \quad (3.1.17)$$

Similarly, the present value of lifetime earnings of an individual who engages in s-d years of schooling is:

$$V_{s-d} = \frac{Y_{s-d}(e^{-r(s-d)} - e^{-rn})}{r} \quad (3.1.18)$$

The ratio, $k_{s,s-d}$, of annual earnings after s years to earnings after s-d years of schooling is found by letting $V_s = V_{s-d}$

$V_s = V_{s-d}$

$$\frac{Y_s(e^{-rs} - e^{-rn})}{r} = \frac{Y_{s-d}(e^{-r(s-d)} - e^{-rn})}{r}$$

$$k_{s,s-d} = \frac{Y_s}{Y_{s-d}} = \frac{e^{-r(s-d)} - e^{-rn}}{e^{-rs} - e^{-rn}} \quad (3.1.19)$$

Multiply e^{rn} both nominator and denominator, we get

$$\frac{Y_s}{Y_{s-d}} = \frac{e^{r(n+d-s)} - 1}{e^{r(n-s)} - 1} \quad (3.1.20)$$

3 conclusions can be reached from equation (3.1.20): one, people with more schooling command higher annual pay. The first difference of equation (3.1.20) is greater than zero. Take first difference equation (3.1.19) with respect to s,

$$\frac{\partial k}{\partial s} = \frac{r[e^{r(n+d-s)} - e^{r(n-s)}]}{[e^{r(n-s)} - 1]^2} > 0 \quad (3.1.21)$$

Two, the difference between earnings of individuals due to the difference in investment d years of schooling is larger the higher the rate of return on schooling. Three, the difference is larger the shorter the general span of working life.

Let n as the fixed span of earning life, then

$$V_s = Y_s \int_s^{n+S} e^{-rt}\, dt = \frac{Y_s(e^{-rs} - e^{-r(n+S)})}{r}$$

$$= \frac{Y_s}{r}(e^{-rs} - e^{-rn}e^{-rs})$$

$$= \frac{Y_s}{r} e^{-rs}(1 - e^{-rn}) \quad (3.1.22)$$

$$V_{s-d} = Y_{s-d} \int_{s-d}^{n+s-d} e^{-rt}\, dt = \frac{Y_{s-d}\, e^{-r(s-d)}(1 - e^{-rn})}{r} \quad (3.1.23)$$

And solving for $k_{s,s-d}$ from the equalization of present values, we get

$V_{s-d} = V_s$

$$\frac{Y_{s-d}\, e^{-r(s-d)}(1 - e^{-rn})}{r} = \frac{Y_s}{r} e^{-rs}(1 - e^{-rn})$$

$$\frac{Y_S}{Y_{S-d}} = \frac{e^{-rs}e^{rd} - e^{-rs}e^{rd}e^{-rn}}{e^{-rs}(1-e^{-rn})} = \frac{e^{rd}(1-e^{-rn})}{1-e^{-rn}}$$

$$k_{s,s-d} = \frac{Y_S}{Y_{S-d}} = e^{rd} \quad (3.1.24)$$

Refer to equation (3.1.19)

$$k_{s,s-d} = \frac{Y_S}{Y_{S-d}} = \frac{e^{-r(s-d)} - e^{-rn}}{e^{-rs} - e^{-rn}} \quad (3.1.19)$$

From comparing equation (2.19) and (2.24), the earnings ratio, k, of income differing by d years of schooling does not at all depend on the level of schooling (s) nor, on the length of earning life (n), when that is finite. Define $k_{s,0} = Y_s/Y_0 = k_s$

$$k_{s,s-d} = \frac{Y_S}{Y_{S-d}} = e^{rd} \quad (3.1.24)$$

We will get $k_{s,0}$ if d =s. So $k_{s,0} = k_s = e^{rs}$. In logarithms the formula becomes

$$k_{s,0} = \frac{Y_S}{Y_0} = e^{rs}$$

$$\ln Y_s = \ln Y_0 + rs \quad (3.1.25)$$

From equation (3.1.25), the percentage increments in earnings are strictly proportional to the absolute differences in the time spent at school, with the rate of return as the coefficient of proportionality.

As mentioned earlier that there are other activities which can improve human capital and eventually earnings. This section will explain how on-the-job training affects earnings and rate of return.

Becker (1993) states that on-the-job training is a process that raises future productivity and differs from school training in that an investment is made on the job rather than in an institution that specializes in teaching. There are two assumptions: one, each employee is hired for a specified time period. Two, both labor and product markets are perfectly competitive. In the absence of on-the-job training, a profit-maximizing firm would be in equilibrium when marginal products equal wages. As expressed by,

$$MP = W \quad (3.1.26)$$

where W is wages or expenditures

MP is the marginal product or receipts

Workers are hired for one period and W and MP in future periods would be independent of a firm's current behavior. So, workers have unique MP and W in each period. A more complete set of equilibrium is

$MP_t = W_t$ (3.1.27)

where t refers to the period t th

When on-the-job training is taken into account, the above condition will be different. For firms, training lowers current receipts and raise current expenditures. Firm would maximize profit until the present value of receipt is equal to the present value of expenditures.

$$\sum_{t=0}^{n-1} \frac{R_t}{(1+i)^{t+1}} = \sum_{t=0}^{n-1} \frac{E_t}{(1+i)^{t+1}} \quad (3.1.28)$$

where E_t is expenditures during period t

R_t is receipts during period t

i is the market discount rate

n is the number of periods

If training is given only in the first period, expenditures in the first period are equal to wages plus the outlay on training. Equation (3.1.28) becomes

$$MP_0 + \sum_{t=1}^{n-1} \frac{MP_t}{(1+i)^t} = W_0 + k + \sum_{t=1}^{n-1} \frac{W_t}{(1+i)^t} \quad (3.1.29)$$

where k measures the outlay on training. If new term is defined,

$$G = \sum_{t=1}^{n-1} \frac{MP_t - W_t}{(1+i)^t} \quad (3.1.30)$$

Equation (3.1.29) can be written as

$MP_0 + G = W_0 + k$ (3.1.31)

The problem with the equation (3.1.31) is that k reflects only outlay on training, not all training costs. The important cost excluded from the equation (3.1.31) is the time which persons spend on training. The difference between what could have been produced, MP_0' and what is produced, MP_0 is the opportunity cost of time spent in training. The equation that reflect the total training costs is

$MP_0' + G = W_0 + C$ (3.1.32)

where C is the sum of opportunity costs and outlays on training

The difference between G and C measures the difference between the return from and the cost of training. Training is further broken down into two types: general and specific training. General training increase the future marginal products of workers in the firm providing it, but also increase their marginal product in many other firms. Consequently, wage rates would rise by exactly the same amount as the marginal product and firms providing general training cannot capture the return.

Under the competitive labor market, firms would provide general training only if they do not have to pay for the training costs. Persons receiving training would be willing to pay for the costs since training raises their future wages. From equation (3.1.32), since wages and marginal products are raised by the same amount, MP_t must equal to W_t for all t = 1,…., n-1

$$G = \sum_{t=1}^{n-1} \frac{MP_t - W_t}{(1+i)^t} = 0 \qquad (3.1.33)$$

Equation (2.32) is reduced to

$$MP_0' = W_0 + C \qquad (3.1.34)$$

$$W_0 = MP_0' - C. \qquad (3.1.35)$$

The wage of trainees would not equal their opportunity marginal product but would be less by the total cost of training. Employees would pay for general training by receiving wages below their productivity. Trained persons would receive lower earnings during the training period and higher earnings at later ages because the return is collected then (Figure 3.1).

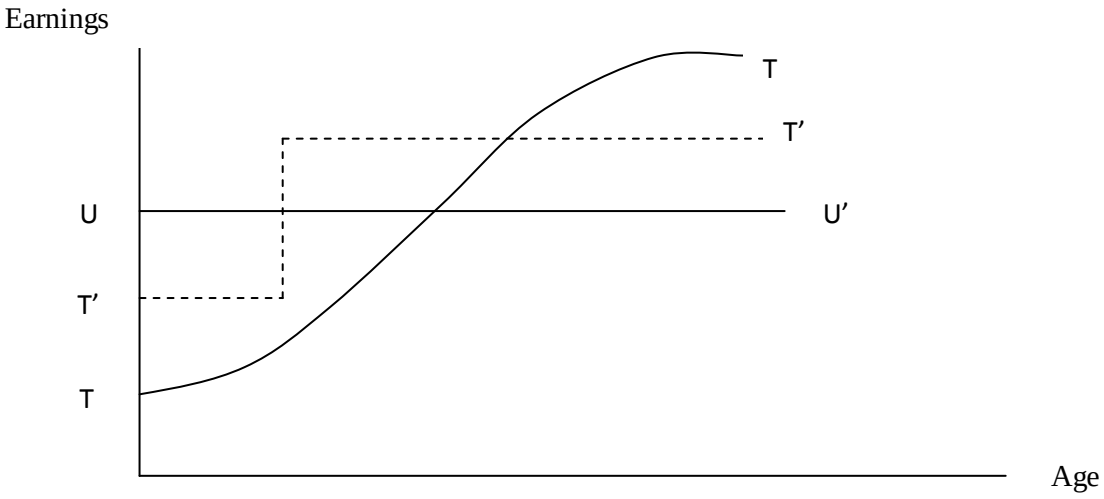


Figure 3.1 The Relationship Between Earning and Training

Suppose, to take an extreme case, that training raises the level of marginal productivity but has no effect on the slope, so that the marginal productivity of trained persons is independent of age, line UU. If earnings equal marginal product, TT would be parallel to and higher than UU. Since earnings of trained persons would be below

marginal product during the training period and equal afterward, they would rise sharply at the end of training period and then level off as line T'T'.

Firms in competitive labor market have no incentive to pay training costs because firms that train workers are supposed to impart external economies to other firms, that is, other firms can use these workers free of any training charge.

Specific training increases productivity by a different amount in firms providing the training than in other firms. If all trainings are completely specific, the wage that an employee can get elsewhere will be independent of the amount of training he receives. Wages are paid by firms would be independent of the amount of training, so firms would pay training costs. Firms would collect the return from such training in the form of larger profits resulting from higher productivity, and training would be provided whenever the return is at least as large as the cost.

Labor turnover becomes important when training costs are imposed on workers or firms. In the case that firms pay specific training costs, firms face loss if workers quit their jobs after completing the training. Firms must hire new employees whose marginal products would be less than that of the one who quit. In other words, a firm is hurt by the departure of a trained person because an equally profitable new employee could not be obtained. If employees pay for specific training costs, employees would suffer from being laid off because they cannot find an equally good job elsewhere.

The solution for this turnover problem is that firm would reduce the likelihood of turnover by offering higher wages after training, that is, a premium is offered to reduce their turnover. This shows that firms pay part of specific training costs. Higher wages would make supply of trainees greater than demand and some rationing would be required. The final step would be to shift some training costs and returns to employees, thereby bringing supply more in line with demand.

$$MP' + G = W + C \qquad (3.1.36)$$

where G is the present value of the return from training collected by firms

Let G' is the return collected by employees

G'' is the total return

$G'' = G + G'$

In the full equilibrium, the total return would equal total costs,

$G'' = C$

Let a is the fraction of the total return collected by firms

$G = aG''$

So equation (3.1.36) can be written as

$MP' + aC = W + C$ (3.1.37)

$W = MP' + aC - C$

$W = MP' + (a-1)C$

$W = MP' - (1-a)C.$ (3.1.38)

From equation (3.1.38), employees pay the fraction of 1-a of costs as they collect in returns. If training is completely general, a = 0, equation (3.1.38) becomes W = MP' – C which is identical to equation (3.1.35). If training is completely specific, firms collect all the return from training, a = 1, the equation becomes W = MP'.

Quit and layoff rates would be inversely related to the amount of specific training. Employees with specific training have less incentive to quit and firms have less incentive to fire them. Temporary economic shocks, say, a decrease in demand for products, would affect untrained persons to be more likely to be laid off than trained persons because of training costs. In the case of general cyclical decline, if the decline reduces marginal product below wages, firms have incentive to lay off trained persons because laid-off persons would be less likely to find other jobs under widespread unemployment.

To Mincer (1974), work experience is regarded as post-school investment. Individuals continue to develop their skills and earning capacity after completion of schooling.

After graduates enter the labor force in year j, the worker devotes resources C_j in furthering his job skills and acquiring job related information, whether in the form of direct dollar outlays or opportunity costs of time devoted to these purposes. Net earnings Y_j in year j are obtained by deducting C_j dollars from gross earnings, E_j.

$E_j = Y_s + \sum_{t=0}^{j-1} r_t C_t$ (3.1.39)

where Y_s is earnings of persons from investing s years of schooling

t is period of time, 0,….., j-1

C_j is resources devoted to acquire skills (dollar outlays and time costs)

Y_j = net earnings = gross earnings – total costs

= E_j = C_j

$$Y_j = Y_s + \sum_{t=0}^{j-1} r_t C_t - C_j \quad (3.1.40)$$

Equation (3.1.40) represents net earnings from investing in work experience. Then the variation of earnings will be analyzed over the working life. There are two assumptions. One, working life starts in period following the completion of schooling. Two, all individuals are assumed to engage in post-school investment of one form or another. The variation of earnings with experience is observed by considering the annual increment of earnings:

$$\Delta Y_j = Y_{j+1} - Y_j$$

$$Y_{j+1} = Y_s + \sum_{t=0}^{j} r_t C_t - C_{j+1}$$

$$Y_{j+1} - Y_j = Y_s + \sum_{t=0}^{j} r_t C_t - C_{j+1} - Y_s - \sum_{t=0}^{j-1} r_t C_t + C_j$$

$$\Delta Y_j = Y_{j+1} - Y_j = r_j C_j - (C_{j+1} - C_j) \quad (3.1.41)$$

$\Delta Y_j > 0$ if $C_j > 0$ and $C_{j+1} - C_j < 0$ or

if $\frac{C_{j+1} - C_j}{C_j} < r_j$

Earnings grow with experience so long as net investment (C_j) is positive and its annual installments either diminishing or increase at a rate lower than the rate of return. If investments increase sharply at a faster rate than r, net earnings will decline but gross earnings always increase, so long as investment is positive.

$$E_j = Y_s + \sum_{t=0}^{j-1} r_t C_t$$

$$E_{j+1} = Y_s + \sum_{t=0}^{j} r_t C_t$$

$$\Delta E_j = Y_s + \sum_{t=0}^{j} r_t C_t - Y_s - \sum_{t=0}^{j-1} r_t C_t$$

$$\Delta E_j = r_j C_j \quad (3.1.42)$$

From Ben-Porath (1967), individuals will invest in work experience by considering their human capital with their own time and with other market resources in a production function:

Q = f(H, T, R)

where Q is investment in other human capital

H is human capital stock

T is time

R is other market resources

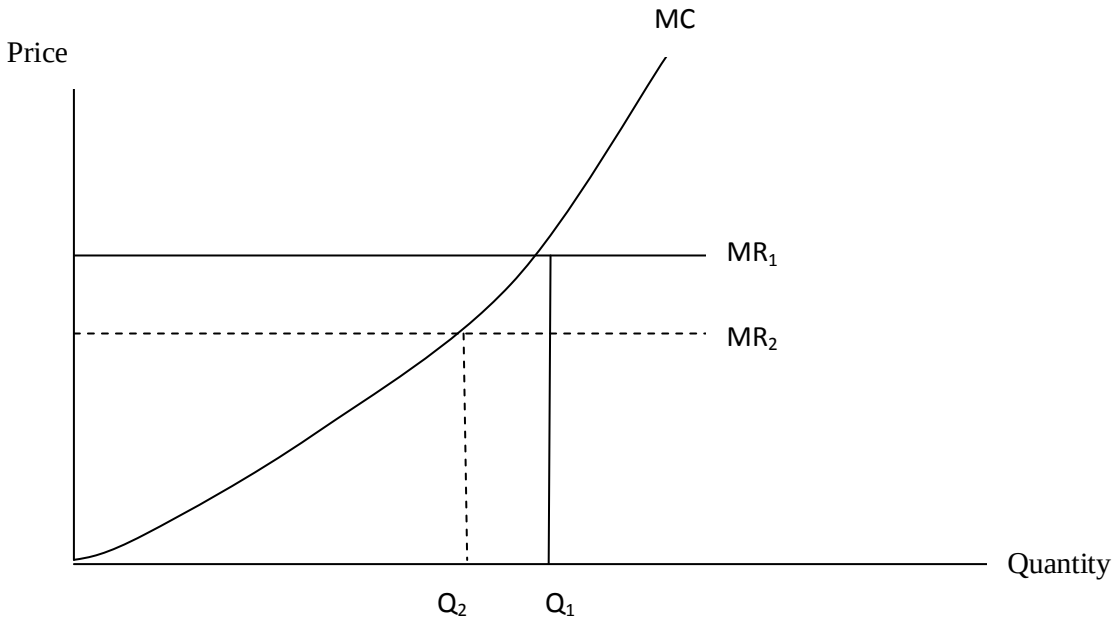


Figure 3.2 Production of Human Capital

Marginal cost of investing in human capital is upward sloping because costs rise with the quantity of human capital production. The marginal revenue obtained by adding a unit of investment to the capital stock is the discounted flow of future increases in earning power. For reason indicated, the benefits of later investments decline. The MR curve slides downward with increasing age, tracing out a declining pattern of investment over the life cycle. The conclusion is that the higher the marginal revenue curve and the lower the marginal cost curve, the larger the investment in human capital in any given period. Marginal revenue is higher the lower the discount rate and the depreciation rate, and the longer the expected length of working life. Marginal cost is lower, the greater the learning ability of the individual. As a result, both gross and net earnings slope upward during the positive net investment period. Moreover, the age profile of gross earnings is concave from below. From equation (3.1.42), the second difference of equation is

$$\Delta^2 E_j = r\Delta C_j \ < \ 0 \qquad (3.1.43)$$

The profile is concave if the decline of investments (C_j) is a nonincreasing function of j. The profile of net earnings has a steeper slope than gross earnings, since $\Delta Y_j = \Delta E_j - \Delta C_j, and\ \Delta C_j < 0$. The peak of both gross and net earnings is reached when positive net investments equal zero.

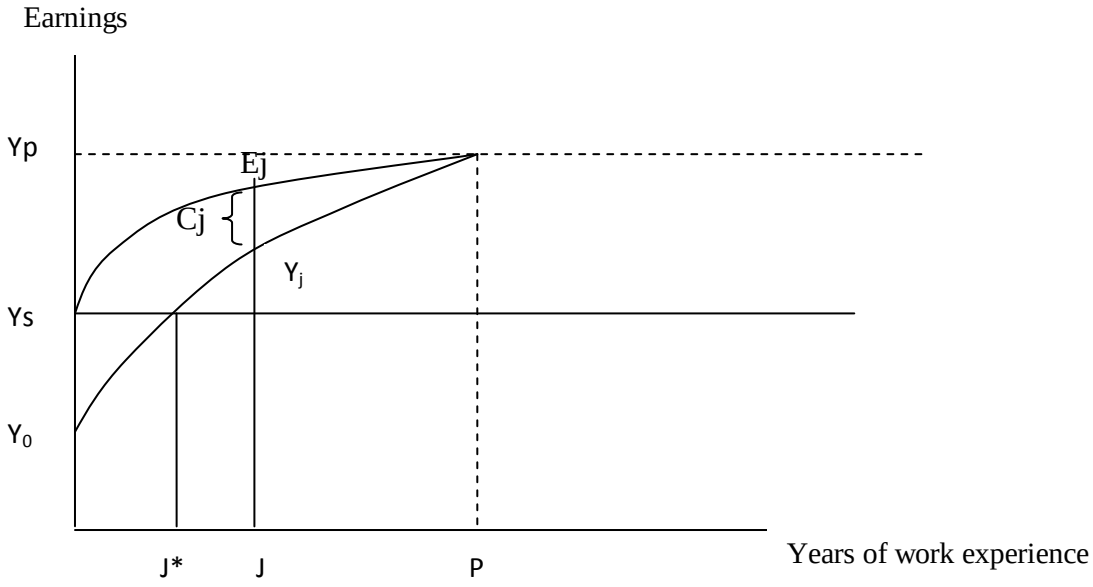


Figure 3.3 Earnings Profile

From figure (3.3), during the early years of experience, earnings of continuing investors are smaller than the Y_s earnings that can be obtained after s years of schooling without further investments. Later, earnings of investors continue to grow and exceed Y_s. j* is the early stage of experience, and its upper limit can be estimated from

$$Y_j = Y_s + \sum_{t=0}^{j-1} r_t C_t - C_j \qquad (3.1.44)$$

$$Y_{j*} = Y_s + r\sum_{t=0}^{j-1} C_t - C_j = \ Y_s$$

Let r_p is the rate of return to post-school investment and p is the end of investment period so the net earnings at the end of period are

$$Y_p = Y_s + r_p \sum_{t=0}^{p} C_t \qquad (3.1.45)$$

The post-school investment cost would be

$$\sum_{t=0}^{p} C_t = \frac{Y_p - Y_s}{r_p} \quad (3.1.46)$$

The educational costs from schooling level s_1 to level s_2 are

$$\sum_{s_1}^{s_2} C_s = \frac{Y_{s_2} - Y_{s_1}}{r_s} \quad (3.1.47)$$

The logarithmic earnings profile is analyzed as the relative variation in earnings is of major interest in the study of income inequality. Another reason is that post-school investment must be expressed in the same time units as schooling. The conversion of investment costs into time equivalent values transform the earning equation into logarithmic version. Let k_j is the ratio of investment cost to gross earnings,

$$k_j = \frac{C_j}{E_j} \quad (3.1.48)$$

$$C_j = K_j E_j$$

$$E_j = E_{j-1} + rC_{j-1}$$

$$= E_{j-1} + r(K_{j-1}E_{j-1})$$

$$= E_{j-1}(1 + rK_{j-1})$$

$$E_j = E_0 \prod_{t=0}^{j-1}(1 + r_t k_t) \quad (3.1.49)$$

If $k \leq 1$, r is small.

$$lnE_j = lnE_0 + \sum_{t=0}^{j-1} r_t k_t \quad (3.1.50)$$

From equation that $Y_j = E_j - C_j$

$$Y_j = E_j - k_j E_j$$

$$= E_j(1-k_j) \quad (3.1.51)$$

$$\ln Y_j = \ln E_j + \ln (1-k_j)$$

substitute equation (3.1.50) into equation (3.1.51), then

$$lnY_j = lnE_0 + \sum_{t=0}^{j-1} r_t k_t + \ln (1 - k_j) \quad (3.1.52)$$

Assume $k_j = 1$ during school year, so $k_j = \frac{C_j}{E_j}$ or $C_j = E_j$

$$lnY_j = lnE_0 + r_s S + r_p \sum_{t=0}^{j-1} k_t + \ln (1 - k_j) \quad (3.1.53)$$

Assume r_j is the same for all post-school investment and let $K_j = \sum_{t=0}^{j-1} k_t$

From equation (3.1.50),

$$lnE_j = lnE_0 + r_s s + r_p K_j \quad (3.1.54)$$

From $lnY_s = lnY_0 + rs$

$$lnE_j = lnY_s + r_p K_j$$

If $r_s = r_p$, the equation (3.1.54) becomes

$$lnE_j = lnE_0 + r_s(s + K_j) \quad (3.1.55)$$

Let $s + K_j = h_j$

$$lnE_j = lnE_0 + rh_j \quad (3.1.56)$$

When investment period is completed, K_j, is the total time devoted to post-school investment. The number of years of post-school training is

$$k_p = \frac{lnY_p - lnY_s}{r_p} \quad (3.1.57)$$

Then, assumptions are relaxed by adding depreciation into the analysis. When workers get older, the incidence of illness would increase and the advances in know-how make earlier education and skill obsolescent. Eventually, effects of skill depreciation outstrip gross investment. Let δ_t is the depreciation rate of human capital stock H_t at time t. After taking into account the depreciation rate, the total earnings will be

$$E_t = E_{t-1} + rC^*_{t-1} - \delta_{t-1}E_{t-1} \quad (3.1.58)$$

where C^*_t is the gross investment

C_t is the net investment

$$E_t = E_{t-1}[(1 - \delta_{t-1}) + \frac{rC^*_{t-1}}{E_{t-1}} \quad (3.1.59)$$

$$\frac{E_t}{E_{t-1}} = 1 - \delta_{t-1} + rk^*_{t-1} \quad (3.1.60)$$

$$= 1 + r[k^*_{t-1} - \frac{\delta_{t-1}}{r}]$$

$$\frac{E_t}{E_{t-1}} = 1 + rK_{t-1} \quad (3.1.61)$$

From equation (3.1.60), take natural logarithm, we get

$$lnE_t = lnE_{t-1} + \ln(1 + rk^*_{t-1} - \delta_{t-1})$$

By recursion, and assuming $rk^*_{t-1} - \delta_{t-1}$ is small, then

$$lnE_t = lnE_0 + \sum_{j=0}^{t-1}(rk^*_j - \delta_j) \quad (3.1.62)$$

From $Y_j = E_j(1-K_j)$

$$lnY_t = lnE_t + \ln(1 - k^*_t) \quad (3.1.63)$$

In a few recent human capital analyses in which depreciation is taken into account, the rate is assumed to be fixed purely for mathematical convenience. Yet, the

depreciation rate on human capital is likely to be related to age, experience, and size and vintage of stock.

In summary, human capital theory is based on the assumption that productivity is an increasing function of the human capital level of worker. Human capital includes not only formal education but also experience and on-the-job training. The model implies that worker characteristics, or the supply side, determine earnings and it is only through exogenous shocks that the demand side affects on real wages.

Overeducation arises when there is an increase in the educational attainment of workers. This causes the relative wage of highly skilled workers to fall. Producers, faced with a cheaper supply of educated labor, substitute away from low skilled workers towards the more highly skilled workers. Educated workers are placed in positions previously filled by low skilled workers. On the supply side, lower returns to education induce individuals to reduce their investment in human capital. The model predicts that when overeducation arises, the labor market is in disequilibrium. So overeducation is temporary as firms adjust their production processes and workers reduce their investment in education. In the long term, workers can better match their education with jobs after they get more on-the-job training or experience. (Linsley, 2005)

3.1.2 Theory of Career Mobility

This is an extension of human capital theory. Sicherman and Galor (1990) theorize that individuals obtain experience and skills (occupation specific) in one occupation in an effort to move to higher levels on the occupational ladder. It may be optimal for individuals to spend time in occupations for which they appear to be overeducated simply to obtain training and experience. Such experience probably helps with future career mobility that can occur intra-firm (promotion) or inter-firm (new job).

Career mobility can be intra-firm or inter-firm mobility. Intra-firm mobility or promotion is subject to the employer's decision whereas inter-firm mobility and its optimal timings are determined by individuals who choose the optimal quitting time so as to maximize their expected lifetime earnings. Intra-firm mobility is uncertain. The probability of promotion is a function of schooling, ability, and job experience.

The optimal investment in human capital and the optimal quitting time maximizes the individual's expected life time income. The assumption under this theory is that wages are constant while working in the same occupation, and wage growth occurs solely through occupational mobility.

Education provides human capital which raises individuals' future earnings through two channels: directly, through the potential returns to schooling in certain occupations, and indirectly, through the improvement in their career path. On the other hands, individuals face three possible occupations: 1) Occupation 1: pays a constant wage rate, w1, regardless of ability, schooling, or market experience 2) Occupation 2: pays a constant wage rate, w2, independent of ability, education, or market experience, w2 > w1. Occupation 2 can be obtained solely through a promotion from occupation 1. The promotion decision is made after the individual has spent a constant time interval in occupation 1. Although formal education is not a necessary requirement for promotion, the probability of promotion is positively related to the level of human capital acquired by individual. 3) Occupation 3: pays a constant wage rate, w3, which is an increasing function of level of human capital obtained at school. In occupation 3, the returns to schooling are in a form of higher wages while occupations 1 and 2's returns are in terms of higher probabilities of advancing to occupations with higher wages.

There are 3 models with different dependent variables. In the first model, 'career mobility' is used as a dependent variable being dummy variable equal to 1 if the worker moves to a higher level occupation between two surveys, and 0 otherwise. The dependent variable becomes 'promotion,' a dummy variable, in the second model which means that the worker moves to a higher level occupation and stays in the firm. 'Across firms' is a dependent variable in the third model which means the worker moves to a higher level occupation but he/she changes firm. Mobility (y=1) occurs when the latent variable $Y_{ijt}^{*} > 0$, where

$$Y_{ijt}^{*} = X_{it}\beta + \gamma ED_i + \delta_j + \epsilon_{ijt} = Z_{it}\tau + \epsilon \qquad (3.1.64)$$

where i = individual index

j = occupation index

t = time

X_{it} is a vector of individual characteristics (schooling, experience, tenure, marital status, union membership, and race) which may vary across time.

Ed_i is the level of schooling

δ_j is an occupation fixed effect. It is assumed to be constant across time and across individuals.

Since Y_{ijt}^* is unobserved, so the probability of a transition is

Prob(y=1) = 1-F(-Zτ),

where F(.) is the CDF of ε. In practice, ε is assumed to be logistically distributed and parameters are estimated by maximum likelihood.

Tenure is defined as the number of years with the employer. In the promotion model the tenure effect is positive. When 'across firm mobility' is the dependent variable, the tenure effect is negative. The reason is a trade-off between career mobility and investment in firm- specific human capital. When an individual works an organization, both general and firm specific human capital increase productivity, and thus promotion rates. On the other hand, the same worker, when considering moving to another firm, has to take into account the loss of earnings due to the loss of firm-specific human capital, which increases with tenure in the firm.

Experience is defined as the numbers of years in the labor force.The rate of career mobility decreases with time in the labor force. The effect of union membership on the probability of career mobility is negative. The same result is found for intra-firm mobility due to the career structure of union members. Typical careers of union members involve occupations in which advancement is by changing grade levels within the same occupation or by moving to a very similar occupation within the same category.

Married workers have higher rates of career mobility than nonmarried workers, other things equal. The effect is negative when inter-firm mobility is the dependent variable because of married workers' lower separation rates. The result has found a positive sign on promotion. Married workers prefer to realize their career path within the firm rather than across firms. This might provide an incentive to both workers and firms to invest more in firm- specific training.

Race is a dummy variable equal to 1 if black, 0 if white. Black workers have lower rate of career mobility than white workers. After controlling for 1- digit

occupation of origin, schooling has a positive effect on career mobility. This effect is much stronger in the promotion model than in the career mobility across firms model. More educated workers are more likely to move to a higher level occupation (within and across firms).

The next analysis is the effect of schooling on wage and on the probability of promotion. The observed differences in returns to schooling across occupations may be due to the differences in promotion probabilities across occupations. The hypothesis is that if the return to human capital (schooling) is lower while working in a specific occupation, the effect of schooling on the probability of being promoted from that occupation will be higher. The fixed effect model is used as follows:

$$Y_{ijt}^{*} = X_{ijt}\beta_1 + \gamma_j ED_i + \delta_j + \epsilon_{ijt} \quad (3.1.65)$$

$$\ln(W_{ijt}) = X_{ijt}\beta_2 + \alpha_j ED_i + \mu_j + \epsilon'_{ijt} \quad (3.1.66)$$

Equation (3.1.65) is a career mobility equation where the schooling effect (γ_j) is occupation specific. Equation (3.1.66) is standard wage regression.

The result has found that individuals may choose an entry level in which the direct returns to schooling are lower than those in other feasible entry levels if the effect of schooling on the probability of promotion is higher in this firm. More specifically, wage penalties for overeducated workers are compensated by better promotion prospects. To the extent that the theory operates, overeducation is a temporary phenomenon over the life cycle and should correct itself as youths find their way into jobs that match better their skills, and overeducation should decline with age. The limitation of theory is that it fails to explain the phenomenon of undereducation.

3.1.3 Job Signaling Theory[4]

Signaling theory does not reject the basic assumptions of human capital theory, namely that productivity and earnings are primarily a function of a worker's

[4] Signalling models are basically equivalent to screening models. The difference is that while in signaling model, workers move first choosing their educational level to signal their productivity to employers, in screening model, employers make the first move by choosing educational level required for a job.

skills (i.e., earnings remain a function of individual characteristics). The primary difference is to emphasize the role of education in the matching function which is overlooked by human capital theory, and to suggest that education may not necessarily add to skills and that it is not the only source of skills or skill development.

Signaling models study interactions marked by the presence of asymmetric information. Hiring is an investment decision. In job market, the employer is not sure of the productive capabilities of an individual at the time he hires him. Therefore, this information will not become available to the employer immediately after hiring him. It takes time to learn an individual's productive capabilities. To hire someone is frequently to purchase a lottery. Spence has assumed that the employer pays the certain monetary equivalent to the individual as wage. If he is risk neutral, the wage is taken to be the individual's marginal contribution to the hiring organization. The employer cannot directly observe the marginal product prior to hiring. He can only observe personal data in the form of observable characteristics and attributes of the individual such as education, previous work, race, sex, criminal records, etc. Of those observable, personal attributes, some are immutably fixed, while others are alterable.

Spence has categorized personal attributes into 2 groups: indices and signals. Indices are observable and unalterable attributes such as sex, race, nationality. Some attributes, like age, do change but not at the discretion of the individual so Spence has also defined those as indices. Signals are observable characteristics attached to the individual that are subject to manipulation by him such as education.

After hiring an individual, the employer will learn the individual's productive capabilities. On the basis of previous experience in the market, the employer will have conditional probability assessments over productive capacity given combinations of signals and indices. Signals and indices are to be regarded as parameters in shifting conditional probability distributions that defines an employer's beliefs.

On employees, potential employees therefore confront an offered wage schedule whose arguments are signals and indices. The applicant cannot change indices but they can manipulate signals. The costs of making these adjustments are called signaling costs for example, education is costly. Signaling costs include psychic and other costs, as well as the direct monetary ones. Individual will invest in

education if there is sufficient return as defined by the offered wage schedule. Individuals, then, are assumed to select signals (education) so as to maximize the difference between offered wages and signaling costs. The critical assumption is that signaling costs are negatively correlated with productivity.

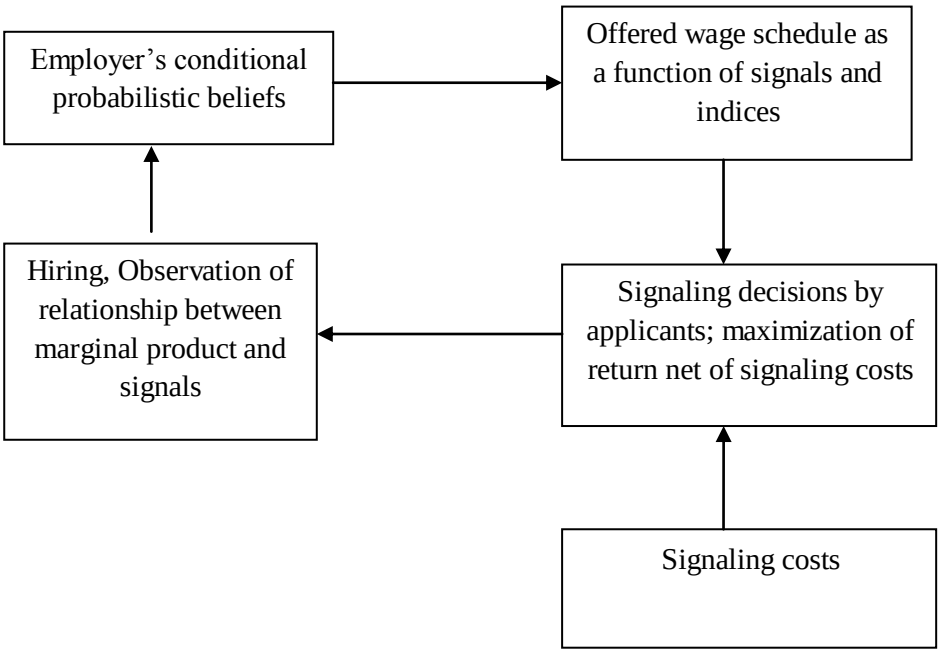


Figure 3.4 Informational Feedback in the Job Market
Source: Spence, 1973.

