

ENTREPRENEURSHIP AND PROVINCIAL SKILL DIVERSITY IN THAILAND

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ABSTRACT

This study investigates the relationship between provincial workforce skill diversity and entrepreneurship in Thailand using pooled cross-sectional data from the 2013 and 2022 Thai Labour Force Surveys, covering 77 provinces, with approximately 270,000 individual observations across the two waves; the regression sample after standard restrictions comprises around 175,000 observations. Provincial skill diversity is operationalised through four distinct indices measuring workforce heterogeneity: (1) educational attainment levels, (2) educational fields among highly educated workers, (3) occupational categories, and (4) industrial sectors. These indices are computed using fractionalisation index. The empirical strategy combines probit regressions to estimate the probability of entrepreneurship with instrumental variable (IV) techniques to address potential endogeneity. Furthermore, a generalised structural equation model (GSEM) was employed to examine indirect mechanisms through three mediators: entrepreneur skill diversity, employee skill diversity, and consumption diversity. The results show that provinces with greater skill diversity exhibit a significantly higher likelihood of entrepreneurship: a one-standard-deviation increase in skill diversity raises the probability of entrepreneurial activity by approximately 0.09-1.06 percentage points in 2013 and 0.003-0.50 percentage points in 2022. Indirect effects operate mainly through entrepreneur skill diversity, consistent with knowledge spillover theory. Conversely, employee skill diversity reduces entrepreneurial activity, while lower consumption diversity is positively associated with entrepreneurship through a necessity-driven channel, both patterns reflecting the informal and survival-oriented nature of Thailand's labour market. Policy implications emphasise inclusive education, balanced regional industrial strategies, and labour mobility to leverage workforce diversity for sustainable, innovation-driven entrepreneurship.

Keywords: Skill diversity, entrepreneurship, workforce heterogeneity, Thailand, provincial analysis

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1. INTRODUCTION

Globalisation has profoundly transformed the foundations of business management, innovation, and entrepreneurship, positioning human-capital diversity as a major determinant of regional competitiveness (Acs, 2006; Audretsch, 2007; Cooke, 2001; Audretsch & Belitski, 2017). Modern economies rely not only on the quantity of labour but on the diversity of skills,

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experiences, and knowledge that workers contribute to local and national production systems. A diverse labour force can foster new idea combinations, facilitate innovation, and create entrepreneurial opportunities through knowledge spillovers and interaction across occupational boundaries (Jacobs, 1969; Hong & Page, 2001). Conversely, excessive heterogeneity may also introduce coordination costs, skill mismatches, and social friction, reducing trust and collective efficiency (Lazear, 1999; Dincer, 2011; Sturgis et al., 2011). Hence, the overall impact of workforce diversity on entrepreneurship remains theoretically ambiguous and empirically contingent upon contextual and institutional settings.

Before proceeding, it is essential to clarify the conceptual scope of 'skill diversity' as used in this paper. Previous literature has examined various forms of workforce diversity, including demographic diversity (age, gender), ethnolinguistic diversity (language, ethnicity), and skill-based diversity (education, occupation, industry). While these concepts are related, they capture distinct dimensions of heterogeneity. This paper focuses specifically on skill diversity, operationalised through four empirical measures: (1) educational attainment levels, (2) educational fields among highly educated workers, (3) occupational categories, and (4) industrial sectors. These measures are selected because they directly reflect the knowledge, competencies, and productive capabilities of the workforce-dimensions most relevant to entrepreneurial opportunities and innovation. The terms 'city skill diversity' and 'provincial skill diversity' are used interchangeably throughout this paper to refer to these four skill-based diversity indices measured at the provincial level.

During the past two decades, Thailand has experienced deep structural transformation that has significantly altered its workforce composition. Economic modernisation and regional industrialization, particularly in the Central region, and the Eastern Economic Corridor (EEC) have accelerated the shift from agriculture to manufacturing and services. Concurrently, higher educational attainment and expansion of vocational and tertiary programmes have increased the heterogeneity of the national workforce. Internal migration from rural to urban areas, coupled with inflows of migrant workers from neighbouring ASEAN countries, has further diversified provincial labour markets (Sussangkarn, 1996). According to the World Bank (2016), migrant labour now constitutes nearly one-tenth of total employment, reinforcing demographic and skill diversity across provinces. These structural and demographic changes provide fertile ground to examine how workforce diversity affects entrepreneurial behaviour and economic performance in Thailand.

The concept of diversity and economic performance has been examined extensively in developed economies. Research on regional growth and urbanisation has demonstrated that diversity in education, skills, and ethnicity can enhance productivity, innovation, and entrepreneurship (Ottaviano & Peri, 2005, 2006; Duranton & Puga, 2000; Bellini et al., 2013; Lee, 2015; Marino et al., 2012; Trax et al., 2015; Kemeny, 2017). From the perspective of the Knowledge Spillover Theory of Entrepreneurship (Acs et al., 2009; Braunerhjelm et al., 2010), heterogeneous knowledge pools stimulate entrepreneurial entry by enabling individuals to recognise and exploit opportunities emerging from diverse human interactions. Similarly, within the Regional Innovation Systems framework (Cooke, 2001), diversity supports innovation by improving the flow of information and skills across firms and industries. However, competing arguments derived from cultural and behavioural economics suggest that diversity may erode social

cohesion, reduce trust, and hinder cooperation (Alesina et al., 2000), especially in societies where institutional mechanisms for integration are weak.

Despite these rich theoretical insights, empirical evidence from developing countries remains limited. Most existing studies are based on high-income contexts with mature institutions, innovation-oriented industries, and well-developed migration systems (Alesina et al., 2000; Longhi, 2013; Kemeny & Cooke, 2018). By contrast, developing economies such as Thailand are characterized by uneven educational attainment, large informal sectors, and significant regional disparities. Approximately half of Thailand's workforce is engaged in informal employment, and many entrepreneurial activities are necessity-driven rather than opportunity-driven (NSO, 2023). These features make Thailand a compelling context in which to test whether the positive effects of diversity, as observed in developed economies, also apply in a middle-income, emerging setting with mixed formal and informal labour markets.

The empirical gap is particularly evident in provincial-level studies of entrepreneurship. Previous Thai research has primarily focused on macroeconomic growth (Paweenawat & McNown, 2018; Tangtipongkul, 2015) or labour supply behaviour (Lekfuangfu, 2017), but few studies have explored how skill diversity, in terms of education, occupation, and industry composition, affects entrepreneurship. Furthermore, Thailand's regional inequality and industrial concentration suggest that the spatial distribution of skills may significantly shape entrepreneurial opportunities (Combes & Duranton, 2006; Eeckhout et al., 2014). The absence of a coherent empirical framework leaves policymakers without evidence on how to manage and promote skill diversity as a tool for innovation, employment, and regional development.

From a theoretical standpoint, the mechanisms through which skill diversity influences entrepreneurship remain underexplored. Diversity may enhance entrepreneurship directly by increasing exposure to heterogeneous knowledge or indirectly by shaping entrepreneur diversity (heterogeneous founder backgrounds), employee diversity (varied skill mixes within labour markets), and consumption diversity (heterogeneous demand structures) (Duranton & Puga, 2000; Ottaviano & Peri, 2005, 2006; Zhang, 2020). Yet these channels may operate differently in economies with high informality, regional inequality, and varying levels of human-capital accumulation. Understanding these interconnections is essential for formulating policies that transform workforce heterogeneity into productive entrepreneurial outcomes.

This study investigates how provincial workforce skill diversity influences entrepreneurship in Thailand using provincial data from the 2013 and 2022 Thai Labour Force Surveys (LFS). The analysis applies multiple quantitative methods, including probit regression, instrumental variable estimation, and a generalised structural equation model (GSEM) to capture both direct and indirect effects through entrepreneur, employee, and consumption diversity. Skill diversity is measured through fractionalisation index capturing heterogeneity in education, occupation, and industry. By integrating microeconomic and regional perspectives, this research provides new insights into how diversity functions as an endogenous driver of entrepreneurship in a developing-economy context.

The remainder of this paper is organised as follows. Section 2 outlines the theoretical framework based on insights from previous studies. Section 3 describes the data sources, the measurement of provincial skill diversity, and provides descriptive statistics derived from the Thai Labour Force

Survey (LFS). Section 4 presents the empirical specifications and results, including robustness checks addressing endogeneity concerns. Finally, Section 5 concludes the paper and provides policy implications.

2. THEORETICAL FRAMEWORK

Entrepreneurship is deeply embedded in the diversity of the local environment, encompassing geography, education, skills, culture, and institutions, all of which collectively shape individuals' propensities to engage in entrepreneurial activity (Glaeser & Kerr, 2009; Obschonka et al., 2017). Diverse environments offer wider knowledge pools, multiple perspectives, and heterogeneous networks that stimulate opportunity recognition and innovation (Hong & Page, 2001; Acs et al., 2009). Building upon the Knowledge Spillover Theory of Entrepreneurship (Acs et al., 2009; Braunerhjelm et al., 2010) and the Regional Innovation Systems framework (Cooke, 2001), this study posits that workforce skill diversity influences entrepreneurship through three interrelated mechanisms: (1) consumption diversity, (2) employee skill diversity, and (3) entrepreneur skill diversity. These channels reflect both demand- and supply-side perspectives of entrepreneurial opportunity formation.

2.1. Provincial Skill Diversity and Consumption Diversity

The first mechanism highlights how workforce diversity stimulates entrepreneurial opportunities by generating diverse regional demand structures. Consumer behaviour varies according to social class, education, and cultural preferences. Regions with heterogeneous populations exhibit greater variance in purchasing power, lifestyles, and consumption preferences, providing fertile ground for new market niches and product innovation. Differences in literacy, knowledge, and income across consumer groups directly influence the diversity of products and services demanded, thereby creating space for new entrepreneurs.

From this perspective, skill diversity contributes to a demand-pull effect: as the range of skills and occupations within a province broadens, so too does the heterogeneity of consumers' needs. Entrepreneurs respond by developing specialised products and services that cater to varied preferences. This mechanism aligns with Jacobs (1969) notion of urban diversity as a driver of innovation and with Ottaviano & Peri's (2005, 2006) finding that cultural and skill heterogeneity fosters market differentiation.

2.2. Provincial Workforce Skill Diversity and Entrepreneurial Opportunities

The second mechanism involves the supply-side channel, through which diverse workforces enhance entrepreneurial potential. Workforce diversity expands the range of available competences, enabling knowledge recombination and innovation (Acs, 2006; Mueller et al., 2008). In regions with greater skill diversity, entrepreneurs can more easily assemble complementary teams, experiment with new ideas, and access broader networks of expertise (Duranton & Puga, 2000; Combes & Duranton, 2006). This diversity fosters productive matching between entrepreneurs and employees, reducing search and coordination costs in labour markets.

Empirical studies reinforce this argument. Suedekum et al. (2014) found that workforce heterogeneity in Germany enhances firm productivity through culture-specific skills. Garnero et al. (2014) demonstrated similar outcomes in Belgium, showing that diverse teams improve firm-level performance. In Israel, Navon (2010) reported that labour diversity increases productivity through human-capital spillovers. Likewise, Hartog et al. (2010), Åstebro & Thompson (2011), Bublitz & Noseleit (2014), and Spanjer & van Witteloostuijn (2017) observed that individuals in heterogeneous skill environments tend to earn higher incomes and are more likely to pursue entrepreneurial careers.

Theoretically, this mechanism corresponds with the Knowledge Spillover Theory of Entrepreneurship, which posits that diverse knowledge stocks within a region enhance opportunity identification and innovation (Acs et al., 2009; Braunerhjelm et al., 2010). Workforce diversity thus provides both informational variety and structural flexibility that lower barriers to entrepreneurial entry (Stephens et al., 2013).

2.3. Entrepreneur Skill Diversity and Innovation Capacity

The third mechanism concerns diversity among entrepreneurs themselves. Entrepreneurs differ in educational backgrounds, experiences, and skill sets, and these variations shape their cognitive frameworks and problem-solving approaches. Hong & Page (2001) demonstrated that heterogeneous groups consistently outperform homogeneous ones in tackling complex problems. Berliant & Fujita (2011, 2012) further argued that diversity enhances innovation because individuals exchange complementary ideas that lead to creative solutions.

