

Mismatch among Thai STEM certificate holders: Determinants and Consequences (Narrow STEM Definition)

Sasithorn Supakienmongkol

ssupakie@gmu.edu

0000-0001-5510-5596

Schar School of Policy and Government, George Mason University,
3351 Fairfax Dr, Arlington, VA 22201 (United States)

Abstract

STEM workforce is a crucial driver of Thailand's economy. Over the past few years, there has been significant concern regarding the adequacy of the supply of STEM workers to meet the demands of the market. A number of national policies have been put in place to support the development of human resources in STEM. With data from Labor Force Surveys, this research examines the Thai STEM workforce in an effort to ascertain whether the notion of STEM shortage is more of a mismatch between degrees and jobs. The study then evaluates determinants and labor market outcomes of the mismatches.

1. Background

Knowledge, as embodied in human beings as “human capital”, has always been central to economic development (OECD, 1996). Education specifically related to STEM disciplines is vital to long-term economic growth and individual welfare because it stimulates innovation and produces workers able to drive and respond to technological advancement (Atkinson and Mayo 2010). Increases in STEM education benefit the entire world, and it is particularly critical for developing countries. STEM human capital and lifelong learning are important tools for developing countries to escape the middle-income trap. However, most developing countries are now experiencing the STEM shortage challenge. Take Thailand for example, despite notably expanding its educational system, the issue of a STEM human capital shortage still exists. In response to the issue, the Thai government has launched the national policy plan to direct more students into STEM pipeline (UNCTAD 2015).

Throughout the policy to increase human resources in STEM, there was evidence of a STEM education – occupation mismatch in Thai job market. STEM shortage captures a misalignment between supply of and demand for in the labor market. Mismatch, or undersupply of skills on some areas implies that the problems of shortage may have more to do with the issue of mismatches between specific STEM degrees and/or skills sets being sought for specific positions. One of the reasons of the mismatch phenomenon that has always been overlooked is the problem of weak institutions in developing countries. Lack of financial and career incentives for scientists or researchers, low investment on national R&D, few research institute or think tanks, these institutional factors hinder STEM professional opportunities to enter a STEM career and as a result, hold jobs in other fields.

2. Purpose of study

The research agenda aims 1) to examine how the relationship between STEM education and skill mismatches has changed over time, especially after Thailand’s government launched a national policy plan in 2012; 2) to ascertain whether the problem of Thailand’s STEM shortage is a mismatch between degrees and jobs; 3) to identify specifics areas of mismatch; 4) to investigate how the mismatch between job and degree can be influenced by educational outcomes, and demographic attributes; 5) to investigate the effect on earnings on working inside and outside one’s STEM degree field.

3. Methodology and Research Design

3.1 Data

The primary data used for this study will result from individual level data from Thailand’s National Labor Force Survey (LFS) which is cross-sectional data. The LFS is a quarterly survey conducted by the National Statistical Office of Thailand (NSO), Statistical Forecasting Bureau, Thailand. The 3rd quarter rounds of the survey (July-September) from 2007 to 2016 are utilized. The 3rd quarter round of the LFS is considered the “full employment” round of the survey.

STEM covers a diverse array of subjects and occupations. The data included in this study uses the narrow STEM definition, and includes the majors listed in Table 1 and 2.

Table 1. ISCO-08 Occupations list (sub-domain)

Occupations	ISCO 2-digit level
Science and Engineering Professionals	21
Information and communications technology professionals	25
Science and Engineering Associate Professionals	31
Information and communication technicians	35

Table 2. ISCED 1997 fields of Narrow STEM definition

Degree program	ISCED 2-digit level
Life sciences	42
Physical sciences	44
Mathematics and statistics	46
Computing	48
Engineering and engineering trades	52
Manufacturing and processing	54

3.2 Method of Analysis

The definition of STEM education-job mismatch is when the skills that a worker possess versus the skills needed for a specific job do not match or there is horizontal mismatch. In order to estimate the mismatch, this study applies a subjective measurement by matching one's educational background with a proper job, referring to criteria developed by U.S. Bureau of Labor Statistics (BLS) and job description by The International Standard Classification of Occupations (ISCO).

Due to the categorical nature of the outcome variable, the study runs Logistic regression analysis along with descriptive statistics to analyze the factors contributing to STEM education – job mismatch among the respondents. To investigate the return to STEM education, gender wage gap in STEM, and the impacts of mismatch on labor market outcomes, pooled OLS regression approach will be adopted.

4. Results

Descriptive Statistics

Table 3 presents the descriptive statistics of the categorical independent variables, and Table 4 presents the descriptive statistics of STEM degree holders by gender.