There is informational feedback to the employer over time. As new market information comes in to the employer through hiring and subsequent observation of productive capabilities as they relate to signals, the employer's conditional probabilistic beliefs are adjusted, offered wage schedules are adjusted, and applicant behavior with respect to signal choice changes. Each cycle, then, generates the next one. An equilibrium is a set of components in the cycle that regenerate themselves. Thus, employer's beliefs can be self-confirming, or offered wage schedules can regenerate themselves, or applicant behavior can be reproduced on the next round.

A numerical example of signaling equilibrium:

The assumption is that there are two productive distinct groups in a population facing one employer. Individuals in group I have a productivity of 1, while those in group II have a productivity of 2. Group I is a proportion q1 of the population; Group II is a proportion of 1-q1. Education is a signal which is available at a cost, assuming equal to y. Educational costs are both monetary and psychic. It is assumed that the cost to a member of group I is y and to a member of group II is y/2. Table shows the underlying data of numerical example.

Table 3.1 Data of the Model

Group	**Marginal product**	**Proportion of population**	**Cost of education level y**
I	1	q_1	y
II	2	$1-q_1$	y/2

Employer would have a set of self-confirming conditional probabilistic beliefs to form wage schedules. Given wage schedules, individual will choose optimal level of education that maximizes the differences between the offered wages and the costs of education.

In this example, the employer believes that there is some level of education, y*, that if $y < y^*$, then productivity is one with probability one and that if $y \geq y^*$, then productivity will be 2 with probability one. If these are his conditional beliefs, offered wage schedule is W(y). Given the offered wage schedule, the person who will set $y < y^*$, he will set $y = 0$ because education is costly. Even though he increases more education to y*, he still gets the same wage. Similarly, any individual who set $y \geq y^*$ will set $y = y^*$ because further increase will incur costs with no benefits. Given costs of education, C_I and C_{II} in the diagram, the costs of education is increasing when individuals invest more in education. If the employer's beliefs are to be confirmed,

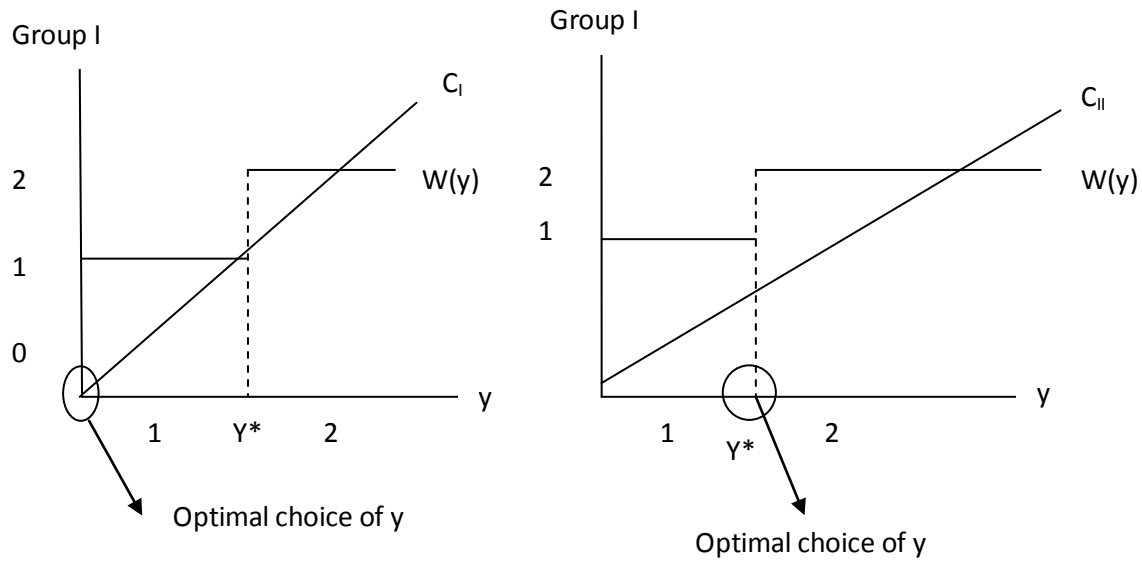


Figure 3.5 Optimizing Choice of Education for Both Groups
Source: Spence, 1973.

then members of group I must set y = 0, while members of group II set y = y* because each group selects y to maximize the difference between the offered wages and the costs of education. This is called signaling equilibrium. Given the signaling equilibrium, the educational level, y*, is an entrance requirement or prerequisite for the high-salary jobs.

From the employer's perspective, the best thing about relying on diplomas is to help narrow the pool of job applicants. In short time, employers may not lay out huge sum of money to learn the potential employee's competence. Employers may value the fact that their employees are certified by third parties (Educational institutions) who specialize in the general education of students. Education is really more of screening device that helps employers to minimize time and resources devoted to interviewing a long line of applicants.

It can be argued that individuals and employers have incentives which are aligned to induce overeducation. Employers have the incentive to hire individuals with higher levels of education for a variety of reasons- the most obvious is to select the most able workers. This provides individuals with the incentive to secure attractive opportunities and higher paying jobs. Alternatively, some employers have

the incentive to hire individuals with higher levels of education than may be required to maintain a more flexible and adaptable workforce against changes in the future. This adds further to the demand for qualifications and incentives to obtain them.

3.2 Demand-Side Theories

3.2.1 Job Competition Theory

Job competition theory is very similar to signaling theory but with an important deviation from the standard neoclassical framework, namely that earnings do not reflect individual performance. That is, earnings are no longer a function of a worker's skills or productivity. Instead, the theory emphasizes the characteristics of the job in determining earnings.

Thurow (1975) has found that there are a lot of puzzles in the labor market that cannot be explained by marginal productivity theory, e.g., the distribution of education has become more equal, but the distribution of earnings has become more unequal, or there are differences in earnings among individuals with identical background characteristics. In his job competition model, instead of competing against one another based on wages that they are willing to accept, individuals compete against one another for job opportunities based on their relative costs of being trained to fill whatever job is being considered.

In contrast with wage competition, job competition model rests on different assumptions. First, wage competition model states that workers acquire laboring skills exogenously in formal education or training and bring these skills into labor market. This assumption is not true in the real world because most cognitive job skills are acquired formally/informally through on-the-job training after the worker finds an entry job. Second, on clearing market, the labor market exists to match labor demand and labor supply in wage competition model. Wages will fluctuate in the short run to clear the market and these wage changes then induce shifts in the long run supply and demand. In job competition model, supply and demand curves shift in the short run to clear market. Market clears by altering hiring requirement or the amount of on-the-job they provide. Third, on earnings, firms pay workers marginal products which depend on personal characteristics in wage competition model. In job competition, marginal

products are inherent in jobs, not in individuals. Workers are trained into marginal products of jobs. Earnings depend on jobs they acquire, not directly on personal characteristics. Wages are solely decided by labor demand in the market.

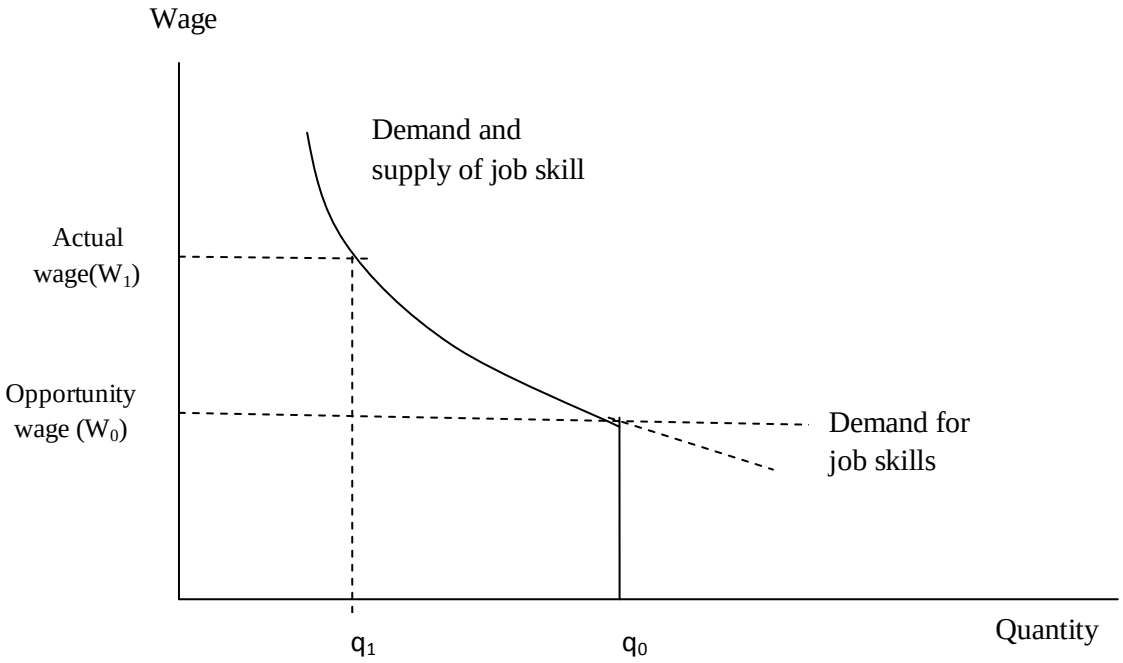


Figure 3.6 Supply and Demand for Labor in a Job Competition Model
Source: Thurow, 1975.

In job competition, the labor market is a market where supplies of trainable labor are matched with training opportunities that are in turn directly associated with the number of job openings that exist. Training opportunities occur when there is a job opening that creates the demand for the skills. So the supply of trained labor depends upon the demand for trained labor.

The supply curve lies along the demand curve as long as the wage rate is above some opportunity wage and high enough to attract trainable labor to this particular job opportunity. At actual wage (w_1), the training would be at q_1. Given identical demand and supply curves, it is impossible to determine an equilibrium wage rate at the intersection of supply and demand curves. They do not intersect; they coincide. Thus, there is no supply curve in the normal sense of model. For exogenously given wage, the demand curve determines how many job openings will exist and how many workers will be trained.

Workers do not possess skills but they possess a variety of personal characteristics, e.g., education, innate abilities, age, gender, and personal habits. These personal characteristics will affect the cost of training. Individuals who have different characteristics have different training costs for each of job ladders they might enter. For some jobs training costs will be low; for other jobs they will be high. Because of differences in personal, each person will have a different structure of associated training costs. Employers must choose workers and train them so they can generate marginal product of job with the smallest training costs which include the costs of inculcating norms of industrial discipline, good work habits, and the uncertainty costs associated with hiring workers.

To minimize training costs, employers will rank workers by training costs. This leads to labor queue. The problem is the lack of direct information on training costs for specific workers so employers will rank workers on the basis of personal characteristics which they use as indirect indicators of the costs necessary to produce the standard work performance. Those workers who yield the lowest training costs are offered employment first. Employer moves down the labor queue until he fills the available job openings.

Because each worker has different training costs for different jobs, workers will appear at different places in the labor queue for different jobs. Thurow assumes that each worker has only one training cost. Different employers may place different weights on personal characteristics being a proxy for training cost. For a set of personal characteristics, some employers may regard it as the best possible set, while other employers may regard the same set as the worst set. Individuals who have identical personal characteristics may not get one identical job depending on the supply of and the demand for workers with particular set of characteristics.

The fact that personal characteristics being diverse could make a problem to employers. The problem is to find personal characteristics that are good predictors of potential training costs differences. Education becomes an indirect measure of an individual's absorptive capacity because the ability to absorb on type of training indicates something about the ability to absorb another type of training.

The position in the labor queue can be explained by cyclical fluctuations in demand for labor and the distribution of job opportunities. Normally, employers use personal characteristics especially educational level to rank labor force from those

with the lowest training costs (the top of the labor queue) to those with the highest training costs (the bottom of labor queue). Some workers at the bottom of labor queue will receive little or no training. In the case of labor shortage, training will extend further down the labor queue as employers are forced to train more costly workers to fill job vacancies. In the case of inadequate jobs, the bottom of labor queue will be left unemployed. The cyclical fluctuation in demand for labor is the fluctuation in demanded hiring characteristics. Because of excess supply of workers, hiring characteristics will be changed to high standards so that the numbers of workers who are qualified will decrease. Labor shortage induces employers to relax hiring characteristics. Consequently, the number of workers who qualified will increase.

For the distribution of job opportunities, the supply of workers will determine how far down the labor queue depending on the training costs. If new workers who enter the labor market have more education than the existing workers, the existing workers are pushed down toward the bottom of the queue. Based on the importance of relative position in job competition model, individual's relative position with respect to personal characteristics becomes more important than absolute position. For example, Mr. X is deciding whether he should go on to college when he knows that his friends are attending colleges.

Wage competition model supports his decision not to attend the college. The supply of college graduates increase so the wages will decrease. The supply of high school graduates goes down so the wages will go up. Job competition model leads to different conclusion. Individual's personal characteristics is to place a worker in a labor queue. Best, highest income jobs will go to the best workers. Every additional college worker may deteriorate the position of remaining high school workers. If they do not go to college, others will, and they will not find their current job open to them.

In job competition model, education may become defensive necessity. As the supply of more highly educated labor increases, individuals find that they must improve their own educational qualifications to defend their current income position. Education becomes a good investment because education helps workers to protect their market share. The private rationality of defensive expenditures can lead to too much expenditure on education from the point of view of society as a whole.

Job competition model can provide an explanation for observed variance in earnings among workers with identical skills and work effort. Identical individuals do

not necessarily earn identical earnings depending on their position in labor queue. They do not receive identical amount of training even if they have identical preferences. The employers' rankings depend upon how the personal characteristics affect training costs and the number of jobs for which these training costs are relevant. The supply of workers is relevant since it determines how far down the distribution of jobs the group is forced to go to be fully employed.

Regarding the distribution of job opportunities, what affects it is mainly the distribution of training costs or the shape of labor queue. If employees improve their personal characteristics, it will lead to lower training costs which, in turn, raises net earnings of employee. Increase in the supply of college employees arises from transforming existing high school laborer into college laborers. High school workers must compete against a larger supply of college workers, but there are also fewer high school workers. Employers would substitute college workers for high school workers in what had been the best high school jobs, since there is now a larger supply of low-training- cost, college educated workers. The new college workers would receive the same jobs that had previously gone to high school laborers but the observed wages would rise above the level paid high school employees in these jobs since training costs have been reduced.

On the other hand, the supply of college employees increases when grade-school workers are transformed into college workers. In this case, high school workers must compete against more college workers and against the same number of high school workers. This means that the average earnings of high school workers fall even more than they do in the first case. The additional supplies of high school and college laborers would force these two groups including grade school workers further down the job distribution. If employers pay for training costs, improved personal characteristics lead to lower training costs so employers gain higher profits. The extent of the growth in profits depends on the elasticity of training cost with respect to personal characteristics. If the elasticity of training cost is high, then the characteristics will have a large effect on training costs. Training costs will rapidly reduce in percentage term if employees improve their personal characteristics. As a result employers will earn greater profits.

In summary, overeducation arises when there is an increase in the educational attainment of workers. This causes a shift in the distribution of workers in the labor

queue, forcing the low skilled into low paid jobs or out of the labor market. Consequently, overeducation leads to low skilled workers being bumped down into lower wage jobs or crowded out of the labor market into unemployment. Furthermore, overeducation reduces the return to education as highly skilled individuals are forced to accept jobs lower in the job queue. Job competition suggests that wages are solely decided by labor demand. Therefore, returns to years of surplus and deficit schooling should be zero.

More specifically, two factors affect demand-side characteristics of educational mismatch: trade and technological effects. There are two theories support trade effects: Heckscher-Ohlin Endowment model (H-O model) and the Stolper-Samuelson Theorem (SS). Together they provide an explanation for the possible effects of international trade on the demand for different types of labor, their remuneration and the intensity with which they are used. H-O and SS model predict that greater trade openness will increase the incentive of domestic producers to specialize in the production of goods that are intensive in their use of the relatively abundant factor of production. Trade liberalization leads to an increase in skill premium and the share of skilled workers has also increased within most industries.

Technological change is recognized as a driving force behind the demand for skilled labor. Mismatch can be affected by technological change. That is, firms in sectors that are subject to change may have an incentive to hire workers with more qualifications than are actually needed in order to ease labor adaptation in the future. This leads to overeducation. The concept of factor-biased technical change is introduced in the analysis. Then, technology-skill complementarity would be explained by three alternative foundations: cheapening of equipment capital, the Nelson-Phelps view of human capital, and Acemoglu explanations. All models mainly explain the importance of technologies toward economic growth in the long run. If technological change is biased toward high skilled workers, their productivity will increase, relative to that of other workers. Profit-maximized producers will respond to this by altering their skill mix in favor of high skilled workers. If SBTC occurs, economy-wide demand for high skilled workers will increase, causing their relative wage to rise.

3.2.2 Heckscher-Ohlin Endowment Model (H-O Model)

The international trade is largely driven by differences in countries' resources is one of the most influential theories in international economics. Developed by two Swedish economists, Eli Heckscher and Bertil Ohlin, the theory is often referred to as the Heckscher-Ohlin theory. Trade is based on different factor endowments across countries. The typical model based on this theory determines trade between two countries that use the same production technologies to produce two consumer goods. The theory predicts that "A nation will export the commodity whose production requires the intensive use of the nation's relatively abundant and cheap factor and import the commodity whose production requires the intensive use of the nation's relatively scarce and expensive factor". In short, the relatively labor rich nation exports the relatively labor intensive commodity and imports the relatively capital intensive commodity. According to H-O model, it can be concluded that the trade liberalization should cause reallocation of labors.

1) Assumptions of the Theory

(1) There are two nations, two commodities, and two factors of production.

(2) Both nations use the same technology in production.

(3) Commodity X is labor intensive, and commodity y is capital intensive in both nations.

(4) Both commodities are produced under constant returns to scale in both nations.

(5) There is incomplete specialization in production in both nations.

(6) Tastes are equal in both nations.

(7) There is perfect competition in both commodities and factor markets in both nations.

(8) There is perfect factor mobility within each nation but no international factor mobility.

(9) There are no transportation costs, tariffs, or other obstructions to the free flow of international trade.

(10) All resources are fully employed in both nations.

(11) International trade between the two nations is balanced.

2) The illustration of the Heckscher-Ohlin Theory:

The H-O theory is illustrated in figure below. Nation 1's production frontier is skewed along the X-axis because commodity X is the labor intensive commodity, nation 1 is labor abundant nation, and both nations use the same technology. Furthermore, since the two nations have equal tastes, they face the same indifference curve map. Indifference curve I is tangent to nation 1's production frontier at point A and to nation 2's production frontier at A'. Point A and A' represent their equilibrium points of production and consumption in the absence of trade (autarky point). Equilibrium relative commodity price is P_A in nation 1 and $P_{A'}$ in nation 2. Since $P_A < P_{A'}$, nation 1 has comparative advantage in commodity X, and nation 2 has a comparative advantage in commodity Y.

With trade, nation 1 specializes in the production of commodity X, and nation 2 specializes in the production of commodity Y. Specialization in production proceeds until nation 1 has reached point B and nation 2 has reached point B', where the transformation curves of the two nations are tangent to the common relative price line

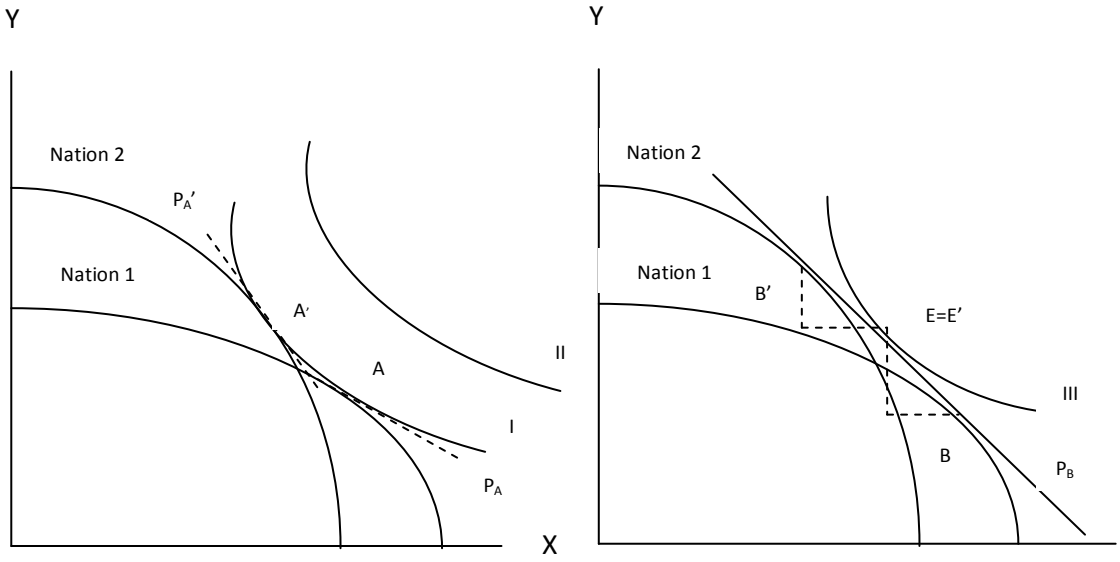


Figure 3.7 The Production Possibility Frontier for Nation 1 and 2

Source: Salvatore, 2004.

P_B. Nation 1 will then export commodity X in exchange for commodity Y and consume at point E on indifference curve II. On the other hand, nation 2 will export Y for X and consume at point E'. Note that nation 1's exports of commodity X equal nation 2's imports of commodity X. Similarly, nation 2's exports of commodity Y equal nation 1's imports of commodity Y. Nation 1 and 2 gain from trade because point E and E' are on higher indifference curve II.

3.2.3 Stolper-Samuelson Theorem

The Stolper-Samuelson theorem postulates that an increase in the relative price of a commodity (as a result of tariff) raises the return or earnings of the factor used intensively in the production of the commodity. Thus the real return to the nation's scarce factor of production will rise with the imposition of a tariff. For example, when nation 2 (the K-abundant nation) imposes an import tariff on commodity X (its L-intensive commodity), P_X/P_Y rises for domestic producers and consumers, and so will the real wage of labor (nation 2's scarce factor).

The reason for this is that as P_X/P_Y rises as a result of import tariff on commodity X, nation 2 will produce more of commodity X and less of commodity Y. Figure below illustrates the general equilibrium effects of a tariff in a small country.

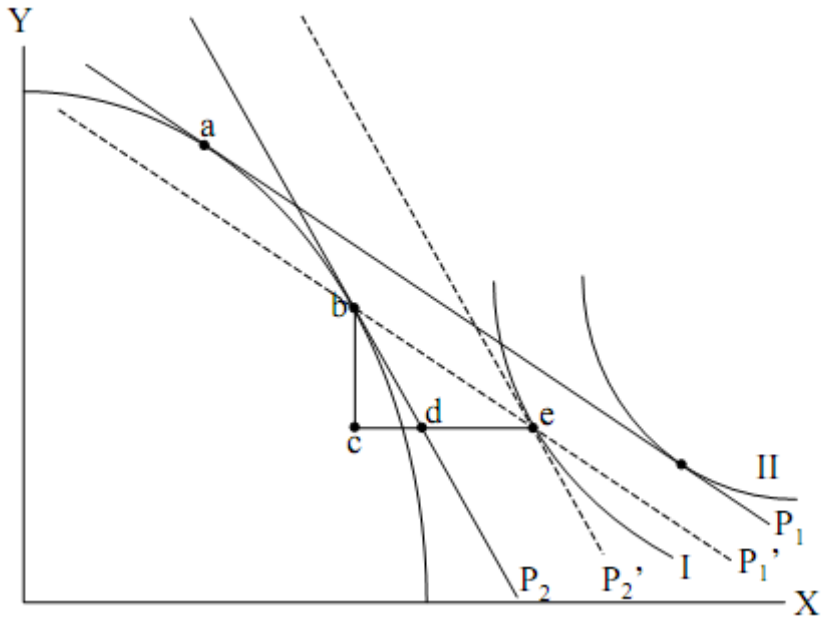


Figure 3.8 The Production and Consumption with Tariff

Source: Salvatore, 2004.

At $P_X/P_Y=P_1$ on the world market, the small nation produces at point a. With a 100 percent ad valorem tariff on imports of commodity X, $P_X/P_Y = P_2$ for individuals in the nation, production takes place at point b and consumption is at point e, and the nation exports bc of goods Y for ce of goods X, of which de of goods X is collected by the government as a tariff. Due to the assumption that the government redistributes the tariff revenue in full to its citizens, consumption with the tariff takes place on indifference curve II' at point e. Thus free trade consumption and welfare are superior to consumption and welfare with the tariff (point e).

After imposing a tariff, the production shifts from point a to b. The expansion in the production of commodity X (the L-intensive commodity) requires L/K in a higher proportion than is released by reducing the output of commodity Y. As a result, w/r rises and K is substituted for L so that K/L rises in the production of both commodities. As each unit of L is now combined with more K, the productivity of L rises, and therefore, w rises. Thus, imposition of an import tariff on commodity X by nation 2 increases P_X/P_Y in the nation and increases the earnings of L (the nation's scarce factor of production). Since national income is reduced by the tariff (compare point H' to point E) and the share of total income going to L is higher, the interest rate and the total earnings of K fall in nation 2. Thus, the small nation as a whole is harmed by the tariff, its scarce factor benefits at the expense of its abundant factor. The Stolper-Samuelson theorem is always true for small nations and is usually true for large nations as well. However, for large nations the analysis is further complicated by the fact that they affect world prices by their trading.

Trade liberalization would benefit abundant factor in the country. That is, when nation 2 does not impose tariff on commodity X anymore, relative price of commodity X would decrease and the demand for labor to produce commodity X would go down. Some papers have applied the SS to explain the effect of the trade liberalization on wage gaps between high skilled and low skilled workers. Since it demonstrates how changes in output prices affects on the prices of the factors when positive production and zero economic profit is maintained in each industry. The rising wage gaps in the globalization are partially because of the change in the relative prices of goods. This change is influenced by changes in prices in the world market.

More really, consider Heckscher Ohlin Stolper Samuelson (HOSS) model with many countries, three goods, and two factors (Davis, 1996), the conclusion can be

diverse, that is, countries which are labor abundant in the global sense can have lower wage rate and higher rental rate after trade liberalization. Assumptions in the model: 1) Both goods and factor markets are perfectly competitive. 2) Technologies are constant returns to scale. 3) Firms employ fixed coefficients. 4) Cross-country endowment differences are too strong for the world trading system to replicate the equilibrium of a fully intergrated world economy. Accordingly, factor prices are not equalized for the world as a whole. Two factors of production are capital and labor, and are available within each country in fixed supply. Three goods are X, Y, and Z, in decreasing order of capital intensity, as reflected by $k_x > k_y > k_z$. Each country is small relative to the world market, so international goods prices are fixed independent of its trade policy choices. This framework is depicted in the well-known Lerner diagram in Figure 3.9

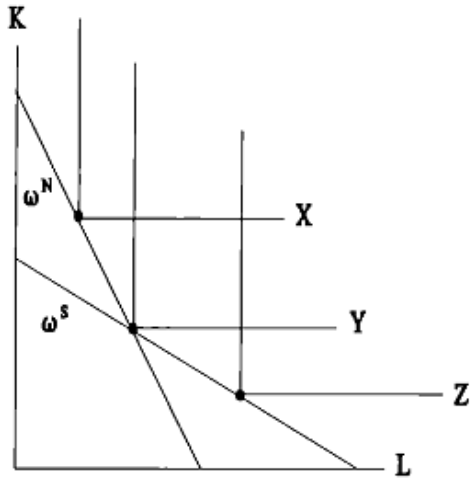


Figure 3.9 Heckscher Ohlin without Factor Price Equalization
Source: Davis, 1996.

The set of countries, which has endowment ratio as $k^c \in (k_Y, k_X)$ is the North and that for which $k^c \in (k_Z, k_Y)$ is the South. These endowment differences lead countries of the North to produce only the goods X and Y, and countries of the South to produce goods Y and Z. That is, the world has two cones of diversification. The endowments of a particular country may be represented as a point within the cone that defines its region (Figure 3.10). In a global sense, the North countries are capital

abundant countries while the South the labor abundant countries. However, the global sense of factor abundance is not relevance for predicting the effects of trade liberalization. Instead, the local factor abundance is crucial.

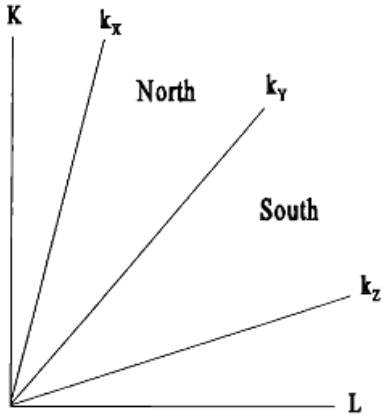


Figure 3.10 Diversification Cones
Source: Davis, 1996.

All countries of the South produce the same set of goods, Y and Z. However, their trade patterns vary depending on their relative factor abundance within the cone. All countries of the South must import X because it is not produced there. The most capital abundant of the South countries are those in region A. They produce a great deal of Y and very little Z. The least capital abundant countries are those in region A' which produce a great deal of Z, but very little Y. The export patterns of A and A' are complementary (Figure 3.11). Then assume that each country imposes ad valorem tariff at rate τ on all imports. Consider first the case of a representative country α from the South region A which exports goods Y and imports goods X and Z. The elimination of protection on X has no influence on local factor prices while the elimination of tariff on Z would lower its domestic price. Thus, trade liberalization in country α has lowered wages and raised rentals. This occurs in spite of the fact that it is capital poor and labor rich in the global sense. Using these results, the impact of trade liberalization on the wage to rental ratio for the various regions within both the North and the South is in Figure 3.12

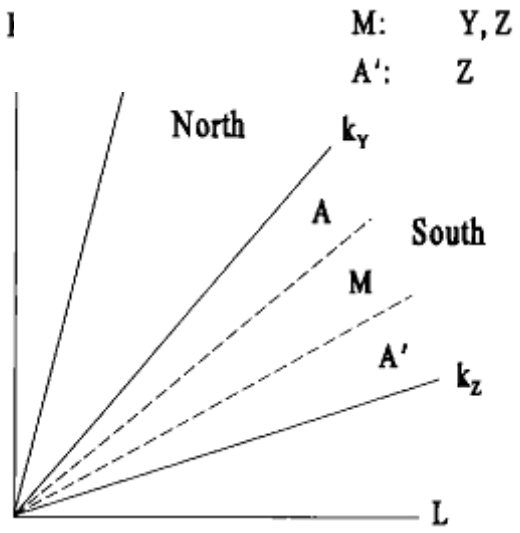


Figure 3.11 Varied Trade Patterns of the South

Source: Davis, 1996.

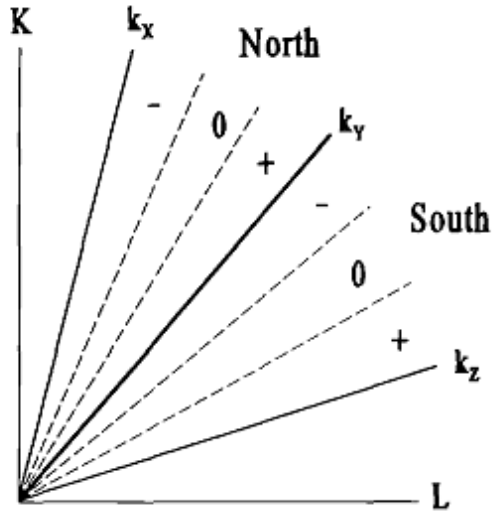


Figure 3.12 Impact of Trade Liberalization on the Wage to Rental ratio

Source: Davis, 1996.

3.2.4 Theories of Technology-Skill Complementarity

Skill-biased technical change is a shift in the production technology that favors skilled over unskilled labor by increasing its relative productivity and its relative demand. This complementarity can be explained by three formulations.

The first formulation "Skilled bias technical change and rising inequality: What is the evidence? What are the alternatives?" Autor (2002) is the sharp decline of the constant-quality relative price of equipment investment. This decline in price leads to an increased use of equipment capital in production. Although capital is likely to be complementary to both skilled and unskilled labor; for example, electric drills complement less skilled workers, adding machines complement more skilled, it tends to be more complementary skilled labor than is unskilled labor. As a result of capital-skill complementarity in production, the faster growth of the equipment stock pushes up the relative demand for skilled labor and, in turn, the skill premium. The aggregate production function will be:

$$Y = K_s^{\alpha}[b_1 L^{\mu} + (1 - b_1)\left(b_2 K_e^{\lambda} + (1 - b_2)H^{\lambda}\right)^{\mu/\lambda}]^{(1-\alpha)/\mu} \qquad (3.2.1)$$

where K_s is structures capital such as buildings

K_e is equipment capital such as machines

H is skilled labor

L^u is unskilled labor

$\sigma_1 = {}^{1}/_{1-\lambda}$ is the elasticity of substitution between equipment and skilled workers

$\sigma_2 = {}^{1}/_{1-\mu}$ is the elasticity of substitution between unskilled workers and the equipment-skilled worker aggregate

If $\sigma_1 > \sigma_2$, equipment capital is more complementary to skilled workers than unskilled workers, and as a result, an increase in equipment capital will increase the wages of skilled workers more than the wages of unskilled workers. Profit-maximizing behavior of price-taking firms implies that the skill premium can be written as

$$w = \frac{w_H}{w_L} = \frac{(1-b_2)(1-b_1)H^{\lambda-1}(b_2K_e^{\lambda}+(1-b_2)H^{\lambda})^{(\mu-\lambda)/\lambda}}{b_1L^{\mu-1}} \quad (3.2.2)$$

Differentiation shows that as long as $\mu > \lambda$, $^{\partial w}/_{\partial K_e} > 0$. So provided that equipment capital is more complementary to skilled workers than unskilled workers, an increase in the quantity of equipment capital will increase the demand for skills.

Computer is one of equipment capital used in firms. Autor, Levy, and Murnane (2002) have concluded that computerization has accelerated demand for more skilled workers by using task-based approach. They have modeled the human tasks that computers complement and those for which they substitute. They argue that computers substitute for routine tasks-such as record-keeping, calculation, or repetitive customer services-while complementing non-routine cognitive tasks demanding flexibility, creativity, generalized problem-solving capabilities, and complex communications. As the price of computer capital falls, these two mechanisms, substitution and complementarity, have raised relative demand for workers who hold a comparative advantage in non-routine tasks, typically college-graduated workers.