At the regional level, higher diversity among entrepreneurs facilitates the emergence of new ventures through variety in demand and workforce skill complementarity effects (Zhang, 2020). Individuals from diverse backgrounds bring unique intellectual capabilities and networks, strengthening collective entrepreneurial capacity (Iranzo et al., 2008; Lee, 2015). Within endogenous growth models, Acs et al. (2009) and Braunerhjelm et al. (2010) emphasised that knowledge diffusion among heterogeneous actors accelerates innovation and firm creation. Similarly, cultural and linguistic diversity increases the likelihood of creative recombination of knowledge (Ottaviano & Peri, 2005, 2006; Alesina et al., 2000).

In essence, diversity among entrepreneurs acts as both a reflection and amplifier of workforce heterogeneity, reinforcing the feedback loop between skill diversity and entrepreneurial dynamism.

2.4. Integrating the Mechanisms in the Thai Context

While these mechanisms have been examined extensively in developed economies such as the United States, United Kingdom, and European Union countries (Alesina & La Ferrara, 2005; Suedekum et al., 2012; Lee, 2015; Zhang, 2020), their validity in developing contexts remains uncertain (Silver et al., 2020). Thailand, as a middle-income economy, presents a unique context for empirical investigation.

The Thai labour market has experienced substantial transformation due to educational expansion, industrial diversification, and labour migration (World Bank, 2016). The share of workers with

tertiary education has steadily increased, particularly in urban provinces, while employment in agriculture has declined (Paweenawat & McNown, 2018). Simultaneously, internal migration from rural areas to industrial centres and cross-border migration from neighbouring countries, including Myanmar, Laos, and Cambodia, have significantly diversified the workforce. This pattern mirrors the “urban skill diversity” observed in global studies, but within a provincial framework suited to Thailand’s decentralized economy.

Despite these developments, research examining how workforce skill diversity affects entrepreneurship in Thailand remains scarce. There is currently no national policy explicitly addressing the management or utilisation of diversity to enhance innovation or entrepreneurship. Existing studies tend to focus on macroeconomic growth, inequality, or labour-market efficiency rather than the diversity–entrepreneurship nexus (Tangtipongkul, 2015; Lekfuangfu, 2017). As Thailand seeks to transition toward a more innovative, high-value economy, understanding these linkages is critical.

It is important to note that the four diversity measures employed in this study, namely educational level, field of education, occupation, and industry, may capture conceptually distinct phenomena. Educational diversity primarily reflects human capital heterogeneity, representing differences in formal knowledge and credentials accumulated by workers. In contrast, occupational and industry diversity reflect the structural composition of employment and production within each province, which may be shaped by factors such as industrial policy, regional comparative advantage, and economic specialisation. These measures should therefore be interpreted not as perfect substitutes but as complementary indicators that together provide a more comprehensive picture of skill diversity. Readers should consider them as capturing different dimensions of provincial economic structure rather than redundant measures of the same underlying concept.

3. DATA AND DIVERSITY MEASURES

The data used in this study are derived from the Thai Labour Force Survey (LFS) for the years 2013 and 2022, obtained from the National Statistical Office of Thailand (NSO). Although the survey is conducted quarterly, this paper utilises data exclusively from the third quarter of each selected year, as Thai agricultural workers typically relocate to urban provinces during the summer months and return to their home provinces during the rainy season (Sussangkarn, 1996; Lekfuangfu, 2017; Paweenawat & McNown, 2018). Employment data from the third quarter tend to reflect full and stable employment conditions, with minimal worker movements across regions, jobs, and firms.

To measure entrepreneurship, this study focuses exclusively on employers, explicitly excluding self-employed individuals, consistent with the approach adopted by Zhang (2020). This choice is justified by the assumption that local employers rely more significantly on the local labour market, thereby contributing to job creation and local employment, unlike self-employed workers who typically have limited influence on local hiring. The skill diversity of the workforce is calculated separately for each province, and the primary dependent variable of this study is the

identification of respondents as employers. The total number of observations is 38,043,837 for 2013 and 39,176,814 for 2022.

In this study, the province was selected as the unit of analysis because it provides a sufficiently large dataset to enable robust statistical analysis. Provincial skill diversity is measured using workforce education data, following methodologies employed by Navon (2010), Ilmakunnas & Ilmakunnas (2011), Lewis (2011), Parrotta et al. (2014a, 2014b), Eeckhout et al. (2014), Garner et al. (2014), Marino et al. (2016), and Vandenberghe (2016). Alternative measures of skill diversity utilise data on current occupational and industrial classifications according to the International Standard Classification of Occupations (ISCO-08) and Thailand's Standard Industrial Classification (TSIC-2009), respectively. The share of workers in each occupational or industrial category is calculated, and subsequently, a fractionalisation index is applied to derive a skill diversity index for each province. The fractionalisation index formula is presented in Equation (1):

$$\text{div}_{jt} = 1 - \sum_{h=1}^H (s_{jt}^h)^2 \quad (1)$$

where s_{jt}^h is the worker share of category h in province j in year t , referencing Parrotta et al. (2014a, 2014b) and Marino et al. (2016). The fractionalisation index ranges from 0 to 1, with a value close to 1 indicating the highest degree of skill diversity.

The primary measure of provincial skill diversity is defined as educational diversity, specifically using data on workers' educational attainment levels (excluding those without formal education). These levels include primary, lower secondary, upper secondary, vocational, higher technical, undergraduate, and graduate education. Importantly, this first measure may also reflect underlying inequalities in access to education and skill-building opportunities. The second measure calculates skill diversity based on the educational fields of highly educated workers, categorised into four groups: engineering, humanities, natural sciences, and social sciences. The third measure utilises occupational data, classifying workers into nine groups according to the ISCO-08 to differentiate high-, medium-, and low-skill segments, reflecting heterogeneity in cognitive, technical, and manual competences that influence entrepreneurial potential, as presented in Table 1. ² Finally, provincial skill diversity is assessed using industry classifications divided into eight groups capture technological and knowledge intensity, distinguishing low-skill from high-skill sectors following TSIC-2009, consistent with the Regional Innovation Systems approach, as shown in Table 2. ³ Provincial and individual control variables included in the model estimations are detailed in Tables 3 and 4, respectively. Provincial variables were obtained from NSO provincial statistics and the Socio-Economic Survey, representing demographic, structural, and institutional conditions. Individual-level controls follow the Thai Labour Force Survey, including gender, age, marital status, education, and household headship to control for personal heterogeneity.

² International Standard Classification of Occupations (ISCO). (2008). ISCO-08. Retrieved from: <https://www.ilo.org/>.

³ Thailand Standard Industrial Classification Revised Version 2009. Retrieved from:

<https://statstd.nso.go.th/classification/description.aspx?id=17>

Table 1: Classification by occupation

Occupation	Job examples	Skills and education required
High skill		
Managers, legislators and senior officials	Managers and school principals	
Professionals		
- Sciences, doctors, engineers and college professors	Physicians, engineers, architects and biologists	Complex problem solving and decision-making based on knowledge in a specialised field. Most occupations in this category require a college degree. A vocational degree may be substituted by experience.
- Business/finance-related professionals	Business analysts and economists	
- Lawyers and other social science professionals	Lawyers and HR-related professionals	
- Artists and journalists	Movie directors, journalists and composers	
- School teachers and associates		
- Technicians and associated professionals	Medical technicians, health-safety inspectors and associated nurses	
Middle skill		
Clerical support workers	Clerks, secretaries and accountants	Producing a written record of work completed, performing simple
Services and sales workers	Shop sale assistants and hairdressers	Arithmetic and good interpersonal communication skills.
Low skill		
Agricultural, forestry and fishery workers	Farmers and fishermen	Agricultural work not related to research.
Craft and related trade workers	Plant sewing workers and craft workers	Manual tasks, sorting and sewing. Operating or repairing machinery and
Plant and machine operators, assemblers and drivers	A/C repairers and bus drivers	electronic equipment, assemblers and vehicle drivers.
Labourers in the non-agricultural sector	Cleaners, gardeners and construction workers	Simple and routine physical tasks.

Source: Wasi et al. (2019).

Table 2: Classification by industry

Sector	Description
Agriculture	Agriculture, fishing, hunting and forestry
Mining	Mining and quarrying
Utilities Construction	Electricity, water supply and gas Construction
Low-skill manufacturing	Food products Tobacco Textiles Footwear Apparel Non-wearing textile products Wood and cork products Furniture and fixtures Leather and fur products not for wearing Rubber products Petroleum products Other non-metallic mineral products

Sector	Description
High-skill manufacturing	Metal products, excluding machines
	Transport equipment
	Miscellaneous
High-skill manufacturing	Paper and paper products, printing and publishing
	Chemicals and chemical products
	Basic metals
	Machinery
	Electrical machinery
	Medical and scientific equipment
	Photographic and optical products
	Watches and clocks
Low-skill services	Retail trade
	Transportation
	Personal and household services
	Hotels and restaurants
	Wholesale trade
	Recreational and cultural services
	Warehousing
High-skill services	Sanitary and similar activities
	Public administration and defence
	Education, scientific and research
	Health and medical services
	Social work and other social and community services
	Communications
	Financial intermediation
	Real estate, business activities, including renting and insurance

Source: Government of Thailand, National Statistical Office 2001–2011; Mehta et al. 2013; Tangtipongkul, K. (2015).

Table 3 presents the individual characteristics derived from the Thai Labour Force Survey (LFS) for 2013 and 2022. Regarding the regional distribution, approximately 30 per cent of observations were located in Thailand's Central region, around 14 per cent resided in Bangkok, about 25 per cent were situated in the Northeastern provinces, and 13 per cent lived in the Southern provinces. Concerning marital status, in 2013, 71.45 per cent of respondents were married and 20.72 per cent were single. By 2022, the proportion of married respondents had declined, while the percentage of single individuals had increased. Notably, respondents classified under other marital statuses, including widowed, divorced, separated, or married but with unknown status, increased significantly from 7.84 per cent in 2013 to 36.74 per cent in 2022. Regarding educational attainment, workers with less than secondary education continued to constitute the majority, although there was a slight increase in the overall educational levels of Thai workers between 2013 and 2022. Occupational statistics reveal that the majority of workers were primarily employed in two occupational categories: (i) service and sales workers and (ii) skilled agriculture, forestry, and fishery workers. Meanwhile, managers, professionals, technicians, and associated professionals collectively accounted for approximately 15 per cent of total employment each year. Finally, regarding industry sectors, most Thai workers were employed in agriculture and low-skilled services. However, the share of agricultural workers declined by approximately 5 per cent by 2022, whereas the proportion employed in high-skilled services and manufacturing sectors increased.

Table 3: Individual characteristics from the LFS

Characteristics	2013		2022	
	Number of observations	Per cent	Number of observations	Per cent
Region				
Bangkok	5,149,977	13.54	5,563,594	14.2
Central region	11,136,735	29.27	12,581,728	32.12
Northern region	6,594,252	17.33	6,171,644	15.75
Northeastern region	10,137,856	26.65	9,677,979	24.7
Southern region	5,025,017	13.21	5,181,869	13.23
Marital status				
Single	7,880,785	20.72	10,466,906	26.72
Married	27,180,617	71.45	14,317,913	36.55
Others ^a	2,982,435	7.84	14,391,996	36.74
Education				
Primary	9,093,729	32.19	8,231,337	25.25
Lower secondary	6,124,403	21.68	6,849,681	21.01
Upper secondary	4,318,219	15.29	6,272,170	19.24
Vocational	1,303,193	4.61	1,554,555	4.77
Higher technical	1,786,046	6.32	2,445,956	7.5
Bachelor's degree	4,887,475	17.3	6,468,454	19.84
Postgraduate	736,026	2.61	775,022	2.38
Main occupation				
Managers	2,013,686	5.29	1,257,162	3.21
Professionals	2,162,421	5.68	2,338,449	5.97
Technicians and associate professionals	1,874,587	4.93	1,938,044	4.95
Clerical support workers	1,316,260	3.46	1,846,658	4.71
Services and sales workers	6,678,078	17.55	8,076,943	20.62
Skilled agriculture, forestry and fishery workers	12,986,291	34.14	11,568,875	29.53
Craft and related trades workers	4,094,613	10.76	4,054,794	10.35
Plant and machine operators and assemblers	3,410,939	8.97	3,870,528	9.88
Elementary occupations	3,506,961	9.22	4,225,362	10.79
Industry				
Agriculture	13,785,816	36.24	12,383,813	31.61
Utilities	217,960	0.57	176,462	0.45
Construction	2,160,899	5.68	2,070,173	5.28
Low-skill manufacturing	4,629,730	12.17	4,378,999	11.18
High-skill manufacturing	1,569,508	4.13	1,668,191	4.26
Low-skill services	10,432,884	27.42	12,463,633	31.81
High-skill services	5,187,353	13.64	5,990,498	15.29

Note: ^a Other marital statuses include widowed, divorced, separated and married but unknown status.

