

Education–Occupation Mismatch and Its Wage Penalties in Informal Employment in Thailand

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This study examines the incidence of vertical mismatch among formal and informal workers in Thailand. Using the 2011, 2013, and 2015 Thailand Household Socio-economic Surveys, the study analyzes the relationship between vertical mismatch and wage penalties and premiums across four types of workers: formal government, formal private firm, informal private firm, and informal own-account workers. The incidence of overeducation is modest among the oldest cohort (8.7%) but prevalent among the youngest cohort (29.3%). Government employees face the highest overeducation wage penalties (28.2%) compared to matched workers, while in private firms, informal workers have consistently higher overeducation wage penalties than formal workers. Educated young workers are increasingly absorbed into low-skill informal work in private firms and face large overeducation wage penalties. The inability of many young workers to capitalize on their educational investments in Thailand’s formal labor market is a concern for future education and employment policy development in Thailand.

Keywords: informality, overeducation, returns to education, Thailand, vertical mismatch

JEL codes: A20, E26, I26, J01

I. Introduction

Over the past several decades, developing economies have emphasized the expansion of education and increasing educational attainment for their citizens as a means to achieve economic development. Despite rapidly increasing educational attainment, subsequent skilled job growth has often lagged behind. The combination of a rapidly growing educated workforce and slow growth of skilled employment can lead to a problem of “overeducation”—also called vertical mismatch—in developing countries, meaning that educated workers engage in employment that requires less formal education than they have acquired.

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The existence of widespread informal employment in developing economies adds a layer of concern against increasing rates of overeducation. According to the International Labour Organization (ILO), own-account workers working in informal enterprises, as well as employees whose “employment relationships [are], in law or in practice, not subject to national labor legislation, income taxation, social protection or entitlement to certain employment benefits,” are considered informally employed (International Labour Organization 2003). Informal employment is generally associated with low skill and low pay. Thus, in a developing country context where formal employment growth is often slow, low-skill informal employment may need to absorb a growing educated workforce, potentially exacerbating overeducation wage penalties.

This paper evaluates the incidence of vertical mismatch and associated wage penalties and premiums across formal and informal employment in Thailand. Thailand is a representative case of a developing country with a rapidly expanding educated workforce alongside high rates of informal employment and slow formal employment growth. Since the government’s supply of education and compulsory education laws vary across different generations of workers, we analyze the incidence of vertical mismatch and associated wage penalties across age cohorts. In addition, this paper analyzes the relationship between vertical mismatch and wage penalties and premiums across four types of workers, including formal government, formal private firm, informal private firm, and informal own-account workers.

We hypothesize that the incidence of overeducation will be higher among younger cohorts due to rapid increases in compulsory education relative to skilled job growth. Likewise, we expect the incidence of overeducation to be higher in informal employment because the average skill level for informal jobs is low while informal work has increasingly absorbed Thailand’s young, educated workforce. We hypothesize that overeducation wage penalties are relatively high for formal government employees compared to other types of workers because of the rigid compensation system that sets pay based on occupation and experience, but gives little additional reward for education completed beyond what is required for the position. By contrast, the private sector is more flexible in allowing overeducated employees to fully utilize their abilities and is more likely to pay based on capabilities (Dolton and Vignoles 2000). By extending the same logic, we expect workers in informal private firm employment and particularly in informal own-account work to have lower overeducation wage penalties than formal government workers. However, it is an empirical question whether formal or informal workers in private firms have higher overeducation wage penalties.

The analysis uses individual-level data from the 2011, 2013, and 2015 rounds of the Thai Socio-economic Survey (SES). Consistent with our hypothesis, we find that the incidence of overeducation is most prevalent (29.3%) among the youngest cohort born between 1981 and 1990 and least prevalent (8.7%) among the oldest cohort born between 1951 and 1960. We also find high rates of overeducation in

informal employment. This is particularly the situation among the youngest cohort, where 37.3% of informal workers in private firms and 50.1% of informal own-account workers are overeducated.

Using an augmented Mincerian wage regression, we find that the overall overeducation wage penalty is 20.9%, while the undereducation wage premium is 10.2%. In general, we find that overeducation wage penalties are higher in older cohorts, suggesting that these penalties become larger later in one's career. The penalties and premiums are similar across men and women. As expected, wage penalties for government employees are relatively high at 28.2%, while the lowest penalties belong to informal own-account workers at 3.9%. As for employees in private firms, informal workers have consistently higher overeducation wage penalties than formal workers across all age cohorts. Educated young workers are increasingly absorbed into low-skill informal work in private firms and face large overeducation wage penalties. The inability of many young workers to capitalize on their educational investments in Thailand's formal labor market is a concern for future education and employment policy development in Thailand.

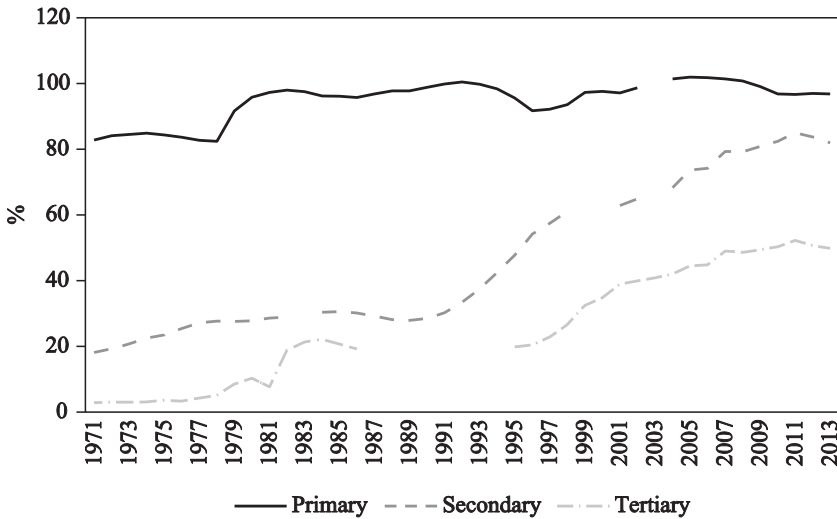
This paper is organized as follows. Section II provides a background on Thailand's education policies since the 1970s, its rising educational attainment, and the growth of its formal workforce. Section III gives a brief review of the literature on measuring overeducation and its wage penalties. This is followed by a description of the data used in the analysis in section IV and the methodology in section V. Section VI presents the empirical results followed by a discussion and conclusion in section VII.