1) Autor, Levy, and Murnane (ALM) model "Skilled bias technical change and rising inequality: What is the evidence? What are the alternatives?" Autor (2002)

ALM make three assumptions. First, computer capital is more substitutable for humans in carrying out routine tasks than non-routine tasks. Second, routine and non-routine tasks are themselves imperfect substitutes. Third, at least in the domain of cognitive tasks, greater intensity of routine inputs increases the marginal productivity of non-routine inputs. The ALM model is built on Cobb Douglas production function with two tasks:

$$Y = N^{\beta}R^{1-\beta} \quad (3.2.3)$$

where N is efficiency unit of non-routine task

R is efficiency unit of routine task

ALM model also assumes that computer capital is a perfect substitute for routine task. The price of computing power is given by ρ which falls exogenously with time due to advances in computer technology.

Workers choose among occupations (routine or non-routine) according to comparative advantage. Each worker possess a productivity endowment in routine and non-routine tasks specified in efficiency units where $E(R_i, N_i)$ where $R_i, N_i > 0 \forall i$. Define the relative efficiency of individual (i) at non-routine versus routine tasks as $\alpha_i = {}^{N_i}/_{R_i}$ where $\alpha \in (0, \infty)$. Assume a large number of workers who choose to supply either efficiency units of routine task input or efficiency units of non-routine task input (i.e., choose an occupations).

Given the perfect substitutability of computer capital and routine skills, the wage efficiency unit of routine labor is given by

$$w_r = \rho \tag{3.2.4}$$

Hence, computer capital is a directly skill-replacing technology and advances in computer technology can lower the wages of workers who are close substitutes.

Workers choose an occupation to maximize earnings. The marginal worker with relative efficiency units α^* in routine versus non-routine tasks is indifferent between routine and non-routine occupations when

$$\alpha^* = \frac{w_r}{w_n} \tag{3.2.5}$$

For $\alpha_i < \alpha^*$, individual i supplies routine labor, and for $\alpha_i \geq \alpha^*$, individual i supplies non-routine labor. Then, denote g(α) and h(α) are the population endowment in efficiency units of routine and non-routine tasks respectively for each value of α. ALM model requires the joint distribution of R and N is non-degenerate and has mass at all α. Productive efficiency requires that factors are paid their marginal products:

$$w_r = \frac{\partial Y}{\partial R} = (1-\beta)\theta^{-\beta} \tag{3.2.6}$$

$$w_n = \frac{\partial Y}{\partial N} = \beta\theta^{1-\beta} \tag{3.2.7}$$

where $\theta = \frac{C^* + \int_0^{\alpha^*} g(x)dx}{\int_{\alpha^*}^{\infty} h(x)dx}$ is the ratio of routine to non-routine task input in production.

$$\frac{\partial ln w_r}{\partial ln \rho} = 1 = -\beta \frac{\partial ln \emptyset}{\partial ln \rho} \tag{3.2.8}$$

$$\frac{\partial ln \emptyset}{\partial ln \rho} = -\frac{1}{\beta} \tag{3.2.9}$$

A decline in the price of computer capital reduces the wage per efficiency unit of routine tasks and increases the relative intensity of routine task input

in production. Since workers self select into occupations based on relative wages, it must be the case that labor input to the routine occupation declines. Hence, the demand for computers rises. Since routine and non-routine tasks are complementary inputs, increased intensity of routine task input raises the wage per efficiency unit of non-routine task input:

$$\frac{\partial lnw_n}{\partial ln\rho} = \frac{\beta-1}{\beta} \quad (3.2.10)$$

A decline in the price of computing power clearly increases the marginal productivity of workers engaged in non-routine tasks.

The second formulation is inspired by the Nelson-Phelps view of human capital. They realized that educated people make good innovators, so that education speeds the process of technological diffusion. In particular, more educated, able or experienced labor deals better with technological change.

2) Nelson & Phelps model "Investment in humans, technological diffusion, and economic growth" , 1966

Some kinds of education, vocational training or higher education, equip a person to perform some jobs or functions, or enable a man to perform a given function more effectively. Education enhances one's ability to receive, decode, and understand information, and that information processing and interpretation is important for performing or learning to perform many jobs.

The model assumes that technical progress is Harrod-neutral Neutral technological change refers to the behavior of technological change in models. A technological innovation is Hicks neutral, following John Hicks (1932), if a change in technology does not change the ratio of capital's marginal product to labor's marginal product for a given capital to labor ratio. A technological innovation is Harrod neutral (following Roy Harrod) if the technology is labor-augmenting (i.e. helps labor); it is Solow neutral if the technology is capital-augmenting (i.e. helps capital). everywhere (i.e., for all capital-labor ratios), so that progress can be described as purely labor-augmenting. The production function may be written as

$$Q(t) = F[K(t), A(t)L(t)] \quad (3.2.11)$$

where Q is output

K is capital

L is labor

T is time

A(t) is the index of technology in practice

Introducing T(t) into the model above, T(t), theoretical level of technology, is defined as the best practice level of technology that would prevail if technology diffusion were completely instantaneous. Another assumption is that the theoretical technology level advances exogenously at a constant exponential rate λ:

$$T(t) = T_0 e^{\lambda t},\ \lambda > 0 \qquad (3.2.12)$$

The first model states that the time lag between the creation of a new technique and its adoption is a decreasing function of some index of average educational attainment, h, of those in a position to innovate. Letting w denote the lag, this notion is as follows:

$$A(t) = T\big(t - w(h)\big), w'(h) < 0 \qquad (3.2.13)$$

The level of technology in practice equals the theoretical level of technology w years age, w a decreasing function of h. Substitution of (3.2.12) in (3.2.13) yields

$$A(t) = T_0 e^{\lambda(t - w(h))} \qquad (3.2.14)$$

If h is constant, two results emerge. First, the index of technology in practice grows at the same rate, λ, as the index of theoretical technology. Second, the level of the technology in practice is an increasing function of h, since an increase of h shortens the lag between T(t) and A(t).

An important feature of this model is that the return to education is greater the faster the theoretical level of technology has been advancing. As equation (3.2.15) shows, the effect upon A(t) of a marginal increase of h is an increasing function of λ, given A(t), and is positive only if λ > 0.

$$\frac{\partial A(t)}{\partial h} = -\lambda w'(h) T_0 e^{\lambda[t - w(h)]} = -\lambda w'(h) A(t) \qquad (3.2.15)$$

The same property is displayed by the marginal productivity of educational attainment. Using (3.2.11) and (3.2.14) to get

$$Q(t) = F[K(t), T_0 e^{\lambda[t - w(h)]} L(t)] \qquad (3.2.16)$$

Hence,

$$\frac{\partial Q(t)}{\partial h} = \lambda T_0 e^{\lambda[t - w(h)]} L(t)[-w'(h)] F_2$$

$$= -\lambda w'(h) \times Wage\ Bill \qquad (3.2.17)$$

Thus the marginal productivity of education is an increasing function of λ, given the current wage bill, and is positive only if λ > 0.

The first model is unrealistic because it supposes that the lag of the best-practice level behind the theoretical level of technology is independent of the profitability of the new techniques not yet introduced. Further, it is somewhat unrealistic to suppose that an increase of educational attainments instantaneously reduces the lag.

The second model states that the rate at which the latest, theoretical technology is realized in improved technological practice depends upon educational attainment and upon the gap between the theoretical level of technology and the level of technology in practice. Specifically,

$$A(t) = \Phi(h)[T(t) - A(t)] \tag{3.2.18}$$

or equivalently

$$\frac{A(t)}{A(t)} = \Phi(h)[\frac{T(t)-A(t)}{A(t)}],\ \Phi(0) = 0,\ \Phi'(h) > 0 \tag{3.2.19}$$

The rate of increase of the technology in practice is an increasing function of educational attainment and proportional to the gap. Two results are received from the above notion. First in the long run, if h is positive, the rate of increase of the level of technology in practice, $\dot{A(t)}/A(t)$, settles down to the value λ, independent of the index of education attainment. The reason is this: if the level of h is sufficiently large that $\dot{A(t)}/A(t) > \lambda$ initially, then the gap narrowed; but the narrowing of the gap reduces $\dot{A(t)}/A(t)$; the gap continues to narrow until, in the limit, $\dot{A(t)}/A(t)$ has fallen to the value λ at which point the system is in equilibrium with a constant gap.

Second is that the asymptotic or equilibrium gap is a decreasing function of educational attainment. Thus increased educational attainment increases the path of the technology in practice in the long run. Both results are shown by (3.2.20) which is the solution to the differential equation (3.2.18) given (3.2.12):

$$A(t) = \left(A_0 - \frac{\Phi}{\Phi+\lambda}T_0\right)e^{-\Phi t} + \frac{\Phi}{\Phi+\lambda}T_0 e^{\lambda t} \tag{3.2.20}$$

The equilibrium path of the technology in practice is given by

$$A^*(t) = \frac{\Phi(h)}{\Phi(h)+\lambda}T_0 e^{\lambda t} \tag{3.2.21}$$

The equilibrium gap is given by

$$\frac{T(t)-A^*(t)}{A^*(t)} = \frac{\lambda}{\Phi(h)} \tag{3.2.22}$$

In technologically stagnant economy (λ=0), the gap approaches zero for every h > 0. In a technologically progressive economy (λ > 0), there is a positive equilibrium gap for every h and λ. The equilibrium gap is increasing in λ and decreasing in h. Equation (3.2.23) below shows that the elasticity of the long run equilibrium level of technology in practice, $A^*(t)$, with respect to h is increasing in λ:

$$\frac{\partial A^*(t)}{\partial h}\frac{h}{A^*(t)} = \left[\frac{h\Phi'(h)}{\Phi(h)}\right]\left[\frac{\lambda}{\Phi(h)+\lambda}\right] \quad (3.2.23)$$

This indicates that the payoff to increased educational attainment is greater the more technologically progressive is the economy.

In sum, the process of education can be viewed as an act of investment in people that educated people are bearers of human capital. The rate of return to education is greater the more technologically progressive is the economy. In other words, the society should build more human capital relative to tangible capital the more dynamic is the technology.

Another formulation is introduced by Acemoglu framework in 1998. The main idea is that the development of skill-biased technologies will be more profitable when there are more skilled workers. Therefore, the equilibrium degree of skill bias, which will be determined endogenously, could be an increasing function of the relative supply of skilled workers. An increase in supply of skills will then lead to skill-biased technical change. Furthermore, in the extreme, an acceleration in the supply of skills can lead to an acceleration in the demand for skills.

3) Acemoglu framework: A basic model "Skilled bias technical change and rising inequality: What is the evidence? What are the alternatives?" Autor (2002)

The production functions are modified by using machines, instead of exogenous technology, termed A(t) in Nelson-Phelp model.

$$Y_L = \frac{1}{1-\beta}\left(\int_0^{N_L} x_L(j)^{1-\beta} dj\right)L^{\beta} \quad (3.2.24)$$

$$Y_H = \frac{1}{1-\beta}\left(\int_0^{N_H} x_H(j)^{1-\beta} dj\right)H^{\beta} \quad (3.2.25)$$

where x_L is machine used in the production of the labor-intensive goods

x_H is machine used in the production of the skill-intensive goods

N_L and N_H are the range of machines that can be used in two sectors

The ranges of machines will be measures of productivity in the two sectors. Therefore, change in N_H/N_L will change the skill bias of technology. Assume that machines are supplied by technology monopolists. Each monopolist sets a rental price $\chi_L(j)$or $\chi_H(j)$and the marginal cost of production is the same for all machines and equal to $\varphi = 1 - \beta$ in terms of final good. The producers of the labor-intensive goods maximize profit as equation:

$$\max_{L,\{x_L(j)\}} p_L Y_L - w_L L - \int_0^{N_L} \chi_L(j) x_L(j) dj \quad (3.2.26)$$

This gives machine demands as

$$x_L(j) = [\frac{p_L}{\chi_L(j)}]^{1/\beta} L \quad (3.2.27)$$

$$x_H(j) = [\frac{p_H}{\chi_H(j)}]^{1/\beta} H \quad (3.2.28)$$

Since machines are supplied by monopolists, the profit-maximizing price will be constant markup over marginal cost. In particular, all machine prices will be given by

$$\chi_L(j) = \chi_H(j) = 1 \quad (3.2.29)$$

Profit of technology monopolists are obtained as

$$\pi_L = \beta p_L^{1/\beta} L \quad (3.2.30)$$

$$\pi_H = \beta p_H^{1/\beta} H \quad (3.2.31)$$

Let V_H and V_L be the net present discounted values of new innovations. The in steady state:

$$V_L = \frac{\beta p_L^{1/\beta_L}}{r} \tag{3.2.32}$$

$$V_H = \frac{\beta p_H^{1/\beta_H}}{r} \tag{3.2.33}$$

The greater is V_H relative to V_L, the greater are the incentives to develop skill-complementary machines, machines used in skill-intensive sector than those in labor-intensive sectors. The relative profitability is

$$\frac{V_H}{V_L} = (\frac{1-\gamma}{\gamma})^{\frac{\varepsilon}{\sigma}}(\frac{N_H}{N_L})^{\frac{-1}{\sigma}}(\frac{H}{L})^{\frac{\sigma-1}{\sigma}} \tag{3.2.34}$$

where $\sigma \equiv \epsilon - (\epsilon - 1)(1 - \beta)$

Greater profitability of skill-complementary technologies leads to more innovations that are skill complementary. Presume that the elasticity of substitution between two factors is high elastic or $\sigma > 1$. This implies that the higher relative supply of skills, H/L, increases V_H/V_L, and via this channel, it induces an increase in N_H/N_L, creating skill-biased technical change. The relative factor prices are

$$\frac{w_H}{w_L} = p^{1/\beta}\frac{N_H}{N_L} = (\frac{1-\gamma}{\gamma})^{\frac{\epsilon}{\sigma}}(\frac{N_H}{N_L})^{\frac{-(\sigma-1)}{\sigma}}(\frac{H}{L})^{\frac{-1}{\sigma}} \tag{3.2.35}$$

What the relative factor price equation give 1) the relative factor reward, w_H/w_L, is decreasing in the relative factor supply, H/L. This is called substitution effect, making the short run relative demand for skills downward sloping. 2) Greater H/L leads to a greater N_H/N_L, which is biased toward skilled workers, and therefore increases w_H/w_L. In other words, an increase in the relative supply of skills causes skill-biased technical change. The question is whether the induced skill bias effect can be strong enough to outweigh substitution effect and lead to an upward sloping relative demand curve.

The production function for the creation of new varieties of machines is created as follows:

$$\dot{N}_L = \eta_L X_L \tag{3.2.36}$$

$$\dot{N}_H = \eta_H X_H \tag{3.2.37}$$

where X is R&D expenditures. The market-clearing condition is

$$\eta_L \pi_L = \eta_H \pi_H \tag{3.2.38}$$

Then, relative physical productivities can be solved for

$$\frac{N_H}{N_L} = \eta^{\sigma} \left(\frac{1-\gamma}{\gamma}\right)^{\epsilon} \left(\frac{H}{L}\right)^{\sigma-1} \tag{3.2.39}$$

Substituting N_H/H_L equation into w_H/w_Lequation to get endogenous-technology factor rewards are

$$\frac{w_H}{w_L} = \eta^{\sigma-1} \left(\frac{1-\gamma}{\gamma}\right)^{\varepsilon} \left(\frac{H}{L}\right)^{\sigma-2} \tag{3.2.40}$$

The response of relative factor rewards to changes in relative supply is more elastic in 2 than in 1. That is, if $\sigma > 2$, the relationship between relative factor supplies and relative factor rewards can be upward sloping. This is the case drawn in Figure 3.13

A large increase in the supply of college graduates has reduced the college premium in the short run because of substitution effect which makes the economy move along a downward sloping relative demand curve. However, the relative supply change has increased the size of the market for technologies complementary to skills, and induced a change in the direction of technical progress. Consequently, the relative demand curve would shift to the right because of the directed technology effect.

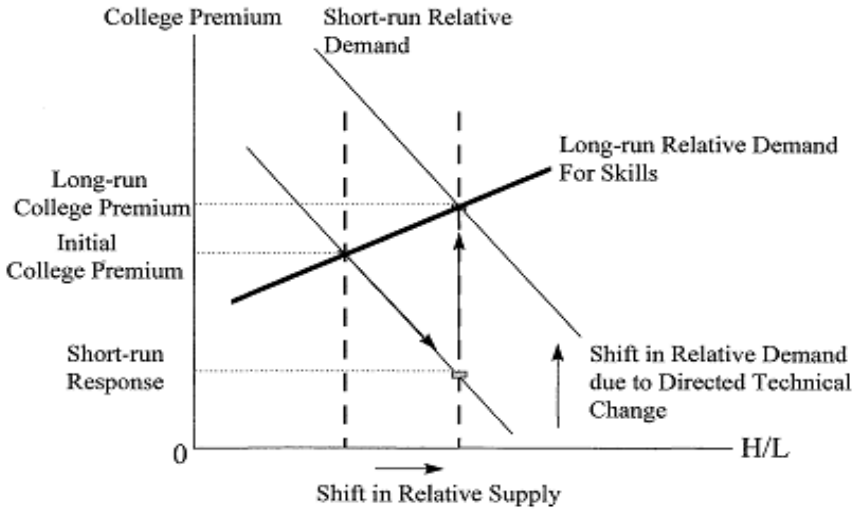


Figure 3.13 Directed Technical Change and Dynamics of College Premium

Source: Acemoglu, 1998.

3.3 Assignment Model

The Assignment model by Sattinger, 1993 explains the distribution of earnings as arising from the market economy's solution to the problem of assigning workers to jobs. The amount a worker can contribute to production depends on which job the worker performs. This is due to many different causes: 1) jobs require many different tasks, and human performances at those tasks are diverse, 2) manufacturing sectors use different technologies that rely on different combinations of human skills, 3) jobs vary in the amounts of resources combined with labor. For the economy as a whole, total outputs depend on how workers are assigned to jobs, i.e., which worker performs which job.

If the economy exists without the assignment problem, workers with only a single observable skill would be able to get the same wage no matter which job he or she takes. Firms would be indifferent as to which workers they employ. Hiring arises by taking the first worker that comes along. Unemployment will arise if the number of workers exceeds the number of jobs.

An assignment of workers to jobs can be defined as a listing of each worker together with the job he or she performs. The existence of many labor market

phenomena, such as search, mobility, hierarchy tournaments, unemployment, and specialized labor markets, can be motivated as labor market responses to the problem of assigning workers to jobs. Assignment models represent the interaction between labor supply and demand in shaping the distribution of earnings.

Much empirical work supports the existence of an assignment problem. Joop Hartog (1985, 1988) finds that both individual and job characteristics affect earnings. Further, there are significant interactions between them, supporting the existence of an assignment problem. Heckman and Guilherme Sedlacek (1990) reject a simpler model with no assignment problem in which worker earnings would be the same in all market sectors. Unequal wage structures among economic sectors provide indirect evidence of an assignment problem. Jose Scheinkman (1987) establishes that worker characteristics receive unequal rewards in different sectors of the economy, so that workers face a choice problem.

The existence of multiple sectors entails an assignment problem. Multiple sectors arise because of the great variety of tasks performed in the production of goods and services and the diversity of human performances at those tasks. Multiple sectors provide workers with choices. Both the existence of choices and the features of those choices affect the distribution of earnings. In the simplest case, where workers are described by a single characteristic, multiple sectors arise because the output in some jobs is more sensitive to that characteristic than others. Workers will choose the sector that is more sensitive to their skill levels to yield higher outputs.

Next, employers do not have complete information in workers' abilities. Workers have different abilities which lead to unequal skill prices. In the economy, the very high offers go to workers in sectors that weight a single aptitude highly. Sectors requiring two or more aptitudes do not make many high offers. The workers getting the highest wages are those who are extremely good at a single skill that is crucial to a sector rather than workers who have a high average of aptitudes.

Multiple sectors together with different workers' abilities lead to a search problem. Workers engage in job search and elicit job offers until they find their matches. Firms spend substantial amounts through personnel departments in advertising positions and interviewing candidates. After employment, firms collect information about workers to facilitate later assignment within the firm through internal labor market.

The three assignment models which will be discussed are apparently different in terms of the description of workers and job characteristics. The linear programming optimal assignment problem is behind the conditions for an efficient assignment. On the other hand, the differential rents model explains wage differentials while Roy's model explains self-selection into occupations. Anyhow, they share one point in common, that is, they explicitly formulate the assignment problem that must be solved in the economy.

First of all, the Linear Programming Optimal Assignment Problem has 3 assumptions: 1) there are no explicit parameters describing workers that would allow one to rank them with regard to skills, 2) a worker's wage depends on the outputs obtained from alternative assignments rather than on the marginal increase in output obtained by using more labor or different labor, 3) workers and jobs are equal in term of discrete numbers. They must be combined in fixed proportions.

Suppose there are n workers and n machines (with 1 machine corresponding to 1 job) and let a_{ij} be the value of output obtained by worker i at machine j. The assignment problem is solved by maximizing the outputs. Let w_i be the dual price for worker i and let r_j be the dual price for machine j. If worker i is assigned to machine j in the optimal solution, then $w_i + r_j = a_{ij}$. With the optimal solution, the dual prices exhaust the product. The dual prices w_i and r_j distribute income in such a way that the assignment problem is solved through the income maximizing behavior of individual agents. These dual prices perform as market prices and could arise from a competitive solution. With the factor analysis, outputs from matches can be represented as:

$$a_{ij} = \sum_{k=1}^{R} \lambda_k p_{ik} q_{jk} \qquad (3.3.1)$$

where R is the rank of the matrix formed from the outputs a_{ij}

P_{ik} is the amount of the k-th latent property of worker i

Q_{jk} is the amount of the k-th latent property of machine j

λ_k is the weight for the k-th property.

With this factorization, the k-th property of workers interacts only with the k-th property of machines in the determination of outputs. Suppose in the optimal assignment that worker i is matched with machine j and that worker c is matched with machine d.

The condition that the owner of machine d would not prefer worker i,

$$a_{id} - w_i \;\leq\; a_{cd} - w_c \tag{3.3.2}$$

$$a_{id} - a_{cd} \;\leq\; w_i - w_c \tag{3.3.3}$$

And the condition that the owner of machine j would not prefer worker c,

$$a_{cj} - w_c \;\leq\; a_{ij} - w_i \tag{3.3.4}$$

$$w_i - w_c \;\leq\; a_{ij} - a_{cj} \tag{3.3.5}$$

Furthermore,

$$a_{id} - a_{cd} \;\leq\; w_i - w_c \;\leq\; a_{ij} - a_{cj} \tag{3.3.6}$$

Combining these inequalities and using (3.3.1) yields:

$$\sum_{k=1}^{R} \lambda_k p_{ik} q_{dk} - \sum_{k-1}^{R} \lambda_k p_{ck} q_{dk} \;\leq\; w_i - w_c \;\leq\; \sum_{k=1}^{R} \lambda_k p_{ik} q_{jk} - \sum_{k=1}^{R} \lambda_k p_{ck} q_{jk}$$

$$\sum_{k=1}^{R} \lambda_k (p_{ik} - p_{ck}) q_{dk} \;\leq\; w_i - w_c \;\leq\; \sum_{k=1}^{R} \lambda_k (p_{ik} - p_{ck}) q_{jk} \tag{3.3.7}$$

The inequalities in (3.3.7) show the upper and lower limits for the wage differences between worker i and worker j. The limits depend on the differences between the latent properties of the two workers, i.e., p_{ik}-p_{ck} appears on both sides of (3.3.7). The limits also depend on the machine properties q_{dk} and q_{jk} . The effect of worker properties on wages depends on which jobs are performed in equilibrium. A change in either the workers or jobs in the economy alters the assignment and the wage differentials that are observed. The determination of limits for machine rents is exactly symmetric to the determination of wage limits:

$$\sum_{k=1}^{R} \lambda_k \left(q_{jk} - q_{dk}\right) p_{ck} \;\leq\; r_j - r_d \;\leq\; \sum_{k=1}^{R} \lambda_k (q_{jk} - q_{dk}) p_{ik} \tag{3.3.8}$$

The problem of assigning workers to machines determines relative wages and machine rents but not their absolute levels.

Under the Differential Rent Model, a different assumption is made, that is, the distributions of workers and jobs are continuous and workers as well as jobs posses one single characteristic. Assignment problem is solved by using hierarchical assignment in which more skilled workers perform jobs with greater resources. With heterogeneous jobs, more skilled workers have their earnings boosted by being assigned to jobs with more capital and responsibilities. As one moves down the list of workers in order of decreasing skill, the machine size assigned to that worker in equilibrium declines, along with the level of production from the match.

The wage differential depends on the assignment of workers to jobs. Suppose that each job is associated with a machine and each machine can be described by its size.

Let $a_{ij} = f(g_i, k_j)$,

where a_{ij} is the output from worker i and machine j

g_i is a measure of worker i's skill

k_j is a measure of the size of machine j

and the production f (g, k) is an increasing function of g and k. Now suppose that the numbers of workers and machines increase indefinitely. Let G (x) be the proportion of workers with skill levels less than or equal to x, and let K (x) be the proportion of machine sizes that are less than or equal to x.

In this economy, the aggregate output is obtained by summing the production from each match of a worker with a machine. In the absence of preferences, the efficient assignment will be the one that maximizes the aggregate production. Let the relationship between wages and the skill level be w (g). The owner of machine size k* who hires worker with skill level g tries to maximize the profit: $\Pi = f(g, k^*) - w(g)$. The first order condition to maximize profit is: $w'(g) = \frac{\delta f}{\delta g}$. The term $w'(g)$ is simply the wage differential, the increase in wages from a given increase in the worker's skill level. The effect of an increase in the worker's skill level, and the size of the wage differential, depends on which job the worker performs. For each value of skill level the wage differential will be calculated. The size of the machine of the employer who hires that labor must be known.

The machine rents are determined simultaneously with the wage function w (g). Let r (k) be the rent for a machine of size k. The machine rent is given by the residual obtained by subtracting the wage form production: $r(k) = f(k, g) - w(g)$.

The distribution of earnings differs in shape from the distribution of abilities. In the context of differential rent model, one obtains a different distribution of abilities among workers depending on which machine is used. If every worker uses the same type of machine, the distribution of earnings would take the same shape as the distribution of abilities. With unequal machine sizes, workers with greater skill levels are assigned to larger machines.

The Roy's model is different from the differential rents model in that workers choose among only a few jobs or occupations instead of a continuum of jobs. Rather than each job being filled by only one worker, a subset of all workers can be found in a given job. The assumption under the model is that it is two-sector model and discrete jobs. Workers can move between sectors depending on relative prices of outputs.

The Roy's model solves the assignment problem with different approaches depending on correlation between two sectors' performances. In the first case, outputs in two sectors are highly correlated, so that workers with higher levels of output in one occupation are also very likely to have higher levels of output in the other sector. In this case, workers are assigned to sectors on the basis of comparative advantage. Workers who do well in a sector do not necessarily select that sector; instead they may select the other sector because they have a comparative advantage in it. Workers may select a sector even though they do badly in it because they have a comparative in that sector.

In the second case, performances in two sectors are negatively correlated. Those with worse performances in an occupation are more likely to choose the other occupation to earn their living. In this case, the assignment is described by absolute advantage, which arises when workers in an occupation are better at that occupation than workers choosing the other occupation. Workers in an occupation tend to have higher outputs in that occupation than workers choosing the other occupation. Each occupation is filled with the best workers in that occupation.

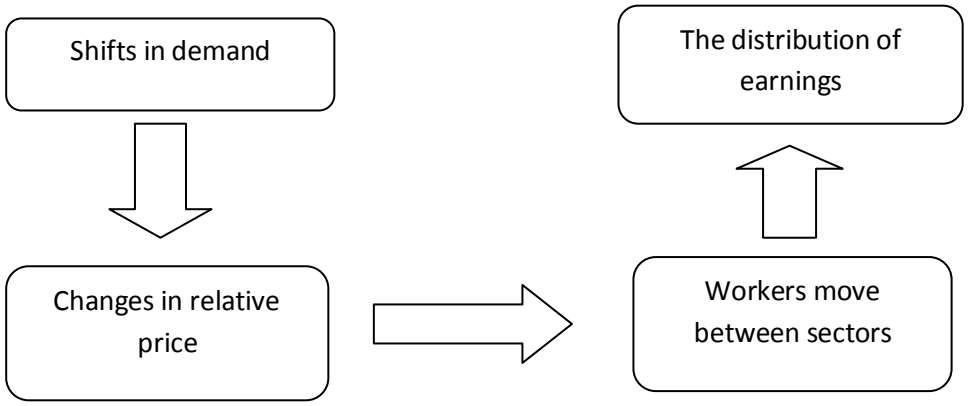


Figure 3.14 The Distribution of Earnings by Shifts in Demand

In the last case, outputs in two occupations are positively correlated but not as much as in the standard comparative advantage case. Workers with better performances in the first sector are more likely to choose that sector, even though they also tend to be slightly better in the second sector. The importance of this case is that a positive correlation between sector performances does not necessarily generate the standard comparative advantage case.

Roy's model can be used to illustrate how demand can influence the distribution of earnings.

Suppose two sectors are sector A and B. As the price of goods in sector A increases, the proportion of workers selecting sector A will go up and sector B will go down. Workers in sector A find their earnings boosted by the price increase relative to workers in sector B who have lower earnings on average. In this case, the increase in the price of goods in sector A raises earning inequality as measured by the variance of logarithms of earnings. As the price of goods in sector A doubles, average earnings of workers in that sector do not increase double. After the price change, average skill levels in the sector A will be lower. The average wage in sector A increases less than the price increase.

It can be drawn from the three models that the existence of multiple sectors entails an assignment problem. Multiple sectors arise because of the great variety of tasks performed in the production of goods and services and the diversity of human performances at those tasks. Multiple sectors provide workers with choices. Both the existence of choice and the features of those choices affect the distribution of earnings. In addition, prices or values of worker characteristics are not uniform across the economy. Assignment models provide a direct explanation of unequal skill prices in an economy. Unequal wage structure in sectors of economy is a direct outcome of the existence of an assignment problem.

There are many approaches to solve assignment problems depending on assumptions used: self-selection, absolute advantage, comparative advantage, scale of operation effects, preferences, etc.

Self-selection is the mechanism that is used to bring about the assignment. Workers select a sector or job, and thereby assign themselves to it, when it offers them greater income or utility than any other sector. Self-selection requires that a

worker has perfect information about potential earnings or utility in each sector. This is reasonable when there are only two sectors. But the assumption of perfect information becomes unreasonable when there are many sectors with little guide to the worker as to which one is suitable.

MacDonald (1980) develops a model in which there are two types of workers and firms. The type of a worker cannot be directly observed, but workers can invest in generating information about their own type. Any information that workers can identify their types leads to improved worker-firm matches. Employers value this information by offering higher wages.

Spence (1973) develops the model of signaling. Workers' investment in information about themselves could give them competitive advantage in the labor market. With an assignment problem in the economy, information investment can yield social return that equals or exceeds the private return, even though it does not change the worker's productivity.

Investment in information affects the life-cycle earnings profile. Hartog (1981) develops a two-period model in which wages in the first period are based on signals and in the second period on capabilities. He shows that dispersion in signal classes increases over time, and more capable individuals experience higher earnings growth.

The reason why some assignments occur instead of others is comparative advantage. Comparative advantage determines the assignment in a market system with assumptions as follows. First, technology has fixed proportion in which employers need to have a fixed set of tasks performed to yield a given level of production. Second, workers do not have preferences for some tasks over others. Let a_{ij} be the number of times that worker i can perform job j's task per period. If

$$\frac{a_{11}}{a_{21}} > \frac{a_{12}}{a_{22}}, \tag{3.3.9}$$

worker 1 has comparative advantage in job 1 and worker 2 has comparative advantage in job 2. The equilibrium assignment must be consistent with the comparative advantage relations.

The equilibrium assignment can explain wage differences. Suppose in equilibrium worker 1 is observed in job 1 while worker 2 is in job 2. Then the ratio of wages for the two workers must lie between the ratio of their performances at the first job and their ratio at second job:

$$\frac{a_{11}}{a_{21}} \geq \frac{w_1}{w_2} \geq \frac{a_{12}}{a_{22}}. \quad (3.3.10)$$

The ratios of performances in the two jobs set limits within which the wage differential must fall.

In summary, comparative advantage establishes the existence of an assignment problem but the direction of the inequality in (2.3.9) is needed to determine which particular assignment happens.

An alternative solution is absolute advantage. Absolute advantage arises when a worker is better at a job than other workers. If $a_{1j} > a_{2j}$, worker 1 has an absolute advantage at job j compared to worker 2. Different from absolute advantage, a worker can still get a job even though he or she is worse at all jobs than other workers in comparative advantage.

If production has complementary inputs such as machine, the scale of operation is a solution for assigning workers to jobs. Consider an economy in which a job is associated with the use of a particular machine that can be used by only one worker at a time. Suppose the values of output obtained per hour from the two workers at two jobs are as follows:

	Job 1	Job 2
Worker 1	\$35	\$20
Worker 2	\$20	\$10

The assignment problem can be solved by comparative advantage. Worker 2 has comparative advantage in job 1 while worker 1 has comparative advantage in job 2 because $\frac{a_{11}}{a_{21}} < \frac{a_{12}}{a_{22}}$ or $\frac{35}{20} < \frac{20}{10}$. The total outputs received from both workers are \$40 which is not maximum outputs the economy can get. The maximum outputs is \$45 which can occur if worker 1 takes job 1 and worker 2 takes job 2. This shows that comparative advantage does not indicate the optimal assignment for a reason that earnings from a job are no longer proportional to physical output at the job. With complements in the production (either explicit in the form of a machine or implicit via scarcity in the jobs available), their opportunity costs for the cooperating factor must be subtracted from the value of output to yield the earnings.

Differences in wages can be explained in terms of differences in the scale of operations. With the scale of operation effect, the wage ratio for the two workers will

not lie between the ratios of outputs as in the comparative advantage case because of the presence of opportunity costs from the use of machine or the filling of a position or job. Consider the model in which the cooperating factor is capital, in the form of heterogeneous units called machines. Assume only one worker at a time can be combined with a machine. Let p_j is the price of a unit of output from machine j

a_{ij} is the output produced per period by worker i at machine j

w_i is the wage rate for worker i

In the first case, the owner of machine j chooses worker. The owner of machine j takes the wage as given and chooses the worker that maximizes $p_j a_{ij} - w_i$ instead of output values.

If the owner of machine 1 is observed to choose worker 1,

$$p_1 a_{11} - w_1 \geq p_1 a_{21} - w_2 \quad (3.3.11)$$

If the owner of machine 2 is observed to choose worker 2,

$$p_2 a_{22} - w_2 \geq p_2 a_{12} - w_1 \quad (3.3.12)$$

Transform equation (3),

$$p_1 a_{11} - p_1 a_{21} \geq w_1 - w_2$$

$$p_1(a_{11} - a_{21}) \geq w_1 - w_2 \quad (3.3.13)$$

Transform equation (4),

$$w_1 - w_2 \geq p_2(a_{12} - a_{22}) \quad (3.3.14)$$

Therefore,

$$p_2(a_{12} - a_{22}) \leq w_1 - w_2 \leq p_1(a_{11} - a_{21}) \quad (3.3.15)$$

The difference in wages must lie between the difference in the value of output produced by the two workers on machine 1, and the corresponding difference on machine 2. The assignment of worker 1 to machine 1 and worker 2 to machine 2 can come about only if $p_2(a_{12} - a_{22}) \leq p_1(a_{11} - a_{21})$. If $p_2(a_{12} - a_{22}) > p_1(a_{11} - a_{21})$, only the opposite assignment could be observed in equilibrium.