Source: Author's calculation from the Thai LFS 2013 and 2022.

The summary statistics of the variables used in the regression analysis are presented in Table 4. Data were obtained from the NSO provincial statistics, Labour Force Survey (LFS), and the Socioeconomic Survey (SES). The dataset consists of 38,043,837 observations for 2013 and 39,176,814 observations for 2022. Employers constitute approximately 3 per cent of the total observations. Female workers account for around 46 per cent of the sample in both years. The average ages of workers were 41.52 years in 2013 and 42.97 years in 2022, reflecting the ageing structure of the Thai labour market. About 41 per cent of individuals were household heads in

2013, increasing to approximately 46 per cent in 2022. The average household size decreased from 3.9 members in 2013 to 3.2 members in 2022. Approximately 45 to 46 per cent of individuals reside in municipal areas. Provincial monthly labour income averaged 17,183.21 THB in 2013, decreasing to 16,017.71 THB in 2022. Gross provincial product per capita notably increased from 119,141.10 THB in 2013 to 139,929.90 THB in 2022. Provincial labour demand averaged 4,059.50 persons in 2013 and rose to 6,381.93 persons in 2022. Additionally, the average number of migrants per province significantly increased from 15,374.48 persons in 2013 to 32,041.86 persons in 2022. Lastly, average government loan credits per person also increased considerably, from 19,991.99 THB in 2013 to 29,086.91 THB in 2022. The descriptive profile indicates Thailand's ageing labour force and growing educational attainment, particularly among female and urban workers, highlighting changing skill structures that underpin this study's hypotheses.

Table 4: Summary statistics of variables in Probit regression by years

Variables	Description	Mean	Std. dev.	Min	Max
2013 with 38,043,837 observations and 77 provinces					
Employer _{ij}	= 1 if worker is employer, = 0 otherwise	0.03	0.16	0.00	1.00
Female _{ij}	= 1 if worker is female, = 0 if worker is male	0.46	0.50	0.00	1.00
Age _{ij}	Age of worker	41.52	13.21	15.00	97.00
Hhead _{ij}	= 1 if worker is household's head = 0 otherwise	0.41	0.49	0.00	1.00
Member _{ij}	Number of household members	3.89	1.91	1.00	19.00
Municipal _{ij}	= 1 if worker is in municipal area, = 0 if worker is in non-municipal area	0.45	0.50	0.00	1.00
avhhinc _j	Provincial labour monthly income (THB)	17,183.21	8,504.71	9,143.55	53,157.95
gpp _j	Per capita gross provincial product	119,141.10	360,419.90	5,952.00	3,098,082.00
vacan _j	Provincial work demand (person)	4,059.50	7,304.26	0.00	59,524.10
mig _j	Migrants (person) in province	15,374.48	31,481.08	33.00	185,490.00
gloan _j	Government loan (THB) in province	19,991.99	40,317.46	2,508.00	356,298.00
2022 with 39,176,814 observations and 77 provinces					
Employer _{ij}	= 1 if worker is employer, = 0 otherwise	0.02	0.15	0.00	1.00
Female _{ij}	= 1 if worker is female, = 0 if worker is male	0.46	0.50	0.00	1.00
Age _{ij}	Age of worker	42.97	13.62	15.00	94.00
Hhead _{ij}	= 1 if worker is household's head = 0 otherwise	0.46	0.50	0.00	1.00
Member _{ij}	Number of household members	3.20	1.58	1.00	15.00
Municipal _{ij}	= 1 if worker is in municipal area, = 0 if worker is in non-municipal area	0.46	0.50	0.00	1.00
avhhinc _j	Provincial labour monthly income (THB)	16,017.71	10,603.47	9,941.31	95,032.41
gpp _j	Per capita gross provincial product	139,929.90	450,402.20	7,539.00	3,894,585.00
vacan _j	Provincial work demand (person)	6,381.93	8,519.86	130.61	65,050.54
mig _j	Migrants (person) in province	32,041.86	74,394.35	366.00	564,822.00
gloan _j	Government loan (THB) in province	29,086.91	131,383.00	1,980.00	1,163,592.00

Note: Obs. denotes observations and Std. dev. denotes sample standard deviations.

Source: Author's calculation from the NSO statistics, LFS, and SES in 2013 and 2022.

Regarding provincial skill diversity in Thailand, diversity indices were calculated based on the definitions discussed previously. Table 5 presents descriptive statistics for each diversity measure. Overall, the level of provincial skill diversity in Thailand is relatively high, with values consistently approaching 1 between 2013 and 2022. The maximum and minimum values for each diversity measure remained stable over the period studied. In 2013, the average provincial skill diversity ranged from approximately 0.66 to 0.75 across different measures. The standard deviations of skill diversity calculated using educational levels and fields were relatively low, at 0.04 and 0.03 respectively. In contrast, standard deviations using occupational and industrial groupings were higher compared to the first two measures. By 2022, the average provincial skill diversity had increased slightly. The standard deviations of skill diversity measures based on education levels and fields remained low at approximately 0.03; however, the variability for occupational and industrial skill diversity measures increased further relative to the earlier measures.

Table 5: Diversity indices using four different measures

Diversity index	Obs.	Mean	Std. dev.	Min	Max
Provincial skill diversity in 2013					
Diversity using education levels ^a	77	0.75	0.04	0.67	0.82
Diversity using educational fields ^b	77	0.69	0.03	0.58	0.74
Diversity using occupation types ^c	77	0.71	0.12	0.41	0.87
Diversity using industry groups ^d	77	0.66	0.10	0.39	0.81
Provincial skill diversity in 2022					
Diversity using education levels ^a	77	0.79	0.03	0.71	0.83
Diversity using educational fields ^b	77	0.69	0.03	0.59	0.74
Diversity using occupation types ^c	77	0.74	0.11	0.39	0.86
Diversity using industry groups ^d	77	0.67	0.09	0.38	0.81

Note: Obs. Denotes observations and Std. dev. Denotes sample standard deviation.

^a Education levels were divided into seven groups, excluding workers without any education, consisting of primary, lower secondary, upper secondary, vocational, higher technical, undergraduate and graduate education.

^b Educational fields were divided into four groups of engineering, humanities, natural sciences and social sciences.

^c Occupation types were classified into nine groups according to ISCO-08.

^d Industry groups were divided into eight classifications according to TSIC-2009.

Source: Author's calculation from the Thai LFS 2013 and 2022.

The distribution of provincial skill diversity changed between 2013 and 2022. Figure 1 illustrates the density distributions across different diversity measures. When assessing skill diversity based on workers' educational levels and fields, the number of provinces exhibiting high skill diversity increased over this period. This increase could reflect positive developments in local labour markets, indicating a larger and more varied pool of skilled workers in many provinces. However, when skill diversity is measured according to occupational and industrial groupings, many provinces experienced a decline in diversity. The reduction in skill diversity observed in some provinces suggests that occupations and industries in Thailand have become less diverse, increasingly concentrating within specific regions.

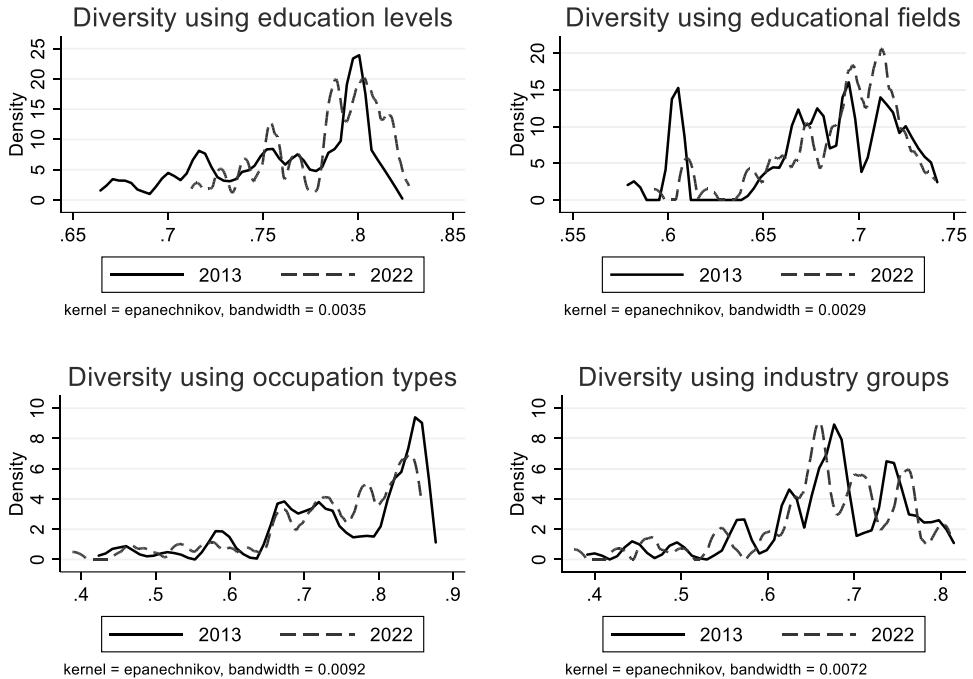
Despite the relatively high correlation among diversity measures (see Table A3 in the appendix), the direction of change differs between skill diversity measures based on education levels and

fields, and those based on occupation and industry. A plausible explanation for this divergence could be the constrained economic conditions following Thailand's 2014 coup d'état, combined with economic fluctuations in major economies such as the US, the EU, and China, which negatively impacted Thailand's exports from 2012 onward. Although the education budget continued to grow during this period, employment increasingly concentrated in a limited number of large urban provinces and specific industries, which offered insufficient variety in job opportunities.

The divergent trends observed between educational diversity (increasing) and occupational/industry diversity (decreasing) between 2013 and 2022 warrant further conceptual discussion. The increase in educational diversity likely reflects Thailand's sustained investment in public education and the expansion of higher education access, leading to a more heterogeneous distribution of educational credentials across provinces. The decrease in occupational and industry diversity, however, may reflect different economic processes: the concentration of certain industries in specific regions due to agglomeration economies, specialisation driven by regional comparative advantages, and structural shifts away from agriculture toward more concentrated service and manufacturing sectors.

These contrasting patterns suggest that the four diversity indices are responding to distinct underlying economic forces. Educational diversity is primarily supply-driven (determined by human capital investment and educational policies), while occupational and industry diversity are demand-driven (shaped by the structure of production and employment opportunities). This distinction has important policy implications: promoting educational diversity through education policy may not automatically translate into greater occupational or industry diversity if the local economic structure remains concentrated. Conversely, policies aimed at industrial diversification may be needed to translate human capital diversity into diverse employment opportunities.