II. Thailand's Rising Educational Attainment, Structural Change, and Formalization of Work

As is the case with many developing countries, Thailand has prioritized the expansion of education as a means to achieve economic development. Since the 1970s, Thailand has increased compulsory levels of schooling from 4 years to 9 years and initiated a large expansion of secondary and tertiary education.¹ The 1980 National Primary Education Act mandated that all villages should be equipped with schools. One of the major changes in the Thai education system was the increase in government-mandated compulsory education from 4 years to 6 years in the 1970s and from 6 years to 9 years implemented in 2002. Consequently, the share of workers who have completed upper secondary school went up from 17% in 1990 to 25% in 2 decades (Aemkulwat 2010). Over the same period, the number of workers with vocational qualifications increased from 1.8 million to

¹The Thai education system is split into primary education (grades 1–6), lower secondary education (grades 7–9), and upper secondary/lower vocational education (grades 10–12). Tertiary education includes postsecondary upper vocational training, 4-year university education, and higher level degrees.

Figure 1. Gross Enrollment Rates in Thailand, 1971–2013



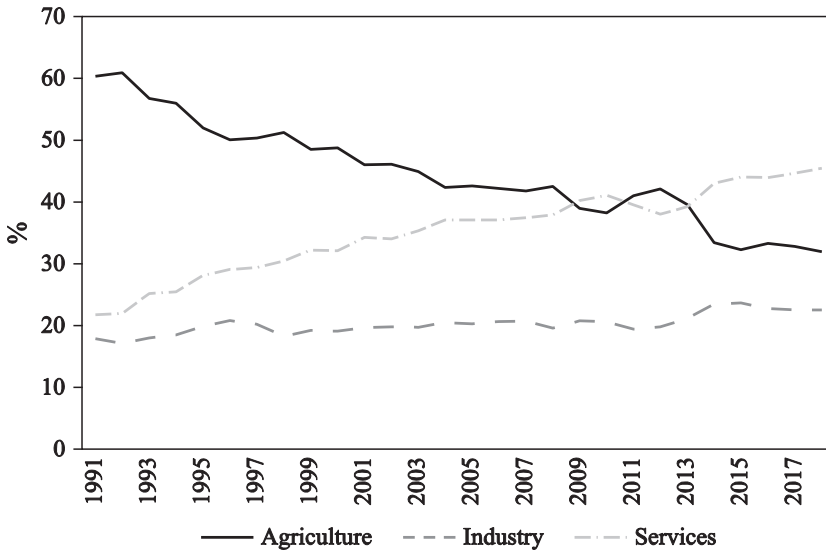
Note: Gaps are due to missing data for some years.

Source: World Bank. World Development Indicators. <https://databank.worldbank.org/source/world-development-indicators> (accessed May 2019).

3 million (Aemkulwat 2010). Thailand also saw a significant increase in the number of educational institutions at all levels, especially at the secondary and tertiary levels. For example, the number of higher education institutions rose from a handful in 1970 to 185 institutions in 2014 (Paweenawat and Vechbanyongratana 2015). The expansion of schools combined with changes in the compulsory education laws led to a steady increase in primary, secondary, and tertiary gross enrollment rates from 1971 to 2013, as shown in Figure 1. Primary education enrollment became universal in the 1980s, while secondary enrollment increased from 18% to 82%, and tertiary education from 3% to 50% since 1970.

In the past, Thailand's economy was based primarily on agriculture. Thailand has undergone a significant economic transformation that started in the 1970s. It experienced a rapid demographic transition, encouraged investment to develop its manufacturing sector, and saw people move out of rural agriculture and into work in urban areas (Baker and Phongpaichit 2009). Following the world's oil crisis in 1973 and other external factors, Thailand shifted toward export-oriented manufacturing in the 1980s, increasing exports of primarily labor-intensive products by approximately 24% per year during 1984–1989 (Baker and Phongpaichit 2009). From the 1990s onward, the tourism and service sectors experienced growth in part due to the government's promotion of Thailand as a tourist destination (Kaosa-ard 2002). Figure 2 shows the contributions of each sector to total employment in Thailand between 1991 and 2018.

Figure 2. Thailand's Sectoral Employment Shares, 1991–2018

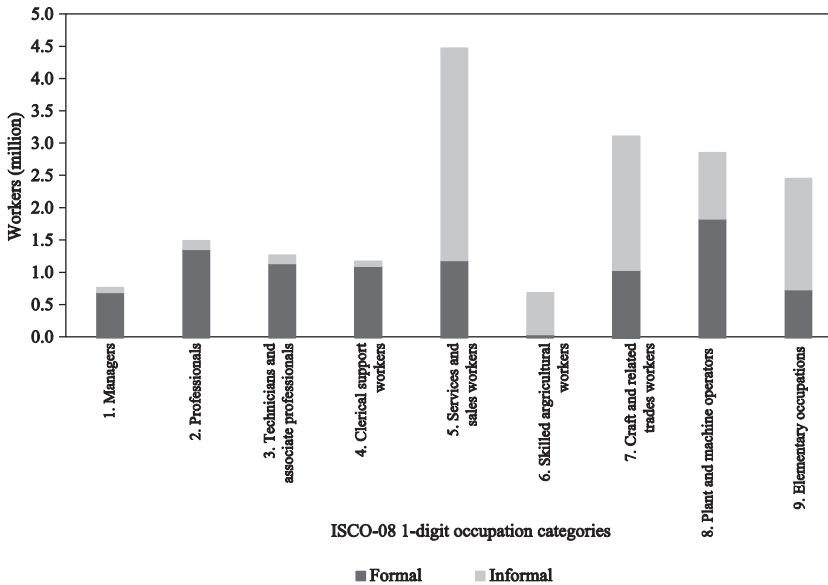


Source: World Bank. World Development Indicators. <https://databank.worldbank.org/source/world-development-indicators> (accessed May 2019).

Figure 2 demonstrates that the agriculture sector saw a rapid decline in its contribution to employment, dropping from 60% to 32% over the 28-year period. At the same time, employment in the service sector rose rapidly from 22% to 45%, while the share of workers in manufacturing continued to rise during this period, albeit more slowly, from 18% to 23%. Thailand's smallholder agricultural past means that most employment was traditionally considered informal. Since the 1990s, a significant number of workers moved from a work status of "unpaid family worker" to "employees of private companies" (Aemkulwat 2010). However, even though Thailand experienced a major transformation of its economy over the past 4 decades, the country largely did not experience concurrent formalization of employment. The Thai government defines formal workers as employees who are covered by employer-provided social insurance (such as the Civil Servants' Welfare Scheme or protection under the Social Security Act B.E. 2533 [1990]) and protection under the labor law.² The growth of formal private firm employment through the expansion of social security has been slow, but it has picked up in recent

²The Thai government defines formal workers as follows: all government officers and employees; all state enterprise employees; all teachers in private schools, according to the Private School Act; government officers and employees of other countries or those who work in international organizations; all employees who have protection under labor legislation; and workers who have social security according to Social Security Act B.E. 2533 (1990) (Ministry of Labour n.d.).