Alternatively, workers can choose machines. Let r_j be the rental cost for machine j. Worker i chooses machine j to maximize $p_j a_{ij} - r_j$. Again, worker 1 is observed to choose machine 1 if

$$p_1 a_{11} - r_1 \geq p_2 a_{12} - r_2 \quad (3.3.16)$$

$$p_1 a_{11} - p_2 a_{12} \geq r_1 - r_2 \quad (3.3.17)$$

Worker 2 chooses machine 2 if

$$p_2 a_{22} - r_2 \geq p_1 a_{21} - r_1 \quad (3.3.18)$$

$$r_1 - r_2 \geq p_1 a_{21} - p_2 a_{22} \quad (3.3.19)$$

Therefore,

$$p_1 a_{21} - p_2 a_{22} \leq r_1 - r_2 \leq p_1 a_{11} - p_2 a_{12} \quad (3.3.20)$$

Differences in wages and rents are determined symmetrically by the problem of assigning workers to jobs.

In addition to production relevant characteristics, preferences may guide the assignment. Based on Tinbergen's model (1951), the assignment problem is solved by matching workers and jobs on the basis of distance between characteristics. This approach can be called hierarchical assignment. In this model, workers prefer jobs with effort requirements that are close to their effort capabilities.

Let h_j is the effort requirement of job j

g_i is the effort capability of worker i

therefore, the wage offer is

$$w_i = w_{0i} + a(g_i - h_j)^2 \quad (3.3.21)$$

W_{0i} is the lowest wage which workers can accept. W_{0i} occurs when the effort requirement equals the effort capability of the workers, i.e., $g_i = h_j$. If effort requirement is higher or lower than g_i , the workers must receive higher wage in order to achieve the same level of utility. Higher values of w_{0i} yield higher wage offer curves and higher levels of utility, so that the worker chooses hj to maximize

$$w_i - a(g_i - h_j)^2 \quad (3.3.22)$$

Workers with higher effort capabilities will always end up in jobs with higher effort requirements. The Tinbergen's model can be contrasted with one in which workers all uniformly prefer jobs with higher values of some characteristics. All workers may dislike a particular job feature such as riskiness, noise, or distance to work so they have different valuations of those characteristics. The unequal valuations lead to an assignment of workers to jobs.

Assigning workers to jobs based on preferences may lead to wage differentials. Wage differences may not occur if the distribution of worker characteristics exactly matches the distribution of job characteristics. If workers end up in jobs with effort

requirements below their capabilities, wages will need to be a decreasing function of capabilities in order to induce workers to take the jobs.

The extension to many sectors would appear to be possible if workers are assumed to engage in search to find jobs. In the standard search model, workers need to know only the distribution of wage offers among jobs and not the wage corresponding to each job. A worker chooses reservation wage and accepts the first job offer with a wage that equals or exceeds it. In the context of search model, firms must pay higher- wages to gain more acceptances from workers with desired characteristics. Wage differences between industries can persist without all workers going to the higher wage industry. With search assigning workers to jobs, the extension of assignment models to manufacturing sectors explain inter-industry differences in wage structures.

Tournaments may be regarded as a mechanism of assigning workers to hierarchical levels in a context in which worker abilities are revealed through competition. As performances depend on effort, large prizes are required for workers in the top ranks to maintain incentives to compete. In addition, labor market provides another mechanism for assigning workers to jobs. Instead of one big labor market, sub-markets arise based on observable characteristics of workers and jobs.

In summary, workers with the same level of human capital are not equally productive; their productivity depends on the job to which they are matched. Therefore, overeducation arises because of a bad job match since overeducated workers are matched with a job that they cannot perform well. In these models, the returns associated with additional education depend, in part, on the quality of the assignment of heterogeneous workers to heterogeneous jobs. The returns associated with investments in human capital via educational attainment are limited if occupations do not utilize all of the schooling of the workers. That is to say, overeducated individuals earn less than others with their level of educational attainment because of an occupational ceiling on productivity. Indeed, the existence of unequal wage structures among economic sectors provides indirect evidence of an assignment problem.

CHAPTER 4

DATA AND STATISTICAL FRAMEWORK

In this chapter, samples, model, and hypotheses are explained into topics: The existence of educational mismatch in Thai labor market, Causes of overeducation, and The effects of overeducation on wages.

4.1 The Existence of Educational Mismatch in Thai Labor Market

4.1.1 Method to Measure Educational Mismatch

OECD method, the correspondence between ISCO occupational classification and ISCED educational classification, is chosen to classify workers into overeducated, properly matched, and undereducated workers. The reasons are:

1) The Labor Force Survey collects educational level, instead of years of schooling so transforming educational level into years of schooling may be biased. Therefore, the number of year of education is not a fully reliable measure of educational attainment because it is frequently upwardly biased (Ortriz, 2008).

2) The incidence of educational mismatch can be compared internationally because countries also use ISCO occupational classification and ISCED educational classification.

The ISCO classification system provided by the International Labor Office can be used to distinguish levels of qualification that can be linked to the educational levels needed to hold the corresponding jobs, and thus to the ISCED categorization of UNESCO. The 1-digit educational and occupational groups are classified as high-skilled, intermediate or low skilled depending on the capacities and abilities related to them and, finally, a correspondence between occupations and educational levels will be obtained from matching.

From the table below, there are three different categories between the occupational groups and the educational levels: overeducated, matched, and

undereducated workers. This approach, however, has some weaknesses. The attempt to achieve uniformity through the ISCO and ISCED classification systems can mask certain particularities associated with specific countries. The content of diplomas of a similar level in two different countries may differ, and within any given country, the value of a diploma may vary over time. Educational attainment at the time individuals complete their schooling excludes their skills acquired outside the classroom.

Table 4.1 Conversion of ISCO 9 Categories to 3 Categories

Occupational titles (ISCO-08)	**Low-skilled**	**Intermediate**	**High-skilled**
1. Managers			X
2. Professionals			X
3. Technicians and associate professionals			X
4. Clerical support workers		X	
5. Services and sales workers		X	
6. Skilled agricultural, forestry and fishery workers		X	
7. Craft and related trades workers		X	
8. Plant and machine operators, and assemblers		X	
9. Elementary occupations	X		

Source: OECD, 2007.

4.1.2 Data

For research question 1, data are from labor force survey in 2006 and 2011. The 2006-occupational groups are based on ISCO-88 while 2011-occupational groups are based on ISCO-08. Thus, ISCO-88 has been converted to ISCO-08 allowing for easy comparison of officials.

Table 4.2 Conversion from ISCED 8 Categories to 3 Categories

Educational level	Low-skilled	Intermediate	High-skilled
1. Pre-school	X		
2. Primary education	X		
3. Lower secondary education	X		
4. Upper secondary education		X	
5. Post-secondary education		X	
6. Bachelor degree			X
7. Master degree			X
8. Doctorate degree			X

Source: OECD, 2007.

Table 4.3 Correspondence between ISCED Educational Level and ISCO Employment Level

ISCED educational level	ISCO employment level		
	Low-skilled	Intermediate	High-skilled
Low-skilled	Matched	Undereducated	Undereducated
Intermediate	Overeducated	Matched	Undereducated
High-skilled	Overeducated	Overeducated	Matched

Source: OECD, 2007.

After focusing on employed workers[5] aged 15-60 years who work as government, state enterprise, and private employees, the sample size (weighted cases) is 60,585,799 and 63,620,613 workers in 2006 and 2011, respectively. Table 4.4 lists and defines variables of interest, including mismatch, educational level, educational level by ISCED/ISCO method, occupational groups, occupational groups by

[5] Employed workers mean individuals with age over 15 years and have at least one out of three characteristics within 7 days before interviewing:
- Individual works more than 1 hour and receive wage in the form of money or things.
- Individual works at least 1 hour in his/her farm/enterprise without wage.
- Individual does not work or work less than 1 hour but he/she receives other benefits or he/she has business to do.

Table 4.4 Definitions of Variables

Variables	Definitions
Mismatch	3 categories by using ISCED/ISCO method including overeducation, matched, and undereducation
Educational level	8 categories including pre-school, primary, lower-secondary, upper-secondary, post-secondary, bachelor, master, and doctorate
Educational level by ISCED/ISCO method	3 educational levels by skills: high-skilled, intermediate, and low-skilled level of education
Occupation	9 categories including 1) managers 2) professionals 3) technicians and associate professionals 4) clerical support workers 5) services and sales workers 6) skilled agricultural, forestry and fishery workers 7) craft and related trade workers 8) plant and machine operators and assembler 9) elementary occupations
Occupational groups by ISCED/ISCO method	3 categories including high-skilled, intermediate, and low-skilled occupations
Experience	Potential experience calculated by subtracting years of schooling and 6 from age
Experience squared	Experience * experience
Female	Dummy variable. Female=1 if female and female=0 if male
Head	Dummy variable. Head=1 if head of household and head=0 if not
Married	Dummy variable. Married=1, and =0 if single or divorced or widowed
Years of schooling	less-than primary = 0-5, primary = 6-8, lower-secondary= 9-11, upper-secondary = 12-17 post-secondary= 14-16, bachelor= 16-17, master= 18, and doctorate=21-22

Table 4.4 (Continued)

Variables	Definitions
Part time job	Dummy variable. Part time job=1 if working hours per week is less than 35 hours, and =0 if equal to or greater than 35 hours
Small firm	Dummy variable. Small firm=1 if working in firm which employs less than 50 workers and =0 if the employment is equal to or greater than 50 workers.
Field of study	8 categories including education, humanities & arts, social science, science, engineering, agriculture, health, and services
Employed	Dummy variable. Employed=1 if individual is employed and employed=0 if individual is unemployed
fields by educational level	16 categorical variables including 8 fields of study in non-tertiary education and 8 fields of study in tertiary education as follows: 1=education non-tertiary 2=education tertiary 3=humanities & arts non-tertiary 4=humanities & arts tertiary 5=social science non-tertiary 6=social science tertiary 7=science non-tertiary 8=science tertiary 9=engineering non-tertiary 10=engineering tertiary 11=agriculture non-tertiary 12=agriculture tertiary 13=health non-tertiary 14=health tertiary 15=services non-tertiary 16=services tertiary

ISCED/ISCO method, experience, experience squared, gender, head of household, marital status, years of schooling, field of study, part time job, and small firm.

4.1.3 Hypotheses in Research Question 1

Hypothesis 1 is that educational mismatch exists in Thai labor market and differs across gender, educational level, fields of studies, and occupational titles. This hypothesis is proved by using descriptive statistics of OECD method. Then, the determinants of mismatched workers will be analyzed (Figure 4.1). Hypothesis 2 is that overeducated workers have more years of schooling, are less experienced, married, and work in part time job. The opposite is true for undereducated workers.

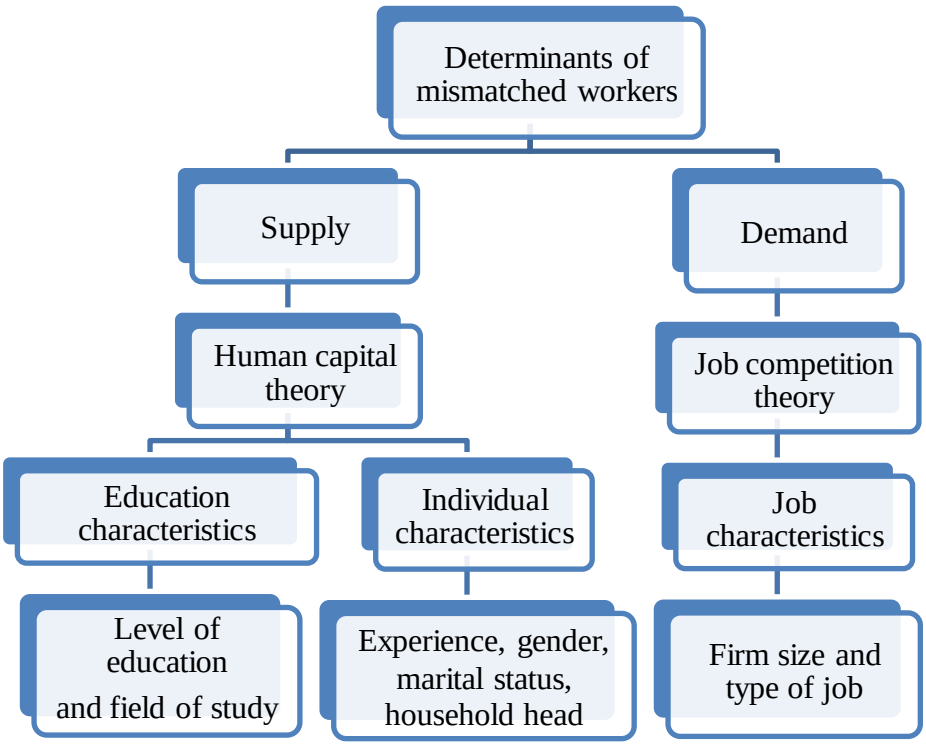


Figure 4.1 The Analysis of the Determinants of Mismatched Workers

This hypothesis is proved by using multinomial logit model. The dependent variables are categorical variable, mismatch, valued equal to 1 if workers are overeducated, 2 if workers are properly matched, and 3 if workers are undereducated. The values of dependent variable are unordered even though outcomes are coded 1, 2, and 3. The numerical values are arbitrary because $1 < 2 < 3$ does not imply that outcome 1 (being overeducated) is less than outcome 2 (being properly matched) is less than outcome 3 (being undereducated).

The model is as follows:

$$\log\left[\frac{P(category\ i)}{P(category\ j)}\right] = \alpha_i + \beta_{i1}X_1 + \cdots + \beta_{ik}X_{1k} + \varepsilon_i$$

where X are experience, years of schooling, female, marital status, head of household, part time job, size of firm.

In the analysis, we let outcome 2 (being properly matched) as baseline category so we will get two logistic equations:

$$\text{Log}\left[\frac{p(overeducated)}{p(properly\ matched)}\right] = \alpha + \beta_1 exp + \beta_2 exp^2 + \beta_3 married + \beta_4 head + \beta_5 \text{part\_time} + \beta_6 small\_firm + \beta_7 female * married + \beta_8 years\ of\ schooling + \varepsilon$$

$$\text{Log}\left[\frac{p(undereducated)}{p(properly\ matched)}\right] = \alpha + \beta_1 exp + \beta_2 exp^2 + \beta_3 married + \beta_4 head + \beta_5 \text{part\_time} + \beta_6 small\_firm + \beta_7 female * married + \beta_8 years\ of\ schooling + \varepsilon$$

Hypothesis 3 is that the probability of being overeducated differs by fields of studies even with same level of education (Figure 4.2). Fields of studies are grouped by educational level and educational mismatch is estimated by using logistic regression. Because of the negative effect of overeducation on both individuals and society, the analysis of fields on overeducation will focus on overeducated workers. The dependent variable (Y_i) is dummy variable being equal to 1 if overeducated and 0 if matched or undereducated. The model is as follows:

$$y_i = \begin{cases} 1 \text{ if workers are overeducated} \\ 0 \text{ if workers are matched or undereducated} \end{cases}$$

y_i is a realization of a random variable Y_i that can take the values one and zero with probabilities π_i and $1-\pi_i$, respectively. The distribution of Y_i is called a Bernoulli distribution with parameter π_i and can be written as

$\Pr(y_i=1) = \pi_i$

$\Pr(y_i=0) = 1- \pi_i$

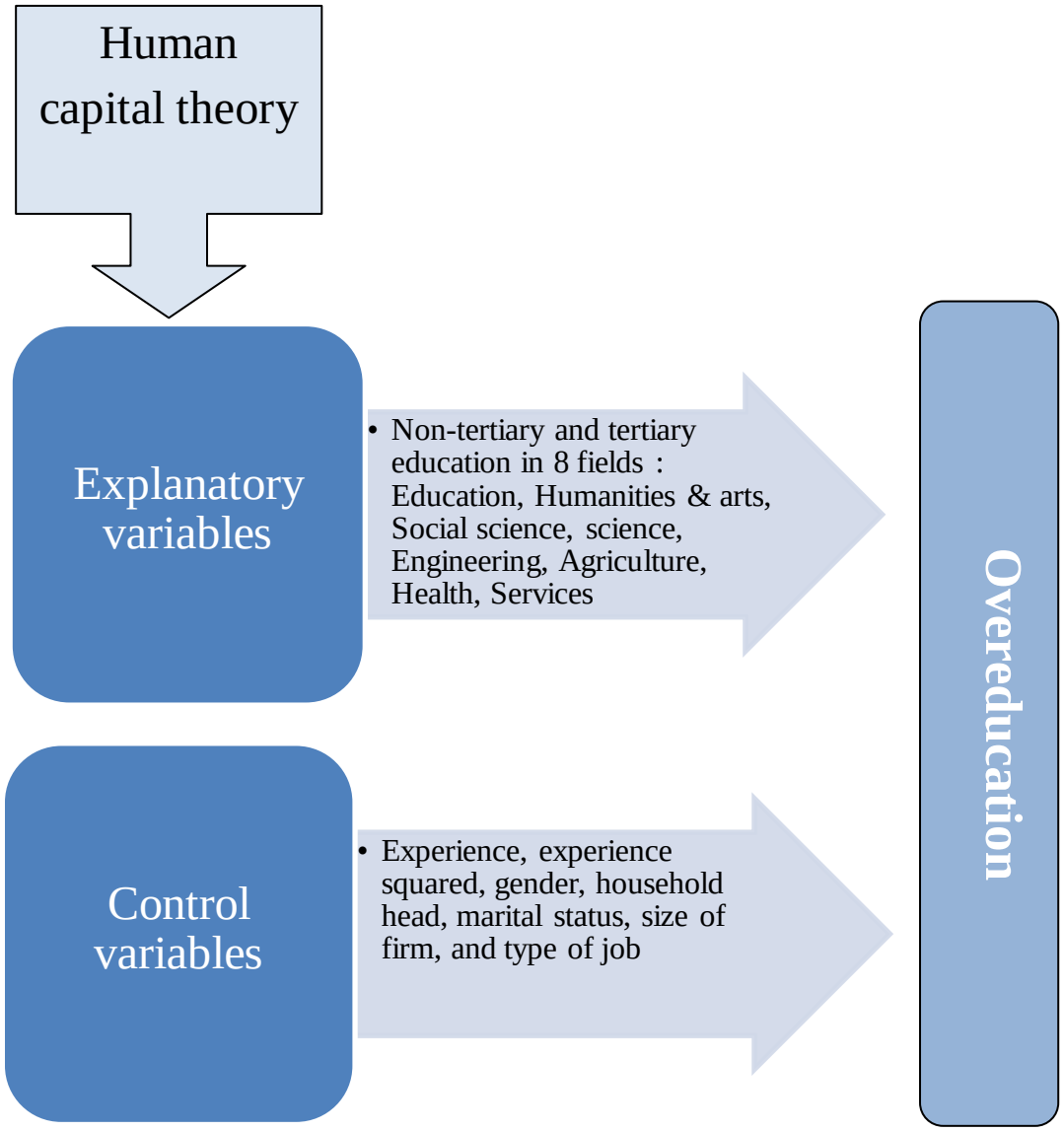


Figure 4.2 The Analysis of Fields of Study and the Probability of Being Overeducated

The probability π_i depends on a vector of observed covariates X_i so π_i is a linear function of the covariates, say

$$\pi_i = X_i' \beta$$

where β is a vector of regression coefficients.

X are fields of studies by educational levels (dummy variables). Educational level is categorized into two groups: non-tertiary (upper-secondary and post-secondary) and tertiary (university level). Fields of study are

categorized into 8 fields of study. There totally are 16 dummy variables that indicate fields of study in two groups of educational level.

Control variables are experience, gender, head of household, marital status, size of firm, and part time job

One problem with the above model is that the probability π_i on the left hand side has to be between zero and one, but the linear predictor $X_i'\beta$ on the right hand side can take any real value. The transformation of the probability is the solution. The probability π_i is changed to the odds as

$$\text{Odds}_i = \frac{\pi_i}{1-\pi_i},$$

which is defined as the ratio of favorable to unfavorable cases or it can be written as called log-odds

$$\eta_i = \log[\frac{\pi_i}{1-\pi_i}]$$

4.2 Causes of Overeducation

Because of negative effects of overeducation on individuals, the dependent variable is overeducation dummy equals 1 if workers are overeducated and 0 if they are matched or undereducated.

The main causes of overeducation can broadly be divided in two groups, dealing with labor supply and labor demand. Three reasons behind the supply-side factors are overeducation as a career strategy, job security, and education inflation. Technological advance is a reason behind demand-side factors (Figure 4.3).

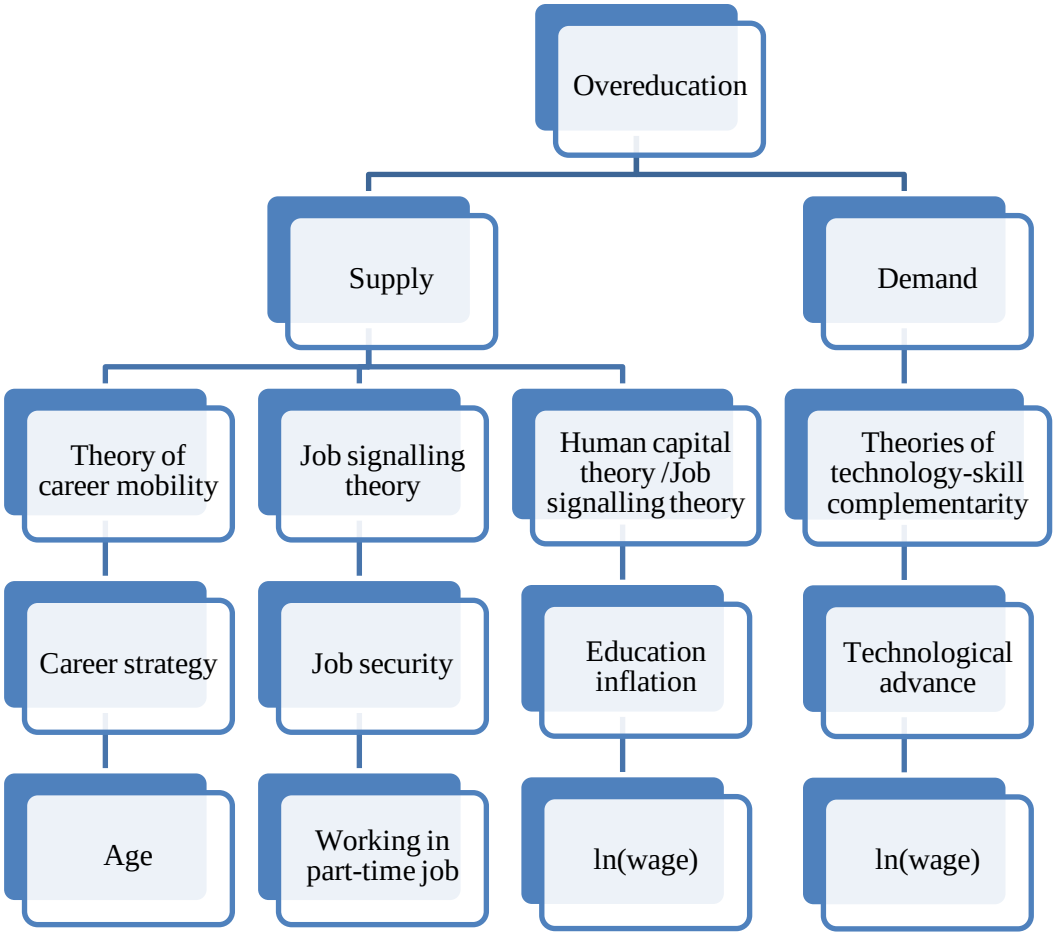


Figure 4.3 Causes of Overeducation

The theory of career mobility advanced by Sicherman and Galor (1990) is a variation of human capital theory that identifies overeducation as an equilibrium labor market outcome. It is assumed that individuals at the beginning of their careers lack job-specific skills and, hence, need to acquire them while working in jobs that require a lower level of education than acquired. As they progress with their on-the-job training, workers are expected to exit overeducation. Like the human capital model, overeducation is a temporary phenomenon for individuals, who progress from being in positions for which they are apparently overeducated to higher level occupations in which they make full use of their qualifications. In sum, young workers generally have the greatest difficulty in obtaining a first job. Independent of how unsatisfactory the first job might be to the worker's aspirations, the entry job becomes fundamental to breaking into any professional career. The first hypothesis is that young workers are more likely to be overeducated.

Job security is another supply-side reason behind the causes of overeducation. The disappearance of whole life jobs, undermining of the traditional commitment between employers and employees, but also melting of job security, is a clearly visible trend. Existing expectations connected with the working contract are changing dramatically toward lower security and certainty. Also for this reason, individuals more often use education as an insurance against unemployment or other unexpected situations which became more likely recently. Education, as commonly understood, can give advantage against these kinds of threats. From the policymakers' perspective, this strategy of individuals becomes ineffective, especially in combination with free public schooling. This can lead to overeducation in the form of disequilibria in the education as well as labor markets.

The job signaling model can explain why individuals give their best effort in studying as high as possible by taking education to find securing jobs. In the job signaling model, firms are assumed to have imperfect information about the productivity of workers. In response to this problem, individuals use education as a signal of quality. Overeducation arises when there is signaling equilibrium under which it is optimal for individuals to invest in more education than is strictly required to perform the tasks of their jobs (Spence, 1973). This implies there is a systematic overinvestment in education, which occurs either when the costs of investing in education are low, or when the expectations of individuals or firms about educational levels are inflated.

There are two alternative hypotheses on the effect of contract type on the likelihood of overeducation. In general, labor market opportunities for workers in a temporary or part-time job are worse than for those in a permanent or full-time position. An important reason for the less favorable labor market position of employees with a temporary or part time contract is that it is less profitable for employers to invest in such workers, because of the shorter pay-off period (Psacharopoulos, 1987). In the case of temporary employment, employers are more reluctant to invest, because of the greater risk of employees leaving, resulting in a shorter expected pay-off period. The hypothesis is that workers with a temporary or part-time contract more often have a mismatched job than workers with a permanent or full-time contract.

On the other hand, job security might turn into an asset much more valuable than in other labor markets. In such a case, human capital might be invested not in order to attain a good match between training and job, but to be well placed in a competition for secure jobs, scarce and valuable as they are. In such a case**,** permanent workers are more likely to be overeducated than those with fixed term contracts.

An indicator of education inflation is the relative decline in the wage differential between those with college degrees and those with only high school diplomas. Jobs that were open to high school graduates a century ago now routinely require not just a bachelor's degree, but a master's degree as well—without an appreciable change in required skills. As more individuals become educated, the financial return to each degree will naturally decrease as more job applicants hold those higher credentials. With highly trained individuals chasing fewer and fewer jobs (thanks to the recession), they displace the lesser-trained individuals. Thus graduate degree holders are taking jobs from undergraduates, and the latter group, in turn, are taking jobs from high school grads.

The screening theory constitutes a powerful explanation as to why job applicants have the tendency to overeducate themselves. Prospective employees tend to exploit the inability of employers to accurately measure an individual's productivity during the hiring stage. Indeed, firms are left with no choice but to select those who are able to signal higher levels of skills. Likewise, the theory warns of the possibility of overeducated workers taking over jobs that conventionally employ less educated workers. The hypothesis is that low wages, due to education inflation, lead to higher overeducation because the productivity in the job positions remain the same and employers employ workers in the overeducated workers just because there is enough of them in the labor market.

Technological advance is demand-side factor behind the causes of overeducation. Requirements on employee's skills are increasing because of new equipment used at the workplace. Technological change leads to an increase in the demand for high-educated workers due to complementarity between new technologies and human capital. A crucial characteristic of skilled workers is their adaptability. Skilled workers are regarded as being more flexible than unskilled workers, in the sense that they can adapt to new technologies at a lower cost relative to the unskilled workers. A

crucial assumption behind the technology-related explanation for the mismatch (overeducation) is that firms have strong disincentives to provide training to their less skilled workers since they may not get fully rewarded for the training costs they have to bear. That is, when workers are willing to change employers, the potential benefits from training accrue not only to the firm providing it and the worker acquiring it, but also to other firms that could make use of it without shouldering any of the cost.

From the Labor Force Survey, high wage is used as a proxy for technological change. Under classical economic theory, if some firms experience a technological shock that increases their demand for high-skilled workers and, consequently, increases the demand for high-skilled workers relative to the supply of high skilled workers in the economy (i.e., more than the technological shock increases the demand for low-skilled workers relative to the supply of low-skilled workers), then wages for high-skilled workers increase relative to that of low skilled workers. The return to education will increase, and even highly skilled workers in firms that do not experience a technological shock will receive higher wages in the short run. More simply, an increase in the level of capital/skill complementarity within a firm increases the firm's relative demand for skilled workers, which increases the national relative demand for high-skilled workers and results in an increase in the market clearing wage for highly skilled workers in the short run. However, unless there is a constraint to workers acquiring the higher skill or education, the return to education should fall to the market rate in the long run. The hypothesis is that high wages, due to new technology, lead to higher overeducation because employers may require qualification higher than those possessed by currently employed workers so new employees are overeducated. On the other hands, employers may reject candidates who turn out to be poorly skilled. Low able educated workers may find jobs that do not require qualification and become overeducated.

In sum, there are 3 explanatory variables: age, part time job, and log of monthly wage. The control variables are other individual characteristics which can affect the probability of being overeducated such as gender, marital status, household head, private sector, and years of schooling. Causes of overeducation can be analyzed by using the binary logistic regression as follows:

$$\text{ov} = \alpha + \beta_1 age + \beta_2 part\_time + \beta_3\, ln\_wage + \beta_4 X + \epsilon$$

where ov is dummy variable equals 1 if a worker is overeducated and 0 otherwise

age is years of age

part_time is dummy variable equals 1 if an individual works part-time and 0 if an individual works full-time

Ln_wage is the logarithm of monthly wage

X is control variables: gender, head, married, private sector, and years of schooling.

Table 4.5 Explanatory Variables to be Tested for Overeducation

Explanation	Indicator	Hypothesis
Career strategy	Age	Young workers are more likely to be overeducated.
Job security	part-time job	Working in part-time job can decrease the likelihood of overeducation.
Education inflation	Wage	Overeducated workers earn less than the rest of their educational group.
Technological advance	wage	Overeducated workers earn more than the rest of their educational group.

4.3 The Effects of Overeducation on Wages

4.3.1 Data

The samples in 2006 and 2011 are pooled together to get pooled cross section data in order to avoid the effect of different time period that may affect earnings. Total samples (weighted case) become 67,601,414. Some differences remain:

1) The explanatory variable, overeducation dummy, equals to 1 if workers are overeducated and 0 if workers are properly matched. In the analysis of overeducation effect on wages, wages are compared between overeducated and

properly matched workers. The previous literatures (Sicherman, 1987; Alba-Ramirez, 1993; Cohn and Ng, 2000; Dolton and Silles, 2008; Santos, Oliveira and Kiker, 1996) have found that overeducated workers receive lower wages than workers with similar levels of schooling who work in jobs where their schooling equals that is required. In other words, the amount of lower wages is called wage penalties which overeducated workers receive because they work in jobs in which they cannot fully utilize their abilities.

2) Industry types are added as a control variable because workers may receive different wages from different industries they work. Labor force survey 2006 uses ISIC Rev.3 and Labor force survey 2011 uses TSIC 2009 which is based on ISIC Rev.4 to classify industry types. ISIC Rev.3 is converted to TSIC 2009[6] to easily compare data between years Industry classification (1-digit) coded 0-9 is used as follows: 0=agriculture, forestry, fishing and mining, 1=manufacture of food and beverage, 2=manufacture of chemical, pharmaceutica products and machinery, 3=water supply, electricity, and gas, 4=construction, wholesale and retail trade, 5= services activities such as transport, warehousing, or postal activities, 6=information and financial activities, insurance, and real estate activities,

3) The dependent variable is log of monthly wages.

4) Year dummy, equal to 1 if year 2011 and 0 if year 2006, is added as a control variable in order to account for shifts in the distribution between different points in time.

4.3.2 Hypotheses and Model

The first hypothesis is that overeducated workers would receive wage penalties. This hypothesis is proved by using Ordinary Least Square (OLS). Verdugo and Verdugo model (VV model)[7] is used to prove the first hypothesis by using variable 'overeducation' as a dummy variable; while, the ORU model has used years of overeducation. The Labor Force Survey has collected the educational attainment of

[6] Thailand Standard Industrial Classification (TSIC 2009), National Statistics Organization (NSO)

[7] Another method to estimate the effect of overeducation on earnings is ORU (Over-, Required-, and Under-education) model by Duncan and Hoffman (1981). His ORU model empirically estimates an earning function in which an individual's actual educational attainment is decomposed into the number of years of education required on his or her job and any years of surplus or deficit education.

individuals, not years of schooling. There is no standard approach of adjusting educational level to years of schooling, so it leaves the judgement to researchers. The Verdugo and Verdugo model is as follows:

$$\text{Ln I} = f(\Sigma\ \text{OVERED}_i\ ,\ \text{EXPER, EDUC, UNEMPRT, } \Sigma\ \text{REGION}_i\text{, SECTOR, } \Sigma\text{OCCUP}_i\text{, MARRIED, UNEMPWKS, HOURS})$$

where Ln I is the natural log of annual earnings (wages and salaries).

Σ OVERED are categorical variables: overeducation, undereducation, and adequately educated (omitted). VV model has used mean method to classify workers into overeducated, undereducated, and adequately educated workers

EXPER is maximum potential years of work experience

EDUC is years of education completed

UNEMPRT is unemployment rate in state of residence

REGION is region of residence

SECTOR is a dummy variable measuring sector of employment (public or private sector)

Σ OCCUP is a series of dummy variables measuring broad Occupational category

MARRIED is marital status dummy

UNEMPWKS is weeks unemployed

HOURS is hours worked

The model used in the analysis is

Ln w = f (OVERED, new_educ, exp, exp_squared, married, female, small_firm, part_time, industry type, year dummy)

where Ln w is log of monthly wage

OVERED is overeducation dummy equals to 1 if workers are overeducated and 0 if workers are properly matched. OECD method classifies workers as overeducated, undereducated, or properly matched

New_educ is categorical variable coded 1 if workers being less than upper-secondary education (reference group), 2 if workers being upper-secondary education, and 3 if workers being university education

Exp is potential experience (age – years of schooling -6)

Exp_squared is experience squared

Married is a dummy variable equals 1 if individual is married, 0 otherwise.

Female is a dummy variable equals 1 if female, 0 if male.

Small_firm is a dummy variable equals 1 if small firm (employees less than 50) and 0 otherwise

Part_time is a dummy variable equals 1 if individual works part- time for less than 35 hours per week

Industry type[8] is categorical variable coded 0-9

Year dummy is dummy variable equals 1 if 2011 and 0 if 2006

A negative sign is expected on 'overeducation' dummy variable to reflect that overeducated workers receive lower wages than matched workers.

The OLS results provide the return estimates at the mean of the wage distribution, which may be hiding important differences in the return estimates at different points of the wage distribution. OLS approach, however, has limitations, as individuals with the same qualification may earn a different return from their educational investment. By focusing on averages, researchers ignore the amount of wage inequality that arises from differences within groups.