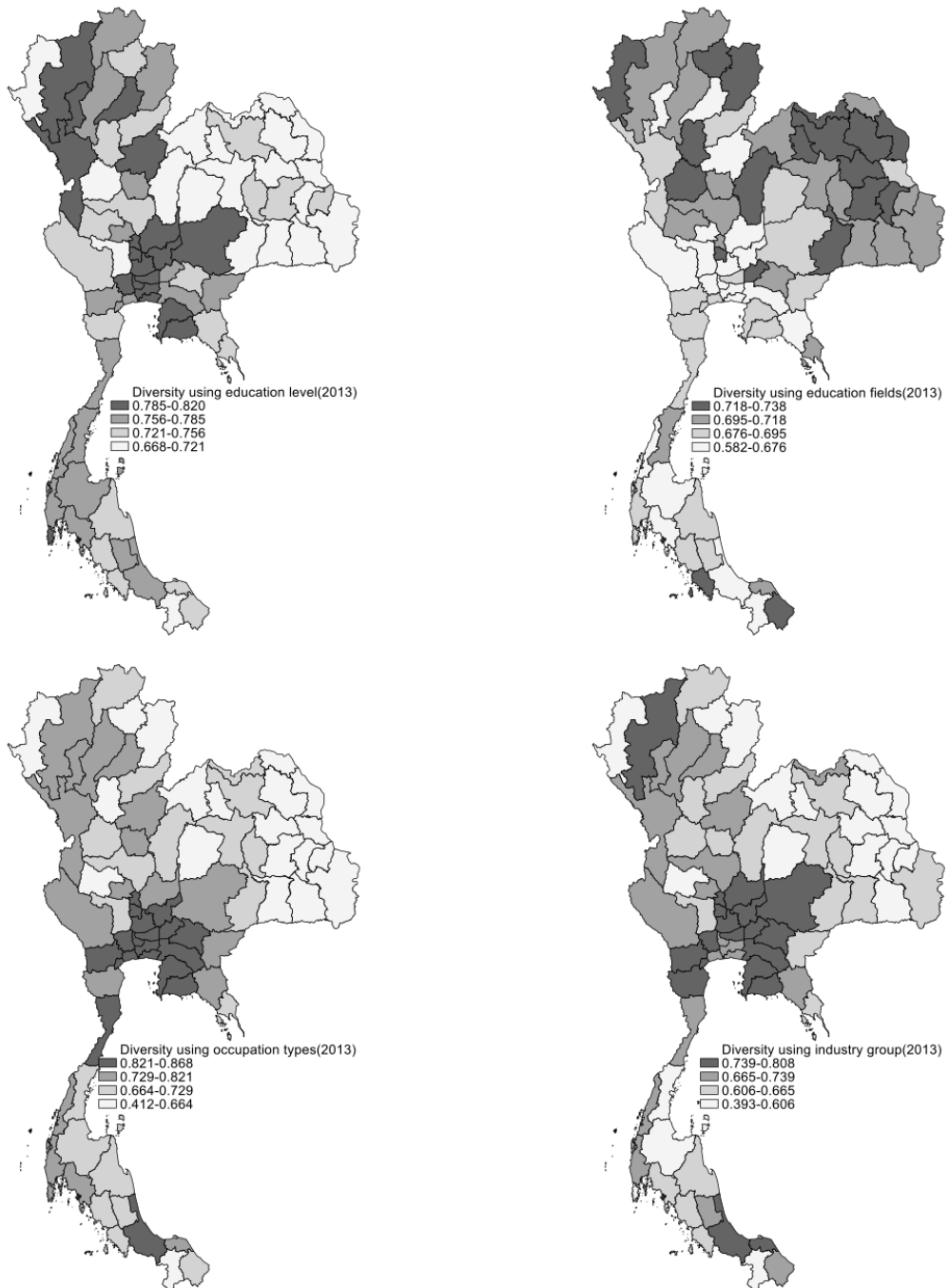
Figure 1: Densities of provincial skill diversity in 2013 and 2022



Source: Author's kernel density estimates from the Thai LFS 2013 and 2022.

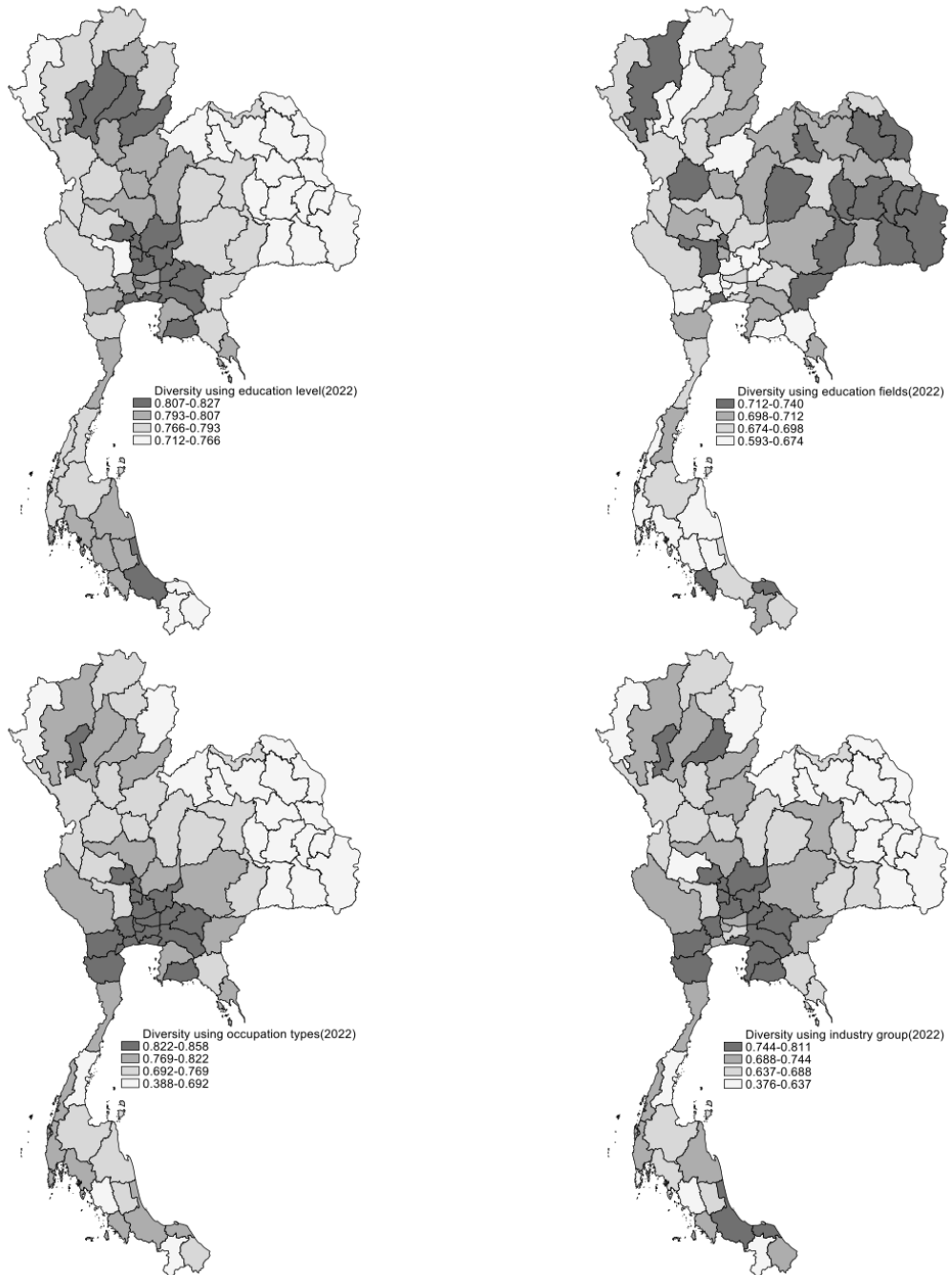
The spatial distribution of provincial skill diversity in 2013 and 2022 is depicted in Figures 2 and 3, respectively. Provinces with high skill diversity, as identified by the four diversity measures, are predominantly clustered in the Central region, the Eastern Economic Corridor (EEC), and the Southern provinces. This geographical clustering remained relatively stable between 2013 and 2022. Bangkok and provinces within the EEC consistently exhibit the highest levels of provincial skill diversity across nearly all measures. Conversely, provinces in the Northeastern region consistently demonstrate relatively lower skill diversity throughout the studied period.

Figure 2: Skill diversity spatial distribution maps in 2013



Source: Author's calculation from the Thai LFS 2013.

Figure 3: Skill diversity spatial distribution maps in 2022



Source: Author's calculation from the Thai LFS 2022.

4. EMPIRICAL SPECIFICATIONS AND RESULTS

4.1. Probit model with endogenous skill diversity

Entrepreneurship is modelled as an occupational-choice decision where individuals compare expected utility between small-scale entrepreneurship and paid work. To address the first research question, namely the extent to which workforce skill diversity affects entrepreneurship at the provincial level, I employ a probit model to estimate the conditional probability of becoming an entrepreneur. The model assumes that ε_{ij} is normally distributed, with mean zero and variance σ_ε^2

$$\text{Entre}_{ij}^* = IC_{ij}'\beta + PC_j'\delta + \text{div}_j'\gamma + \varepsilon_{ij} \quad (2)$$

where Entre_{ij}^* is the latent variable. $\text{Entre}_{ij}^* > 0$ indicates the individual is an entrepreneur and $\text{Entre}_{ij}^* < 0$ indicates the opposite case. IC_{ij} is a vector of individual controls that may affect the entrepreneurship of individual i in province j . PC_j is a vector of the provincial controls of province j , div_j is a vector of provincial skill diversity of province j and ε_{ij} is a stochastic disturbance term. I estimate the equation describing the probability of individual entrepreneurship using

$$P(\text{Entre}_{ij} = 1|X) = \Phi((IC_{ij}'\beta + PC_j'\delta + \text{div}_j'\gamma)/\sigma_\varepsilon) \quad (3)$$

where $\Phi(\cdot)$ is the cumulative standard normal distribution. The empirical strategy used is to estimate the probit model for each year since the survey data do not collect repeated samples. Also, due to the high correlation between skill diversity indices, I estimate four specifications using one definition of skill diversity for each year. The provincial skill diversity indices enter the model in their original fractionalisation form, ranging from 0 (no diversity) to 1 (maximum diversity), without prior standardisation. To facilitate interpretation, marginal effects are subsequently expressed in terms of a one-standard-deviation change by multiplying the estimated coefficients with the standard deviations reported in Table 5.

A potential concern regarding endogeneity arises due to the possibility of reverse causality between provincial skill diversity and entrepreneurship. Self-selection or sorting behaviour might occur if highly skilled and diverse entrepreneurs preferentially migrate to provinces already characterised by high skill diversity, thereby further enhancing diversity in these areas. Consequently, provincial skill diversity may be an endogenous variable in the model, potentially leading to biased and inconsistent estimators.

To address this potential issue, provincial skill diversity is instrumented using two strategies. The first and most common approach in urban economics literature is to employ ten-year lagged diversity as instrumental variables (IVs), as these lagged values are unlikely to correlate with the error terms (Ciccone & Hall, 1996; Combes & Duranton, 2006; Zhang, 2020). Accordingly, I calculate skill diversity from the Thai Labour Force Survey (LFS) data from 2003 and 2012, using them as instruments for provincial skill diversity in 2013 and 2022, respectively.

The second strategy involves employing a shift-share methodology, widely adopted in empirical studies examining diversity at the provincial level (e.g., Ottaviano & Peri, 2005, 2006; Kemeny & Cooke, 2018; Moretti, 2011). Following Ottaviano & Peri (2005, 2006) and Zhang (2020), I construct variations in provincial skill diversity based on the initial share of each skill group in 2003. Subsequently, I calculate predicted (or imputed) diversity for 2013 and 2022 by adjusting the initial share of each skill group with the overall population growth rate that each group experienced over the prior decade. Consequently, this imputed measure of skill diversity change is less likely to be influenced by the recent inflows of skilled workers into a province. For an example of how to implement a shift-share variable, let s_i^c be a share of individuals in category i in province c . The overall national share of every individual in category i is $s_i = \sum_{c=1}^C s_i^c$. The growth rate between 2003 and 2013 is

$$(g_i)_{2003-2013} = [(s_i)_{2013} - (s_i)_{2003}] / (s_i)_{2003} \quad (4)$$

I subsequently impute the share of individuals in category i who resided in province c in 2013 in the following equation:

$$(s_i^c)_{2013} = (s_i^c)_{2003} [1 + (g_i)_{2003-2013}] \quad (5)$$

Once the imputed shares for 2013 are constructed, the predicted or imputed skill diversity index for each province in 2013 can be calculated from

$$\text{div}_{c,2013} = 1 - \sum_{h=1}^H (s_i^c)^2_{2013} \quad (6)$$

The underlying exclusion restriction for these instruments is that, as the imputed skill diversity for each province in 2013 is built using the province's share in 2003 and the 2003–2013 national growth rates of each group of individuals, this imputed index value is independent of any province-specific shock during the period.