Table 3: Descriptive statistics of the dependent variable (N=28,628)

	Freq.	Percent	Cum.
Mismatch	22,382	78.18	78.18
Match	6,246	21.82	100
Total	28,628	100	

Figure 1: Mismatch between STEM education and occupation from 2007-2016

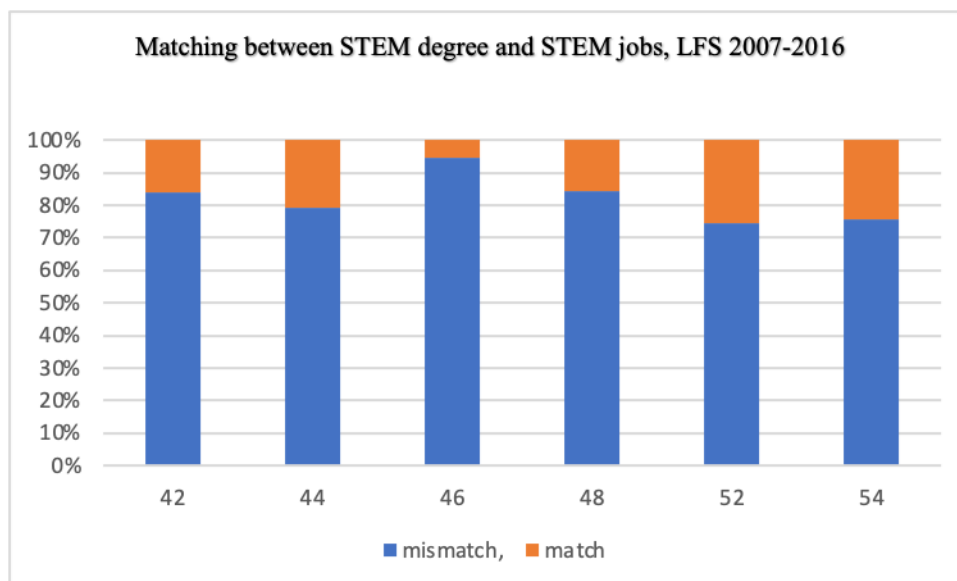


Table 4: Descriptive statistics of STEM degree holders by gender from 2007-2016

Subject	--- Male ---		--- Female ---	
	Mismatch	Match	Mismatch	Match
42	416	100	695	115
44	497	138	601	150
46	150	8	287	16
48	2,160	761	4,219	426
52	12,237	4,080	476	245
54	311	138	333	69

Logistic Regression Analyses

Table 5 presents the findings of the Logistic Regression analysis. Findings from the matched-mismatch category show that demographic characteristics, and STEM major were all found to be statistically significant predictors of the odds of a STEM graduate to be matched or mismatched with their jobs. On the other hand, findings from the same category suggest that graduates who live outside Bangkok, live outside municipality, and being female have higher odds of being mismatched with their jobs than matched compared to their peers.

Table 5: Logistic Regression Model for STEM Degree Holders -Job Match

(1)

(2)

Variables **Dependent Variables: Mismatch (0), Match (1)**

Region (reference: Bangkok)		
Central	-0.310*** (0.0460)	-0.298*** (0.0466)
Northern	-1.065*** (0.0578)	-1.020*** (0.0584)
Northeastern	-1.377*** (0.0596)	-1.294*** (0.0602)
Southern	-1.185*** (0.0636)	-1.128*** (0.0642)
Municipality (reference: living inside municipal)		
Living outside	-0.0767* (0.0367)	-0.0859* (0.0370)
Sex (reference: Male)		
female	-1.005*** (0.0402)	-0.638*** (0.0463)
AGE (20-60)		
	0.0151*** (0.00199)	0.0155*** (0.00204)
Marital status (reference: single)		
Married	-0.0222 (0.0356)	-0.0443 (0.0359)
Widowed	-0.368 (0.288)	-0.405 (0.291)
Divorced	-0.150 (0.152)	-0.184 (0.154)
Separated	-0.432** (0.148)	-0.447** (0.149)
Level of education (reference: Diploma)		
higher vocational	0.0594 (0.210)	-0.0557 (0.211)
Bachelor's degree	1.216*** (0.210)	1.286*** (0.211)
Master's degree	1.157*** (0.218)	1.272*** (0.220)
Doctorate degree	0.0603 (0.333)	0.212 (0.338)

year of survey (reference=2007)

year of survey=2008	-0.0113 (0.0693)	-0.0163 (0.0698)
year of survey=2009	0.00919 (0.0696)	0.00854 (0.0700)
year of survey=2010	-0.0589 (0.0779)	-0.0608 (0.0785)
year of survey=2011	-0.137* (0.0699)	-0.145* (0.0704)
year of survey=2012	-0.0510 (0.0676)	-0.0573 (0.0680)
year of survey=2013	-0.0952 (0.0681)	-0.133 (0.0688)
year of survey=2014	-0.0124 (0.0683)	-0.0555 (0.0689)
year of survey=2015	-0.111 (0.0687)	-0.159* (0.0694)
year of survey=2016	-0.177** (0.0682)	-0.210** (0.0688)

Subject (Reference: Life science)

Physical sciences		0.298** (0.103)
Mathematics and statistics		-1.137*** (0.226)
Computing		0.424*** (0.0850)
Engineering and engineering trades		0.981*** (0.0841)
Manufacturing and processing		0.629*** (0.114)

Constant	-1.521*** (0.226)	-2.344*** (0.243)
-----------------	----------------------	----------------------

Observations	28628	28628
R-squared	0.1062	0.1186

Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

How costly is the mismatch?