Figure 3. **Distribution of Formal and Informal Workers across Occupational Categories, 2015**



ISCO-08 = 2008 International Standard Classification of Occupations.

Notes: The tabulation includes only workers who receive labor income, including government workers, private firm employees, and own-account workers. The tabulations exclude employers and unpaid family workers.

Source: Authors' calculations from the 2015 Thailand Socio-economic Survey.

years. The number of private firm workers covered by Section 33 of the Social Security Act has grown from 8.6 million workers in 2008 to 10.8 million workers in 2017, which represents an increase from 23% to 29% of the total workforce. Despite efforts to expand formal employment, Thailand's informal workers continue to make significant contributions to the country's economy, with official figures putting the share of informal workers in the total workforce at 55% in 2018 (National Statistical Office 2018).

Informal employment is not distributed evenly across all occupations. Figure 3 shows the distribution of formal workers (government workers and formal private firm employees) and informal workers (informal private firm employees and own-account workers) who receive cash remuneration across occupational categories based on the 1-digit 2008 International Standard Classification of Occupations (ISCO-08). Occupations requiring the highest levels of education and skill are located toward the left side of Figure 3, including managers, professionals, and technicians and associate professionals. These categories largely encompass civil servants and highly skilled workers in larger private firms, and thus workers employed in these occupations are generally formal. The occupational categories that require the least education and skills are located toward the right side of the

figure, including craft and related trades workers, plant and machine operators and assemblers, and elementary occupations. Informal workers are disproportionately represented in the occupational groups located on the right side of the figure. The one exception is the high number of formal workers in occupation category 8—plant and machine operators and assemblers—which encompasses lower skilled factory work. The government’s push to develop the manufacturing sector during the 1980s and 1990s attracted larger firms such that the government subsequently required them to register for tax (including employment tax) purposes, which explains why workers in occupation category 8 are largely formal. Despite the government’s mandate that all firms hiring one or more workers must register their employees for social security, many smaller enterprises remain unregistered, often intentionally to avoid taxation and social security contributions. Own-account workers—who are informally employed by definition—generally work in lower skill occupational categories. In fact, approximately 95% of own-account workers are classified as working in occupation categories 5 through 9, making up a significant proportion of workers in these categories.

Although one finds that informal workers are disproportionately represented in occupations requiring lower skill and education, it is important to note that within the Thai context, one finds both formal and informal workers often performing the same jobs. For example, according to the 2016 Thai Labor Force Survey Informal Supplement, informal workers engaged in food, beverages, textile, and wearing apparel manufacturing constituted 38%, 32%, 32%, and 47% of the workers in these manufacturing subcategories, respectively (Vechbanyongratana et al. 2021).

III. Related Literature on Education–Occupation Mismatch

With the growth in educated workforces around the world and the unintended consequences of vertical education–occupation mismatch, several empirical studies on the incidence and implications of a mismatch between attained and required levels of education have been published in recent years. One of the challenges in studying the wage impacts of vertical mismatch is how to quantify it. Hartog (2000) summarizes three possible options as follows:

- i. **Job analysis.** This method follows systematic evaluation by professional job analysts such as the Dictionary of Occupational Titles published by the United States (US) Department of Labor or recommendations of minimum required degrees by Thailand’s Ministry of Labor (e.g., Paweenawat and Vechbanyongratana 2015).
- ii. **Worker self-assessment.** Mismatch is directly evaluated by workers themselves. Surveys ask workers their opinion on the minimum

education needed to perform their jobs (e.g., Duncan and Hoffman 1981, Sicherman 1991, Dolton and Vignoles 2000).

- iii. **Realized matches.** This method was introduced by Verdugo and Verdugo (1989). This study used the mean education level plus 1 standard deviation to determine the required level of education needed to perform a job. This is then compared with the actual level of education attained by each worker, which determines whether a worker has the education that matches the required education for employment. Other studies apply this method but use a modal value instead of the mean (e.g., Mendes de Oliveira, Santos, and Kiker 2000). Our paper uses the modal method described here.

Duncan and Hoffman (1981) made significant contributions to empirically measuring the impact of overeducation on wages by introducing the overeducation, required education, and undereducation (ORU) model. In this model, overeducation or undereducation is determined by the difference in attained and required education. Earnings are regressed on required years of education, years of overeducation, and years of undereducation. Using the US 1976 Panel Study of Income Dynamics, Duncan and Hoffman (1981) find that 46% of individuals are perfectly matched, while 42% of workers receive higher levels of education than required for their jobs. In addition, the results show that wages are determined mainly by the required education level, and the coefficient of surplus education (overeducation) is positive and significant. This method has been used by scholars in several country contexts to estimate wage impacts of vertical mismatch, including Dolton and Vignoles (2000) using British data; Hartog (2000) on the Netherlands, Portugal, Spain, the United Kingdom, and the US; and Johansson and Katz (2007) and Korpi and Tählén (2009) using Swedish data. All of these studies find that returns to required levels of schooling are higher than returns to surplus education, which is consistent with the original findings by Duncan and Hoffman (1981).

Several studies regress the natural log of wages on a series of dummy variables that identify workers as overeducated, undereducated, or matched educated. The expected sign on the overeducation dummy variable is negative since it is expected that workers who are overeducated for their job would earn less than a matched-educated worker (excluded category) with the same amount of education. Verdugo and Verdugo (1989) pioneered this approach and found a 13% wage penalty among workers in the US. A study using Australian data by Mavromaras et al. (2013) shows a 21.5% penalty among male workers aged 16–64 with a university degree or equivalent. Similarly, a study using data from the United Kingdom by McGuinness and Sloane (2011) estimates a 31% to 39% wage penalty among early career university graduates.

There are two recent studies on overeducation wage penalties specific to Thailand. The first by Paweenawat and Vechbanyongratana (2015) analyze wage penalties among male university graduates. The average wage penalty was found to be 19%, but when stratified by cohort, younger workers were found to have higher overeducation wage penalties that can be explained by an increasing supply of young university graduates and a dearth of commensurate jobs in the market. Another study by Pholphirul (2017) estimates both vertical and horizontal mismatch (i.e., a mismatch between job and field of study) using Thailand's 2008 Labor Force Survey. For vertical mismatches, the author uses the modal value method to determine education–occupation matches for each worker. The author finds that overeducated workers who completed compulsory lower secondary education or above face on average an 18.6% wage penalty.