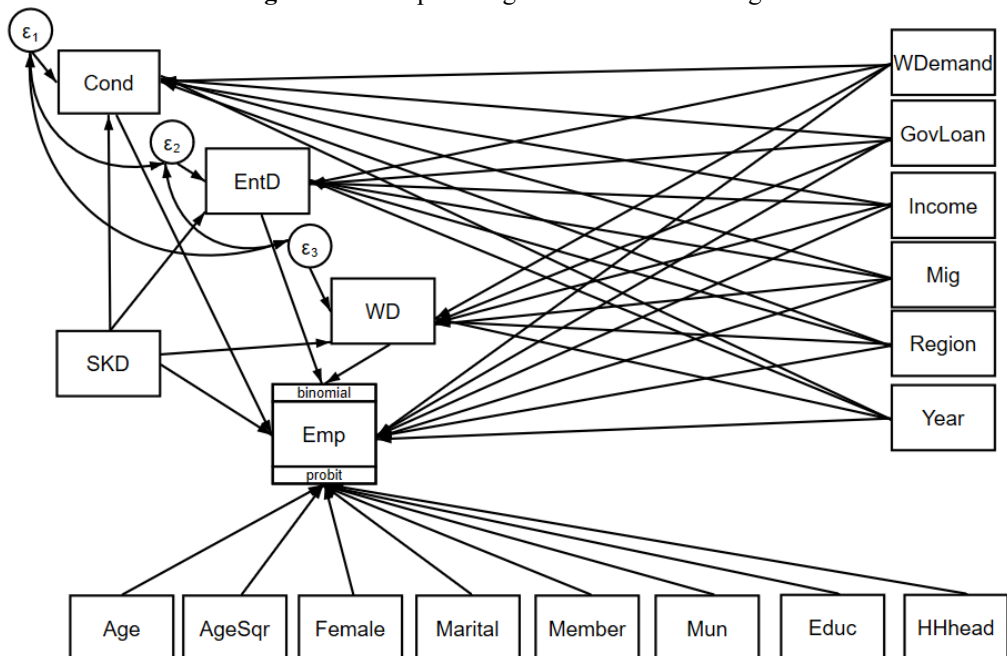
4.2. Generalised structural equation model

Regarding the second research question, provincial skill diversity could positively influence the probability of becoming an entrepreneur through three intermediate mechanisms: greater consumption diversity, increased employee diversity, and enhanced entrepreneurial skill diversity. Employee and entrepreneur skill diversities in each province are calculated using data on educational attainment from the Labour Force Survey (LFS). It should be noted that each mediator variable, namely consumption diversity, employee skill diversity, and entrepreneur skill diversity, is aggregated at the provincial level. This aggregation approach is consistent with the provincial-level analysis employed throughout this study, though readers should be mindful of potential ecological fallacy when interpreting individual-level implications from these aggregate measures. Additionally, I use provincial gross product per capita obtained from the Office of the National Economic and Social Development Council as a proxy for consumption diversity, assuming for simplicity that a higher per capita provincial product implies greater consumption diversity. This is due to data limitation of expenditure-category share in Thailand. To statistically assess the indirect effects of each intermediate variable on the relationship between provincial skill diversity and entrepreneurial activity, I employ a generalised structural equation model

(GSEM) suitable for a dichotomous outcome. I estimate the model using robust maximum likelihood with bootstrapped indirect effects (500 replications) to obtain accurate standard errors for the mediation pathways. Subsequently, I calculate the direct, indirect, and total effects of provincial skill diversity on entrepreneurship via these three intermediate variables. The structural path diagram illustrating this model is presented in Figure 4. The three mediating pathways correspond to the theoretical mechanisms outlined in Section 2:

- Consumption diversity (ConD), proxied by per capita gross provincial product, captures the demand-side mechanism (H1): greater skill diversity generates diverse consumer preferences, creating entrepreneurial opportunities.
- Employee skill diversity (WD) represents the labour supply mechanism (H2): diverse provincial skill pools reduce search costs and enable entrepreneurs to match workers to suitable positions efficiently.
- Entrepreneur skill diversity (EntD) reflects the knowledge complementarity mechanism (H3): skill diversity fosters complementary intellectual abilities among entrepreneurs, stimulating innovation and new venture creation.

Figure 4: Basic path diagram of the model design



Note: SKD = provincial skill diversity, ConD = consumption diversity, EntD = entrepreneur skill diversity, WD = employee skill diversity and Emp = employer indicator. The rest are the individual and provincial controls used in the probit regression model.

4.3. Results from the Probit analysis

This section presents the results of the probit regression analysis examining the relationship between provincial skill diversity and the probability of becoming an entrepreneur. Results are reported separately for the years 2013 and 2022, given the cross-sectional nature of the Thai

Labour Force Surveys. Four model specifications are estimated for each year, incorporating both individual and provincial control variables. Standard errors are robust and clustered at the provincial level. Overall, the findings align with Zhang (2020).

The results based on the 2013 data are presented in Table 6. The regressions indicate that the relationship between provincial skill diversity and the probability of becoming an entrepreneur is positive and statistically significant across all specifications, except specification 2. In specification 2, the estimated coefficient for provincial skill diversity, measured using individuals' educational fields, is positive but statistically insignificant. Specification 1 reveals that higher provincial skill diversity based on educational levels significantly increases the predicted probability of entrepreneurship. Similar results emerge in specifications 3 and 4. The coefficient for provincial skill diversity measured by occupational categories is notably the largest among all measures. The results show that provincial skill diversity is positively associated with entrepreneurship, supporting the hypothesis that heterogeneous human capital enhances opportunity recognition through knowledge spillovers. This finding suggests that occupational diversity may better capture functional complementarity in local labour markets compared to educational diversity measures. While educational classifications reflect formal qualifications, occupational categories more directly represent the variety of actual skills and job functions available to entrepreneurs when assembling their workforce. Consequently, provinces with diverse occupational structures offer entrepreneurs greater flexibility in matching workers to specific business needs, thereby facilitating new venture creation.

Regarding the marginal effects of provincial skill diversity in specifications 1–4, the average marginal effects are 0.048, 0.029, 0.088, and 0.070, respectively. Detailed marginal effects are reported in Appendix B3. Using the standard deviations of each diversity index, a one-standard-deviation increase in provincial skill diversity a decade ago could have increased the probability of becoming an entrepreneur by approximately 0.09 to 1.06 percentage points in Thailand.⁴ Among the different measures, skill diversity based on educational fields has the smallest impact on entrepreneurial probability.

Table 6: Provincial-level diversity 2013 using probit regressions

Dependent variable: being employer	(1) Diversity index using education levels	(2) Diversity index using education fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Diversity index				
Education levels	0.9337* (0.4835)			
Educational fields		0.5641 (0.5673)		
Occupation types			1.7146*** (0.2492)	
Industry groups				1.3686*** (0.2408)

⁴ I compute the standard deviations (SDs) of diversity as shown in Table 5 referencing Ottaviano and Perri (2005), then multiply these SDs with the estimated coefficients of the diversity index.

Dependent variable: being employer	(1) Diversity index using education levels	(2) Diversity index using education fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Individual characteristics	Included	Included	Included	Included
Provincial characteristics	Included	Included	Included	Included
Constant	-4.3489*** (0.5871)	-4.1928*** (0.6403)	-4.6823*** (0.6451)	-4.5460*** (0.5298)
Pseudo R ²	0.2863	0.2861	0.2880	0.2877
Observations	89,335	89,335	89,335	89,335

Note: Robust standard errors are in parentheses. ***, ** and * denotes significance at 1%, 5% and 10% levels, respectively. For more details, see Table B1 in the Appendix.

Source: Author's estimation using the Thai LFS 2013.

Table 7 presents the results based on the 2022 data. The estimated coefficient of provincial skill diversity measured by educational levels in specification 1 is positive and statistically significant, and the magnitude of this coefficient is larger compared to that observed in the 2013 data. However, in the remaining specifications, the probit regressions show that the estimated coefficients for provincial skill diversity based on educational fields are positive but statistically insignificant. Subsequently, I estimate the marginal effects of provincial skill diversity in each specification. The average marginal effects observed are broadly similar to those found previously for the 2013 data. Specifically, the estimated average marginal effects of provincial skill diversity are 0.097, 0.001, 0.045, and 0.042 for specifications 1, 2, 3, and 4, respectively. Detailed marginal effects are reported in Appendix B3. In 2022, a one-standard-deviation increase in provincial skill diversity increases the probability of becoming an entrepreneur by approximately 0.003 to 0.5 percentage points.

Table 7: Provincial-level diversity 2022 using probit regressions

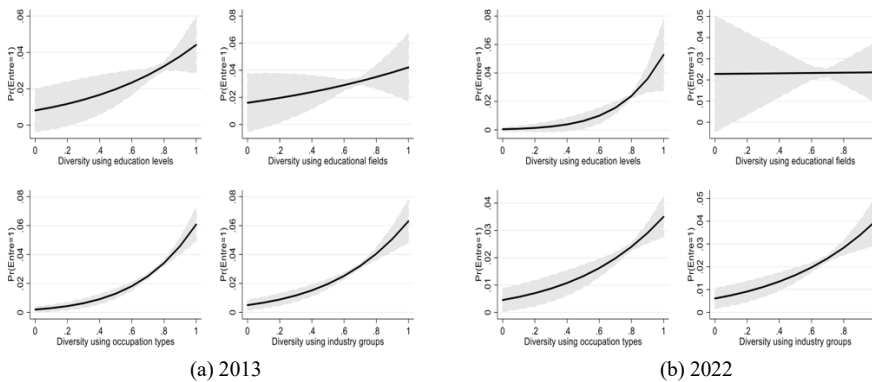
Dependent variable: being employer	(1) Diversity index using education levels	(2) Diversity index using education fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Diversity index				
Education levels	2.4292*** (0.7535)			
Educational fields		0.0187 (0.5312)		
Occupation types			1.1137*** (0.2910)	
Industry groups				1.0565*** (0.2655)
Individual characteristics	Included	Included	Included	Included
Provincial characteristics	Included	Included	Included	Included
Constant	-4.0939*** (0.8352)	-2.3970*** (0.8064)	-2.7966*** (0.6946)	-2.6676*** (0.6806)
Pseudo R ²	0.3015	0.3011	0.3019	0.3019
Observations	85,444	85,444	85,444	85,444

Note: Robust standard errors are in parentheses. ***, ** and * denotes significance at 1%, 5% and 10% levels, respectively. For more details, see Table B2 in the Appendix.

Source: Author's estimation using the Thai LFS 2022.

Figure 5 presents estimates of the marginal effects of provincial skill diversity in 2013 and 2022 across the different measures of skill diversity, illustrating that the probability of becoming an entrepreneur rises as provincial skill diversity increases. This pattern remains consistent across both years and across all diversity indices. Entrepreneurial opportunities are notably higher for individuals residing in provinces where the skill diversity index exceeds 0.8. Notably, the strongest positive effects of provincial skill diversity on entrepreneurship are concentrated in the Central region and the Eastern Economic Corridor (EEC) provinces, including Chonburi, Rayong, and Chachoengsao. These areas exhibit both high skill diversity indices and robust entrepreneurial activity, reflecting their roles as Thailand's primary industrial and economic hubs. This spatial pattern aligns with the agglomeration effects documented in the urban economics literature, whereby diverse labour markets in economically dynamic regions provide fertile ground for entrepreneurial ventures. These provinces are typically large, urbanised areas located primarily in the Central region, the Eastern Economic Corridor (EEC), and selected provinces in the Northern and Southern regions.

Figure 5: Marginal effects estimation of provincial skill diversity in 2013 and 2022



Source: Author's calculation from the Thai LFS 2013 and 2022.

For the 2013 models, variance inflation factor (VIF) diagnostics suggest broadly moderate multicollinearity across specifications, with mean VIFs of 4.68 (diversity index using education levels), 4.89 (educational fields), 4.86 (occupation types), and 4.80 (industry groups); the pooled specification does not report a mean VIF in the table, but displays a comparable pattern of a few high-VIF covariates. Focusing only on regressors with $VIF > 10$, very high VIFs consistently arise from the polynomial age controls (Age approximately 34.18–34.23; Age² approximately 32.39–32.43). In the pooled specification, additional variables exceed 10, namely occupation types (23.60), industry groups (11.83), the Northeastern region dummy (10.65), and low-skill services (10.02). In the diversity-index specifications, the only non-age regressor above 10 is low-skill services (10.01), while all other covariates remain below 10.