Table 6 reports descriptive statistics on number of men and women having STEM degrees and their average monthly salary. There are few numbers of women who have STEM degree compared to men. Additionally, women who earn STEM degree are paid less than men and experience greater wage penalty from working in non-STEM career compared to their male workers.

Table 6: Descriptive statistics on men and women from being matched/mismatched between STEM degrees and jobs and their average monthly wage (THB)

Sex	Mismatch	Match
Male	15108.28	24211.88
Female	13550.22	20709.27

Multiple Regression Analyses

Table 9 presents the findings of the Multiple Regression analysis. As shown in Table 9, model one includes only indicators for workers' background characteristics. The result represents the overall wage gap among male and female workers who holds STEM degrees. Model two controls for the matching between STEM degree and STEM jobs of workers. Model three adds an indicator for different degree fields.

Table 7: Returns to STEM Education (Pooled OLS)

Variables	(1) Log monthly earnings regression	(2)	(3)
Match (reference: Mismatch)		0.268*** (0.00649)	0.266*** (0.00650)
Sex (reference: Male)	-0.140*** (0.00620)	-0.101*** (0.00609)	-0.0537*** (0.00733)
AGE (20-60)	0.0222*** (0.00231)	0.0190*** (0.00224)	0.0187*** (0.00223)
AGE2	0.000160*** (0.0000302)	0.000194*** (0.0000294)	0.000188*** (0.0000293)

Region (reference: Bangkok)

Central	-0.232*** (0.00914)	-0.211*** (0.00890)	-0.214*** (0.00886)
Northern	-0.466*** (0.0104)	-0.414*** (0.0102)	-0.415*** (0.0101)
Northeastern	-0.481*** (0.0102)	-0.420*** (0.0100)	-0.418*** (0.00999)
Southern	-0.440*** (0.0109)	-0.385*** (0.0107)	-0.388*** (0.0106)
Municipality (reference: living inside municipal)			
Living outside	-0.0229*** (0.00608)	-0.0200*** (0.00590)	-0.0215*** (0.00588)
Marital status (reference: single)			
Married	0.0545*** (0.00615)	0.0561*** (0.00597)	0.0572*** (0.00595)
Widowed	-0.0410 (0.0414)	-0.0290 (0.0402)	-0.0296 (0.0400)
Divorced	-0.0497* (0.0228)	-0.0438* (0.0221)	-0.0446* (0.0220)
Separated	-0.152*** (0.0219)	-0.137*** (0.0213)	-0.128*** (0.0212)
Level of education (reference: Diploma)			
higher vocational degree	0.0309 (0.0282)	0.0328 (0.0274)	0.0216 (0.0273)
Bachelor's degree	0.426*** (0.0283)	0.380*** (0.0275)	0.375*** (0.0274)
Master's degree	0.788*** (0.0306)	0.745*** (0.0298)	0.729*** (0.0297)
Doctorate degree	0.902*** (0.0503)	0.909*** (0.0489)	0.882*** (0.0488)
year of survey (reference=2007)			
year==2008	0.00690 (0.0121)	0.00798 (0.0117)	0.00646 (0.0117)

year==2009	-0.0154 (0.0121)	-0.0155 (0.0118)	-0.0148 (0.0117)
year==2010	0.00821 (0.0134)	0.0110 (0.0130)	0.0108 (0.0129)
year==2011	0.0307* (0.0120)	0.0371** (0.0116)	0.0386*** (0.0116)
year==2012	0.140*** (0.0117)	0.143*** (0.0114)	0.141*** (0.0113)
year==2013	0.209*** (0.0118)	0.214*** (0.0115)	0.211*** (0.0115)
year==2014	0.254*** (0.0119)	0.255*** (0.0116)	0.253*** (0.0115)
year==2015	0.262*** (0.0119)	0.268*** (0.0115)	0.266*** (0.0115)
year==2016	0.276*** (0.0117)	0.284*** (0.0113)	0.282*** (0.0113)

Subject (Reference: Life science)

Physical sciences			0.0242 (0.0164)
Mathematics and statistics			0.0879*** (0.0231)
Computing			-0.0821*** (0.0131)
Engineering and engineering trades			0.0230 (0.0135)
Manufacturing and processing			-0.0374* (0.0189)

Constant	8.513*** (0.0509)	8.491*** (0.0495)	8.516*** (0.0507)
-----------------	----------------------	----------------------	----------------------

Observations	28628	28628	28628
R-squared	0.532	0.559	0.563

Standard errors in parentheses

* p<0.05, ** p<0.01, *** p<0.001

Competing interests

The author has no competing interests.

References

Atkinson, Robert D. and Merrilea Mayo. (2010). Refueling the U.S. innovation economy: Fresh approaches to science, technology, engineering and mathematics (STEM) education. Washington, DC: Information Technology and Innovation Foundation.

OECD (1996) 'The Knowledge-Based Economy' OECD (Eds) STI Outlook OECD Paris

Speer, J. (2020). STEM Occupations and the Gender Gap: What Can We Learn from Job Tasks?.

UNCTAD. (2015). United Nations Conference on Trade and Development, Science, Technology, & innovation review, Thailand.