Despite the existence of recent studies on Thailand, no study, to date, has taken into consideration potential systematic differences in the incidence and wage impacts of undereducation and overeducation across formal and informal workers. This is important to consider since a significant proportion of workers in Thailand's economy—and developing economies more generally—are in fact informally employed and not covered by relevant labor regulations. This paper adds to the literature by determining the incidence of undereducation and overeducation and estimating wage premiums and penalties associated with vertical education–occupation mismatch between formal and informal workers. Furthermore, this study considers the incidence of vertical mismatch and the associated penalties and premiums across four cohorts of workers who were exposed to different education policies and early career labor market opportunities in Thailand's rapidly changing economy.

IV. Data

This study uses the Thailand SES, a nationally representative household survey collected by the National Statistical Office, for the years 2011, 2013, and 2015 (National Statistical Office 2011, 2013, and 2015). We define formal employees as government and private firm workers who are covered by the Civil Service Welfare Scheme, Section 33 under the Social Security Act (1990), or other employer-provided welfare program.³ Informal workers are defined as those in private firm employment without employer-provided social welfare, as well as those engaged in own-account work.⁴ The dataset includes observations on

³There are three schemes under the Social Security Act (1990), including Section 33, Section 39, and Section 40. Section 33 refers to employer-provided social security, while Sections 39 and 40 are voluntary schemes.

⁴We deviate slightly from the government's definition of informal employment by defining all own-account workers as informally employed even if they are coded as being covered by social security (less than 4% of own-account workers). We are interested in workers with employer-provided protections. Own-account workers with

Table 1. **Thai Education Classifications Harmonized with ISCO-08 Skill Level Classifications**

Level	Description
0	Completed less than primary education
1	Completion of primary education or the first stage of basic education
2	Lower secondary education, upper secondary education, postsecondary, nontertiary Education (<i>Por Wor Chor</i>)
3	Higher educational institution following completion of secondary education for a period of 1–3 years (<i>Por Wor Sor</i> and <i>Por Wor Tor</i>)
4	Higher educational institution for a period of 3–6 years leading to the award of a first degree or higher qualification

ISCO-08 = 2008 International Standard Classification of Occupations.

Sources: International Labour Organization (2012) and National Statistical Office (2010).

104,137 workers who report labor income.⁵ A total of 53,206 workers are classified as informally employed, of which 27,481 work in private firms and 25,725 are own-account workers.

The workers are coded into five education classifications that are harmonized with the ISCO-08 skill level classifications (International Labour Organization 2012). Table 1 shows the National Statistical Office's harmonization of Thai education levels with the ISCO-08 skill level classifications. The classification of overeducation, undereducation, and matched education for each individual is based on realized matches suggested by Verdugo and Verdugo (1989) and Mendes de Oliveira, Santos, and Kiker (2000). Following Mendes de Oliveira, Santos, and Kiker (2000), the modal educational category (0–4) within each occupation is used to determine “required education.” After finding the modal educational category within each ISCO-08 occupation code at the 3-digit level, each worker's education level is then compared to the modal education level for their occupation to determine whether the worker is overeducated, undereducated, or matched educated.⁶ For example, if a worker completed an upper secondary diploma (category 3) but works in a job that primarily employs workers with primary education (category 1), this worker would be considered overeducated for their current job. Table 2 reports summary statistics for the sample used in this study.

Informal private firm employees and own-account workers on average have lower levels of education, with 62.6% and 53% having completed primary school or less, respectively. This is in contrast to formal government workers of which only

social security coverage are most likely registered for one of the voluntary social security schemes (Section 39 or 40). The coding does not impact the results.

⁵For own-account workers, we use business income instead of labor income. Since own-account workers are self-employed and do not have other employees, business income is comparable to labor income in this case.

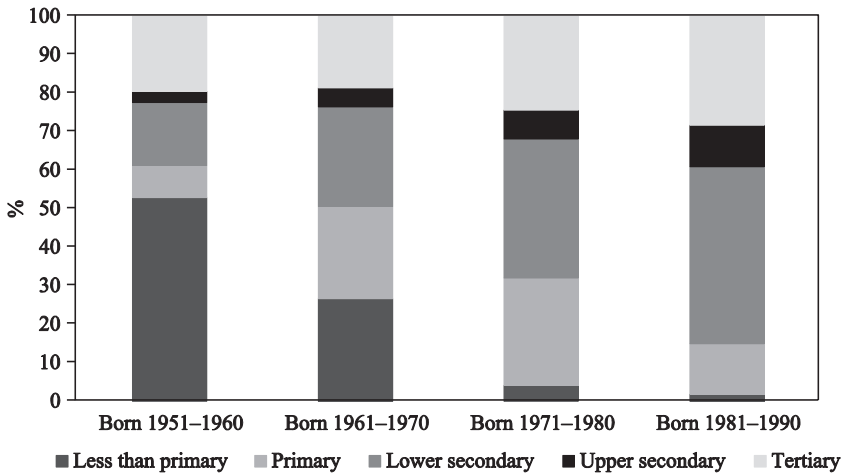
⁶If there is more than one modal value, the smaller value is selected. Also, the estimations are not sensitive to the method of constructing the vertical mismatch dummy variables. Using the median level of education in each occupational category yields qualitatively similar results to the modal method.

Table 2. Summary Statistics

Variable	All (N = 104,137)		Formal Government Employee (N = 23,141)		Formal Private Firm Employee (N = 27,790)		Informal Employee (N = 27,481)		Own-Account Worker (N = 25,725)	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
Real monthly total earnings (2015 baht)	14,178	12,095	21,855	15,206	14,810	10,279	7,759	5,711	13,448	11,716
Matched educated (0/1)	0.506	0.500	0.703	0.457	0.551	0.497	0.431	0.495	0.362	0.480
Overeducated (0/1)	0.220	0.414	0.123	0.328	0.199	0.399	0.257	0.437	0.291	0.454
Undereducated (0/1)	0.274	0.446	0.174	0.379	0.250	0.433	0.312	0.463	0.348	0.476
Less than primary (0/1)	0.183	0.386	0.056	0.229	0.083	0.276	0.286	0.452	0.295	0.456
Primary (0/1)	0.201	0.401	0.054	0.226	0.153	0.360	0.340	0.474	0.235	0.424
Lower secondary (0/1)	0.322	0.467	0.232	0.422	0.416	0.493	0.299	0.458	0.326	0.469
Upper secondary (0/1)	0.067	0.250	0.074	0.262	0.110	0.313	0.029	0.167	0.055	0.229
Tertiary (0/1)	0.228	0.419	0.584	0.493	0.238	0.426	0.047	0.211	0.089	0.285
Potential experience	25.311	12.529	23.369	11.404	19.500	11.129	27.411	12.461	31.090	11.869
Female (0/1)	0.484	0.500	0.480	0.500	0.493	0.500	0.416	0.493	0.550	0.498
Married (0/1)	0.699	0.459	0.723	0.447	0.653	0.476	0.684	0.465	0.743	0.437
Urban (0/1)	0.680	0.466	0.736	0.441	0.698	0.459	0.576	0.494	0.723	0.447
Bangkok (0/1)	0.089	0.285	0.045	0.207	0.184	0.388	0.049	0.216	0.070	0.254
Central (0/1)	0.344	0.475	0.246	0.431	0.508	0.500	0.305	0.460	0.297	0.457
North (0/1)	0.192	0.394	0.240	0.427	0.111	0.314	0.190	0.393	0.237	0.425
Northeast (0/1)	0.215	0.411	0.315	0.465	0.093	0.291	0.231	0.422	0.239	0.427
South (0/1)	0.160	0.367	0.154	0.361	0.104	0.306	0.224	0.417	0.158	0.364

Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

Figure 4. Educational Attainment by Birth Cohort

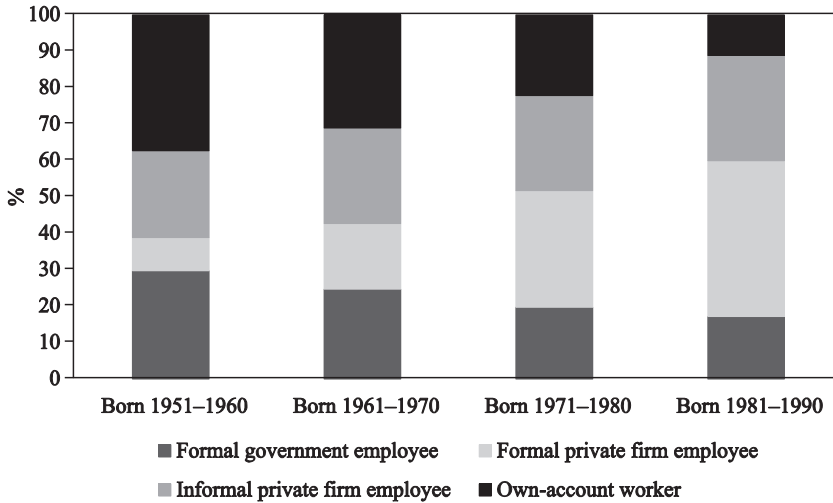


Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

11% have completed primary school or less. Formal government workers are also significantly more likely to have completed higher education with 58% completing a bachelor's degree or higher compared to only 5% of informal private firm employees and 9% of own-account workers. Thus, it is not surprising that real monthly earnings for formal workers are on average significantly higher than for informal workers. Formal government employees and formal private firm employees earn on average 21,855 baht (B) and B14,810 compared to B7,759 and B13,448 for informal employees and own-account workers, respectively.

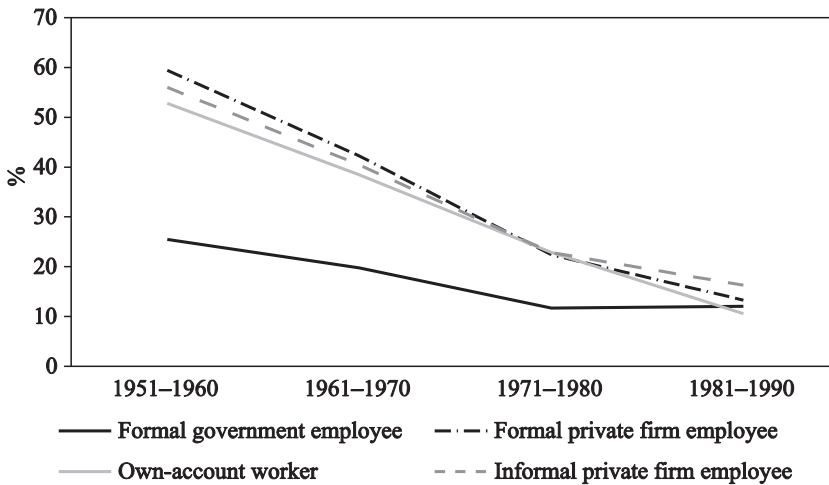
Given generational differences in access to education and early career labor market opportunities, it is instructive to see the differences in completed education and the incidence of formal and informal employment stratified by birth cohort shown in Figures 4 and 5. The overall picture in Figure 4 is one of increasing educational attainment across successive birth cohorts. Among the oldest cohort, more than half of workers completed less than primary education and 39% completed lower secondary education or more. Among the youngest cohort, only 2% completed less than primary education, while 85% completed lower secondary education or higher. Figure 5 indicates that there is declining informality across successive birth cohorts. The incidence of informality among employees and own-account workers is highest among the oldest cohort at 61%. However, despite rapid industrialization and structural change in the Thai economy, the rate of informal employment is still high among the youngest cohort at 40%. Interestingly, individuals in the youngest cohort are much less likely to be own-account workers and government employees than previous generations. The youngest workers are

Figure 5. Employment Sector by Birth Cohort



Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

Figure 6. Undereducated Workers by Birth Cohort and Employment Sector

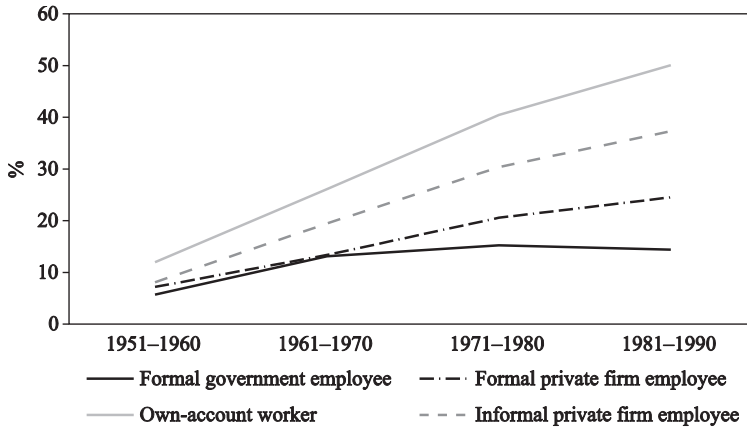


Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

much more likely to be employed by private firms, but the incidence of informality among young workers in private firms is 40%.

The incidence of undereducation and overeducation for the entire sample stands at 27.4% and 22%, respectively, but differs across birth cohorts and employment sector, as illustrated in Figures 6 and 7.