For the 2022 models, mean VIFs are higher but still similar across specifications: 7.80 (diversity index using education levels), 7.74 (educational fields), 7.75 (occupation types), and 7.83 (industry groups); again, the pooled specification does not report a mean VIF but shows the same concentration of high VIFs in a subset of controls. Among variables with $VIF > 10$, the age

polynomial remains dominant (Age approximately 45.54–45.56; Age² approximately 43.69–43.71). Several provincial-level controls also consistently exceed 10 across the diversity-index specifications, including log of government loan credit (approximately 30.60 to 31.03), log of gross provincial product (approximately 25.13 to 27.73), the Central region dummy (approximately 21.92 to 23.60), log of migrants (approximately 11.67 to 11.85), low-skill services (approximately 10.87 to 10.88), and regional dummies, particularly the Northeastern region (approximately 10.75 to 11.89) and the Southern region (approximately 10.30 to 10.81), with the Northern region exceeding 10 in the industry-groups specification (10.41). In the pooled specification, additional covariates are above 10 as well, notably occupation types (20.73), industry groups (13.18), and multiple region dummies.

While multicollinearity may affect statistical precision for a subset of covariates, it does not address the central identification concern, namely the potential endogeneity of provincial skill diversity, thereby motivating the discussion and empirical strategy in Section 4.4. Detailed VIF statistics are reported in Appendix B4 to B5. Although several provincial-level controls in the 2022 model exhibit VIFs above the conventional threshold of ten, most notably log of government loan credit, log of gross provincial product, and the Central region dummy, these high VIFs reflect shared variation among aggregate macroeconomic controls rather than collinearity between these controls and the diversity index. While these high VIFs may inflate standard errors on the affected aggregate controls, they do not threaten the identification of the provincial-skill-diversity coefficient, which remains statistically significant across all four specifications.

4.4. Endogeneity issues

To address potential reverse causality issues in my empirical analysis, I employ an instrumental variable (IV) regression technique, applying the strategies previously discussed, and treat provincial skill diversity as an endogenous variable. Two primary sets of instruments are utilised: (1) ten-year lagged provincial skill diversity, and (2) shift-share imputed diversity, calculated based on the population growth of individuals within each skill category over the ten years preceding the dataset used in this study. I compare the results from the second-stage IV estimations with those obtained from specification 1 in Tables 6 and 7. Table 8 presents the IV estimation results using all instruments for the year 2013, while Table 9 provides the corresponding results for 2022. Additionally, for robustness checks, I estimate the IV regressions separately. All specifications include regional controls, with Bangkok as the reference category. The inclusion of these dummies absorbs region-specific shocks and helps ensure that the estimated effects are not driven by particular regional outliers⁵.

As noted, Table 8 presents the IV regression results using the 2013 data. In the first-stage regressions, all instrumental variables behave as expected, indicating that individuals tend to migrate to provinces already characterised by either similar skill groups or higher overall diversity. Specifically, the estimated coefficients for ten-year lagged and shift-share provincial skill diversity are positive and statistically significant across all specifications.

⁵ The detailed estimates are presented in the Appendix C.

However, the second-stage IV estimates show a contrasting trend compared to the original probit estimations reported in Table 6. The estimated coefficients for provincial skill diversity are negative and statistically insignificant across all specifications. The negative coefficients observed in the 2013 IV estimates may reflect the unique economic conditions of that period. Following the global financial crisis of 2008–2009 and preceding Thailand's political upheaval in 2014, labour markets experienced reduced mobility and early-stage urban concentration. During this transitional period, the benefits of skill diversity may not have fully materialised, as workers and entrepreneurs faced heightened uncertainty and constrained geographic movement. This interpretation aligns with the broader literature suggesting that diversity effects are contingent upon supportive economic and institutional environments. Diagnostic tests confirm that the instrumental variables are neither under-identified nor weakly identified. Specifically, the first-stage F-statistics exceed the conventional threshold of 10 across all specifications (ranging from 5,719 to 6,181), confirming that the instruments are sufficiently strong. Furthermore, Hansen's J test for overidentification yields p-values that support the validity of the instruments in most specifications (see Tables 8 and 9 for detailed statistics). These diagnostics provide confidence that the IV estimates adequately address potential endogeneity concerns. The Wald test of exogeneity rejects the null at the 1 per cent level across all 2013 IV specifications (Wald = 10.8 to 13.4), confirming that provincial skill diversity is endogenous and that IV estimation is the appropriate strategy. The negative second-stage coefficients in 2013 are consistent with negative selection: mobile high-skilled workers had already left provinces with stagnant diversity dynamics during the post-2008 slowdown, generating a downward bias in the IV-corrected estimates relative to the original probit results.

The IV estimation results for the 2022 data are presented in Table 9. The first-stage regressions indicate that the estimated coefficients of both the ten-year lagged and shift-share diversity instruments are positive and statistically significant across all specifications. The second-stage results show that the estimated coefficients for provincial skill diversity remain positive and are generally similar to those from the original probit estimates. However, these coefficients are statistically significant only in the specifications employing shift-share diversity as the instrument. Specifically, in specification 3, the coefficient for provincial skill diversity is slightly lower than the original estimate. Additionally, IV estimates confirm the causal impact of provincial skill diversity on entrepreneurship. Both ten-year-lagged and shift-share instruments are strong (F-tests > 5,000) and pass Hansen J tests, indicating no overidentification problems. The positive coefficient for education-based diversity supports the Knowledge Spillover Theory, suggesting that diverse educational backgrounds facilitate idea recombination and business creation. By contrast, the Wald test of exogeneity in 2022 fails to reject the null in three of four IV specifications (Wald = 0.01 to 2.41), indicating that endogeneity bias in the 2022 probit estimates of Table 7 is small and that those original probit coefficients can be interpreted as reasonably consistent.

Table 8: Instrumental variables estimation results using 2013 data

Dependent variable: being employer	(1) Probit baseline (no IV)	(2) IV: 10-year lagged diversity	(3) IV: Shift- share diversity	(4) IV: Lagged + shift-share (education levels)	(5) IV: All instruments (lagged + shift-share education/occupation/industry)
<i>Second-Stage Regression</i>					
Diversity index					
Education levels	0.9336* (0.4834)	-0.9550 (0.6493)	-0.8110 (0.6564)	-0.9310 (0.6498)	-1.0363 (0.6527)
Individual characteristics	Included	Included	Included	Included	Included
Provincial characteristics	Included	Included	Included	Included	Included
Constant	-4.3489*** (0.5871)	-2.9107 *** (0.5770)	-2.9957*** (0.5823)	-2.9257*** (0.5777)	-2.8135*** (0.5796)
Wald test of exogeneity		13.09***	10.8***	12.76***	13.36***
Hansen's J overidentification test				1.36	1.39
<i>First-Stage Regression</i>					
Education levels (Ten-year lagged)		0.4497*** (0.0020)		0.3717*** (0.0122)	0.3908*** (0.0123)
Education levels (Shift-share)			0.5893*** (0.0026)	0.1046*** (0.0161)	0.0642*** (0.0169)
Occupation types (Shift-share)					-0.0549*** (0.0028)
Industry groups (Shift-share)					0.0663*** (0.0028)
Individual characteristics		Included	Included	Included	Included
Provincial characteristics		Included	Included	Included	Included
Constant		0.4783*** (0.0027)	0.3417*** (0.0030)	0.4532*** (0.0047)	0.4760*** (0.0049)
F-test (weak IV test)		6,147.25***	6,062.62***	5,993.51***	5,752.35***
Observations	89,335	88,341	88,341	88,341	88,341

Note: Robust standard errors are in parentheses. ***, ** and * denotes significance at 1%, 5% and 10% levels, respectively. All specifications use the education-levels diversity index as the endogenous variable. For more details, see Table C1 in Appendix C.

Source: Author's estimation using the Thai LFS 2003 and 2013.

Table 9: Instrumental variables estimation results using 2022 data

Dependent variable: being employer	(1) Probit baseline (no IV)	(2) IV: 10-year lagged diversity	(3) IV: Shift- share diversity	(4) IV: Lagged + shift-share (education levels)	(5) IV: All instruments (lagged + shift-share education/occupation/industry)
<i>Second-Stage Regression</i>					
Diversity index					
Education levels	2.4292*** (0.7535)	0.2892 (1.0199)	2.2994** (1.0886)	0.9009 (1.0275)	2.1678** (0.9545)
Individual characteristics	Included	Included			Included
Provincial characteristics	Included	Included			Included
Constant	-4.0939*** (0.8352)	-2.5206*** (0.8660)	-3.9237*** (0.9168)	-2.9671*** (0.8716)	-3.8319*** (0.8363)
Wald test of exogeneity		5.48**	0.02	2.41	0.01
Hansen's J overidentification test				0.67	1.1
<i>First-Stage Regression</i>					
Education levels (Ten-year lagged)		0.4475*** (0.0022)		0.3009*** (0.0050)	0.2304*** (0.0052)
Education levels (Shift-share)			0.6323*** (0.0032)	0.2369*** (0.0072)	0.1630*** (0.0079)
Occupation types (Shift-share)					0.1430*** (0.0018)
Industry groups (Shift-share)					-0.0541*** (0.0018)
Individual characteristics		Included	Included	Included	Included
Provincial characteristics		Included	Included	Included	Included
Constant		0.5140*** (0.0025)	0.3226*** (0.0030)	0.4339*** (0.0035)	0.4679*** (0.0035)
F-test (weak IV test)		5,719.01***	5,485.07***	5,670.28***	6,181.68***
Observations	85,444	85,444	85,444	85,444	85,444

Note: Robust standard errors in parentheses. ***, ** and * denotes significance at 1%, 5% and 10% levels, respectively. All specifications use the education-levels diversity index as the endogenous variable. For more details, see Table D2 in Appendix D.

Source: Author's estimation using the Thai LFS 2012 and 2022.

Comparing the results across the two time periods reveals that the positive impact of provincial skill diversity on entrepreneurship strengthened considerably by 2022. While the 2013 estimates

were largely insignificant or negative, the 2022 coefficients are positive and statistically significant, particularly when using shift-share instruments. This temporal pattern suggests that as Thailand's industrial base broadened and diversified over the decade, driven by the expansion of the Eastern Economic Corridor, growth in high-skill manufacturing, and increased service sector complexity, the economic returns to workforce skill diversity became more pronounced. The findings underscore that diversity-driven entrepreneurship benefits may require sufficient economic development and structural diversification to fully materialise.

4.5. Results from the Generalised Structural Equation Model

In this section, I examine empirically how the effects of provincial skill diversity influence entrepreneurship, specifically considering whether provincial skill diversity contributes to greater diversity in consumption patterns and skills among both employees and entrepreneurs within provinces. To explore these relationships, I employ a generalised structural equation model (GSEM) that includes the three mediating variables mentioned above. All regressions are estimated with robust standard errors.⁶ Model fit statistics for the estimated model indicate a log-likelihood of 675,266.8 with 49 degrees of freedom, alongside information criteria of AIC (-1,350,436) and BIC (-1,349,927). These metrics provide a basis for assessing relative model fit in alternative specifications

Figure 6 presents a path diagram based on estimated coefficients derived from the GSEM analysis, highlighting several notable findings. First, the estimated direct effect of provincial skill diversity on the probability of becoming an entrepreneur is 0.7337, consistent with the results of the earlier empirical analyses. The smaller magnitude here results from combining data from both years and explicitly modelling indirect effects through mediation analysis. Moreover, the indirect effect of provincial skill diversity on entrepreneurship, mediated by increased entrepreneur skill diversity, is positive ($1.8880 = 1.5671 \times 1.2048$), aligning well with theoretical predictions.

Second, the estimated indirect effect of provincial skill diversity on entrepreneurship, mediated through provincial consumption diversity, is positive ($0.0079 = -0.6832 \times -0.0116$), as theoretically anticipated. However, rather than contradicting previous literature, the observed mechanism reveals a "necessity-driven entrepreneurship effect" that reflects structural adaptation within the Thai context. Higher provincial skill diversity appears to reduce consumption diversity (proxied by per capita income), and lower per capita income is positively associated with the probability of becoming an entrepreneur. This pattern suggests that in provinces with lower income levels, entrepreneurship emerges as a livelihood strategy rather than a purely opportunity-driven choice.