Returns to overeducation may reflect differences across individuals in terms of other unobserved components of their human capital stocks. People may acquire more schooling than would normally be required for their job to compensate for a shortage in some other human capital components such as experience, ability. Consistent with the human capital theory that overeducation merely arises because of lack of controls that allows for the substitution of different types of human capital and/or worker

[8] The classification of industry in 2006 is based on ISIC REV.3 while it is based on ISIC Rev.4 in 2011. Researcher adjusts 2006-industry type to follow ISIC Rev.4.

heterogeneity within the standard wage equation framework or the phenomenon of overeducation is transitory. Sicherman (1997) has concluded that overeducated workers have low skill (experience). Chavalier (2003) has added unobservable skills into wage regression and found that wage penalties decrease for overeducated workers but they still exist. The second hypothesis is that the wage penalties would be higher in the lower segment of the wage distribution. Quantile regression is used in the analysis and the conditional distribution of wages reflects the distribution of unobserved skills. Thus, differences in the overeducation wage effect between workers at high-pay and low-pay jobs can be interpreted as differences between workers with high and low unobservable skills. We expect that less able graduates who locates in the lower segments of wage distribution will receive higher wage penalties.

The methodology used to prove the second hypothesis is based on quantile regression, assuming that earnings capacity is given by the individuals' unobserved abilities. Quantile regression presents two appealing features. (Budria and Moro-Egido, 2006). First, the literature to date has typically assumed that the impact of overeducation on wages is uniform over the conditional wage distribution. Within this context, the switch from matched to mismatched work can be trivially represented by a shift of the conditional wage distribution. This shift, which represents the percentage wage differential between an overeducated worker and his well-matched counterpart, is assumed to be constant across conditional quantiles. With QR, in turn, the impact of overeducation on wages can be measured at different points of the wage distribution.

Second, the QR approach allows for a non-trivial interaction between the explanatory variables and unobserved factors related to productivity. Conditional on observable characteristics, workers located at higher quantiles of the wage distribution are precisely those who have more productive skills (due to ability, motivation, better academic credentials and other unmeasured characteristics affecting individual-specific productivity). Thus, if the conditional distribution of wages emerges from the underlying distribution of unobserved skills, then differences in the overeducation wage effect between workers at high-pay and low-pay jobs can be interpreted as differences between workers with high and low unobservable skills. In sum, OLS returns measure the average differential between educational groups, differences in

quantile returns represent the wage differential between individuals that are in the same group (same observable characteristics) but located at different quantiles (different unobserved skills).

The QR model can be formally written as follows:

$$lnw_i = X_i\beta_\theta + e_{\theta i} \qquad \text{with } Quant_\theta(lnw_i|X_i) = X_i\beta_\theta$$

where X_i is the vector of exogenous variables and β_θ is the vector of parameters. $Quant_\theta(lnw_i|X_i)$ denotes the Θ th conditional quantile of ln w given X. The Θth regression quantile, 0 < Θ < 1, is defined as a solution to the problem

$$\min_{\beta \in R^k}\{\sum_{i:lnw_i \geq X_i\beta_\theta} \theta|lnw_i - X_i\beta_\theta| + \sum_{i:lnw_i < X_i\beta_\theta}(1-\theta)|lnw_i - X_i\beta_\theta|\}$$

which, after defining the check function $\rho_\theta(z) = \theta_z \; if \; z \geq 0 \; or \; \rho_\theta(z) = (\theta - 1)z \; if \; z < 0$ can be written as

$$\min_{\beta \in R^k}\{\sum_i \rho_\theta(lnw_i - X_i\beta_\theta)\}$$

Overeducated workers receive wage penalties but wage penalties may differ across educational levels even they are all overeducated. Thus, ‘match’ variable is created to differentiate matched and overeducated individuals in the same educational level. ‘match’ variable is categorical variable coded 1-5: 1 if the individual graduates with less than upper-secondary education and works in job that matches his/her educational level, 2 if the individual graduates with upper-secondary education and work in job that require educational level lower than he/she acquires, 3 if the individual graduates with upper-secondary education and work in job that matches his/her educational level, 4 if he/she graduates with university education and works as overeducated, and 5 if he/she is matched workers and graduates university level. We will run ‘match’ variable on log of monthly wage to get returns to different types of workers. The differences between returns to overeducation and required education reflect wage penalties across educational level. The third hypothesis is that tertiary

educated individuals who work as overeducated workers would receive the highest wage penalties. The hypothesis will proved by using OLS equation as follows:

Ln w = f (match, exp, exp_squared, married, female, small_firm,
part_time, industry type, year dummy)

Tertiary graduated workers may receive wage penalties differed across the wage distribution so we will use quantile regression to find out this problem. The fourth hypothesis is that tertiary graduated individuals who are located at lower segment of the wage distribution would receive higher wage penalties than those located at higher segment. Following human capital theory, overeducated workers may substitutes their educational level for a lack of skill (experience). The lower segment of the wage distribution reflects low-skilled workers so they would receive higher wage penalties when they are overeducated.

CHAPTER 5

EMPIRICAL RESULTS

This chapter discusses the sample profile and analyze research findings. The findings are broken down into the existence of educational mismatch in Thai labor market, the causes of overeducation, and the impact of overeducation on wages.

5.1 The Existence of Educational Mismatch in Thai Labor Market

5.1.1 Sample Profile

After focusing on employed workers[9] aged 15-60 years who work as government, state enterprise, and private employees, the sample size (weighted cases) is 60,585,799 and 63,620,613 in 2006 and 2011, respectively. More than half of employed workers are males and married. One fourth of male workers have graduated with primary education while that of female workers have graduated with bachelor degree in both 2006 and 2011. College graduated women are two times higher than men. Workers have higher educational attainment from 2006 to 2011; i.e. male (female) workers with college education have increased from 12 (23) % to 14 (26)% from 2006 to 2011, respectively. About 40% of male workers have graduated in engineering while half of female workers have graduated in social sciences. Overall, very few workers have graduated in agriculture, health, and services (Table 5.1).

One fourth of male individuals work as craft and related trade workers while those of females work in elementary occupations such as cleaners and laborers. Very few individuals work as managers. From 2006 to 2011, individuals have increasingly worked in medium- and high-skilled occupations. For example, individuals have worked as professional from 9.66% in 2006 to 10.99% in 2011. More than half of the samples work full time in small firms.

[9] Individuals aged over 15 years and posses at least one of the following:
- work more than 1 hour and receive money wage or things
- work at least 1 hour in his/her farm/enterprise without any compensations
- does not work or work less than 1 hour but receive other benefits or has business

Table 5.1 Sample Profile by Gender

	2006			2011		
variables	**overall**	**male**	**female**	**overall**	**male**	**female**
Married	65.56	67.27	63.41	63.54	64.3	62.6
Small firm	61.85	66.8	55.6	64.35	68.65	58.85
Part-time job	11.94	12.03	11.8	10.02	10.13	9.88
Educational level						
Pre-school	20.3	20.42	20.15	14.65	14.75	14.53
Primary	22.2	24.65	19.11	21.63	24.23	18.42
Lower-secondary	16.82	18.52	14.67	17.71	20.15	14.69
Upper-secondary	15.9	16.61	15.01	16.76	17.66	15.66
Post-secondary	5.84	5.89	5.77	6.82	7.1	6.47
Bachelor	16.9	12.02	23.05	19.33	13.56	26.47
Master	1.95	1.77	2.16	2.97	2.43	3.64
Ph.D	0.1	0.11	0.09	0.12	0.12	0.13
Field of education						
Education	16.67	13.89	19.2	14.91	11.56	17.79
Humanities & Arts	4.15	3.19	5.03	4.27	3.6	4.86
Social science	41.73	27.56	54.57	43.22	28.87	55.54
Science	6.59	5.8	7.3	7.58	6.44	8.56
Engineering	19.88	39.01	2.54	19.78	40.48	2.00
Agriculture	2.69	3.91	1.6	2.39	3.46	1.47
Health	5.39	2.43	8.06	4.82	2.28	7.01
Service	2.9	4.22	1.69	3.03	3.32	2.78
Occupations						
Managers	3.13	4.09	1.93	3.84	4.95	2.45
Professionals	9.66	7.04	12.95	10.99	7.68	15.1
Technicians and associate professionals	8.56	7.15	10.33	7.11	5.93	8.57
Clerical support workers	7.82	4.81	11.62	7.9	4.37	12.26
Services and sales workers	10.02	8.55	11.88	13.34	11.55	15.55
Skilled agricultural, forestry, fishery workers	6.75	7.29	6.08	5.65	6.21	4.96
Craft and related trade workers	18.35	24.75	10.3	17.71	25.5	8.07
Plant and machine operators	15.14	17.08	12.71	14.33	16.67	11.44
Elementary occupations	20.56	19.25	22.21	19.14	17.15	21.6

In particular, overeducation deserves more attention than undereducation because of its unpleasant outcomes. For an individual worker, being overeducated may hamper earnings, productivity, and job satisfaction. For a society, the prevalence of overeducation results in underemployment and inefficiency in terms of educational resource allocation. This thesis will place an emphasis on overeducation.

5.1.2 Incidence of Educational Mismatch

The incidence of educational mismatch may suggest an increase in educational requirement for jobs (demand side) but also shows that the increase in average years of schooling (supply side) cannot quite keep pace with the rise in educational requirement in Thailand. The causes of overeducation (supply or demand) will be considered later. This section will concentrate on the incidence of mismatch by gender, level of education, and field of study.

Using OECD definition of overeducation and undereducation, it is found that for the group of employed workers aged 15-60 years, the percentage of overeducated workers has increased from 6.27% in 2006 to 8.51% in 2011 and the percentage of undereducated workers has decreased from 45.44% in 2006 to 41.19% in 2011. Most of overeducated workers work as clerical support workers and work in elementary occupations; while most of undereducated workers work as craft, trade workers, and plant/machine operators and assemblers.

Table 5.2 Educational Mismatch by Gender

Mismatch	2006			2011		
	Overall	Male	Female	overall	male	female
Overeducated (%)	6.27	4.81	8.11	8.51	6.26	11.28
Matched (%)	48.3	44.0	53.69	50.3	45.3	56.49
Undereducated (%)	45.44	51.17	38.21	41.19	48.44	32.23
#observations	60,585,799	33,776,870	26,808,928	63,620,613	35,168,748	28,451,864

Females have double higher percentage of overeducation than their male counterparts, that is, among overeducated workers, 8.11% (11.28%) are females and 4.81% (6.26%) are males in 2006 (2011). The reason behind this finding is that females have lower job opportunities than males so the former try to study as much as possible to get jobs. In addition, Asian society gives an importance to males than females.

From the correspondence between ISCED educational level and ISCO employment level by OECD, individuals with less than upper-secondary education would not face the incidence of overeducation because of low level of education;

while, individuals with college education would also not face the incidence of undereducation because at least they can find jobs which match their educational level (i.e., being matched workers) or they could become overeducated workers as they have chosen jobs that require lower level of education than theirs.

Table 5.3 Educational Mismatch by Educational Level

Educational level	overeducation-2006			overeducation-2011		
	overall	**male**	**female**	**overall**	**male**	**female**
1.Pre-school	-	-	-	-	-	-
2.Primary	-	-	-	-	-	-
3.Lower-secondary	-	-	-	-	-	-
4.Upper-secondary	27.45	37.55	19.91	22.33	27.95	18.48
5.Post-secondary	2.93	4.01	2.11	2.81	4.1	1.92
6.Bachelor	67.73	56.51	76.12	71.52	65.31	75.77
7.Master	1.83	1.88	1.79	3.32	2.61	3.81
8.Doctorate	0.06	0.05	0.07	0.03	0.03	0.03
	undereducation-2006			**undereducation-2011**		
	overall	**male**	**female**	**overall**	**male**	**female**
1.Pre-school	27.27	27.75	26.46	21.73	22.06	21.13
2.Primary	33.07	34.04	31.42	34.99	36.06	33
3.Lower-secondary	29.34	28.92	30.05	33.38	32.9	34.28
4.Upper-secondary	5.77	5.49	6.25	5.22	5.07	5.49
5.Post-secondary	4.55	3.80	5.82	4.68	3.91	6.11
6.Bachelor	-	-	-	-	-	-
7.Master	-	-	-	-	-	-
8.Doctorate	-	-	-	-	-	-

Note: As a result of OECD's definition, there are blanks in overeducation for persons who have graduated with pre-school, primary, and lower-secondary education. Similarly, some blanks are found in undereducation for individuals who have graduated with college education and higher.

By level of education, workers with undergraduate education are by far the most likely to be overeducated, and it has increased over time from 67.73% in 2006 to 71.52% in 2011. Next are upper secondary workers (27.45% and 22.33% in 2006 and 2011, respectively) workers with graduate education (1.83% and 3.32%), and post-secondary workers (2.93% and 2.81%). Note that the opposite is true for workers with

doctorate education; their overeducation has gone down from 0.06% in 2006 to 0.03% in 2011. Females have higher probability to be overeducated than males if they graduate with college education. For example, female workers have 76.12 percent of overeducation while male workers have 56.51 percent of overeducation in 2006.

Education in Thailand can be grouped into 3 types: academic, vocational, and teacher. Lower-secondary graduates can choose the type of education they will continue. Academic education is general education in science and arts. Vocational education is based on occupation or employment. Teacher education is designed to equip teacher prospects with knowledge and skills required in teaching students. The result has found that workers with academic education have the highest percentage of overeducation; while, the lowest is among teacher workers (Table 5.4).

On the other hand, undereducation is quite high among primary and lower-secondary workers, 33.07% (34.99%) and 29.34% (33.38%) in 2006 (2011). Primary and lower-secondary graduates are, disproportionately, plant operators, production process controllers, or assembly line operator. Over time, the incidence of undereducation has declined among pre-school and upper-secondary workers.

Table 5.4 Educational Mismatch by Types of Education

Field	2006 Overeducation (%)			2011 Overeducation (%)		
	overall	**male**	**female**	**overall**	**male**	**female**
Academic	85.31	83.25	86.84	84.41	84.02	84.67
Vocational	8.58	11.37	6.5	10.11	12.52	8.46
Teacher	6.11	5.38	6.66	5.48	3.45	6.88

Field of study (see details in fields of studies in Appendix C) (in fact might be one of the factors helping to identify different stocks of human capital, which lead, in turn, to different recognition of skills and, eventually to overeducation. There are several reasons why employers may value differently the stock of human capital associated with fields of study. First, the average length of study may vary within a given field and a given level of education. It is not just that the duration of college study may vary from one field to another, the actual number of years it takes to complete

Table 5.5 Overeducation by Field of Study, 2006 and 2011

Educational level/field	2006 overeducation (%)			2011 overeducation (%)		
	Overall	Male	Female	Overall	Male	Female
Upper-secondary education						
Education	0.18	0.12	0.28	-	-	-
Humanities & Arts	0.52	0.87	-	2.27	2.01	2.53
Social science	36.18	9.03	77.08	42.18	12.95	72.3
Science	1.92	1.33	2.81	4.83	2.0	7.75
Engineering	50.46	78.72	7.88	42.21	76.9	6.46
Agriculture	7.58	8.69	5.9	3.26	5.61	0.85
Health	-	-	-	0.06	0.13	-
Service	3.16	1.24	6.04	5.19	0.41	10.11
Post-secondary education						
Education	5.27	3.22	8.04	1.19	1.68	0.46
Humanities & Arts	1.09	1.13	1.05	2.21	2.89	1.2
Social science	37.54	14.36	68.89	42.07	22.1	71.39
Science	3.39	1.66	5.73	11.09	9.08	14.04
Engineering	43.13	71.46	4.81	36.78	59.11	3.98
Agriculture	7.64	6.17	9.63	4.69	4.58	4.84
Health	0.11	-	0.25	0.24	0.09	0.45
Service	1.84	2.01	1.61	1.75	0.46	3.65
Bachelor degree						
Education	8.94	9.38	8.69	7.42	5.4	8.61
Humanities & Arts	8.0	5.27	9.51	7.46	5.83	8.42
Social science	64.85	57.39	68.99	63.59	56.58	67.69
Science	8.24	8.46	8.11	8.58	9.0	8.34
Engineering	5.59	13.81	1.03	7.05	16.65	1.43
Agriculture	2.15	3.36	1.48	1.97	2.73	1.52
Health	0.51	0.55	0.49	0.89	0.87	0.9
Service	1.72	1.78	1.69	3.03	2.93	3.1
Master degree						
Education	4.18	3.53	4.70	3.79	3.22	4.07
Humanities & Arts	5.55	1.96	8.4	3.52	4.22	3.18
Social science	81.17	90.08	74.11	77.39	72.67	79.64
Science	3.15	1.9	4.13	6.21	5.4	6.6
Engineering	1.78	-	3.19	4.65	10.08	2.05
Agriculture	1.18	2.17	0.39	1.11	2.47	0.45
Health	1.13	0.36	1.74	2.62	1.37	3.22
Service	1.86	-	3.33	0.71	0.57	0.78

Table 5.5 (Continued)

Educational level/field	2006 overeducation (%)			2011 overeducation (%)		
	Overall	Male	Female	Overall	Male	Female
Doctorate degree						
Education	-	-	-	-	-	-
Humanities & Arts	-	-	-	-	-	-
Social science	64.27	-	100.0	67.25	39.93	100.0
Science	-	-	-	32.75	60.07	-
Engineering	35.73	100.0	-	-	-	-
Agriculture	-	-	-	-	-	-
Health	-	-	-	-	-	-
Service	-	-	-	-	-	-

Note: Services Include Personal Services, Transport Services, Environmental Protection, and Security Services (Following ISCED 1997 Classification).

a university degree may also vary from one field to another such as pharmacy takes 6 years to get a degree. Accounting and engineering take 4 years. Second, fields of study entail a degree of specialization, but some fields are more occupationally focused than others. Degrees in 'health and welfare' are clearly aimed at certain occupations such as doctors, nurses, or dentists, whereas other fields, as 'services' and 'humanities & arts,' are quite general, leading to a wider range of occupations, for example, one can work as a translator, English teacher, or secretary if he/she finishes education in English.

Social sciences have the highest across rate of overeducation particular for educational level in master degree holders. Males with less than college education in engineering have the highest rate of overeducation, while, those with college education and higher in social sciences have the highest rate of overeducation. Similarly, women for all educational levels in social sciences have the highest rate of overeducation. The lowest percentage of overeducation is among health graduates. These results point out that some types of education are designed to foster general skills such as social sciences so their graduates are more likely to be overeducated than those graduates with occupational-specific skills such as health or science.

Regarding occupations, clerical support workers have the highest rate of overeducation (44.41% in 2006 and 43.59% in 2011, respectively) and females have higher percentage of overeducation than males. Over time, the percentage of overeducation has increased across occupations, especially services and sales workers whose overeducation has increased about 5 % from 2006 to 2011 (Table 5.6). The percentages of overeducation also decrease in clerks, machine operators, and elementary occupations.

Table 5.6 Overeducation by Occupations (%)

Occupational titles	2006 overeducation(%)			2011 overeducation(%)		
	overall	male	female	overall	male	female
1.Managers	-	-	-	-	-	-
2. Professionals	-	-	-	-	-	-
3. Technicians and associate professionals	-	-	-	-	-	-
4. Clerical support workers	44.41	25.28	58.7	43.59	25.71	55.85
5. Services and sales workers	15.9	16.87	15.17	20.89	23.62	19.01
6. Skilled agricultural, forestry and fishery workers	0.34	0.58	0.16	0.38	0.68	0.18
7. Craft and related trades workers	4.43	9.21	0.85	5.4	10.67	1.78
8. Plant and machine operators, and assemblers	3.16	4.83	1.91	3.12	5.66	1.38
9. Elementary occupations	31.77	43.22	23.21	26.62	33.67	21.79

Note: There are blanks in high-skilled occupations because these occupations require high skills (see the correspondence between ISCED educational level and ISCO employment level in Table 4.3).

5.1.3 Determinants of Mismatched Workers

In this section, the determinants of mismatched workers are estimated by using multinomial logit model. The likelihood ratio tests for the hypothesis of whether to combine any two of the three categories are rejected so no categories should be combined. Then the results are presented for overeducated and undereducated workers. For demographic characteristics, work experience, gender, household head, and marital status are used in the analysis. Part-time jobs and size of firm are used for job characteristics. Also, years of schooling is used for educational characteristics because the use of educational level may be colinear with the educational mismatch (educational mismatch comes from the correspondence between educational level and occupational titles). Initially, fields of study are not included in the analysis.

Table 5.7 Relative Risk Ratio of Multinomial Logit Model

Variables	2006		2011	
	log[prob(ov)/ prob(m)]	log[prob(un)/ prob(m)]	log[prob(ov)/ prob(m)]	log[prob(un)/ prob(m)]
experience	0.97*	1.03*	0.977*	1.04*
experience squared	0.999	0.999*	0.999*	0.998*
years of schooling	1.44*	0.74*	1.434*	0.726*
female	1.01*	0.83*	1.24*	0.76*
female*married	0.98*	0.74*	0.96*	0.65*
head	0.9*	1.18*	0.83*	1.18*
married	1.05*	1.4*	1.01*	1.43*
part time job	1.17*	0.82*	1.27*	0.9*
small firm	1.43*	0.62*	1.38*	0.64*

Note: * indicates significance at the 5% level

The existence of overeducation is consistent with human capital theory, as it predicts that workers with higher levels of education will be paid higher wages but the evidence is that workers with the same level of education have different wages, depending on their occupations. For example, if he/she has graduated college education in English, he/she working as a translator would receive higher wages than one working as a bank teller. Discrepancies between job requirement and educational attainment could result from substitution among the various forms of human capital. Indeed, overeducated workers may substitute education for the lack of skills, accepting jobs requiring less education than they actually possess in order to acquire the necessary experience for job mobility. Undereducated workers may substitute experience for the lack of education, or undereducation may reflect a situation where workers and employers believe that the actual mix of schooling and experience is adequate. The incidence of overeducation would be higher among less experienced workers and undereducation would be more prevalent among more experienced workers. The results in Table 5.1.7 reveal the substitution between education and work experience. One more year of experience decreases the odd of being overeducated relative to matched by about 3% (2.3%) and increases the odd of being undereducated relative to matched by 3% (4%) in 2006 (2011).

One year of schooling increases the odd of being overeducated versus matched by about 44% (43.4%) and decreases the odd of being undereducated relative to

matched by 26% (27.4%) in 2006 (2011). In 2006, married males with 19 years of work experience and working full time job in a small firm, individuals with two years of additional schooling from post-secondary to college education face an increase in the odd of being overeducated by +0.125; while, the odd of being overeducated increases by +0.175 from two years of additional schooling, say, from college to graduate education. The probability of being overeducated increases by +0.34 if graduates continue their study to doctorates.

Compare to college graduates with 19 years of work experience and other things equal, graduates with less than 9 years of work experience would be more likely to be overeducated by about 25% (19%) in 2006 (2011). If the same person becomes a household head, he/she would be less likely to be overeducated 10% (15%) in 2006 (2011). On the other hand, a head of household has 18% (18%) higher probability to be undereducated in 2006 (2011). One reason behind it is that household heads have, disproportionately, low level of education and more years of work experience.

Gender has a significant impact on the probability of being mismatched in both years. Females have 1.0% (24%) higher probability to be overeducated in 2006 (2011); while, they have 17% (24%) lower probability to be undereducated than males in 2006 (2011). The explanations are that females have lower job opportunities and Thai society gives a higher importance to males than females. Similarly, married individuals have 5% (1%) higher probability to be overeducated and 40% (43%) higher probability to be undereducated than unmarried individuals. Thus, married individuals have a higher probability to be mismatched workers because individuals cohabiting with their partners may face job search constraints. This is due to the problem of dual job search for couples which is much more difficult to optimize than a single job search. The theory of differential overqualification, developed by Robert Frank (1978), claims that married women in smaller labor market run a higher risk of working in jobs for which their current qualifications exceed the educational requirements of the job. They are overqualified. In this situation, husbands may follow the “male chauvinist family location decision rule” and optimize their individual job search. Their wives are “tied movers” or “tied stayers,” that is, their job search is undertaken under the condition that the job search of their husbands is

optimized. This leads especially in smaller local labor markets (with fewer vacancies) to a higher risk of a mismatch between formal qualifications and job requirements.

The result for married females contradicts the theory of differential overqualification. Married females have 2% (4%) lower probability to be overeducated in 2006 (2011). The reason is that married females are not the main income earner in the family or in some case they may not work at all so they try to find matched jobs to maximize their satisfaction, instead of their incomes if they decide to work outside home.

The education-job match is also found to be associated with some characteristics of the job. Overeducation is found to depend negatively on the size of firm. In other words, the larger the size of firm, the less likely that the worker being overeducated. The result is that working in a small firm increases the odd of being overeducated by about 43% (38%) in 2006 (2011). This result supports Wolbers (2003) and Witte and Kalleberg (1995) that the match is generally better in larger firms. A larger firm might increase the match because there are more positions available for one to find a position that matches his/her skills. Furthermore, due to personal or institutional barriers to geographical mobility, some workers may choose to work in areas where firms are predominantly small and accept jobs for which they are overeducated. Having a part- time job increases the odd of being overeducated by 17% (27%) in 2006 (2011). As in Wolber (2003), having a full- time job is associated with an increased match. A college-educated woman who works full- time in a large firm would be less likely to be overeducated by about 16.3%, ceteris paribus.

Fields of study are also important in determining the odd of being mismatched workers. To be specific, graduates in some fields may face higher percentage of overeducation than those in other fields in spite of earning the same educational level. Thus, fields of study are added in the model to determine which fields cause overeducation.

Results in Table 5.8 show that the percentage of overeducation is the highest among tertiary graduates in social sciences (59 % and 59.4% in 2006 and 2011, respectively). Graduates with non-tertiary education have lower percentage of overeducation than those graduated tertiary education in all fields of study. For example, education graduates would face 0.21 % of overeducation; while, those with tertiary education face 7.95 % of overeducation.

Table 5.8 Overeducation by Fields of Study, 2006 and 2011

Fields by educational level	Overeducation (%)	
	2006	**2011**
Education non-tertiary	0.21	0.04
Education tertiary	7.95	6.72
Humanities & Arts non-tertiary	0.07	0.17
Humanities & Arts tertiary	7.16	6.74
Social sciences non-tertiary	3.54	3.15
Social sciences tertiary	59.0	59.4
Sciences non-tertiary	0.24	0.58
Sciences tertiary	7.31	7.85
Engineering non-tertiary	4.58	2.97
Engineering tertiary	4.98	6.42
Agriculture non-tertiary	0.73	0.29
Agriculture tertiary	1.92	1.78
Health non-tertiary	0.0	0.01
Health tertiary	0.48	0.89
Services non-tertiary	0.25	0.27
Services tertiary	1.56	2.71
total	100.0	100.0

Note: Educational levels which are higher than upper-secondary education provide choices of fields so tertiary means university level (bachelor, master, and doctorate) and non-tertiary means upper-secondary and post-secondary level.

Fields of study are added in the logistic regression to compare the percentage of overeducation across study fields. The signs of control variables are almost the same as those in multinomial logit model (Table 5.9). A little difference is the negative female variable in 2006 turns positive in 2011. The difference between odd

ratio for tertiary and non-tertiary fields of study are more salient. Non-tertiary studies have the lower probability to be overeducated relative to the reference group (humanities & arts tertiary) than the corresponding tertiary studies. For example, workers with non-tertiary education have 63 % lower probability to be overeducated workers in 2006. Only two fields of tertiary studies, social sciences and services, have a higher probability to be overeducated than tertiary educated workers in humanities & arts in 2006; while, those fields become agriculture and service in 2011.

Table 5.9 Coefficients and Odd Ratio of Logistic Regression

Variables	Coeffficients		Odd ratio	
	2006	**2011**	**2006**	**2011**
experience	-0.09	-0.07	0.92	0.93
experience squared	0.002	0.001	1.002	1.001
female	-0.04	0.06	0.96	1.06
head	-0.1	-0.2	0.9	0.82
married	0.15	0.07	1.16	1.07
small firm	0.35	0.24	1.42	1.28
part time	0.18	0.16	1.2	1.17
Non-tertiary				
Education	-0.98	-2.34	0.37	0.09
Humanities & arts	-2.89	-2.02	0.06	0.13
Social science	-2.13	-2.37	0.12	0.09
Science	-3.57	-2.8	0.03	0.06
Engineering	-2.3	-2.73	0.1	0.06
Agriculture	-0.92	-1.78	0.4	0.17
Health	-	-3.18	-	0.04
Service	-2.04	-2.43	0.13	0.09
Tertiary				
Education	-0.65	-0.7	0.52	0.5
Social science	0.01	-0.07	1.01	0.93
Science	-0.29	-0.42	0.75	0.66

Table 5.9 (Continued)

Variables	Coeffficients		Odd ratio	
	2006	**2011**	**2006**	**2011**
Engineering	-0.61	-0.37	0.54	0.7
Agriculture	-0.22	0.12	0.8	1.13
Health	-1.5	-1.07	0.22	0.34
Service	0.6	0.54	1.83	1.71

Note: 1) Health non-tertiary is dropped from the analysis as only one health non-tertiary graduate is overeducated.

2) Reference group is humanities & arts tertiary.

3) All coefficients are statistically significant at 5% level.

This points out that very specific fields, like health, sciences, or engineering, might be less vulnerable to overeducation than general fields, like social sciences, or humanities & arts. The result is consistent with Robst (2006), that is, graduates from majors that emphasize general skills have a higher likelihood of mismatch. Specific skills are the skills an individual requires to work in a specific occupation and cannot be transferable among employers. General skills can be productive in any firms. It has been found that the individual who stays in the same firm is more likely to have a larger investment in firm-based human capital, whereas investment in occupation-specific human capital or general human capital is more likely to characterize the individual who changes jobs or occupations (Dolton and Kidd, 1998)[10].

Over time, the signs of social sciences and agriculture tertiary have changed. In 2006, tertiary workers in social sciences have 1% higher probability in being overeducated relative to those in humanities & arts. However, the latter become more likely to be overeducated in 2011. One explanation is that humanities & arts is the

[10] General human capital is valued by all potential employers. Firm-specific human capital involves skills and knowledge that have productive value in only one particular company. Occupation specific human capital is a type of general human capital that is highly relevant for workers who are members of relatively well-defined occupations and it is easily transferred across industry and firm settings.

field that gives more general skills than social sciences so this field is more likely to be overeducated (Robst, 2006). In 2006, tertiary workers in agriculture are less likely to be overeducated relative to those in humanities & arts, and vice versa in 2011. One explanation is an increase in the demand for humanitites & arts graduates (language graduates) because international trade under ASEAN economic community (AEC) would increase the demand for translators.

In conclusion, overeducation does exist in Thai labor market. Tertiary workers have the higher probability of being overeducated than non-tertiary workers. In particular, tertiary educated services workers are more likely to be overeducated relative to other fields of study. The phenomenon of overeducation makes a lot of costs to individuals, firms, and society so it is more reasonable to find out causes of overeducation and solutions.

5.2 Causes of Overeducation

From the previous section, the percentages of overeducation and undereducation were about 6.3% and 45.4% in 2006 and 8.51% and 41.2%, respectively in 2011. Compared to undereducation, overeducation has negative effects on individuals and the society as a whole. For individuals, overeducated workers receive wage penalties (Sicherman, 1987; Duncan and Hoffman, 1981; Verdugo, R. and Verdugo, N., 1988; Hartog and Oosterbeek, 1988) and have lower job satisfaction (Hersch, 1991; Tsang, 1987; Verhofstadt and Omey, 2003). For the society, overeducation can be viewed as a waste of public resources. Simply knowing the reason for overeducation is not sufficient enough, it would be better to find the ways out to correct it. In this regard, it is very important to understand the channels through which the demand and supply forces operate. This section will concentrate on the cause of overeducation and investigate the impact of selected demand and supply factors on the probability of being overeducated.

5.2.1 Sample Profiles

On individual characteristics, average age of overeducated workers are about 31 (33) years in 2006 (2011); while, they are 35 (36) years of ages for the rest of

samples. Overeducated workers are younger than the rest of workers. Most of overeducated workers are females, single, and are not heads of households. The percentage of overeducation is higher for married males than married females. Overeducated workers have higher years of education than undereducated and matched workers. Females have higher years of schooling than males. Overeducated have about 15 (15) years of schooling while undereducated and matched have about 9 (10) years of schooling in 2006 (2011).

Table 5.10 Individual and Job Characteristics of Overeducated Workers in 2006

Variables	Overeducated			Rest of samples		
	Overall	**Male**	**Female**	**Overall**	**Male**	**Female**
Individual characteristics						
age	31.22	31.63	30.92	34.78	34.96	34.53
head	25.82	38.59	16.33	38.34	51.29	21.35
married	47.96	52.4	44.66	66.64	67.94	64.93
years of schooling	14.88	14.44	15.21	9.1	8.75	9.57
Job characteristics						
wage	9,393	9,409	9,382	7,458	7,512	7,388
part-time job	6.64	7.71	5.84	11.57	11.72	11.36
-Clerks	29.66	12.92	46.08	1.95	1.36	2.75
-Services and sales workers	12.16	8.31	15.94	5.31	3.67	7.52
-Skilled agricultural, forestry and fishery workers	1.79	2.11	1.48	24.05	23.07	25.38
-Craft and related trades workers	3.17	5.15	1.22	15.35	20.18	8.82
-Plant and machine operators and assemblers	1.26	1.78	0.74	7.52	9.89	4.31
-Elementary occupations	51.96	69.73	34.53	27.85	25.95	30.42
private sector	66.92	68.65	65.63	80.98	81.02	80.93

Note: Mean is presented in the table if the variable is continuous and percentage is shown if it is binary.

Table 5.11 Individual and Job Characteristics of Overeducated Workers in 2011

Variables	Overeducated			Rest of samples		
	Overall	**Male**	**Female**	**Overall**	**Male**	**Female**
Individual characteristics						
age	32.75	33.5	32.25	36.37	36.38	36.37
head	24.06	36.07	15.88	36.68	46.66	23.64
married	49.8	53.12	47.53	64.68	47.53	64.55
years of schooling	15.15	14.89	15.32	9.63	9.23	10.16
Job characteristics						
wage	10,445	10,969	10,088	9,087	9,033	9,157
part-time job	6.39	6.86	6.08	9.97	10.05	9.86
-Clerks	36.14	19.59	48.86	2.14	1.26	3.3
-Services and sales workers	10.96	9.34	12.22	6.09	3.81	9.12
-Skilled agricultural, forestry and fishery workers	2.28	3.82	1.09	26.52	26.57	26.45
-Craft and related trades workers	3.04	5.75	0.96	13.5	18.89	6.33
-Plant and machine operators and assemblers	3.7	7.25	0.97	8.66	10.06	6.81
-Elementary occupations	43.88	54.24	35.9	25.11	24.03	26.54
private sector	60.89	61.25	60.65	79.03	79.9	77.89

Note: Mean is Presented in the Table if the Variable is Continuous and Percentage is Shown if it is Binary.

On job characteristics, overeducated workers receive 25% higher wages than undereducated and matched in 2006 and the wage difference between two groups is 15% in 2011. That is, overeducated workers receive average wage about 9,393 (10,445) baht per month while the rest receives 7,458 (9,087) baht per month in 2006 (2011). More than a half of overeducated individuals work full-time jobs and they work as plant and machine operators and assemblers as well as skilled agricultural, forestry and fishery workers. About 60% of overeducated individuals work in private sector.

5.2.2 Logistic Regression Results

The logit result supports an argument that temporary employment is significantly less associated with overeducation than permanent employment. Human capital is invested for job security. Workers are placed in the queue for better jobs by levels of human capital, but better jobs here mean secure ones. Employers use human capital as a filter and employees know human capital is an asset for getting a permanent job. Therefore, there is a positive relationship between a permanent job and overeducation.