Figure 7. Overeducated Workers by Birth Cohort and Employment Sector



Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

The proportion of undereducated workers has declined over successive birth cohorts for every work status, particularly for formal private firm employees, own-account workers, and informal private firm employees. This pattern is consistent with increasing educational attainment among the younger cohorts due to more compulsory education and increased opportunities to complete secondary and tertiary education. The proportion of overeducated formal government workers is similar across cohorts. However, the incidence of overeducated formal and informal private firm employees and own-account workers has increased over successive cohorts, which is consistent with increasing levels of education. Although the youngest cohort is the least likely to be engaged in own-account work, the incidence of overeducation among those in this group is high at 50%. Likewise, among the 30% of the youngest cohort employed informally by private firms, the incidence of overeducation is 37%.

V. Methodology

We use an augmented Mincerian wage regression model to estimate the overeducation and undereducation wage penalties and premiums, respectively. We run an ordinary least squares model that includes dummy variables for overeducation and undereducation with matched education as the excluded category.

$$\ln w_i = \alpha + \beta_1 \text{OverEd}_i + \beta_2 \text{UnderEd}_i + X_i' \gamma + \varepsilon_i \quad (1)$$

The dependent variable, $\ln w_i$, is the natural log of real monthly earnings, X_i is a vector of individual characteristics, including potential work experience

(*age* – *years of schooling* – 6) and potential work experience squared; and dummy variables for level of education completed (primary, lower secondary, upper secondary, and tertiary); married; female; urban area; region (central, north, northeast, and south); and survey year. *OverEd_i* is a dummy variable that indicates that an individual's educational attainment is greater than the modal value of education found in their occupation, and *UnderEd_i* is a dummy variable that indicates that an individual's level of education is lower than the modal value for their occupation.

We first run regression (1) using the pooled sample from 2011, 2013, and 2015, and then we run it separately by employment sector. We then repeat the analysis stratified by male and female to see whether there are any gendered differences in overeducation wage penalties and undereducation wage premiums. The final analysis is stratified by birth cohorts and employment sector to see if the overeducation wage penalties and undereducation wage premiums diverge for individuals facing different compulsory education policies, educational access, and early career labor markets.

VI. Empirical Findings

The empirical results for the baseline pooled regression and regressions stratified by sector of employment are reported in Table 3. The average overeducation wage penalty and undereducation wage premium are 20.9% and 10.2%, respectively. The 20.9% wage penalty is comparable to the previous estimate of 19% in the study by Pholphirul (2017) using the 2008 Labor Force Survey. The overeducation wage penalties differ across employment sectors. The largest overeducation wage penalty is in the formal government sector at 28.2%. The high penalty may reflect the rigidity of the Thai civil service system where remuneration is strictly tied to occupation and experience. A government worker with high levels of education would be paid similarly with a government worker with lower academic credentials working in the same position. At 21.8%, informal private firm workers have higher overeducation wage penalties than formal private firm workers (17.9%). Interestingly, own-account workers have the lowest overeducation wage penalties at 3.9%. This may reflect the nature of own-account work in which workers are their “own bosses,” allowing them flexibility to work according to their own productivity regardless of occupation.

Table 3 indicates that on average—after controlling for a full set of covariates—women earn 19.2% less than men. The results stratified by employment sector show that the gender wage differentials are smaller within formal work (15.7%–17.5%) compared to informal work (22.1%–22.2%). Given that women appear to be at a wage disadvantage compared to men, it is of interest to know whether women and men experience different overeducation wage penalties and

Table 3. Overeducation Wage Penalties and Undereducation Wage Premiums in Thailand, Ordinary Least Squares Regressions

	(1)	(2)	(3)	(4)	(5)
	Dependent Variable: Ln(Monthly Labor Income)				
	Pooled Baseline	Formal Employment		Informal Employment	
Government Employee		Private Firm Employee	Private Firm Employee	Own- Account Worker	
Overeducated	-0.209*** (0.005)	-0.282*** (0.011)	-0.179*** (0.007)	-0.218*** (0.008)	-0.039** (0.015)
Undereducated	0.102*** (0.006)	0.133*** (0.014)	0.096*** (0.008)	0.180*** (0.008)	0.096*** (0.015)
Elementary	0.175*** (0.008)	0.268*** (0.027)	0.096*** (0.012)	0.186*** (0.010)	0.064*** (0.019)
Lower secondary	0.495*** (0.009)	0.910*** (0.024)	0.447*** (0.015)	0.464*** (0.013)	0.237*** (0.022)
Upper secondary	0.866*** (0.012)	1.418*** (0.026)	0.838*** (0.017)	0.723*** (0.024)	0.376*** (0.031)
Tertiary	1.264*** (0.011)	1.907*** (0.025)	1.134*** (0.016)	1.153*** (0.022)	0.571*** (0.029)
Formal employee	-0.015*** (0.005)				
Informal employee	-0.352*** (0.006)				
Own-account workers	-0.050*** (0.007)				
Potential experience	0.040*** (0.001)	0.050*** (0.001)	0.028*** (0.001)	0.022*** (0.001)	0.024*** (0.002)
Potential experience ²	-0.006*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)	-0.004*** (0.000)
Female indicator	-0.192*** (0.004)	-0.157*** (0.007)	-0.175*** (0.005)	-0.222*** (0.006)	-0.221*** (0.010)
Married	0.086*** (0.004)	0.040*** (0.008)	0.049*** (0.005)	0.083*** (0.007)	0.137*** (0.012)
Central	-0.167*** (0.006)	-0.139*** (0.015)	-0.158*** (0.007)	-0.309*** (0.014)	-0.177*** (0.019)
North	-0.358*** (0.007)	-0.193*** (0.015)	-0.399*** (0.010)	-0.495*** (0.014)	-0.414*** (0.020)
Northeast	-0.316*** (0.007)	-0.200*** (0.015)	-0.397*** (0.010)	-0.486*** (0.014)	-0.318*** (0.020)
South	-0.209*** (0.007)	-0.121*** (0.016)	-0.276*** (0.010)	-0.326*** (0.014)	-0.207*** (0.022)
Municipal area	0.096*** (0.004)	0.169*** (0.008)	0.007 (0.005)	0.053*** (0.006)	0.174*** (0.012)
Survey year 2013	0.123*** (0.004)	0.075*** (0.008)	0.184*** (0.006)	0.154*** (0.007)	0.084*** (0.012)
Survey year 2015	0.145*** (0.004)	0.110*** (0.008)	0.201*** (0.006)	0.182*** (0.007)	0.124*** (0.012)
Constant	8.411*** (0.015)	7.436*** (0.030)	8.640*** (0.019)	8.504*** (0.024)	8.835*** (0.043)
F-statistic	4,585.75	1,804.62	1,241.08	516.355	192.903
Adjusted R ²	0.427	0.559	0.458	0.281	0.111
Observations	104,137	23,141	27,790	27,481	25,725