This structural adaptation may be attributed to Thailand's unique economic context during the study period. Specifically, Thailand experienced declining gross enrolment rates across educational levels, particularly among males, compounded by a prolonged economic downturn following the COVID-19 pandemic, the 2014 coup d'état, and global economic instability beginning in 2012. Under such conditions, individuals in lower-income provinces faced constrained formal employment opportunities, making small-scale entrepreneurship a necessary avenue for economic survival rather than a reflection of reduced entrepreneurial potential.

⁶ See the detailed results in Table E3 in the Appendix.

Finally, the estimated indirect effect of provincial skill diversity on the probability of becoming an entrepreneur, mediated by increased employee skill diversity, is positive ($1.1506 = -0.36 \times -3.1961$), also consistent with theoretical expectations. Moreover, the estimations show that skill diversity among employees is negatively associated with entrepreneurship. The large absolute value of the structural coefficient on employee skill diversity (-3.1961) reflects the unit of measurement: the diversity index ranges from 0 to 1, so a one-unit change in this coefficient corresponds to a movement across the entire range. At the sample mean, a one-standard-deviation increase in employee skill diversity (approximately X) implies a change in the latent entrepreneurship probability of approximately X percentage points.

In the context of Thailand, provinces characterised by lower employee skill diversity—predominantly consisting of workers with primary or secondary education—exhibit higher levels of entrepreneurial activity. This relationship likely arises from several factors. First, in areas where most employees have lower educational attainment, wages and job security tend to be limited. Consequently, the financial and career-related risks associated with starting a new business are relatively low, making entrepreneurship an attractive alternative to formal employment. This lower opportunity cost significantly encourages individuals to pursue entrepreneurial ventures rather than remaining in unstable or low-paid employment.

Furthermore, entrepreneurship in these provinces is often necessity driven. Low-skilled workers frequently face limited upward career mobility and constrained employment choices, making entrepreneurship a vital strategy for income generation and economic self-sufficiency, especially where formal employment opportunities are scarce. In provinces dominated by low-skilled labour markets, stable and well-paid formal-sector jobs are limited, leading individuals to pursue entrepreneurship as a practical alternative to secure livelihoods. According to data from the ILO Department of Statistics (2022), the number of small-scale entrepreneurship individuals (aged 15-64 yrs) in Thailand rose notably from approximately 17.64 million in 2016 to 18.29 million in 2022, reflecting the increased reliance on small-scale entrepreneurship following the economic disruptions caused by COVID-19.⁷

Lastly, according to a report from Thailand's National Statistical Office (2022), approximately half (51 per cent) of the Thai workforce participates in the informal sector, underscoring the prevalence and importance of informal and small-scale entrepreneurial opportunities.⁸ Informal enterprises typically require minimal initial investment, limited specialised skills, and lower educational qualifications, making them particularly accessible to individuals with primary or secondary education. Such entrepreneurial activities are widespread across Thailand, especially in less-developed provinces, significantly contributing to local economic diversity and employment.

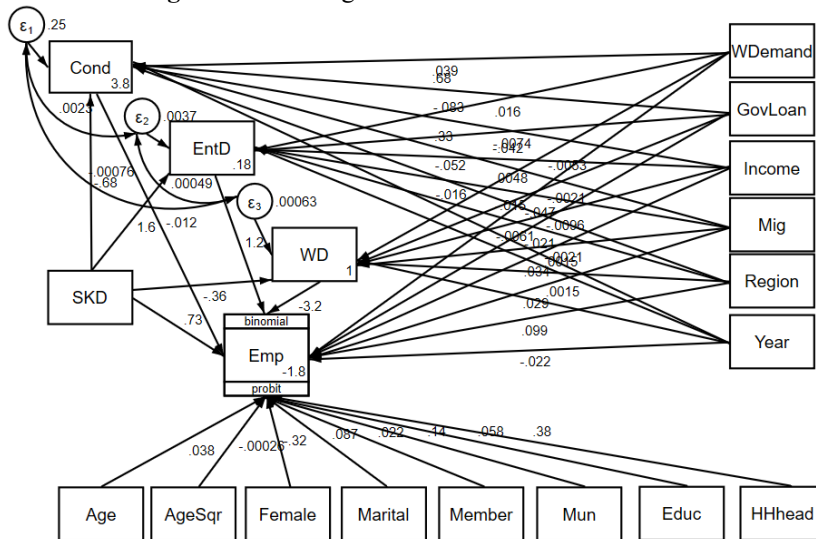
These national statistics provide external validity for the GSEM findings. The negative indirect effect of provincial skill diversity on entrepreneurship, mediated through employee skill diversity, aligns with the observed prevalence of informal sector employment (51 per cent) and

⁷ See <https://ilostat.ilo.org/topics/employment/>

⁸ See https://www.nso.go.th/nsoweb/storage/survey_detail/2023/20231218155504_43190.pdf

the rising trend of small-scale entrepreneurship documented by NSO (2023). Specifically, the GSEM results indicating that lower employee skill diversity is associated with higher entrepreneurship probability are consistent with national patterns showing that Thai workers increasingly turn to small-scale entrepreneurship when formal sector opportunities are limited. This convergence between our econometric findings and national labour statistics confirms that the necessity-driven entrepreneurship mechanism identified in this study captures a genuine structural feature of Thailand's labour market rather than a statistical artefact.

Figure 6: Path diagram with estimated coefficients



Note: Detailed estimations are in Table D1 in the Appendix.

Source: Author's estimation using the Thai LFS 2013 and 2022.

In summary, when examining the three hypothesised channels through which provincial diversity might influence entrepreneurship, the estimated indirect effect of provincial skill diversity mediated by entrepreneur skill diversity is positive, aligning closely with theoretical predictions. However, the mechanism operating through the consumption diversity channel contradicts the theoretical expectation that provincial diversity positively relates to consumption diversity. This discrepancy may reflect Thailand's specific economic context, the composition of local business activities with low-income status, and entrepreneurial preferences during the study period. Given the relatively basic structure of the current model, additional research is warranted to further clarify these relationships.

5. CONCLUSION AND POLICY RECOMMENDATIONS

This study examined how provincial workforce skill diversity influences entrepreneurship in Thailand using pooled cross-sectional data from the 2013 and 2022 Thai Labour Force Surveys. The probit estimates show that higher provincial skill diversity is positively associated with the probability of becoming an entrepreneur: a one-standard-deviation increase raises the probability

of entrepreneurship by approximately 0.09–1.06 percentage points in 2013 and 0.003–0.50 percentage points in 2022, with the strongest effects observed for occupational and industrial diversity. Although these marginal effects appear modest, they translate into meaningful absolute numbers when scaled across the provincial workforce: in a province of 100,000 workers, a 0.3 percentage point increase implies approximately 300 additional entrepreneurs, and the effects are likely to compound over time through spillover and network mechanisms. Entrepreneurial benefits are most pronounced in highly diverse urbanised areas in the Central region, the Eastern Economic Corridor (EEC), and selected Southern provinces. These findings align with Zhang (2020) and confirm, in a developing-economy context, the predictions of the Knowledge Spillover Theory of Entrepreneurship.

Between 2013 and 2022, the four diversity indices moved in opposite directions: educational diversity rose while occupational and industrial diversity declined and became increasingly concentrated in a small set of provinces. Instrumental-variable estimates using ten-year lagged and shift-share instruments broadly support the probit results, particularly in 2022, where the Wald exogeneity test indicates limited endogeneity bias. The generalised structural equation model further shows that provincial skill diversity influences entrepreneurship indirectly through entrepreneur skill diversity (positive, consistent with knowledge spillovers) and, less conventionally, through employee skill diversity and consumption diversity in directions that reflect Thailand's specific economic context. The negative coefficient on employee skill diversity and the positive necessity-driven effect of lower consumption diversity – proxied by per capita provincial product, given the absence of expenditure-category data – reflect the prevalence of informal, low-cost-of-entry, and survival-oriented entrepreneurial activities in provinces dominated by lower-skilled workers. The economic disruptions of the COVID-19 pandemic likely amplified these patterns by intensifying sectoral concentration and pushing workers towards small-scale entrepreneurship.

Several limitations should be acknowledged. The four diversity measures, drawn from the LFS, capture educational, occupational, and industrial heterogeneity but cannot fully reflect cognitive abilities or non-formal skills. The consumption-diversity proxy is a stopgap given the absence of expenditure-share data in Thailand. Migrant workers, who occupy a substantial share of low- and semi-skilled positions, are typically underrepresented in the LFS, which may bias the diversity measures downward in destination provinces. Finally, the cross-sectional nature of the data precludes panel analysis of how diversity and entrepreneurship co-evolve at the individual level over time. Future research should employ richer panel data and behavioural models that track transitions between paid employment, self-employment, and employer status.

Several policy recommendations follow from these results, each contributing to specific Sustainable Development Goals (SDGs). First, sustained and inclusive investment in education and skill development, tailored to evolving provincial economic needs, is essential – aligning directly with SDG 4 (Quality Education), particularly targets 4.3 and 4.4 on equitable access to technical, vocational and tertiary education and on building relevant skills for decent work and entrepreneurship. Second, balanced sectoral and industrial policies should reverse the trend of occupational and industrial concentration in already-diverse hubs such as Bangkok and the EEC, broadening the spatial distribution of entrepreneurial opportunity in line with SDG 10 (Reduced Inequalities) and SDG 11 (Sustainable Cities and Communities). Third, targeted labour-mobility

and managed-migration policies should help skilled workers reach provinces currently experiencing lower skill diversity, supporting SDG 9 (Industry, Innovation and Infrastructure) and its target 9.5 on upgrading regional technological capabilities. Fourth, provincial governments should strengthen entrepreneurial ecosystems through training, skill-matching services, and networks that leverage existing local diversity. Together, these measures advance SDG 8 (Decent Work and Economic Growth), particularly target 8.3 on supporting entrepreneurship, creativity, and the growth of small and medium-sized enterprises, and they confirm that promoting workforce skill diversity is not only an economic objective but a contribution to multiple, interconnected dimensions of sustainable development in Thailand.

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APPENDICES TO ACCOMPANY ENTREPRENEURSHIP AND PROVINCIAL SKILL DIVERSITY IN THAILAND

Appendix A: Detailed skill diversity by provinces

Table A1: Detailed skill diversity by provinces in 2013

Province	Skill diversity			
	Education levels	Educational fields	Occupation types	Industry groups
Bangkok	0.798	0.604	0.854	0.683
Samut Prakan	0.801	0.666	0.846	0.737
Nonthaburi	0.799	0.582	0.868	0.730
Pathum Thani	0.790	0.679	0.859	0.785
Phra Nakhon Si Ayutthaya	0.813	0.669	0.850	0.808
Ang Thong	0.798	0.718	0.840	0.807
Lop Buri	0.796	0.668	0.819	0.766
Sing Buri	0.820	0.705	0.834	0.779
Chai Nat	0.770	0.663	0.761	0.703
Saraburi	0.802	0.652	0.848	0.786
Chon Buri	0.815	0.689	0.825	0.748
Rayong	0.797	0.693	0.860	0.807
Chanthaburi	0.750	0.659	0.760	0.686
Trat	0.744	0.709	0.729	0.647
Chachoengsao	0.779	0.650	0.844	0.795
Prachin Buri	0.743	0.718	0.840	0.799
Nakhon Nayok	0.770	0.734	0.838	0.788
Sa Kaeo	0.765	0.695	0.732	0.658
Nakhon Ratchasima	0.790	0.694	0.792	0.745
Buriram	0.697	0.738	0.707	0.659
Surin	0.712	0.698	0.664	0.627
Si Sa Ket	0.676	0.715	0.452	0.440
Ubon Ratchathani	0.716	0.715	0.656	0.628
Yasothon	0.693	0.730	0.470	0.452
Chaiyaphum	0.703	0.692	0.574	0.497
Amnat Charoen	0.727	0.703	0.504	0.490
Bueng Kan	0.690	0.717	0.412	0.393
Nong Bua Lam Phu	0.681	0.738	0.576	0.552
Khon Kaen	0.716	0.712	0.707	0.665
Udon Thani	0.754	0.734	0.681	0.628
Loei	0.673	0.709	0.433	0.399
Nong Khai	0.704	0.726	0.705	0.677
Maha Sarakham	0.726	0.708	0.678	0.648
Roi Et	0.737	0.727	0.595	0.571
Kalasin	0.700	0.723	0.610	0.563
Sakon Nakhon	0.683	0.729	0.586	0.567
Nakhon Phanom	0.669	0.737	0.588	0.570
Mukdahan	0.721	0.690	0.530	0.508
Chiang Mai	0.808	0.709	0.820	0.762
Lamphun	0.808	0.663	0.807	0.739
Lampang	0.785	0.697	0.735	0.711
Uttaradit	0.751	0.694	0.683	0.617