The odd of being overeducated for part- time over that for full- time workers is 37% lower in 2006 and 21% lower in 2011. This lends its support to human capital argument that one invests in higher education not to get a matched job, but to be well placed in a competition for securing jobs. In labor market where job security becomes a valuable asset, this relationship between working in part-time job and overeducation may turn out to be negative, revealing that workers in full-time job are more likely to be overeducated than temporary ones. Human capital may partly aime at attaining secure jobs, rather than matched jobs. The chance of being overeducated for married males working full- time in a private firm is 71% (26%) higher than those working part-time in 2006 (2011).

Lower wage increases the likelihood of being overeducated. Education inflation is a possible explanation. Due to increased supply of college graduates, employers get more picky on employees to fill existing jobs. However, firms' demand cannot keep pace with graduates' supply. College graduates would face lower wages. Holding other variables at the fixed values, the odd of being overeducated for low-wage earners is about 78% (76%) higher than that for high-wage earners in 2006 (2011). Assuming that a 19-years-old, single male with mean years of schooling works full time in a private firm, if monthly wages increase by 10% from their mean, the odd of being overeducated would decrease by 20% (12%) in 2006 (2011).

Table 5.12 Logit Result of Overeducation

Variables	2006		2011	
	Coeff	**OR**	**Coeff**	**OR**
age	0.004*	1.004	0.004*	1.004
part-time job	-0.46*	0.63	-0.23*	0.79
wage	-1.52*	0.22	-1.43*	0.24
female	-0.03*	0.97	0.11*	1.12
married	-0.05*	0.95	-0.09*	0.91
head	-0.07*	0.93	-0.12*	0.89
years of schooling	0.67*	1.96	0.61*	1.84
private sector	0.42*	1.52	0.26*	1.3

Note: * represents the significance at 5% level

The positive relationship between age and the odd of being overeducated does not support a career-strategy reason for overeducation. The result shows that if individuals are a year older, the odd of being overeducated increases by 0.4% in both years. One reason is that qualification becomes obsolete at some point in time due to technological advancement in information and computer technology while young workers are more likely to escape from overeducation than older workers (Groot and Brink, 2000; Wolbers, 2003). Witte and Kalleberg (1995) offers two reasons for expecting an increasing likelihood of having a job mismatch with age. One, the skills obtained in initial education may become obsolete, mainly due to changing technology. Two, the relative value of vocational qualifications attended in initial education in the total amount of human capital acquired decreases during the career, since other forms of human capital (work experience, on-the-job training) accumulate with age. Older workers are more work experienced and less likely to be overeducated.

In sum, overeducation in Thai labor market can briefly be explained by supply-side factors: job security and inflation of education. Individuals give an importance to get jobs, instead of unemployment, even that jobs do not match with their education. Based on job signaling model, employers have imperfect information on workers' productivity. They use education as a screening device so employers have the incentive to hire individuals with higher levels of education because educated workers are more flexible and adaptable. At the same time, employees give their best efforts to study as high as possible to get securing jobs. The results have found the negative relationship between temporary employment and overeducation.

Education inflation has an effect on the odd of being overeducated. Education inflation involves increased demand for educational qualifications and the devaluation of qualification. Education inflation stems from ever-expanding access to higher education and the overproduction of degrees. This has resulted in low-level jobs that were once available to those who didn't finish high school now expecting graduate. Thus, education inflation is reflected in lower wages so the negative relationship between wage and overeducation is found.

Overeducation seems to be a consequence of excess supply in educated workers because supply-side variables, namely, part-time job and wage, are

significant in the regression. It can be traced back to several causes behind the increase in college graduates. (Yongyuth Chalamwong, 2011).

First, free 15-year basic education, launched in 2009, allows access to education without having to pay for school fees and books. Second, the Student Loan Fund (SLF) introduced in 1996. Its main objective is to provide higher education opportunity to students from low-income families. In 2006, income contingent student loan (ICL) scheme was introduced but it lasted only 1 year and was replaced with the reintroduction of SLF in 2007. However, in 2008 the ICL was brought back with the new strict condition that the lending would be made to students studying the fields which are in demand and supportive of the human resource development of the country. Third, firms have higher demand for college graduates due to economic prosperity so students try to study as high as possible. Even in economic downturn, individuals still study in order to avoid unemployment. Fourth, Thai society values college certificates and highly educated individuals would receive high earnings so that students try to study as high as possible.

The effects of overeducation on labor outcomes will be shown in the next section. Although the main cause of overeducation comes from excess supply in graduates, it cannot be quickly concluded that higher education no longer needs support. An increase in the supply of highly educated individuals is good for long-run growth and development as well as non- economic benefits such as low crimes, better health, etc. The suggestion is that educational institutions should produce graduates with right skills that match with those required in the labor market.

5.3 The Effects of Overeducation on Wages

The results have shown that overeducation exists in Thai labor market. So, this section studies the effects of overeducation on labor outcome, especially wages. In an early study, Sicherman (1991) has found that overeducated workers are paid less than if they are matched. These results have been confirmed in a large number of subsequent studies (Alba-Ramirez ,1993; Cohn and Ng, 2000; Cohn and Khan, 1995; Dolton and Silles, 2008). Exceptions are papers by Bauer (2002) and Tsai (2010) who have found that the overeducation pay penalty can be attributed to unobserved

heterogeneity so the estimated wage effects of overeducation become smaller, or in some cases disappear when controlling for unobserved heterogeneity. This section firstly presents sample profiles and estimates the effect of overeducation from the the simple ordinary least square (OLS) regression. The results show the negative signs on 'overeducation' variable indicating wage penalties. To take unobservable heterogeneity into account, the model is run by using quantile regression so the expected result is that wage penalties will be higher in the lower segment of wage distribution. Then, overeducation is grouped by educational level to find out the difference in wage penalties across educational levels.

5.3.1 Sample Profiles

Overeducated workers have lower years of experience, compared to matched workers. Overeducated workers have about 11 years of experience while matched workers have about 18 years of experience. Overeducated workers, disproportionately, are tertiary educated. The percentage of overeducation is about 72.74% among tertiary workers; while, it has been 27.26% among upper-secondary workers. The percentage of overeducation is higher among male if they graduate in upper-secondary education. Female have higher percentage of overeducation if they graduate in tertiary education. Most overeducated individuals work full- time. Overeducated men earn 6% higher wages than matched workers while overeducated women earn 0.2% lower wages than matched workers.

Then, samples are broken down into 10 quantiles of wage distribution to reflect the difference in unobservable skills. The top quantiles of wage distribution show high unobservable skills and the opposite is true for the lower quantiles. A good preliminary indication of the relationship between overeducation and unobservable skill is achieved by plotting the incidence of overeducation within the various quantiles of the wage distribution for both males and females (Table 5.14 and Figure 5.1).

Table 5.13 Descriptive Statistics of Overeducated and Matched Workers

Variables	2006		2011	
	Overeducated	**Matched**	**Overeducated**	**Matched**
Experience	10.36	17.45	11.6	18.16
Wage	9,386	8,891	10,445	10,615
Married	48.08	62.07	49.8	60.88
Part time	6.66	10.85	6.39	9.08
Small firm	48.68	59.84	53.8	62.35
Educational level				
-Less than upper-sec	-	38.21	-	33.77
-Upper-sec	30.47	32.44	25.04	35.58
-Tertiary	69.53	29.35	74.96	30.64

Note: Mean is presented in the table if the variable is continuous and percentage is shown if it is binary.

Table 5.14 The Percentage of Overeducation Across Wage Quantiles

Quantiles	% Overeducation	
	Male	**Female**
1	7.47	4.15
2	8.99	7.24
3	7.87	6.87
4	10.33	9.86
5	10.24	13.97
6	13.96	19.5
7	14.31	17.13
8	13.41	12.36
9	8.99	6.19
10	4.42	2.72

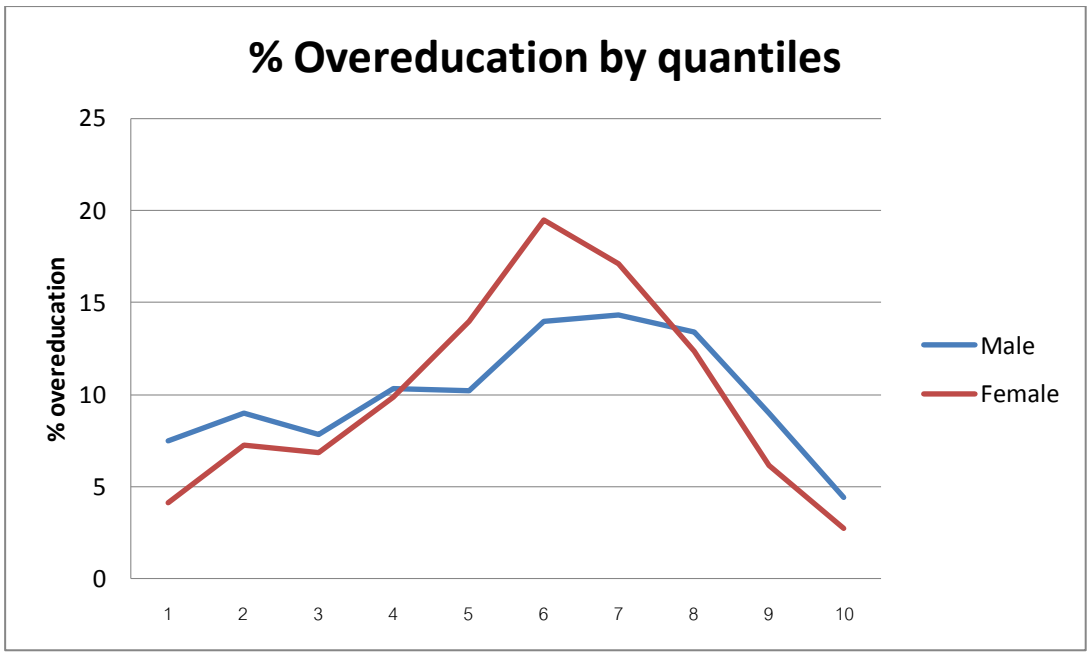


Figure 5.1 The Percentage of Overeducation by Wage Quantiles

The relationships between the percentage of overeducation and the wage distribution are quite similar for both males and females, that is, the relationships are bell-shaped. The percentages of overeducation slowly rise until the middle of the wage distribution before a gradual decline. The incidence of overeducation both in males and females does not disappear and it remains a relatively significant presence in all segments of the wage distribution. Within the ability range of the distribution between 5^{th} and 7^{th} quantile, the incidence of overeducation stands on the average at 13% for males and 17% for females. At high ability end of the spectrum. i.e., the top three quantiles, the percentage of overeducation decreases to 4% for male workers and 3% for female workers. It is correct to state that the incidence of overeducation is heavily concentrated among the middle of the wage distribution. This conclusion does not support human capital theory that the consequences of overeducation are not an outcome produced by a lack of unobservable skills. Instead, there is an imperfect relationship between workers' potential productivity and the maximum possible productivity of the job.

5.3.2 Empirical Results

OLS results for males and females are estimated and shown in Table 5.15 Both models are relatively well specified explaining 62% of the variation in male and female models, the first thing that becomes apparent is that higher educated workers would receive higher earnings compared to those with less than upper-secondary education. The OLS returns to tertiary and upper-secondary graduates are, respectively, 123% and 43% for men and 114% and 43% for women, compared to less than upper-secondary graduates. Both groups benefit from more years of work experience. Married men would receive higher earnings than those unmarried; while, the opposite is true for married women. Workers in small firms and in part- time jobs would receive lower wages than those in large firms and in full- time jobs.

In relation to the employment mismatch dummy, overeducated males are found to earn 33.8% less than their well-matched counterparts; while, overeducated females earn 27.7% less than adequately matched females. Note that, females suffer lower wage penalties than males. The reason is that females have low earnings and low labor force participation. Most of overeducated female study in social science that give general field so they suffer lower wage penalties. As in Robst (2007), the wage penalties from overeducation are greater in fields that teach occupation specific skills. In order to assess the extent to which the effects of overeducation may vary throughout male and female wage (ability) distributions, OLS equations are re-estimated in quantile regression form with the same controls thus differences in

Table 5.15 Ordinary Least Square (OLS) Results by Gender

Variables	Overall	Male	Female
upper-secondary	0.44*	0.431*	0.430*
tertiary	1.18*	1.234*	1.144*
experience	0.03*	0.029*	0.031*
experience squared	-0.001*	-0.001*	-0.001*
married	-0.002	0.041*	-0.031*
small firm	-0.21*	-0.198*	-0.223*

Table 5.15 (Continued)

Variables	Overall	Male	Female
part time job	-0.25*	-0.246*	-0.259*
year dummy	0.20*	0.205*	0.199*
overeducation	-0.31*	-0.338*	-0.277*

Note: 1) Different level of significance are denoted as follows: * (5% level), ** (10% level).
2) Industry dummies are also added as control variables.
3) OLS estimation is heteroskedastic-robust.

educational and job backgrounds are explicitly controlled for within the quantile regressions. The F-test indicates that differences across quantiles are jointly significant. This confirms that the wage effects of overeducation cannot be described in an average sense. However, for convenience, only the results with respect to overeducation variables are reported. The effects of the other exogenous variables remain relatively stable within the quantile regression analysis and are broadly consistent with the impacts reported in the OLS specification (see Appendix E).

The wage effects of overeducation are not homogenous across the conditional wage distribution (Table 5.16). In terms of overeducation penalty, all segments of wage distribution suffer wage penalties. If overeducation is simply a consequence of low skills, then its influences should be restricted to the lower segments of the earning distribution. Males' wage penalties are found to be greater when moving up along the distribution. That is, the lowest quantile receives the lowest wage penalty about 29.5% and the highest quantile receive the highest wage penalties at 36.4%. For females, the highest quantile has 31.1% wage penalties and they are 22.4% for the lowest quantile of wage distribution. Individuals with high (unobservable) skills are exposed to a larger wage decrease if they end up in mismatched work. This result suggests that graduates in the middle and high segment of the wage distribution (medium- and high-skills) suffer wage costs relative to their well-matched counterparts of similar ability. Job characteristics are imposing productivity ceiling on

the activities of some graduates, lending support to an assignment interpretation of the labor market. The assignment theory has concluded that the problem of overeducation arises when workers are not allocated to jobs in which they have a comparative advantage. Hence, skill underutilization has negative impact on productivity and earnings (see assignment theory in Chapter 3).

Another thing is that males also receive higher wage penalties than females in all segments of wage distribution because males have graduated in specific skilled fields and the vice versa is for females. 38% of male workers graduate in engineering which has some specific skills; while, 50% of female workers graduate in social sciences which is relatively more general skills. Robst (2007) has concluded that the negative wage effect from overeducation is greater in fields that are oriented toward specific skills.

Table 5.16 Wage Penalties by Quantiles

Quantiles	Male	Female
1	-0.295*	-0.224*
2	-0.295*	-0.229*
3	-0.290*	-0.223*
4	-0.312*	-0.230*
5	-0.306*	-0.253*
6	-0.325*	-0.270*
7	-0.337*	-0.287*
8	-0.359*	-0.299*
9	-0.364*	-0.311*

Note: 1) Control variables are educational level, experience, marital status, size of firm, part- time job, year dummy and industry type.

2) Different level of significance are denoted as follows: * (5% level), ** (10% level).

The wage penalties are in fact higher in the highest deciles so that the consequences of overeducation are not an outcome produced by a lack of unobserved skills. Also, overeducation contributes to a reduction in wage differences between individuals at high and low-pay jobs, as it carries a larger penalty for those who precisely earn more, that is, those located at the upper quantiles.

The results show the differences in wage penalties across quantiles but wage penalties may differ across educational levels. Variable "match" is generated to represent the relationship between educational level and educational mismatch so "match" is grouped into: less than upper-secondary matched, upper-secondary-matched, upper-secondary overeducated, tertiary matched, and tertiary overeducated. OECD argues that workers who graduate with upper-secondary and tertiary education are likely to be overeducated so those graduate with less than upper-secondary education can only be matched workers. The effects of 'match' variable on wages are estimated by OLS regression (Table 5.17).

Table 5.17 OLS Results of Wage Regression

Variables	Overall	Male	Female
upper-secondary overeducated	0.184*	0.162*	0.198*
upper-secondary matched	0.430*	0.420*	0.421*
tertiary overeducated	0.837*	0.836*	0.845*
tertiary matched	1.195*	1.263*	1.153*
experience	0.031*	0.029*	0.030*
experience squared	-0.001*	-0.001*	-0.001*

Notes: 1) OLS estimation is heteroskedastic-robust.
2) Control variables are marital status, size of firm, part- time jobs, and industry type. Reference group is less-than upper secondary matched.
3) Different level of significance are denoted as follows: * (5% level), ** (10% level).

With same level of education, matched workers receive higher wages than overeducated workers (relative to matched workers with less than upper-secondary education). For the upper-secondary educated matched workers, they receive 43% higher wages than matched workers with less than upper secondary education; while, overeducated workers receive 18.4% higher wages than the reference group. With tertiary education, matched workers receive 120% higher wages than those in less than upper secondary education; while, overeducated workers receive 84% higher wages than reference group. As a whole, overeducated workers receive lower wages than matched workers for all levels of education. In other words, workers would receive wage penalties if they are overeducated. The pay penalty of overeducated workers is measured by the differential in the return to education earned by matched and overeducated workers. The results suggest that both men and women receive wage penalties if they are overeducated (Tables 5.18). Overeducated workers with tertiary education receive higher wage penalties than overeducated workers with upper-secondary education. One explanation is an increase in the supply of tertiary graduates because of educational policies such as 15-year free education or income contingent loan and individual decision (high rate of returns and certificate valuation).

Moreover, men receive higher wage penalties than women. The effect is 26% for men and 22% for women with upper-secondary education and 43% for men and 31% for women with tertiary education. The result that there are earnings penalties at upper-secondary and tertiary levels may be overstated in the OLS model because workers who are more likely to be overeducated may possess certain unobserved skills that may largely determine earnings. Thus, the model is re-estimated by using quantile regression to take unobserved heterogeneity into account.

Table 5.18 Wage Penalties for Overeducated Workers

Wage penalties	Overall	Male	Female
Upper-secondary overeducated	-0.246	-0.258	-0.223
Tertiary overeducated	-0.358	-0.427	-0.308

Note: Wage penalty is obtained from the difference between returns to overeducation and returns to required education.

Tables 5.19 report the quantile returns to education for matched and overeducated workers. The estimates are plotted in Figure 5.2 and 5.3. The results suggest that the return differential between matched and overeducated workers is not constant over the wage distribution. The wage penalty is the highest within the upper segment of the wage distribution. Overeducated male in tertiary education suffer 48.7%, the highest wage penalties in the 7^{th} quantile of wage distribution while the highest wage penalty, 35.4%, is in the 8^{th} quantile of wage distribution for female. Moreover, wage penalty is the highest in the top segment of wage distribution in both male and female graduating in upper-secondary education. Wage penalty is 34.4% for male and 28.3% for female in the 9^{th} quantile of the wage distribution.

Wage penalties are higher among workers with tertiary education. Male workers with upper-secondary education face wage penalties from -0.21 in the 1^{st} quintile to -0.344 in the top quintile; while, male graduates with tertiary education face wage penalties from -0.385 in the 1^{st} quintile to -0.405 in the top quintile. The result is true for females for example, tertiary overeducated females in the top quantile of wage distribution receive 34% lower wages than reference group; while, upper-secondary overeducated females receive 28% lower wages than reference group. This conclusion does not support trade-off between overeducation and unobserved skills. However, males would suffer from higher wage penalties than females.

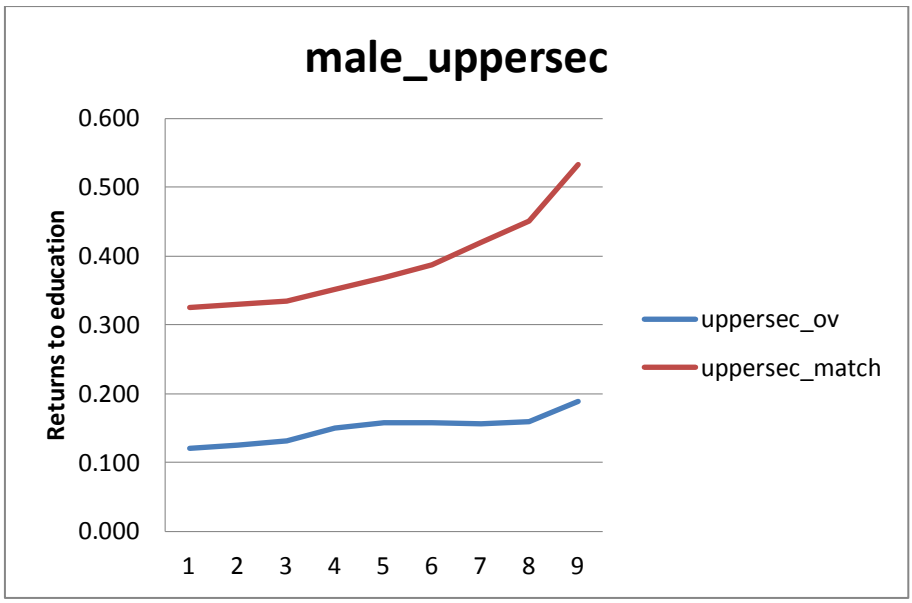
In summary, overeducation is an event that reduces wage among all skill groups. Overeducation contributes to reduce wage differences between workers at high- and low-paid jobs as it carries larger penalties for those who earn more (those located at the upper segment of wage distribution). Therefore, the structure of pay contributes to reduce wage inequality or differences between groups because tertiary educated workers are penalized higher than upper-secondary educated worker

Table 5.19 Returns to Education

Quantiles	upper secondary overeducated		upper secondary matched		tertiary overeducated		tertiary matched	
	males	**females**	**males**	**females**	**males**	**females**	**males**	**females**
1	0.120*	0.129*	0.325*	0.296*	0.624*	0.593*	1.010*	0.857*
2	0.126*	0.152*	0.330*	0.296*	0.667*	0.635*	1.065*	0.912*
3	0.131*	0.158*	0.334*	0.318*	0.695*	0.689*	1.123*	0.967*
4	0.150*	0.162*	0.351*	0.337*	0.756*	0.734*	1.204*	1.019*
5	0.157*	0.171*	0.369*	0.359*	0.794*	0.783*	1.275*	1.089*
6	0.157*	0.187*	0.387*	0.397*	0.849*	0.833*	1.326*	1.168*
7	0.156*	0.200*	0.419*	0.435*	0.893*	0.918*	1.380*	1.256*
8	0.160*	0.223*	0.451*	0.466*	0.965*	0.983*	1.433*	1.337*
9	0.188*	0.239*	0.532*	0.522*	1.063*	1.100*	1.467*	1.442*

Note: 1) Different level of significance are denoted as follows: * (5% level), ** (10% level).

2) Quantile standard errors are obtained using 20 replications.



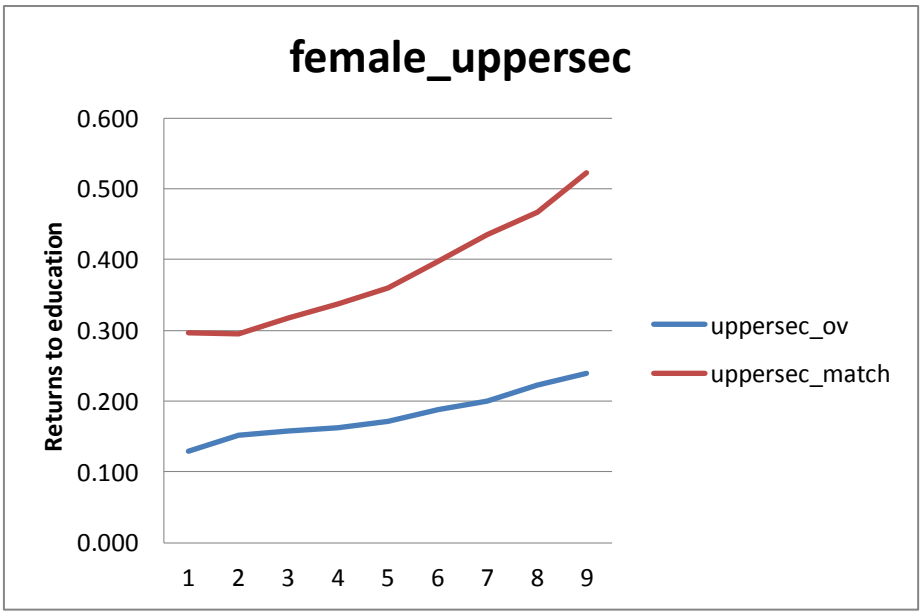
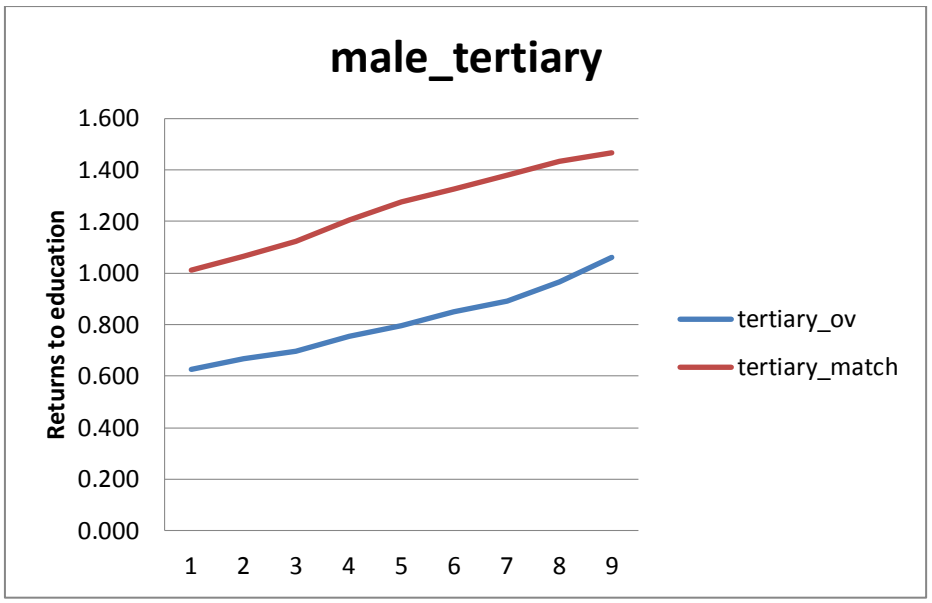


Figure 5.2 Returns to Education by Gender in Upper-Secondary Level



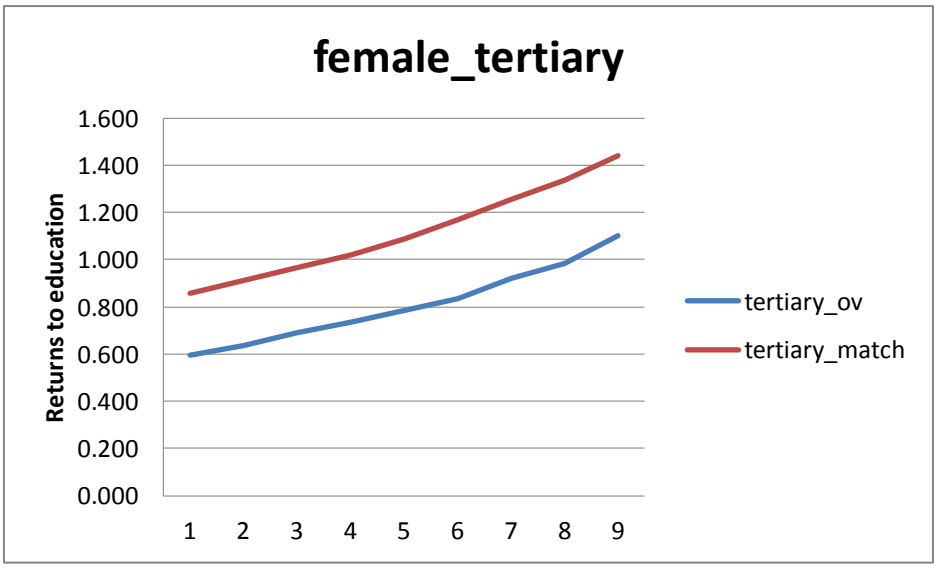


Figure 5.3 Returns to Education by Gender in Tertiary Level

CHAPTER 6

CONCLUSION AND POLICY IMPLICATION

6.1 Conclusions

The study has found that educational mismatch does exist in Thai labor market. The percentage of overeducation has increased from 6.27% in 2006 to 8.51% in 2011. Women have 1% (24%) higher probability to be overeducated than men while men have 17% (24%) higher probability to be undereducated than women. Married workers have higher chance of being educational mismatch both overeducated and undereducated. However, married female have lower chance of being overeducated because they are not main earners of families. A head of household has lower probability to be overeducated while he has higher probability to be undereducated.

The incidence of overeducation is higher among less-experienced workers while that of undereducation is more prevalent among more-experienced workers. This conclusion is consistent with the trade-off between education and experience in the human capital theory. More years of schooling are associated with the higher probability of being overeducated and the lower likelihood of being undereducated. Job characteristics matter too. The odd of being overeducated will be decreased by size of firm; a part-time job increases it.

Tertiary graduates in all fields of study have higher probability to be overeducated than non-tertiary graduates. Among tertiary graduates, those with services education have higher probability and those with health education have the lowest probability of being overeducated relative to those in humanities & arts. In sum, very specific fields, like health, sciences, or engineering, might be less vulnerable to overeducation than general fields, like social sciences, or humanities & arts.

Two main reasons are behind overeducation in Thai labor market. One is job security. The result has found that the odd of being overeducated for full-time workers is higher than that for part-time workers. Individuals invest in higher education to avoid unemployment, not to get matched jobs. Two is education inflation. Lower wages increase the likelihood of being overeducated. An increase in the supply of college graduates causes low wages. Individuals study as high as possible because educational attainment is used as a signal to employers because they have imperfect information about the productivity of employees. This causes an overinvestment in education. Individuals with higher educational level would get jobs which formerly are occupied by high-school workers.

The negative effect of overeducation through the estimation of Mincerian wage equations with an overeducation is about 33.8% for males and 27.7% for females. To be precise, males have higher wage penalties than females. The estimation of quantile regressions suggests that the incidence of overeducation reflects a real mismatch beyond the effect of unobservable characteristics. Wage penalties are higher when moving up along the wage distribution. These findings reject the trade-off between educational level and other human capital. To be specific, the wage penalties would be higher in the lower segment of the wage distribution (a group of low skill). In sum, overeducation contributes to reduce wage differences between workers at high- and low-paid jobs as it carries a larger penalty for those who earn more (those located at the upper segment of the wage distribution).

Considering wage penalties by educational level, tertiary workers receive higher wage penalties than upper-secondary and less than upper-secondary workers. This contributes to narrow wage difference between groups because tertiary workers are penalized more if they end up in overeducated jobs.

Despite wage penalties, individuals strive for higher education because returns to tertiary education are higher than those with upper-secondary education even they are overeducated. Clearly, tertiary overeducated workers receive double higher wages than upper-secondary matched workers for both males and females. In turn, overeducated workers face higher wage penalties. Individuals should give a serious thought on the worth between the net returns from being tertiary overeducated and upper-secondary matched.

6.2 Policy Implications

University graduates, especially those with degrees in general education, namely, social sciences, humanities and arts, have been found being the largest worker groups with overeducation (for an estimate of 70% of employed workers). This phenomenon could be due to an excess supply of college graduates and an overemphasis of most academic institutions on general education (i.e., the supply-side factors). Government should re-emphasize educational system away from general fields toward more vocationally oriented subjects with higher levels of job relevant skills. It is of some concern of the government because it has devoted a substantial portion of budget to education. The government can cope with overeducation by lowering supply of college educated workers. One, it may reallocate more of its educational budget to vocational education because workers in academic education have a greater probability to be overeducated than those in vocational education. Two, it should increase the ratio of vocational students to academic students by increasing more requirements for students to study in academic education such as GPA requirement. Three, raise private costs of college education to reduce the supply of college graduates and eventually overeducation. For example, the student loan fund (SLF) may add additional requirements for students who seek loans.

Fields of study affect the probability of being overeducated as well. Upper-secondary schools should provide better guidance to students in making the choice of field of study in order to reduce the incidence of overeducation. Current guidance provision is limited and of poor quality because teachers and staff providing career guidance lack the knowledge of the labor market in terms of jobs and career prospects.

Overeducated workers are less experienced and have more years of schooling, implying that overeducated workers substitute education for a lack of job experience and accept jobs that require lower level of education. To mitigate overeducation, students should be provided with job experience while in college possibly through cooperative programs. Cooperative program takes a new importance in helping students to make the school-to-work transition, service learning, and experiential learning initiatives. This program combines classroom-based education with practical

work experience so students can get hands-on experience in their fields of study. Currently, some college programs have cooperative programs as a basic requirement to finish college degrees. University should add cooperative programs as another requirement for all degrees.

6.3 Limitations of the Study

This research has investigated the issue and causes of overeducation in Thai labor market as well as its effect on earnings. Due to time and data availability, this research suffers from certain limitations as follows:

6.3.1 Definition of Overeducation

In this research, overeducation refers to the educational mismatch, being a discrepancy between the educational level for which an individual has attained and the level of education required by the job. However, other forms of mismatch do exist, i.e., horizontal mismatch and skill mismatch. The horizontal mismatch occurs when a discrepancy exists between an individual's field of study and his/her occupation; while, a discrepancy between the skill possessed by a worker and the skills required by the job leads to the skill mismatch. The adoption of a different definition could produce different results and possibly improve the findings, particularly with regard to the causes of overeducation.

6.3.2 Scope of Analysis

The effects of academic quality of educational institutions have been excluded from this research due to the lack of relevant data. Interestingly, previous researches (Ordine and Rose, 2009; Di Pietro and Cutillo, 2006; McGuinness, 2003) report a strong negative correlation between university quality and overeducation, that is, low quality of university increases the probability of overeducation. Since Thailand has hundreds of universities of different academic quality and reputation, an analysis of the effects of the quality of the educational institutions and programs on overeducation would improve the findings and, thereby, should be included into the model of future research.

In addition, this research has focused exclusively on the pecuniary effects of overeducation. Previous research studies (Fleming and Kler, 2008; Verhofstadt and Omey, 2003; Hersch, 1995; House, 1974; Vroom, 1964), however, have placed an importance to the non-pecuniary effects, e.g., job satisfaction, well-being, and job turnovers. Several non-pecuniary effects on overeducation are reported to be negative. Workers with more education than their jobs require have been found to be more dissatisfied with their jobs, exhibit higher rate of absenteeism and turnover, and poorer health. This negative outcomes lead to lower firm output. Thus, overeducation is negatively related to firm output. Thus, adding in these negative outcomes associated with overeducation would give justice to employers for not hiring overeducated workers.

BIBLIOGRAPHY

Acemoglu, D. 1998. Why Do New Technologies Complement Skills? Directed Technical Change and Wage Inequality. **The Quarterly Journal of Economics.** 113 (4): 1055-1089.

Alba-Ramirez, Alfonso. 1993. Mismatch in the Spanish Labor Market: Overeducation?. **The Journal of Human Resource.** 28 (2): 259-278.