Notes: Robust standard errors in parentheses. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

Table 4. Overeducation Wage Penalties and Undereducation Wage Premiums in Thailand by Gender, Ordinary Least Squares Regressions

		(1)	(2)	(3)	(4)	(5)
		Dependent Variable: Ln(Monthly Labor Income)				
		Formal Employment			Informal Employment	
		Pooled Baseline	Government Employee	Private Firm Employee	Private Firm Employee	Own-Account Worker
Men	Overeducated	-0.197*** (0.007)	-0.257*** (0.014)	-0.212*** (0.011)	-0.209*** (0.010)	-0.033 (0.021)
	Undereducated	0.125*** (0.008)	0.177*** (0.017)	0.170*** (0.014)	0.189*** (0.010)	0.078*** (0.023)
	<i>F</i> -statistic	2,439.89	1,065.54	636.293	265.740	104.933
	Adjusted R ²	0.423	0.544	0.448	0.250	0.121
	Observations	53,735	12,025	14,077	16,056	11,577
	Women	Overeducated	-0.219*** (0.008)	-0.275*** (0.022)	-0.180*** (0.010)	-0.221*** (0.013)
	Undereducated	0.081*** (0.008)	0.106*** (0.027)	0.048*** (0.010)	0.162*** (0.012)	0.109*** (0.021)
	<i>F</i> -statistic	2,471.88	904.934	686.816	256.025	69.467
	Adjusted R ²	0.433	0.587	0.472	0.290	0.074
	Observations	50,402	11,116	13,713	11,425	14,148

Notes: Robust standard errors in parentheses. Other controls: education, potential experience, potential experience², married, urban, region, and survey year. *** $p < 0.01$ ** $p < 0.05$ * $p < 0.1$.

Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

undereducation wage premiums. Table 4 reports the regression results stratified by gender.

Despite the fact that women have a wage disadvantage when controlling for personal characteristics, women experience similar wage penalties and premiums as men. Overall, the wage penalty for men is 19.7% compared to 21.9% for women, while the undereducation wage premiums are 12.5% and 8.1% for men and women, respectively. The wage penalties are also similar across all four employment sectors. The similarities in overeducation wage penalties may be due in part to the fact that men and women in the Thai labor market have similar worker characteristics, including labor force participation and educational attainment.

As mentioned previously, many of the oldest workers were required to complete only 4 years of compulsory schooling and entered the labor market when Thailand was just beginning its structural transformation, and it was still primarily an agricultural economy. In contrast, the youngest cohort in the sample was required to complete 6–9 years of compulsory education and had access to free education through secondary school and expanded tertiary education opportunities. Moreover, younger workers entered the job market in an economy that was much more diversified with a broader range of occupations requiring various skill levels. Because the oldest and youngest workers faced very different

education policies and labor market conditions, which resulted in lower incidences of undereducation and higher incidences of overeducation in younger cohorts, it is of interest to see whether older and younger workers face different undereducation wage premiums and overeducation wage penalties. Table 5 reports regression results across employment sectors and birth cohorts.

Columns (1) and (2) in Table 5 show results across four birth cohorts in formal government and formal private firm employment, while columns (3) and (4) show the results for informal workers in private firms and own-account work. The results show that along with the decrease in the incidence of undereducation, the undereducation wage premium is lower for formally employed workers in younger cohorts. Similar to workers in formal employment, informally employed private firm workers and own-account workers generally have decreasing undereducation wage premiums across successive birth cohorts. The youngest generation of workers born in the 1980s, for which undereducation is rare, have no undereducation wage premiums with the exception of a small premium in informal private firm work.

Despite the increase in the incidence of overeducation over successive birth cohorts, the overeducation wage penalty is lower for younger workers in formal government employment, formal private firm employment, and informal private firm employment. Since the survey data used for the analysis was collected between 2011 and 2015, we observe wages for each of the cohorts at different points within their careers. The high overeducation wage penalties in the oldest cohort and relatively low wage penalties in the youngest cohort likely reflect different earnings trajectories for overeducated versus matched-educated workers. For example, a university graduate who spends their career in restaurant service (overeducated) will likely have a shallower earnings trajectory than a university graduate who works as an accountant (matched educated) throughout their career. This scenario would result in larger overeducation wage penalties later in one's career. For the youngest cohort of formal workers, the overeducation wage penalty is relatively modest at around 15%. However, the wage penalties *within* each cohort are higher for informally employed private firm workers than for formally employed private firm workers. This is an important observation considering that informal work in private firms continues to absorb a large number of younger workers (see Figure 5) who are more likely to be overeducated than in previous generations (see Figure 7).

As for informal own-account work, there is no clear pattern across generations. Most own-account workers are employed in services and crafts and related trades (ISCO-08 occupational categories 5 and 7). Although the overeducation wage penalty is 14.5% among the oldest cohort born in the 1950s, cohorts born in the 1960s and 1970s face no overeducation wage penalties. Although only 11% of the youngest cohort is employed as own-account workers, 50% are overeducated and face a wage penalty of 9.3%.

Table 5. Overeducation Wage Penalties and Undereducation Wage Premiums in Thailand by Birth Cohorts, Ordinary Least Squares Regressions

		(1)	(2)	(3)	(4)
		Dependent Variable: Ln(Monthly Labor Income)			
		Formal Employment		Informal Employment	
		Government Employee	Private Firm Employee	Private Firm Employee	Own-Account Worker
All workers	Overeducated	-0.282*** (0.011)	-0.179*** (0.007)	-0.218*** (0.008)	-0.039** (0.015)
	Undereducated	0.133*** (0.014)	0.096*** (0.008)	0.180*** (0.008)	0.096*** (0.015)
	<i>F</i> -statistic	1,804.62	1,241.08	516.355	192.903
	Adjusted R ²	0.559	0.458	0.281	0.111
	Observations	23,141	27,790	27,481	25,725
Born 1951–1960	Overeducated	-0.456*** (0.040)	-0.322*** (0.055)	-0.338*** (0.045)	-0.145*** (0.045)
	Undereducated	0.276*** (0.030)	0.236*** (0.032)	0.221*** (0.019)	0.120*** (0.027)
	<i>F</i> -statistic	377.877	103.247	91.303	38.519
	Adjusted R ²	0.596	0.535	0.318	0.096
	Observations	5,048	1,562	4,045	6,348
Born 1961–1970	Overeducated	-0.358*** (0.020)	-0.217*** (0.020)	-0.243*** (0.018)	-0.027 (0.026)
	Undereducated	0.108*** (0.023)	0.122*** (0.016)	0.166*** (0.013)	0.061** (0.024)
	<i>F</i> -statistic	572.910	380.047	158.260	81.911
	Adjusted R ²	0.556	0.534	0.290	0.112
	Observations	7,645	5,598	8,113	9,631
Born 1971–1980	Overeducated	-0.234*** (0.017)	-0.175*** (0.012)	-0.211*** (0.013)	0.004 (0.026)
	Undereducated	0.031 (0.026)	0.103*** (0.013)	0.181*** (0.015)	0.153*** (0.033)
	<i>F</i> -statistic	284.011	475.371	156.470	48.318
	Adjusted R ²	0.445	0.461	0.272	0.096
	Observations	6,237	10,138	8,231	7,012
Born 1981–1990	Overeducated	-0.151*** (0.021)	-0.150*** (0.010)	-0.191*** (0.013)	-0.093** (0.038)
	Undereducated	-0.019 (0.026)	-0.007 (0.012)	0.131*** (0.017)	-0.012 (0.058)
	<i>F</i> -statistic	115.388	345.815	109.281	13.920
	Adjusted R ²	0.322	0.388	0.228	0.070
	Observations	4,211	10,492	7,092	2,734