Albrecht, J. and Vroman, S. 2002. A Matching Model with Endogenous Skill Requirements. **International Economic Review**. 43 (1): 283-305.

Allen, J. and Velden, R. 2001. Educational Mismatches Versus Skill Mismatches: Effects on Wages, Job Satisfaction, and on-the-Job Search. **Oxford Economic Paper.** 53 (3): 434-452.

Ammar Siamwalla; Dilaka Lathapipat and Somkiat Tangkitvanich. 2011. New Educational Reform to Qualified Education for All. In **Revamping Thai Education System: Quality for All.** Bangkok: TDRI. (In Thai)

Ariga, K. 2006. Are Education and Training Always Complements? Evidence from Thailand. **Industrial & Labor Relations Review.** 59 (4). :613.

Autor, D.; Katz, L., and Krueger, A. 1998. Computing Inequality: Have Computers Changed the Labor Market?. **The Quarterly Journal of Economics.** 113 (4): 1169-1213.

Autor, D.; Levy, F and Murnane, R. 2003. The Skill Content of Recent Technological Change: An Empirical Exploration. **The Quarterly Journal of Economics.** 2003 (November): 1279-1333.

Baert. S.; Cockx, B., and Verhaest, D. 2012. Overeducation at the Start of the Career: Stepping Stone or Trap?. **Labour Economics.** 25 (C): 123-140.

Bank of Thailand. 2010. **Imbalance in Thai Labor Market: Labor Shortage.** Khon Kaen: Northeast Office, Bank of Thailand. (In Thai).

Battu, H.; Belfield, C., and Sloane, P. 2000. How Well Can we Measure Graduate Over-Education and Its Effects?. **National Institute Economic Review.** 171 (1): 82-93.

Battu, H.; Seaman P., and Sloane, P. 1998. **Are Married Women Spatially Constrained? A Test of Gender Differentials in Labour Market Outcomes.** Retrieved June 24, 2015 from http://www-sre.wu-wien.ac.at/ersa/ersaconfs/ersa98/papers/24.pdf

Bauer, T. 2002. Educational Mismatch and Wages: A Panel Analysis. **Economics of Education Review.** 21: 221-229.

Becker, Gary S. 1993. **Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education.** 3rd ed. London: The University of Chicago Press.

Belfield, C. 2010. Over-Education: What Influence Does the Workplace Have?. **Economics of Education Review.** 29 (April): 236-245.

Belfield, C. and Harris, R.D. 2002. How Well Do Theories of Job Matching Explain Variations in Job Satisfaction Across Education Levels? Evidence for UK Graduates. **Applied Economics.** 34 (5): 535-548.

Ben-Porath Y. 1967. The Production of Human Capital and the Life Cycle of Earnings. **The Journal of Political Economy.** 75 (August): 352-365.

Berg I.; Freedman, Marcia., and Freeman Michael. 1978. **Managers and Work Reform: A Limited Engagement.** New York. Free press.

Berman E., Bound J. and Griliches, Z. 1994. Changes in the Demand for Skilled Labor within US Manufacturing industries: Evidence from the Annual Survey of Manufacturing. **Quarterly Journal of Economics.** 109 (May): 367-398.

Berman E.; Bound J. and Machin, S. 1998. Implications for Skill Biased Technological Change: International Evidence. **Quarterly Journal of Economics.** 113 (4): 1245-1279.

Berman, Eli and Machin, Stephen. 2000. Skill-Biased Technology Transfer Around The World. **Oxford Review of Economic Policy.** 16 (3): 12–21.

Bernard, A. B. and J. B. Jensen. 1995. Exporters, Skill Upgrading, and the Wage Gap. **Journal of International Economics.** 42 (Febuary): 3-31.

Bhula, R. and Kripornsak, P. 2008. Trends of Labour Demand for High-Skilled Workers and Their Wages in Thailand. **Journal of International Business Research.** 7 (March): 71-87.

Borghans, L. and De Grip, A. 2000. The Debate in Economics about Skill Utilization. In **The Overeducated Worker? The Economics of Skill Utilization.** L. Borghans and A. De Grip, eds. Cheltenham: Edward Elgar. Pp. 3-23.

Boudarbat, B. and Chernoff, V. 2009. **The Determinants of Education-Job Match Among Canadian University Graduates.** IZA Discussion Paper No. 4513.

Bresnahan, T.; Brynjolfsson E., and Hitt, L.M. Information Technology, Workplace Organization and the Demand for Skilled Labor: Firm-Level Evidence. **The Quarterly Journal of Economics.** 117 (Febuary): 339-376.

Buchel, F. 2002. The Effects of Overeducation on Productivity in Germany-the Firms' Viewpoint. **Economics of Education Review.** 21 (3): 263-275.

Buchel, F. and A. Mertens. 2004. Overeducation, Undereducation and the Theory of Career Mobility. **Applied Economics.** 36 (8): 803-816.

Buchel, F. and Battu, H. 2003. The Theory of Differential Overqualification: Does it Work?. **Scottish Journal of Political Economy.** 50 (1): 1-16.

Buchel, F. and Mertens, A. 2000. **Overeducation, Undereducation, and the Theory of Career Mobility.** IZA Discussion Paper No.195.

Buchel, F. and Pollman-Schult, M.. 2004. Overeducation and Human Capital Endowments. **International Journal of Manpower.** 25 (2): 150-165.

Buchel, F. and Van Ham, M. 2002. **Overeducation, Regional Labour Markets and Spatial Flexibility.** IZA Discussion paper No. 424.

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): 1–30.

Budria, Santiago. 2005. **Can Over-Education Account for the Positive Association Between Education and within-groups Wage Inequality?.** Retrieved June 24, 2015 from https://mpra.ub.uni-muenchen.de/92/1/MPRA_paper_92.pdf

Budria, Santiago. 2010. **Are Educational Mismatches Responsible for the 'Inequality Increasing Effect' of Education?.** Retrieved June 24, 2015 from https://mpra.ub.uni-muenchen.de/23420/1/MPRA_paper_23420.pdf

Budria, Santiago and Moro-Egilo, Ana I. 2004. **Education, Educational Mismatch, and Wage Inequality: Evidence for Spain.** MPRA Paper No. 93.

Budria, Santiago and Moro-Egilo, Ana I. 2006. **Overeducation and Wages in Europe: Evidence from Quantile Regression.** Retrieved June 24, 2015 from http://campus.usal.es/~ehe/Papers/eee229.pdf

Budria, Santiago and Moro-Egilo, Ana I. 2009. The Overeducation phenomenon in Europe. **Revista International de Sociologia (RIS).** 67 (2): 329-345.

Bustos, Paula. 2005. **The Impact of Trade Liberalization on Skill Upgrading: Evidence from Argentina.** Retrieved June 24, 2015 from http://sticerd.lse.ac.uk/seminarpapers/DG15102007.pdf

Caplan, R; Cobb, S; French, J; Harrison, R and Pinneau, S. 1980. **Job Demands and Worker Health: Main Effects and Occupational Differences.** Research Report Series-Institute for Social Research University of Michigan.

Chaiyuth Panyasawatsut. 2008. **Human Capital and Returns to Education**. The Chaipattana Foundation, Office of the National Economic and Social Development Board, and Thailand Development Research Institute. (In Thai).

Chapman, B.; Kiatanantha Lounkaew; Piruna Polsiri; Rangsit Sarachitti and Thitima Sitthipongpanich. 2010. Thailand's Student Loans Fund: Interest Rate Subsidies and Repayment Burdens. **Economics of Education Review.** 29 (5): 695-709.

Chevalier, A. 2003. Measuring Over-Education. **Economica.** 70 (279): 509-531.

Chevalier, A. and Lindley, J. 2007. **Over-Education and the Skills of UK Graduates.** Retrieved June 24, 2015 from http://cee.lse.ac.uk/ceedps/ ceedp79.pdf

Cohn, E. and Khan, S. 1995. The Wage Effects of Overschooling Revisited. **Labour Economics.** 2 (March): 67-76.

Cohn, E. and Ng, Y. 2000. Incidence and Wage Effects of Overschooling and Underschooling in Hong Kong. **Economics of Education Review.** 19 (April): 159-168.

Croce, Giuseppe and Ghignoni, Emanuela. 2012. Demand and Supply of Skilled Labour and Overeducation in Europe: A Country-Level Analysis. **Comparative Economic Studies.** 54 (2): 413-439.

Cuadras-Morato, Xavier and Mateos-Planas, Xavier. 2013. Overeducation and Skill-Biased Technical Change. **The B.E. Journal of Macroeconomics.** 13 (September): 18.

Daly, M., Buchel, F. and Duncan, G. 2000. Premiums and Penalties for Surplus and Deficit Education Evidence from the United States and Germany. **Economics of Education Review.** 19 (2): 169-178.

Davis, D. 1996. **Technology, Unemployment, and Relative Wages in a Global Economy.** NBER Working Paper No. 5636 Retrieved June 24, 2015 from http://www.nber.org/papers/w5636.pdf

Di Pietro, G. and Cutillo, A. 2006. University Quality and Labour Market Outcomes in Italy. **Labour.** 20 (March): 37-62.

Dilaka Latthapipat. 2010. Educational Inequality and Wage Trends in Thailand. In **Reducing Inequality and Creating Economic Opportunity.** Thailand Development Research Institute (TDRI). (In Thai).

Dilaka Latthapipat. 2011. The Effects of Educational Accountability on Educational Fulfillment. In **Revamping Thai Education System: Quality for All**, Thailand Development Research Institute (TDRI). (In Thai).

Di Pietro, G. 2002. Technological Change, Labor Markets, and Low-Skill, Low-Technology Traps. **Technological Forecasting and Social Change.** 69 (December): 885-895.

Dolado, J.; Jansen, M., and Jimeno, J. F. 2009. On the Job Search in a Matching Model with Heterogeneous Jobs and Workers. **Economic Journal.** 119 (January): 200-228.

Dolado, Juan J.: García-Serrano, Carlos and Jimeno, Juan F. 2002. Drawing Lessons from the Boom of Temporary Jobs in Spain. **The Economic Journal.** 112 (480): F270–F295.

Dolton, P and Kidd, M. 1998. Job Changes, Occupational Mobility and Human Capital Acquisition: An Empirical Analysis. **Bulletin of Economic Research.** 50 (October): 265-295.

Dolton, P. and Silles, M. 2008. The Effects of Over-Education on Earnings in the Graduate Labour Market. **Economics of Education Review.** 27 (April): 125-139.

Dolton, P. and Vignoles, A. 2000. The Incidence and Effects of Overeducation in the U.K. Graduate Labor Market. **Economics of Education Review.** 19 (April): 179-198.

Duncan, Greg and Hoffman, Saul. 1981. The Incidence and Wage Effects of Overeducation. **Economics of Education Review.** 1 (Winter): 75-86.

Egger, H. and Koch, M. 2013. T**rade and the Firm-Internal Allocation of Workers to Tasks.** Working Papers No. 139. Bavarian Graduate program in Economics (BGPE). Retrieved June 24, 2015 from http://www.bgpe.de/texte/DP/139_EggerKoch.pdf

Feensta, R. and Hanson, G. 1996. Glabalization, Outsourcing, and Wage Inequality. **The American Economic Review.** 86 (May): 240-245.

Fleming, C. and Kler, P. 2008. I'm Too Clever for This Job: A Bivariate Probit Analysis on Overeducation and Job Satisfaction in Australia.. **Applied Economics.** 40 (9): 1123-1138.

Frank, R. 1978. Why Women Earn Less: The Theory and Estimation of Differential Overqualification. **American Economic Review.** 68 (June): 360-373.

Frenette, Marc. 2004. The Overqualified Canadian Graduate: The Role of the Academic Program in the Incidence, Persistence, and Economic Returns to Overqualification. **Economics of Education Review.** 23 (Febuary): 29-45.

Galasi, P. 2005. **Overeducation, Undereducation and Demand.** TARKI Social Report Reprint Series No. 14. Retrieved June 24, 2015 from http://www.tarki.hu/adatbank-h/kutjel/pdf/a733.pdf

Galasi, P. 2008. **The Effect of Educational Mismatch on Wages for 25 Countries.** Budapest Working Papers on the Labour Market BWP–2008/8 Retrieved June 24, 2015 from http://www.econ.core.hu/file/download/bwp/BWP0808.pdf

Garcia-Espejo, Isabel, and Ibanez, Marta. 2006. Education-Skill Matches and Labour Achievements among Graduates in Spain. **European Sociological Review.** 22 (2): 141-155.

Glebbeek, A.C. 1993. **Perspectieven Op Loopbanen.** Doctoral thesis, University of Groningen.

Goldin, C. and Katz, L. 1998. The Origins of Technology-Skill Complementarity. **The Quarterly Journal of Economics.** 113 (August): 693-732.

Grayson, Paul J. 2004. Social Dynamics, University Experiences, and Graduates' Job Outcome. **British Journal of Sociology of Education.** 25 (5): 609-627.

Green, F., Mcintosh, S., and Vignoles, A. 2002. The Utilization of Education and Skills: Evidence from Britain. **The Manchester School.** 70 (6): 792-811.

Groeneveld, S. and Hartog, J. 2004. Overeducation, Wages and Promotions within the Firm. **Labour Economics.** 11 (December): 701-714.

Groot, W. and Brink, H. 2000. Overeducation in the Labor Market: A Meta-Analysis. **Economics of Education Review.** 19 (April): 149-158.

Grossman, G. 2013. **Heterogeneous Workers and International Trade.** NBER Working Paper No. 18788. Retrieved June 24, 2015 from http://www.nber.org/papers/w18788.pdf

Grossman, G. and Rossi-Hansberg, E. 2008. **External Economies and International Trade Redux.** NBER Working Paper No. 14425. Retrieved June 24, 2015 from http://www.nber.org/papers/w14425.pdf

Halaby, C. 1994. Overeducation and Skill Mismatch. **Sociology of Education.** 67 (1): 47-59.

Hartog, J. 1980. Earnings and Capability Requirements. **Review of Economics and Statistics.** 62 (2): 230–240.

Hartog, J. 1985. Earnings Functions: Testing for the Demand Side. **Economics Letters.** 19 (3): 281-285.

Hartog, J. 2000. Over-Education and Earnings: Where are we, Where Should We Go?. **Economics of Educaton Review.** 19 (April): 131-147.

Hartog, J. and Oosterbeek, H. 1988. Education, Allocation and Earnings in the Netherlands: Overschooling?. **Economics of Education Review.** 7 (2): 185-194.

Hartog, J. and Tsang, M. 1987. **Estimating, Testing and Applying A Comparative Advantage Earnings Function for the US 1969- 1973-1977.** Amsterdam : Universiteit van Amsterdam.

Heckman, James J. and Scheinkman, Jose. 1987. The Importance of Bundling in a Gorman-Lancaster Model of Earnings. **The Review of Economic Studies.** 54 (April): 243-55.

Heckman, James J. and Sedlacek, Guilherme L. 1990. Self-Selection and the Distribution of Hourly Wages. **Journal of Labor Economics.** 8 (January): S329-S363.

Heijke, H.; Meng, C.and Ramaekers, G. 2003. An Investigation into the Role of Human Capital Competences and Their Pay-Off. **International Journal of Manpower.** 24 (7): 750-773.

Hernandez, L. and Serrano, L. 2012. Overeducation and its Effects on Wages: A Closer Look at the Spanish Regions. **Investigaciones Regionales.** 2012 (June): 59-90.

Herrera-Idarraga, Paula; Lopez-Bazo, Enrique and Motellon, Elisabet. 2013. Double Penalty in Returns to Education: Informality and Educational Mismatch in the Columbian Labour Market. **Research Institute of Applied Economics.** Retrieved June 24, 2015 from http://www.ub.edu/irea/working_papers/2013/201307.pdf

Hersch, J. 1991. Education Match and Job Match. **The Review of Economics and Statistics.** 73 (1): 140-144.

Hersch, J. 1995. Optimal 'Mismatch' and Promotions. **Economic Inquiry.** 33 (4): 611.

House, J. 1974. The Effects of Occupational Stress on Physical Health. In **Work and the Quality of Life.** J. O'Toole, ed. Cambridge, Massachusettes: MIT Press. Pp. 145-170.

Hung, C. 2008. Overeducation and Undereducation in Taiwan. **Journal of Asian Economics.** 19 (April): 125-137.

ILO. 2013. **Global Employment Trends 2013: Recovering from a Second Jobs Dip.** Switzerland: ILO.

Johnson, G.J., and Johnson, W.R. 2000. Perceived Overqualification and Dimensions of Job Satisfaction: A Longitudinal Analysis. **The Journal of Psychology.** 134 (5): 537-555.

Karakaya, G.; Plasman, R. and Rycx, F. 2005. The Incidence and Determinants of Overeducation in Belgium. **Brussels Economic Review.** 48 (1-2): 113-136.

Kiker, B. F.; Santos, M. and Oliveira, M. 1997. Overeducation and Undereducation: Evidence for Portugal. **Economics of Education Review.** 16 (2): 111-125.

Kornhauser, A. 1965. **Mental Health of the Industrial Worker: A Detroit Study.** New York: Wiley.

Korpi, T. and Tahlin, M. 2009. Educational Mismatch, Wages, and Wage Growth: Overeducation in Sweden, 1974-2000. **Labour Economics.** 16 (April): 183-193.

Krahn, Harvey and Bowlby, Jeffrey W. 1999. **Education Job-Skills Match: An Analysis of the 1990 and 1995 National Graduates Surveys.** Ottawa-Ontario: Human Resources Development Canada.

Layne, C. 2010. **The Demographics of Over-education in the U.S., 1971-2006.** Paper Presented to the 2010 International Labor Process Conference. Retrieved March 10, 2015 from http://www.ilpc.org.uk/Default.aspx?tabid=5246&absid=10429

Lin, C. and Wang, C. 2005. The Incidence and Wage Effects of Overeducation: The Case of Taiwan. **Journal of Economic Development.** 30 (June): 31-48.

Lindley, J., and McIntosh, S. 2009. **A Panel Data Analysis of the Incidence and Impact of Overeducation.** Working Paper. Department of Economics, University of Sheffield.

Linsley, Ingrid. 2005. Causes of Overeducation in the Australian Labour Market. **Australian Journal of Labour Economics.** 8 (June): 121-143.

Lucas, R. E., 1988. On the Mechanics of Economic Development. **Journal of Monetary Economics.** 22 (1): 3-42.

Luglio, R. 2012. **Educational Qualifications Mismatch in Europe: Is It Demand or Supply Driven?** Working Paper No. 154, Dipartimento Di Economia Pubblica.

Machin, S. and Reenen, J. 1998. Technology and Changes in Skill Structure: Evidence from Seven OECD Countries. **The Quarterly Journal of Economics.** 113 (November): 1215.

Matsuyama, K. 2007. Beyond Icebergs: Toward a Theory of Biased Globalization. **Review of Economic Studies.** 74(1): 237-253.

McGoldrick, K. and Robst, J. 1996. Gender Differences in Overeducation: A Test of the Theory of Differential Overqualification. **American Economic Review.** 86 (2): 280-284.

McGuinness, S. 2003. University Quality and Labour Market Outcomes. **Applied Economics.** 35 (18): 1943-1955.

McGuinness, S. 2006. Overeducation in the Labour Market. **Journal of Economic Surveys.** 20 (3): 387-418.

McGuinness, S. 2008. How Biased are the Estimated Wage Impacts of Overeducation? A Propensity Score Matching Approach. **Applied Economics Letters.** 15 (2): 145-149.

McGuinness, S and Bennett, J. 2007. Overeducation in the Graduate Labour Market: A Quantile Regression Approach. **Economics of Education Review.** 26 (3): 521-531.

Mehta, A.; Felipe, J.; Quising, P. and Camingue, S. 2011. Overeducation in Developing Economies: How Can We Test for It, and What Does It Mean?. **Economics of Education Review.** 30 (December): 1334-1347.

Mendes de Oliveira, M.; M. Santos and B. Kiker. 2000. The Role of Human Capital and Technological Change in Overeducation. **Economics of Education Review.** 19 (April): 199-206.

Mincer, J. 1974. **Schooling, Experience, and Earnings.** New York: Columbia University Press.

The Ministry of Education. The Office of Education Council. 2013. **The Number of Tertiary Graduates.** Bangkok: The Ministry of Education.

Mora, M. 1992. **Does Overeducation Imply Poor Schooling Quality for Mexican American men?.** Master's thesis, The University of New Mexico.

National Statistical Office. 2002. **The Child and Youth Survey 2002.** Bangkok: National Statistical Office.

National Statistical Office. 2013. **The Labor Demand of Establishment Survey.** Bangkok: National Statistical Office.

Nelson, R. and Phelps, E. 1966. Investment in Humans, Technological Diffusion, and Economic Growth. **The American Economic Review.** 56 (May): 69-75.

Nipon Poapongsakorn et al. 2011. Connection between Educational Institutions and Labor Market: Graduates' Quality and the Shortage of Qualified Labor. In **Revamping Thai Educational System: Quality for All.** Bangkok: TDRI (In Thai)

OECD. 2007. Matching Educational Background and Employment: A Challenge for Immigrants in Host Countries. In **International Migration Outlook 2007.** Paris: Organisation for Economic Co-operation and Development.

Office of the National Economic and Social Development Board. 2015. **The Number and Ratio of Upper-Secondary Graduates to Vocational Graduates.** Bangkok: Office. (In Thai).

Oliveira, M.; Santos, M.C., and Kiker, B.F. 2000. The Role of Human Capital and Technological Change in Overeducation. **Economics of Education Review.** 19 (April): 199-206.

Oosterbeek, H. and Webbink, D. 1996. Over Scholing, Overscholing En Inkomen. **Economisch statistische Berichten.** 81: 240-241.

Ordine, P. and Rose, G. 2009. Overeducation and Instructional Quality: A Theoretical Model and Some Facts. **Journal of Human Capital.** 3 (1): 73-105.

Ortriz, Luis. 2008. Not the Right Job, But a Secure One: Overeducation and Temporary Employment in France, Italy, and Spain. **Work Employment & Society.** 24 (March): 47-64.

Ortriz, Luis and Kucel, Aleksander. 2008. Do Field of Study Matter for Over-Education?: The Case of Spain and Germany. **International Journal of Comparative Sociology.** 49 (4-5): 305-327.

Pryor, F. and Schaffer, D. 1997. Wages and the University Educated: A Paradox Resolved. **Monthly Labor Review.** 120 (7): 3.

Psacharopoulos, George. 1987. The Manpower Requirements Approach. In **Economics of Education: Research and Studies.** G. Psacharopoulos, ed. London: Pergamon Press. Pp. 331-335.

Quinn, M. and Rubb, S. 2006. Mexico's Labor Market: The Importance of Education-Occupation Matching on Wages and Productivity in Developing Countries. **Economics of Education Review.** 25 (April): 147-156.

Quintini, G. 2011. **Right for the Job: Overqualified or Under-Skilled?.** OECD Social, Employment and Migration Working Papers No. 120.

Riley, J. 1979. Testing the Educational Screening Hypothesis. **Journal of Political Economy.** 87 (5): s227-s252**.**

Robst, J. 1994. College Quality and Overeducation. **Economics of Education Review.** 14 (3): 221-228.

Robst, J. 1995. Career Mobility, Job match, and Overeducation. **Eastern Economic Journal.** 21 (4): 539-550.

Robst, J. 2006. Education and Job Match: The Related of College Major and Work. **Economics of Education Review.** 26 (4): 397-407.

Robst, J. 2007. Education and Job Match: The Relatedness of College Major and Work. **Economics of Education Review.** 26 (4): 397-407.

Rubb, S. 2003. Overeducation in the Labor Market: A Comment and Re-analysis of a Meta-Analysis. **Economics of Education Review.** 22 (December): 621-629.

Rumberger, R. 1981. The Impact of Surplus Schooling on Productivity and Earnings. **Journal of Human Resource.** 22 (1): 24-50.

Salvatore, Donimick. 2004. **International Economics.** 8th ed. New York: J. Wiley.

Santos, M. C. 1992. **An Exploration of Different Measures for Job Requirements: Over- (under) Education on the Portuguese Labor Market.** Working Paper Faculdade Economia de Porto.

Santos, M. C. 1995. **Education and Earning differentials in Portugal.** Doctoral thesis, Porto University.

Santos, M.; Oliveira, M., and Kiker B. F. 1997. Overeducation and Undereducation: Evidence for Portugal. **Economics of Education Review.** 16 (April): 111-125.

Sasaki, H. and Sfakura, K. 2005. **Changes in the Demand for Skilled Labor within Japan's Manufacturing Sector: Effects of Skill-Biased Technological Change and Globalization.** Working Paper Series No. 05-E-12. Bank of Japan.

Sattinger, M. 1993. Assignment Models of the Distribution of Earnings. **Journal of Economic Literature**. 31 (June): 831-880.

Schultz, T.W. 1961 Investment in Human Capital. **American Economic Review.** 51 (1): 1-17.

Schultz, T.W. 1975. The Value of the Ability to Deal with Disequilibria. **Journal of Economic Literature.** 3 (3): 827-846.

Sicherman, Nachum. 1987. **Overeducation in the Labor Market.** Working Paper No. 48.. Center for the study of the Economy and the State University of Chicago.

Sicherman, Nachum. 1991. Overeducation in the Labor Market. **Journal of Labor Economics.** 9 (2): 101-122.

Sicherman, N. and Galor, O. 1990. A Theory of Career Mobility. **Journal of Political Economy**. 98 (1): 169-192.

Sloane, P.J.; Battu, H. and Seaman P.T. 1996. Overeducation and the Formal Education/Experience and Training Trade-Off. **Applied Economics Letters.** 3 (8): 511-515.

Sloane, P. J.; Battu, H. and Seaman, P. T. 1999. Overeducation, Undereducation and the British Labour Market. **Applied Economics.** 31 (11): 1437-1453.

Somchai Amornthum and Yongyuth Chalamwong. 2001. Rate of Return to Education. In **Human Resources and the Labor Market of Thailand.** Bangkok: Thailand Development Research Institute (TDRI).

Somkiat Tangkitvanisch and Areeya Manasboonphempool. 2010. Evaluating the Student Loan Fund of Thailand. **Economics of Education Review.** 29 (5): 710-721.

Somkiat Tangkitvanisch; Supanat Sasiwuttiwat, and Bank Ngarmarunchot. 2011. Financial and Management Systems for Accountability in Education. In **Revamping Thai Education System: Quality for All**. Bangkok: Development Research Institute (TDRI).

Spence, M. 1973. Job Market Signaling. **The Quarterly Journal of Economics.** 87 (3): 355-374.

Stefanik, Miroslav. 2011. What Can Existing Overeducation Tell Us About the Situation in Supply and Demand of Tertiary Educated?. **Review of Applied Socio-Economic Research.** 1 (1): 11-28.

Stiglitz, J. 1973. **The Theory of "Screening", Education, and the Distribution of Income.** Cowles Foundation Discussion Paper No. 354.

Storen, Liv Anne and Arnesen, Clara Ase. 2006. What Promotes a Successful Utilization of Competence in the Labour Market Five Years after Graduation? Does Vocational Higher Education Result in a Better Match than Academic Generalist Education? In **The European Research Network on Transition in Youth – 2006 Workshop, Marseilles, 7–9 September 2006**.

Thurow, L. 1975. **Generating inequality: Mechanisms of Distribution in the U.S. Economy.** New York: Basic Books.

Tsai, Y. 2010. Returns to Overeducation: A Longitudinal Analysis of the U.S. Labor Market. **Economics of Education Review.** 29 (August): 606-617.

Tsang, M. 1987. The Impact of Underutilization of Education on Productivity: A Case Study of the U.S. Bell Companies. **Economics of Education Review.** 6 (3): 239-254.

Tsang, M. and Levin, H. 1985. The Economics of Overeducation. **Economics of Education Review.** 4 (2): 93-104.

Tsang, M., Rumberger, R., and Levin H. 1991. The Impact of Surplus Schooling on Worker Productivity. **Industrial Relations.** 30 (2): 209-228.

Tunny, G. 2002. **The Demand for Skilled Labour in Queensland.** Retrieved June 24, 2015 from http://s3.amazonaws.com/zanran_storage/ trainandemploy.qld.gov.au/ContentPages/2457237210.pdf

Tyler, J.; Murnane, R., and Levy, F. 1995. Are More College Graduates Really Taking 'High School' Jobs?. **Monthly Labor Review.** 18 (December): 18-27.

UNESCO and OECD. 2002. Financing Education: Investment and Returns. In **Analysis of the World Education Indicators: 2002 Edition.** Paris: UNESCO.

Van der Meer, P. and Wielers, R. 1996. Educational Credentials and Trust in the Labor Market. **Kyklos.** 49 (Febuary): 29-46.

Verdugo, R. and Verdugo, N. 1988. The Impact of Surplus Schooling on Earnings: Some Additional Findings. **The Journal of Human Resources.** 24: 629-643.

Verhaest, D. and Omey, E. 2009. **The Determinants of Overeduction: Different Measures, Different Outcomes?.** Working Papers No. 09/592. Belgium: Faculty of Economics and Business Administration, Ghent University.

Verhaest, D. and Van der Velden, R. 2010. **Cross-Country Differences in Graduate Overeducation and Its Persistence.** ROA Research Memorandum No. 007. Maastricht University.

Verhofstadt, E. and Omey, E. 2003. **The Impact of Education on Job Satisfaction in the First Job.** Working Papers No. 03/169. Belgium: Faculty of Economics and Business Administration, Ghent University.

Verhoogen, E.A. 2008. Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector. **Quarterly Journal of Economics.** 123 (2): 489-530.

Vieira, J. 2005. Skill Mismatch and Job Satisfaction. **Economics Letters.** 89 (1): 39-47.

Vroom, V. 1964. **Work and Motivation.** New York: John Wiley.

Wieling, M. and Borghans, L. 2001. Discrepancies Between Supply and Demand and Adjustment Processes in the Labor market. **Labour.** 15 (1): 33-56.

Wirz, A. and Atukeren, E. 2005. An Analysis of Perceived Overqualification in the Swiss Labor Market. **Economics Bulletin.** 9 (2): 1-10.

Witte, James C. and Kalleberg, Arne L. 1995. Matching Training and Jobs: The Fit between Vocational Education and Employment in the German Labor Market. **European Sociological Review.** 11 (3): 293.

Wolbers, M. 2003. Job Mismatches and Their Labour Market Effects Among School Leavers in Europe. **European Sociological Review.** 19 (3): 249-266.

Wolff, E. 1995. **Technology and the Demand for Skills.** Working Paper No. 153. New York University. Retrieved June 24, 2015 from http://econwpa.repec.org/eps/mac/papers/9810/9810004.pdf

Wolff, E. 2000. Technology and the Demand for Skills. In **The Overeducated Worker?: The Economics of Skill Utilization.** L. Borghans and A. de Grip, eds. Cheltenham, UK ; Northampton, MA, USA: E. Elgar.

World Bank. 2011. **Putting Higher Education to Work: Skills and Research for Growth in East Asia.** Washington, DC: World Bank.

Xu, Bin. 2003. Trade Liberalization, Wage Inequality and Endogenously Determined Nontraded Goods. **Journal of International Economics.** 60 (2): 417-431.

Yongyuth Chalamwong. 2011. The Change in the Demand for Labor under Technological Change, Industrial Structure, and Educational Policies. In **Revamping Thai Education System: Quality for All.** Bangkok: Development Research Institute (TDRI). (In Thai).

Yilmaz, Y. 2010. **Higher Education Institutions in Thailand and Malaysia: Can They Deliver? Background.** Retrieved June 24, 2015 from http://siteresources.worldbank.org/INTEASTASIAPACIFIC/Resources/Thailand-Malaysia-HEInstitutions.pdf

Zhu, Xiaodong. 2012. Understanding China's Growth: Past, Present, and Future. **Journal of Economic Perspectives.** 26 (4): 103-24.

APPENDICES

APPENDIX A

STUDENT LOAN FUNDS (SLF) AND INCOME CONTINGENT LOAN (ICL)[1]

The government of Thailand, led by the Chartthai Party, established the Student Loan Funds (SLF) in 1996, the main objective being to enhance access to upper secondary and higher education for students from low income families. Other objectives are to promote more equal income distribution in the long run and to develop a demand-side financing system by increasing the capacity of households in contributing more resources to education. The SLF loans cover tuition fees, education-related expenses and other living expenses. Only high-school or tertiary-level students whose household income is under 150,000 baht per year are eligible to apply for the loan.

Organization structure of the SLF

The top of administrative structure of the SLF is the SLF Board, chaired by the Permanent Secretary of the Ministry of Finance. The board has an authority to set student loan policies and other related regulations, and to decide the amount of budgets and administrative costs that should be allocated to related agencies. The SLF budget for loan is divided into two portions: one for upper secondary level (high school and vocational schools), which is supervised by the Sub-Committee on the First Expense Account; another for undergraduate level, which is supervised by the Sub-Committee on the Second Expense Account. The Krung Thai Bank, a major commercial bank owned by the government, has been hired to disburse the approved loans and collect repayments.

[1] Chapman et al, 2010; Somkiat & Areeya, 2010, and Sakulrat, 2011

Loan budget allocation and distribution

The budget of the SLF is divided by educational levels, upper secondary, vocational and undergraduate education. At university level, the Commission on Higher Education has directly provided loans to each university by being based on the number of loan recipients in previous years. The university's loan committee authorizes the distribution of finances to eligible students. Loans are provided in the same amount for high school and vocational certificate while they are differently provided by fields for high vocational certificate and university level students (Table A1). For example, the ceiling for a high-school

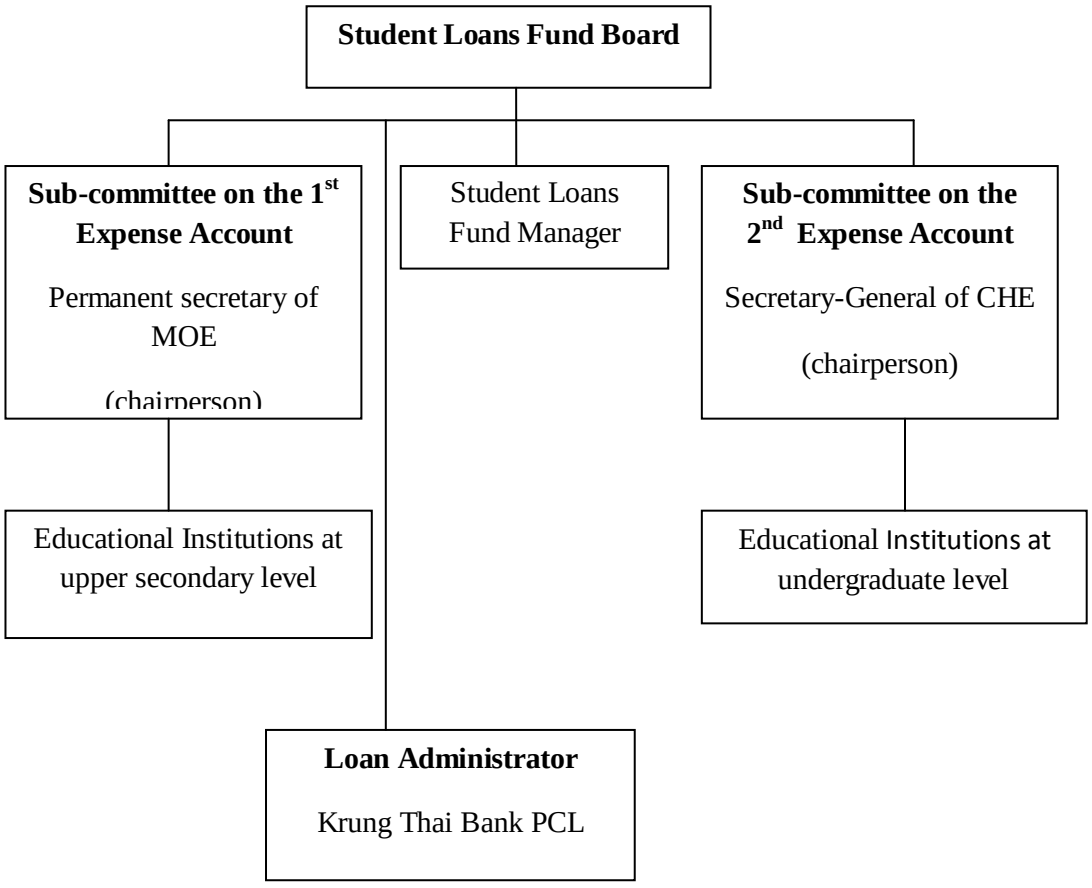


Figure A1 Organization structure of the Student Loans Fund

Source: Student Loans Fund officer's handbook, 2005.

Note: *MOE: Ministry of Education

**CHE: Commission on Higher Education, under Ministry of Education

student is set at 26,000 baht per year, while that of a vocational school student is 36,000 baht per year. The maximum loan for an undergraduate student depends on the field of education, ranging from 84,000 baht per year for social sciences, arts and humanities to 174,000 baht per year for medical sciences.

Table A1 Loan Ceiling by Educational Level

Educational level/Field of education	**Tuition fees and education-related expenses**	**Living expense**	**Total**
1.High school	14,000	12,000	26,000
2.Vocational certificate	21,000	15,000	36,000
3.High vocational certificate/ associate degree 3.1 Business administration, Arts, Agriculture, Domestic science, Tourism	25,000	20,000	45,000
3.2 Manufacturing, Information Technology, Communication	30,000	20,000	50,000
4.Undergraduate			
4.1 Social sciences, Arts, Humanities, Education	60,000	24,000	84,000
4.2 Architecture	60,000	24,000	84,000
4.3 Engineering, Sciences and Technology	70,000	24,000	94,000
4.4 Agriculture	70,000	24,000	94,000
4.5 Public Health, nurse, Pharmacology	80,000	24,000	104,000
4.6 Medical science, veterinary, dentistry	150,000	24,000	174,000

Source: Office of the Student Loan Fund, 2007.

Debt Repayment

Under the current scheme, all borrowers have to begin to repay their debts within 2 years after their graduation or after they stop borrowing, regardless of their income level. As a result, high school graduates who borrow from the SLF but do not enroll in universities or those who enroll but do not continue to borrow have to start repaying their debts immediately, unless they apply for deferral and debt forgiveness. The rates of repayment are set progressively according to a pre-specified percentage of the total loan size as shown in the Table A2. The total repayment period is 15 years, with no interest rate charged in the first year. Borrowers are then charged 1% interest rate of the repayment period. However, borrowers are penalized at the rate of 12-18% of the installment loan for failure to repay their debt on time. Deferral of

Table A2 Repayment Rate of the SLF

Year	Repayment (% of loan)
1	1.5
2	2.5
3	3
4	3.5
5	4
6	4.5
7	5
8	6
9	7
10	8
11	9
12	10
13	11
14	12
15	13
Total	100

Source: Office of the Student Loan Fund, 2007.

Note: A loan amount is 200,000 baht and on-going inflation rate of 4% per annum.

payment up to 2 years is allowed on a case-by-case basis if the borrower can prove that they have income below 4,700 baht per month or have been negatively affected by natural disasters. In addition, the outstanding debts will be forgiven if the debtors decease or become handicapped.

Income Contingent Loan (ICL)

Thailand has introduced an income contingent loan (ICL) in 2006, known as the Thailand Income Contingent Allowance and Loan System (TICAL). The ICL is loan for anyone who wants to study at the higher education level, particularly at university level. The loans provide only tuition fees with no living allowance. The ICL will be directly transferred to the universities after the loan application contracts are approved. The loan collector is at first defined as the Revenue Department. Borrowers will begin their repayment when their incomes are equal to 16,000 baht which is a minimum revenue a person has to pay for revenue tax. As time passed, it was changed in 2009 to be like the Thai SLF in regards to both the loan collector and no minimum earnings, but 2 years as a grace period instead. In the year 2011, the first batch of Thai ICL will begin to repay their loans. Then, the ICL is suspended for 1 year in 2007 and then implanted again in 2008 and 2009 due to the change in the government. Unfortunately, Prime Minister Abhisit Vejjajiva's government has stopped the ICL from lending to new borrowers until now.

Repayment Scheme for the ICL

1) Graduates have minimum income 16,000 baht per month or 192,000 baht per year.

2) The debt collector is the Revenue department. Graudates pay progressive repayment rate by income (Table A3)

Table A3 Repayment Rate by Income Level

Income level		Repayment
Per month	**Per year**	**(% of income per year)**
16,000-30,000	192,000-360,000	5
30,001-70,000	360,001-840,000	8
70,000 up	840,000 up	12

Source: Office of Student Loan Fund.

3) When borrower is 60 years old and income does not meet requirement in repayment or repayment is not finished yet, the debt must be eliminated.

4) The debt is also eliminated if borrower dies or is disabled.

The benefits of the ICL are that there is no concern with intra-family sharing so long as the scheme is universal. That is, family income is not required. Collection mechanism is efficient, that is, tax system is used to collect the debt. The ICL's repayment depends on income so there should be no concern for students with respect to incapacity to repay, or repayment hardships due to low income. The students' prospects of default or repayment hardship are eliminated. Table A4 shows the differences in target groups, type of borrowing, and repayment scheme between the SLF and ICL.

Nowadays, the numbers of SLF new borrowers have increased from 198,687 in 2008 to 209,594 in 2012. One fourth of new borrowers are bachelor students, another one fourth of them are lower and upper vocational students, and almost a half of them are upper secondary students (Table A5). In 2012, the numbers of borrowers are the highest among social science, humanities & arts, and education students, 315,637 students (Table A6).

Table A4 The Differences Between the SLF and the ICL

	SLF	**ICL**
Borrowing		
-Target groups	-Anyone who has no enough income and family income is below 150,000 per year -borrowers' ages (include the numbers of schooling years, 2 years free repayment, and 15 years of repayment) are below the age of 60.	-No family income is required. -Borrowers' age is below 30 years.
-Educational level	-Upper-secondary, vocational, and undergraduate education	-Vocational and undergraduate education - At undergraduate level, only students in demanding fields can borrow.
-Types of borrowing	-Tuition fees -Educational expenses -Living expenses	-Tuition fees -Educational expenses
Repayment		
-Repayment	-2 years after graduating and must finish repayment within 15 years -Interest rate is 1% per year	-Borrowers in year 2006, 2008, and 2009 use same repayment scheme as the SLF repayment scheme. -Borrowers in year 2012 forward will start repayment when their income is 16,000 baht per month or 192,000 baht per year and must finish their repayment within 15 years with 1% interest rate.

Source: Office of Student Loan Funds.

Table A5 The Number of New Borrowers, 2008-2012

Years	Sub-committee on the 1st expense account			Sub-committee on the 2nd expense account	Total
	Upper-secondary	Lower-vocational	Upper-vocational	Post graduate/ ungraduate	
2008	151,454			47,233	198,687
2009	209,860			88,269	298,129
2010	98,271	52,426	37,950	90,671	279,318
2011	107,420	47,684	28,481	66,282	249,867
2012	86,528	44,043	23,612	55,411	209,594

Source: SLF Annual Report.

Table A6 The Numbers of Borrowers by Fields of Study, 2012

Field code	Description of field	Borrowers
1000	Social science, humanities & arts, and education	315,637
2000	Architecture and Fine arts	15,701
3000	Engineering and science & technology	123,699
4000	Agriculture	12,732
5000	Health, Nursing, and Pharmacy	37,900
6000	Medicine, Veterinary, Dentistry	4,322
7000	Industrial technician and Information technology	37,163
8000	Business administration, Touristic industry, and catering	56,944
Total		604,098

Source: SLF Annual Report, 2012.

APPENDIX B

THE INTERNATIONAL STANDARD CLASSIFICATION OF OCCUPATIONS (ISCO)[2]

The International Standard Classification of Occupations (ISCO) is one of the main international classifications for which ILO is responsible. ISCO is a tool for organizing jobs into a clearly defined set of groups according to the tasks and duties undertaken in the job. Its main aims are to provide:

- A basis for the international reporting, comparison and exchange of statistical and administrative data about occupations
- A model for the development of national and regional classifications of occupations
- A system that can be used directly in countries that have not developed their own national classifications.

The first version of ISCO was adopted in 1957 by the Ninth International Conference of Labor Statistics (ICLS). It is known as ISCO-58. This version was superseded by ISCO-68, which was adopted by the eleventh ICLS in 1966. The third version, ISCO-88, was adopted by the fourteenth ICLS in 1987. Many current national occupational classifications are based on one of these three ISCO versions.

ISCO-88 has been designed and constructed around two key concepts: the concept of the job and the skills required for competent performance of the job. A job is defined as the set of tasks or duties designed to be performed by one person. Skill is defined as the ability to carry out the tasks and duties of a particular job. To provide an operational indication of the concept of skill levels, ISCO-88 references 4 levels which are equated with levels of formal education via the International Standard Classification of Education (ISCED). However, the ILO has indicated that the use of

[2] International Standard Classification of Occupations (Volume I), ILO(2012)

ISCED categories to define the four skill levels does not imply that the skills necessary to perform the tasks and duties of a given job can be acquired only through formal education. The skills may be acquired through informal training and experience.

Table B1 The Correspondence Between Skill Levels and Educational Level

Skill level	Corresponding education
First skill level	Primary education
Second skill level	Secondary education
Third skill level	Tertiary education
Fourth skill level	Tertiary education

Source: ILO, 1990.

Table B2 ISCO-88 Major Groups and Skill Levels

Major group	ISCO skill level
1.Legislators, senior officials and managers	-
2. Professionals	4th
3.Technicians and associate professionals	3rd
4.Clerks	2nd
5.Service workers and shop and market sales workers	2nd
6. Skill agricultural and fishery works	2nd
7.Craft and related workers	2nd
8.Plant and machine operators and assemblers	2nd
9.Elementary occupations	1st
10. Armed forces	-

Source: ILO, 1990.

Eight of ten occupational groups are related to the four skill levels. For the managerial major group (Major group 1; Legislator, senior officials, and managers), the range of tasks which can constitute a managerial occupation is deemed too large to link directly with a particular skill level. For the armed force (Major group 0), many countries have indicated that the information required to categorize occupations within their armed forces would not be available for statistical classification. Table B3 shows descriptions in sub-major groups.

ISCO has recently been updated to take into account developments in the world of work since 1988 and to make improvements in light of experience gained in using ISCO-88. The updating do not change the basic principles and top structure of ISCO-88 but significant structural changes are made in some areas. The updated classifications were adopted in December 2007 and are known as ISCO-08. Many countries are now updating their national classification either based on ISCO-08 or to improve alignment with the new international statistical standard.

ISCO-88 was seriously out of date in some areas, most notably as a result of the impact of developments in technology on professional, technical and clerical work associated with the use of computers and telecommunications. Some categories in ISCO-88 have therefore been merged, split, or moved to reflect occupational and technological change in the labor market. New categories have been created to allow for the identification of new or merging occupational groups.

The relationship between ten ISCO-08 major groups and the four skill levels is summarized in Table B4. Within major group 1, occupation in sub-major group 14: Hospitality, retail and other services managers are at skill level 3. All other occupations in major group 1 are at skill level 4. Within major group 0: Armed force occupations, each of the three sub major-groups is at a different skill level.

Table B3 The Sub-Major Groups of ISCO-88

Major groups	Sub-major groups
1 Legislators, senior officials and managers	11 Legislators and senior officials 12 Corporate managers 13 General managers
2 Professionals	21 Physical, mathematical and engineering science professionals 22 Life science and health professionals 23 Teaching professionals 24 Other professionals
3Technicians and associate professionals	31 Physical and engineering science associate professionals 32 Life science and health associate professionals 33 Teaching associate professionals 34 Other associate professionals
4 Clerks	41 Office clerks 42 Customer services clerks
5Service workers and shop and market sales workers	51 Personal and protective services workers 52 Models, salespersons and demonstrators
6 Skill agricultural and fishery works	61 Market-oriented skilled agricultural and fishery workers 62 Subsistence agricultural and fishery workers
7 Craft and related workers	71 Extraction and building trades workers 72 Metal, machinery and related trades workers 73 Precision, handicraft, printing and related trades workers 74 Other craft and related trades workers
8 Plant and machine operators and assemblers	81 Stationary plant and related operators 82 Machine operators and assemblers 83 Drivers and mobile-plant operators
9 Elementary occupations	91 Sales and services elementary occupations 92 Agricultural, fishery and related laborer 93 Laborers in mining, construction, manufacturing and transport
0 Armed forces	01 Armed forces

Source: ILO, 1990.

Table B4 Mapping of ISCO-08 Major Groups to Skill Levels

ISCO-08 major groups	**Skill level**
1.Managers	3+4
2.Professionals	4
3.Technicians and Associate professionals	3
4. Clerical support workers	2
5. Services and sales workers	2
6. Skilled agricultural, forestry and fishery workers	2
7. Craft and related trades workers	2
8. Plant and machine operators and assemblers	2
9. Elementary occupations	1
0.Armed forces occupations	1+2+4

Source: International Standard Classification of Occupation: ISCO, National Statistics Office.

Table B5 Mapping of the Four ISCO-08 Skill Levels to ISCED-97 Levels of Education

ISCO-08 skill level	**ISCED-97 groups**
4	6 Second stage of tertiary education 5a First stage of tertiary education, 1st degree (medium duration)
3	5b First stage of tertiary education (short and medium duration)
2	4 Post secondary, non-tertiary education 3 Upper secondary level of education 2 Lower secondary level of education
1	1 Primary level of education

Source: International Standard Classification of Occupation: ISCO, National Statistics Office.

In those cases where formal education and training requirements are used as part of the measurement of the skill level of an occupation, these requirements are defined in terms of ISCED-97. A mapping between ISCO skill levels and levels of education in ISCED-97 is provided in table B5. Descriptions in sub-major groups of ISCO-08 are given in table B6. Table B7 shows the differences in the number of sub-major groups between ISCO-88 and ISCO-08.

Table B6 Sub-Major Groups of ISCO-08

Major groups	Sub-major groups
1 Managers	11 Chief executives, senior officials and legislators 12 Administrative and commercial managers 13 Production and specialized services managers 14 Hospitality, retail and other services managers
2 Professionals	21 Science and engineering professionals 22 Health professionals 23 Teaching Professionals 24 Business and Administration professionals 25 Information and Communications Technology professionals 26 Legal, social and cultural professionals
3 Technicians and associate professtionals	31 Science and engineering associate professionals 32 Health associate professionals 33 Business and administration associate professionals 34 Legal, social, cultural and related associate professionals 35 Information and communications technicians
4 Clerical support workers	41 General and keyboard clerks 42 Customer services clerks 43 Numerical and material recording clerks 44 Other clerical support workers

Major groups	Sub-major groups
5 Services and sales workers	51 Personal services workers 52 Sales workers 53 Personal care workers 54 Protective services workers
6 Skilled agricultural, forestry, and fishery workers	61 Market-oriented skilled agricultural workers 62 Market-oriented skilled forestry, fishery and hunting workers 63 Subsistence farmers, fishers, hunters and gatherers
7 Craft and related trades workers	71 Craft and related trades workers 72 Metal, machinery and related trades workers 73 Handicraft and printing workers 74 Electrical and electronics trades workers 75 Food processing. Wood working, garment, and other craft and related trades workers
8 Plant and machine operators and assemblers	81 Stationary plant and machine operators 82 Assemblers 83 Drivers and mobile plant operators
9 Elementary occupations	91 Cleaners and helpers 92 Agricultural, forestry and fishery laborers 93 Laborers in mining, construction, manufacturing and transport 94 Food preparation assistants 95 Street and related sales and services workers 96 Refuse workers and other elementary workers
0 Armed forced occupations	01 Commisioned armed forces officers 02 Non-commissioned armed forces officers 03 Armed forces occupations, other ranks

Source: International Standard Classification of Occupation: ISCO, National Statistics Office.

Table B7 Numbers of Groups at Each Level of ISCO-08

Major group	**Sub-major groups**	**Minor groups**	**Unit groups**
1.Managers	4(3)	11(8)	31(33)
2.Professionals	6(4)	27(18)	92(55)
3.Technicians and associate professionals	5(4)	20(21)	84(73)
4. Clerical support workers	4(2)	8(7)	29(23)
5.Services and sales workers	4(2)	13(9)	40(23)
6.Skilled agricultural, forestry and fishery workers	3(2)	9(6)	18(17)
7. Craft and related trades workers	5(4)	14(16)	66(70)
8. Plant and machine operators and assemblers	3	14(20)	40(70)
9.Elementary occupations	6(3)	11(10)	33(25)
0 Armed forces occupations	3(1)	3(1)	3(1)
Total ISCO-08 (ISCO-88)	**43(28)**	**130(116)**	**436(390)**

Source: International Standard Classification of Occupations (ISCO-08), ILO, 2012.

Note: Numbers for ISCO-88 are shown in brackets where different.

APPENDIX C

INTERNATIONAL STANDARD CLASSIFICATION OF EDUCATION (ISCED 1997)

The world's education systems vary widely in terms of structure and curricular content. Consequently, it can be difficult for national policymakers to compare their own education systems with those of other countries or to benchmark progress towards national and international goals. Thus, UNESCO developed the International Standard Classification of Education (ISCED) to facilitate comparisons of education statistics and indicators across countries on the basis of uniform and internationally agreed definitions. ISCED classified educational programmes by two main axes: levels of education (Table C1) and fields of education (Table C2).

Table C1 Levels of Education

Code	Name of the level
0	Pre-primary education
1	Primary education
2	Lower secondary education
3	Upper secondary education
4	Post secondary education
5	First stage of tertiary education (not leading directly to an advanced research qualification)
6	Second stage of tertiary education (leading to an advanced research qualification)

S**ource:** Educational standard classification, National Statistics Organization, 2005.

Educational level at level 0 is pre-primary level which is defined as the initial stage of organized instruction. This level is designed for children aged at least 3 years. Educational level 1 is designed to give students a basic education in reading, writing, mathematics along with an elementary understanding of other subjects such as history, geography, social science, arts, and music. The educational aim of level 2 is to lay the foundation for lifelong learning and human development. The programmes at this level are on a more subject-oriented pattern using more-specialized teachers and several teachers conducting classes in their fields of specialization. The entry is after some 6 years of primary education. The level 3 of education begins at the end of full time compulsory education. More specialization may be observed at this level than level 2 and teachers need to be more qualified or specialized than for level 2.

ISCED level 4 captures programmes that straddle the boundary between upper-secondary and post-secondary education. However, this level cannot be regarded as tertiary programmes. They are often not significantly more advanced than programmes at level 3 but they serve to broaden the knowledge of participants who have already completed a program at level 3. ISCED 5 is the first stage of tertiary education consisting of programmes which have an educational content more advanced than those offered at level 4. The level 6 is reserved for tertiary programmes which lead to the award of an advanced research qualification. The program is devoted to advanced study and original research and are not based on coursework only.

ISCED 97 classifies upper-secondary level and tertiary level into 8 fields of study: Education, Humanities & arts, Social science, science, engineering, agriculture, health, and services (Table C2).

Table C2 Fields of Education

Titles	Sub-titles
1.Education	14 Teacher training and education science
2.Humanities & Arts	21 Arts 22 Humanities
3.Social science, business and law	31 Social and behavioral science 32 Journalism and information 34 Business and administration 38 Law
4. Science	42 Life science 44 Physical science 46 Mathematics and statistics 48 Computing
5. Engineering, manufacturing and construction	52 Engineering and engineering trades 54 Manufacturing and processing 58 Architecture and building
6. Agriculture	62 Agriculture, forestry and fishery 64 Veterinary
7. Health and welfare	72 Health 76 Social services
8. Services	81 Personal services 84 Transport services 85 Environmental protection 86 Security services

S**ource:** Educational standard classification, National Statistics Organization, 2005.

APPENDIX D

INTERNATIONAL STANDARD INDUSTRIAL CLASSIFICATION OF ALL ECONOMIC ACTIVITIES (ISIC)

The International Standard Industrial Classification of All Economic Activities (ISIC) is the international reference classification of productive activities. Its main purpose is to provide a set of activity categories that can be utilized for the collection and reporting of statistics according to such activities. ISIC is a basic tool for studying economic phenomena, fostering international comparability of data, providing guidance for the development of national classifications and for promoting the development of sound national statistical systems.

Table D1 Development of ISIC

Version	Year of issue
ISIC	1948
ISIC Revision 1	1958
ISIC Revision 2	1968
ISIC Revision 3	1990
ISIC Revision 3.1	2004
ISIC Revision 4	2008

Source: The Impact of BOT Data Management from ISIC Rev.3 to ISIC Rev. 4, Bank of Thailand, 2011.

The updated version of ISIC is ISIC Rev.4 which was published in 2008. ISIC Rev.1,2,3, and 3.1 were published in 1958, 1968, 1989, and 2002, respectively. The third and fourth revisions of ISIC put increased emphasis on harmonization with other

activity classifications and product classifications, adding considerable complexity and constraints that did not apply in earlier revisions of ISIC. ISIC Rev.4 has been launched because of the emergence of new technologies and new divisions of labor between organizations. The objectives of the fourth revision were formulated in terms of improving and strengthening its relevance and comparability with other classifications.

The individual categories of ISIC have been aggregated into the following 21 sections:

Section	Description
A	Agriculture, forestry and fishing
B	Mining and quarrying
C	Manufacturing
D	Electricity, gas, steam and air conditioning supply
E	Water supply; sewerage, waste management and remediation activities
F	Contruction
G	Wholesale and retail trade; repair of motor vehicles and motorcycles
H	Transportation and storage
I	Accomodation and food service activities
J	Information and communication
K	Financial and insurance activities
L	Real estate activities
M	Professionals, scientific and technical activities
N	Administrative and support service activities
O	Public administration and defence; compulsory social security
P	Education
Q	Human health and social work activities
R	Arts, entertainment and recreation
S	Other service activities
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U	Activities of extraterritorial organizations and bodies

The example of section A in ISIC-Rev4

Section A: Agriculture, forestry and fishing

Division	Group	Class	Description
Division 01			Crop and animal production, hunting and related service activities
	011		Growing of non-perennial crops
		0111	Growing of cereals (except rice), leguminous crops and oil seeds
		0112	Growing of rice
		0113	Growing of vegetables and melons, roots and tubers
		0114	Growing of sugar cane
		0115	Growing of tobacco
		0116	Growing of fibre crops
		0119	Growing of other non-perennial crops
	012		Growing of perennial crops
		0121	Growing of grapes
		0122	Growing of tropical and subtropical fruits
		0123	Growing of citrus fruits
		0124	Growing of pome fruits and stone fruits
		0125	Growing of other tree and bush fruits and nuts
		0126	Growing of oleaginous fruits
		0127	Growing of beverage crops
		0128	Growing of spices, aromatic, drug and pharmaceutical crops
		0129	Growing of other perennial crops
	013	0130	Plant propagation
	014		Animal production
		0141	Raising of cattle and buffoloes
		0142	Raising of horses and other equines
		0143	Raising of camels and camelids
		0144	Raising of sheep and goats
		0145	Raising of swine/pigs
		0146	Raising of poultry
		0149	Raising of other animals
	015	0150	Mix farming
	016		Support activities to agriculture and post-harvest crop activities
		0161	Support activities for crop production
		0162	Support activities for animal production
		0163	Post-harvest crop activities
		0164	Seed processing for propagation
	017	0170	Hunting, trapping and related service activities
Division 02			Forestry and logging
	021	0210	Silviculture and other forestry activities
		0220	Logging
		0230	Gathering of non-wood forest products
		0240	Support services to forestry
Division 03			Fishing and aquaculture
	031		Fishing
		0311	Marine fishing
		0312	Freshwater fishing
	032		Aquaculture
		0321	Marine aquaculture
		0322	Freshwater aquaculture

Source: International Standard Industrial Classification of All Economic Activities (ISIC), Rev. 4, 2008.

Table D2 The Differences Between ISIC Rev.3 and ISIC Rev.4

	ISIC REV.3	ISIC REV.4
1	Differences in sections	Differences in sections
	17 sections	21 sections (A-U)
	60 divisions	88 divisions
	159 groups	238 groups
	292 classes	419 classes
2	Include service activities in main activities. For example, machine-fixing is included in machine production.	Give an importance to services by grouping service activities into one group
3	There is no group for electronic equipment, computer, and tele-communication	Grouping ICT business in more detail: production, retail, wholesale, and service
4	Shipping is grouped into time-specified shipping and shipping with non-specified time.	Shipping is grouped into passenger and product shipping.
5	Financial intermediation is in section J including 3 divisions, 5 groups, and 12 classes.	Financial intermediation is in section K called financial and insurance activites including 3 divisions, 10 groups, and 18 classes. New classes are Activities of holding companies, Trust, fund, and other financial vehicles, Reinsurance, and Fund management activities.

Source: The Impact of BOT Data Management from ISIC Rev.3 to ISIC Rev. 4, Bank of Thailand, 2011.

The differences between International Standard Industrial Classification (ISIC 3) and Thailand Standard Industrial Classification (TSIC 2009) are shown in Table D2 and D3.

National Statistics Organization (NSO) has revised Thailand Standard Industrial Classification (TSIC) 2009 on the basis of three international industrial classifications: International Standard Industrial Classification of all economic activities, Revision 4 (ISIC Rev.4) by United Nations Statistics Division (UNSD), ASEAN Common Industrial Classification (ACIC) by ASEAN secretariat, and East Asia Manufacturing Industrial Classification (EAMIC) Version 1 by EAMS secretariat. TSIC categorizes industries into 21 sections, 88 divisions, 243 groups, 440 classes, and 1,089 activities (Table D4).

Table D3 The Differences Between ISIC Rev.3 and ISIC Rev.4 by Sections, Divisions, Groups, and Classes

ISIC Rev.3				ISIC Rev.4			
Section		Division	Class	Section		Division	Class
A	Agriculture, hunting & forestry	2	9	A	Agriculture, forestry & fishing	3	38
B	Fishing	1	1				
C	Mining and quarrying	5	12	B	Mining and quarrying	5	14
D	Manufactruing	23	127	C	Manufacturing	24	137
E	Electricity, gas, and water supply	2	4	D	Electricity, gas, steam and air conditioning supply	1	3
				E	Water supply; sewerage, waste management and remediation activities	4	8
F	Construction	1	5	F	Construction	3	11
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	3	29	G	Wholesale and retail trade; repair of motor vehicles, motorcycles	3	43
H	Hotel and restaurants	1	2	I	Accomodation and food service activities	2	7
I	Transport, storage and communications	5	17	H	Transport and storage	5	20
				J	Information and communication	6	23
J	Financial Intermediation	3	12	K	Financial and insurance activities	3	18
K	Real estate, renting and business activities	5	31	L	Real estate activities	1	2
				M	Professional, scientific and technical activities	7	14
				N	Administrative and support service activities	6	26
L	Public administration and defense; compulsory social security	1	8	O	Public administration and defense; compulsory social security	1	7
M	Education	1	5	P	Education	1	8
N	Health and social network	1	6	Q	Human health and social work activities	3	9
O	Other community, social and personal service activities	4	22	R	Arts, entertainment and recreation	4	10
				S	Other service activities	3	17
P	Activities of private households with employed persons	1	1	T	other service activities employers; undifferentiated goods-and services-producing activities of households for own use	2	3
Q	Extra-territorial organizatio and bodies	1	1	U	Activities of extraterritorial organizations and bodies	1	1
Total	17	60	292		21	88	419

Source: The Impact of BOT Data Management from ISIC Rev.3 to ISIC Rev. 4, Bank of Thailand, 2011.

Table D4 TSIC Industrial Classification

Section	The biggest industrial groups	21	A-U
Division	sub-industrial groups from sections	88	2-digit code
Group	sub-industrial groups from divisions	243	3-digit code
Class	sub-industrial groups from groups	440	4-digit code
Activity	The smallest industrial groups	1,089	5-digit code

Source: Thailand Standard Industrial Classification 2009, National Statistics Organization.

APPENDIX E

THE RESULTS OF WAGE REGRESSION ON OVEREDUCATION DUMMY (Full Model)

Table E1 OLS and Quantile Results

Variables	OLS		Q1		Q2		Q3		Q4	
	Males	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Upper-secondary	0.431*	0.430*	0.335*	0.310*	0.342*	0.308*	0.345*	0.330*	0.366*	0.346*
Tertiary	1.234*	1.144*	0.978*	0.855*	1.031*	0.897*	1.070*	0.948*	1.158*	0.999*
Experience	0.029*	0.031*	0.02*	0.021*	0.024*	0.024*	0.025*	0.025*	0.028*	0.027*
Experience squared	-0.001*	-0.001*	-0.0004*	-0.0004*	-0.0004*	-0.0004*	-0.0005*	-0.0004*	-0.0005*	-0.0005*
Married	0.041*	-0.031*	-0.035*	-0.044*	0.027*	-0.036*	0.033*	-0.039*	0.030*	-0.038*
Small firm	-0.198*	-0.223*	-0.236*	-0.299*	-0.201*	-0.241*	-0.181*	-0.222*	-0.173*	-0.212*
Part time	-0.246*	-0.259*	-0.35*	-0.347*	-0.355*	-0.329*	-0.304*	-0.319*	-0.266*	-0.273*
Year dummy	0.205*	0.199*	0.240*	0.223*	0.241*	0.216*	0.225*	0.204*	0.216*	0.204*
Overeducation dummy	-0.338*	-0.277*	-0.295*	-0.224*	-0.295*	-0.229*	-0.290*	-0.223*	-0.312*	-0.230*

Variables	Q5		Q6		Q7		Q8		Q9	
	Males	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
Upper-secondary	0.380*	0.374*	0.405*	0.406*	0.430*	0.449*	0.462*	0.475*	0.536*	0.534*
Tertiary	1.213*	1.071*	1.276*	1.144*	1.342*	1.241*	1.409*	1.319*	1.462*	1.437*
Experience	0.027*	0.029*	0.029*	0.029*	0.030*	0.031*	0.032*	0.033*	0.033*	0.036*
Experience squared	-0.0005*	-0.0005*	-0.0005*	-0.0005*	-0.0005*	-0.0005*	-0.0006*	-0.0006*	-0.0006*	-0.0006*
Married	0.034*	-0.033*	0.030*	-0.028*	0.028*	-0.019*	0.036*	-0.017*	0.063*	-0.009*
Small firm	-0.171*	-0.195*	-0.164*	-0.192*	-0.167*	-0.182*	-0.169*	-0.167*	-0.162*	-0.154*
Part time	-0.259*	-0.246*	-0.217*	-0.231*	-0.201*	-0.210*	-0.180*	-0.189*	-0.160*	-0.167*
Year dummy	0.195*	0.204*	0.189*	0.194*	0.179*	0.188*	0.176*	0.183*	0.169*	0.175*
Overeducation dummy	-0.306*	-0.253*	-0.325*	-0.270*	-0.337*	-0.287*	-0.359*	-0.299*	-0.364*	-0.311*

Note: Different level of significance are denoted as follows: * (5% level), ** (10% level). Another variable is included in the regression isindustry type.

APPENDIX F

THE RESULTS OF WAGE REGRESSION ON 'MATCH' VARIABLE (Full Model)

Table F1 The Result of OLS and Quantile Regression on Earnings

Variables	OLS		Q1		Q2		Q3		Q4	
	Males	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
upper-secondary overeducated	0.162*	0.198*	0.120*	0.129*	0.126*	0.152*	0.131*	0.158*	0.150*	0.162*
upper-secondary matched	0.420*	0.421*	0.325*	0.296*	0.330*	0.296*	0.334*	0.318*	0.351*	0.337*
tertiary overeducated	0.836*	0.845*	0.624*	0.593*	0.667*	0.635*	0.695*	0.689*	0.756*	0.734*
tertiary matched	1.263*	1.153*	1.010*	0.857*	1.065*	0.912*	1.123*	0.967*	1.204*	1.019*
experience	0.029*	0.030*	0.021*	0.021*	0.023*	0.023*	0.025*	0.025*	0.027*	0.027*
experience squared	-0.001*	-0.001*	-0.0004*	0.000*	-0.0004*	0.000*	-0.0005*	0.000*	-0.0005*	0.000*
married	0.042*	-0.031*	0.037*	-0.042*	0.029*	-0.035*	0.034*	-0.039*	0.031*	-0.039*
small firm	-0.199*	-0.223*	-0.240*	-0.299*	-0.207*	-0.243*	-0.182*	-0.222*	-0.177*	-0.211*
part time	-0.247*	-0.259*	-0.349*	-0.350*	-0.357*	-0.330*	-0.303*	-0.321*	-0.274*	-0.272*
year dummy	0.206*	0.199*	0.239*	0.221*	0.244*	0.215*	0.228*	0.208*	0.215*	0.206*

Variables	Q5		Q6		Q7		Q8		Q9	
	Males	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**	**Males**	**Females**
upper-secondary overeducated	0.157*	0.171*	0.157*	0.187*	0.156*	0.200*	0.160*	0.223*	0.188*	0.239*
upper-secondary matched	0.369*	0.359*	0.387*	0.397*	0.419*	0.435*	0.451*	0.466*	0.532*	0.522*
tertiary overeducated	0.794*	0.783*	0.849*	0.833*	0.893*	0.918*	0.965*	0.983*	1.063*	1.100*
tertiary matched	1.275*	1.089*	1.326*	1.168*	1.380*	1.256*	1.433*	1.337*	1.467*	1.442*
experience	0.026*	0.028*	0.028*	0.029*	0.030*	0.031*	0.032*	0.033*	0.033*	0.036*
experience squared	-0.0005*	-0.001*	-0.0005*	0.000*	-0.0005*	-0.001*	-0.0006*	-0.001*	-0.0006*	-0.001*
married	0.034*	-0.031*	0.031*	-0.029*	0.029*	-0.019*	0.035*	-0.017*	0.063*	-0.009
small firm	-0.172*	-0.195*	-0.167*	-0.195*	-0.164*	-0.182*	-0.169*	-0.165*	-0.162*	-0.156*
part time	-0.256*	-0.244*	-0.219*	-0.231*	-0.202*	-0.212*	-0.183*	-0.192*	-0.160*	-0.167*
year dummy	0.197*	0.203*	0.190*	0.195*	0.180*	0.188*	0.177*	0.186*	0.166*	0.174*

Note: Different levels of significance are denoted as follows: * (5% level), ** (10% level). Another variable is included in the regression is industry type.

BIOGRAPHY

NAME	Akkaya Senkrua
ACADEMIC BACKGROUND	Bachelor's degree in Economics from Thammasat University, Bangkok, Thailand in 1996 Master's degree in Economics from California State University, Los Angeles, The United State of America in 2000
PRESENT POSITION	2005-Present Lecturer of Faculty of Business, Economics, and Communication, Naresuan University
EXPERIENCE	Lecturer of Faculty of Management, Suan Dusit Rajabhat University