Notes: Robust standard errors in parentheses. Other controls: education, potential experience, potential experience squared, married, urban, region, and survey year. ****p* < 0.01 ***p* < 0.05 **p* < 0.1.
 Source: Authors' calculations from 2011, 2013, and 2015 Thailand Socio-economic Surveys.

We acknowledge that workers are not randomly assigned to be overeducated, matched educated, or undereducated for their jobs, which could bias the coefficient estimates. There are relevant unobservable factors, such as low ability or degree

completion from low-quality institutions, that cannot be corrected for using the existing data, potentially leading to overestimated wage penalties for overeducated persons who in fact work at their correct level of productivity. Although we cannot directly solve the ability bias in this present study, previous work on overeducation wage penalties shows that even when taking into account unobserved individual heterogeneity, the negative impact of overeducation on wages generally does not disappear. For example, Korpi and Tählén (2009) employ a fixed-effect approach using panel data from Sweden. Their results suggest that even after accounting for unobservable personal characteristics, returns to years of education beyond what is required for the job are positive and significant, suggesting that the ordinary least squares estimates are not merely capturing differences in unobserved ability. A study by Mavromaras et al. (2013) employs fixed effect and random effect models to panel data and finds that unobservable individual heterogeneity cannot explain all of the negative impact of overeducation and overskilling among working-age Australian men. Papers by McGuinness and Bennett (2007) and Paweenawat and Vechbanyongratana (2015) use a quantile approach to show that overeducation occurs at all points along the wage and ability distribution, which suggests that overeducation is not synonymous with low ability in Northern Ireland and Thailand, respectively. Specifically in the case of Thailand, overeducated male university graduates born between 1966 and 1985 face large overeducation wage penalties at all points along the ability distribution, which is consistent with an imbalance between the number of university graduates and jobs available in the economy (Paweenawat and Vechbanyongratana 2015). Results from previous related studies give us some level of confidence that our estimated coefficients on the undereducation and overeducation variables are not entirely driven by the ability bias and do in fact capture in part the relationship between vertical education–occupation mismatch and wages in formal and informal employment.

VII. Discussion and Conclusions

Since the 1970s, Thailand has enacted a variety of policies to pursue economic development. These policies include increasing compulsory education from 4 years to 9 years, providing free education through upper secondary school and expanding higher education opportunities. The government also worked to change the structure of the economy, transforming it from a largely informal agriculture-based economy to a formalized industrial and service-based economy. While the former has resulted in dramatic increases in the average educational attainment of the populace, the latter, while diversifying job opportunities, has failed to fully formalize work, leaving the majority of Thailand’s workers still engaged in informal employment.

This paper estimates the incidence of vertical education–occupation mismatch and its associated wage premiums and penalties across formal and

informal employment over four cohorts of workers. It adds to the existing literature by considering the consequences of vertical mismatch in a developing country context where the labor force is largely informal. The paper also extends Pholphirul's (2017) earlier work on Thailand by going beyond the mean wage impact of vertical mismatch on wages by taking into consideration informality and generational differences in education and early career labor market conditions. Informal workers continue to make large contributions to the Thai economy, thus understanding the interaction of vertical mismatch and its consequences within formal and informal employment is important for pinpointing potential inefficiencies in education and labor market policies and helping to develop potential solutions.

This paper has shown that the Thai government's education and economic policies have led to an increase in the incidence of overeducation among younger cohorts of workers, which is especially pronounced among informal workers. This implies that employment opportunities in Thailand do not match with its increasingly educated populace. Although the youngest cohort born between 1981 and 1990 is more likely to be formally employed than in previous generations, 40% of this cohort is still absorbed into informal employment, of which 41% are classified as overeducated. Overeducated informal workers in private firms face the highest overeducation wage penalties within the youngest birth cohort.

Dissonance between formal job development and government education policies is an issue that policy makers in developing economies need to heed. Thailand's current approach to education that encourages students to complete high levels of general education without the promise of formal employment commensurate with their educational qualifications incurs costs to both individuals (i.e., time costs, wage penalties, and potentially forced entry into informal employment) and society (i.e., inefficient education spending and potential losses of tax revenues from unregistered employees). The government may want to consider better aligning its curriculum and degree offerings with formal job development.

At present, the Thai government is focused on increasing high-skilled job opportunities. Thailand has introduced the "Thailand 4.0" policy, which is aimed at advancing the development of the country through innovation (Royal Thai Embassy 2018). As part of its strategy, the government has identified 10 target industries for development.⁷ One of the government's current target industries, for example, is automobile manufacturing. The development of vocational education aimed at filling formal technical jobs within automobile manufacturing would (i) better target the amount of education an individual needs to complete, thus minimizing time and monetary costs of education and (ii) channel young workers into well-matched formal employment. If the government is successful in moving Thailand 4.0 forward

⁷Eastern Economic Corridor Office of Thailand. <https://www.eeco.or.th/en/content/targeted-industries>.

and creating more high-skilled, formal employment that is commensurate with academic credentials, vertical education–occupation mismatch and its penalties would be expected to decline. Time will tell whether this or other government policies to develop more formal sector high-skill jobs will help alleviate the high incidence of informality among younger workers and allow them to earn at their potential.

Finally, we acknowledge the limitations of the above analysis given the use of cross-sectional data. However, given the results from previous related research using panel data, particularly the research by Paweenawat and Vechbanyongratana (2015) that shows overeducation occurs across the entire ability distribution in Thailand, we believe our results are not entirely driven by the ability bias. In the future, we hope to extend this work and better control for individual heterogeneity by using panel data. Future work will also include an analysis by level of education, particularly differences in penalties between vocational and general education.

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