Province	Skill diversity			
	Education levels	Educational fields	Occupation types	Industry groups
Phrae	0.796	0.658	0.745	0.711
Nan	0.765	0.724	0.520	0.486
Phayao	0.746	0.728	0.587	0.548
Chiang Rai	0.771	0.697	0.694	0.659
Mae Hong Son	0.717	0.723	0.499	0.460
Nakhon Sawan	0.743	0.716	0.729	0.670
Uthai Thani	0.730	0.715	0.661	0.577
Kamphang Phet	0.721	0.721	0.697	0.627
Tak	0.795	0.694	0.745	0.694
Sukhothai	0.751	0.723	0.660	0.615
Phitsanulok	0.806	0.664	0.765	0.721
Phichit	0.777	0.707	0.733	0.659
Phetchabun	0.668	0.720	0.673	0.625
Ratchaburi	0.771	0.679	0.834	0.771
Kanchanaburi	0.734	0.672	0.772	0.670
Suphanburi	0.717	0.672	0.713	0.644
Nakhon Pathom	0.801	0.655	0.858	0.748
Samut Sakhon	0.767	0.679	0.826	0.674
Samut Songkhram	0.773	0.678	0.848	0.765
Phetchaburi	0.742	0.685	0.817	0.760
Prachuap Khiri Khan	0.768	0.695	0.822	0.738
Nakhon Si Thammarat	0.756	0.680	0.729	0.663
Krabi	0.758	0.670	0.747	0.657
Phangnga	0.766	0.685	0.747	0.683
Phuket	0.804	0.683	0.814	0.568
Surat Thani	0.761	0.676	0.672	0.606
Ranong	0.779	0.648	0.753	0.695
Chumphon	0.756	0.716	0.673	0.583
Songkhla	0.784	0.669	0.822	0.742
Satun	0.751	0.728	0.722	0.650
Trang	0.754	0.681	0.671	0.623
Phatthalung	0.782	0.677	0.708	0.674
Pattani	0.748	0.709	0.821	0.774
Yala	0.706	0.645	0.465	0.446
Narathiwat	0.725	0.728	0.728	0.707

Source: Author's calculation from LFS 2013

Table A2: Detailed skill diversity by provinces in 2022

Province	Skill diversity			
	Education levels	Educational fields	Occupation types	Industry groups
Bangkok	0.806	0.610	0.841	0.658
Samut Prakan	0.818	0.684	0.848	0.762
Nonthaburi	0.809	0.593	0.858	0.695
Pathum Thani	0.800	0.697	0.855	0.744
Phra Nakhon Si Ayutthaya	0.820	0.659	0.834	0.787

Province	Skill diversity			
	Education levels	Educational fields	Occupation types	Industry groups
Ang thong	0.816	0.709	0.850	0.811
Lop Buri	0.819	0.685	0.817	0.773
Sing Buri	0.827	0.716	0.856	0.797
Chai Nat	0.811	0.694	0.822	0.759
Saraburi	0.814	0.653	0.847	0.763
Chon Buri	0.803	0.710	0.813	0.746
Rayong	0.824	0.641	0.850	0.803
Chanthaburi	0.788	0.674	0.756	0.653
Trat	0.798	0.711	0.788	0.688
Chachoengsao	0.818	0.705	0.836	0.799
Prachin Buri	0.814	0.683	0.840	0.807
Nakhon Nayok	0.815	0.674	0.829	0.755
Sa Kaeo	0.790	0.721	0.814	0.714
Nakhon Ratchasima	0.785	0.701	0.787	0.717
Buri Ram	0.780	0.737	0.718	0.669
Surin	0.750	0.712	0.686	0.652
Si Sa Ket	0.718	0.720	0.459	0.428
Ubon Ratchathani	0.740	0.717	0.632	0.604
Yasothon	0.729	0.714	0.474	0.461
Chaiyaphum	0.768	0.730	0.723	0.655
Amnat Charoen	0.757	0.729	0.664	0.630
Bueng Kan	0.712	0.688	0.388	0.376
Nong Bua Lam Phu	0.750	0.740	0.665	0.627
Khon Kaen	0.786	0.679	0.741	0.698
Udon Thani	0.766	0.707	0.661	0.615
Loei	0.725	0.707	0.531	0.477
Nong Khai	0.787	0.710	0.710	0.664
Maha Sarakham	0.762	0.722	0.677	0.639
Roi et	0.755	0.727	0.590	0.557
Kalasin	0.756	0.710	0.670	0.637
Sakon Nakhon	0.728	0.715	0.535	0.501
Nakhon Phanom	0.757	0.717	0.612	0.590
Mukdahan	0.755	0.696	0.571	0.537
Chiang Mai	0.792	0.713	0.816	0.721
Lamphun	0.822	0.643	0.822	0.762
Lampang	0.816	0.671	0.779	0.736
Uttaradit	0.808	0.704	0.777	0.700
Phrae	0.816	0.675	0.815	0.762
Nan	0.784	0.698	0.668	0.632
Phayao	0.799	0.699	0.705	0.651
Chiang Rai	0.785	0.674	0.719	0.650
Mae Hong Son	0.755	0.696	0.495	0.460
Nakhon Sawan	0.799	0.686	0.781	0.710
Uthai Thani	0.787	0.712	0.700	0.626
Kamphaeng Phet	0.767	0.720	0.743	0.664
Tak	0.793	0.687	0.718	0.656
Sukhothai	0.793	0.695	0.709	0.665
Phitsanulok	0.797	0.663	0.769	0.709

Province	Skill diversity			
	Education levels	Educational fields	Occupation types	Industry groups
Phichit	0.802	0.698	0.731	0.665
Phetchabun	0.802	0.701	0.736	0.672
Ratchaburi	0.802	0.670	0.845	0.770
Kanchanaburi	0.772	0.698	0.788	0.691
Suphan Buri	0.739	0.733	0.750	0.674
Nakhon Pathom	0.800	0.670	0.850	0.763
Samut Sakhon	0.811	0.716	0.824	0.710
Samut Songkhram	0.808	0.693	0.845	0.744
Phetchaburi	0.787	0.710	0.837	0.757
Prachuap Khiri Khan	0.801	0.696	0.817	0.723
Nakhon Si Thammarat	0.806	0.644	0.762	0.691
Krabi	0.800	0.655	0.791	0.661
Phangnga	0.791	0.664	0.802	0.719
Phuket	0.807	0.621	0.787	0.544
Surat Thani	0.786	0.693	0.730	0.650
Ranong	0.767	0.664	0.778	0.696
Chumphon	0.789	0.703	0.692	0.600
Songkhla	0.811	0.690	0.822	0.760
Satun	0.793	0.724	0.776	0.708
Trang	0.794	0.657	0.669	0.635
Phatthalung	0.798	0.650	0.729	0.675
Pattani	0.741	0.722	0.801	0.746
Yala	0.751	0.705	0.565	0.546
Narathiwat	0.743	0.690	0.743	0.704

Source: Author's calculation from LFS 2022

Table A3: Diversity indices correlation matrices

Diversity index	(1)	(2)	(3)	(4)
Provincial skill diversity in 2013				
(1) Diversity using education levels	1			
(2) Diversity using educational fields	-0.5414***	1		
(3) Diversity using occupation types	0.7591***	-0.4594***	1	
(4) Diversity using industry groups	0.7015***	-0.3436***	0.9473***	1
Provincial skill diversity in 2022				
(1) Diversity using education levels	1			
(2) Diversity using educational fields	-0.4901***	1		
(3) Diversity using occupation types	0.8265***	-0.3608***	1	
(4) Diversity using industry groups	0.7833***	-0.2121*	0.9383***	1

Note: ***, **, * denotes significance at 1% 5% and 10% respectively.

Source: Author's calculation from LFS 2013 and 2022

Appendix B: Results from probit regression**Table B1: Detailed model for provincial diversity in 2013**

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Diversity index				
Education levels	0.9337* (0.4835)			
Educational fields		0.5641 (0.5673)		
Occupation types			1.7146*** (0.2492)	
Industry groups				1.3686*** (0.2408)
<i>Individual characteristics</i>				
Age	0.0409*** (0.0074)	0.0400*** (0.0074)	0.0404*** (0.0074)	0.0406*** (0.0074)
Age ²	-0.0002*** (0.0001)	-0.0002*** (0.0001)	-0.0002*** (0.0001)	-0.0002*** (0.0001)
Municipal area	0.1161*** (0.0291)	0.1060*** (0.0289)	0.1094*** (0.0290)	0.1124*** (0.0290)
Household's head	0.3500*** (0.0350)	0.3490*** (0.0349)	0.3489*** (0.0350)	0.3495*** (0.0350)
Female	-0.2615*** (0.0350)	-0.2596*** (0.0349)	-0.2596*** (0.0349)	-0.2611*** (0.0350)
Member	0.0116 (0.0082)	0.0129 (0.0081)	0.0124 (0.0081)	0.0121 (0.0081)
<i>Region: Bangkok is a base group</i>				
Central Region	-0.2199*** (0.0688)	-0.2149*** (0.0737)	-0.3551*** (0.0725)	-0.3963*** (0.0790)
Northern Region	-0.2833*** (0.0810)	-0.2953*** (0.0911)	-0.2713*** (0.0819)	-0.3668*** (0.0846)
Northeastern Region	-0.4706*** (0.0825)	-0.5373*** (0.0958)	-0.3746*** (0.0819)	-0.5250*** (0.0794)
Southern Region	-0.0150 (0.0726)	-0.0301 (0.0816)	-0.0064 (0.0735)	-0.0813 (0.0759)
<i>Marital status: Single is a base group</i>				
Married	0.0828* (0.0456)	0.0829* (0.0457)	0.0831* (0.0457)	0.0820* (0.0457)
Others	0.1530** (0.0703)	0.1533** (0.0703)	0.1550** (0.0704)	0.1514** (0.0705)
<i>Education: Primary is a base group</i>				
Lower secondary	0.2046*** (0.0409)	0.2090*** (0.0409)	0.2062*** (0.0410)	0.2058*** (0.0410)
Upper secondary	0.3465*** (0.0428)	0.3507*** (0.0429)	0.3493*** (0.0430)	0.3482*** (0.0430)
Vocational	0.3562*** (0.0703)	0.3628*** (0.0707)	0.3578*** (0.0706)	0.3586*** (0.0706)

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Higher technical	0.3972*** (0.0576)	0.4042*** (0.0575)	0.3974*** (0.0577)	0.3981*** (0.0578)
Bachelor's degree	0.5448*** (0.0510)	0.5514*** (0.0512)	0.5455*** (0.0512)	0.5479*** (0.0512)
Postgraduate	0.3847*** (0.1013)	0.3916*** (0.1014)	0.3859*** (0.1014)	0.3882*** (0.1015)
<i>Main Occupation: Elementary Occupations is a base group</i>				
Managers	1.6929*** (0.1071)	1.6953*** (0.1071)	1.6976*** (0.1073)	1.6993*** (0.1074)
Professionals	0.3528*** (0.1344)	0.3538*** (0.1343)	0.3565*** (0.1346)	0.3589*** (0.1346)
Technicians and Associate Professionals	0.3847*** (0.1277)	0.3866*** (0.1277)	0.3842*** (0.1280)	0.3881*** (0.1280)
Clerical Support	-0.0659 (0.1590)	-0.0613 (0.1593)	-0.0668 (0.1588)	-0.0591 (0.1592)
Services and sales	0.5093*** (0.1068)	0.5099*** (0.1068)	0.5112*** (0.1069)	0.5108*** (0.1069)
Skilled Agriculture, Forestry and Fishery	0.7000*** (0.1302)	0.6989*** (0.1301)	0.7120*** (0.1300)	0.7095*** (0.1304)
Craft and related trades	0.7809*** (0.1028)	0.7826*** (0.1027)	0.7808*** (0.1030)	0.7804*** (0.1030)
Plant and machine Operators	0.0294 (0.1231)	0.0315 (0.1230)	0.0286 (0.1231)	0.0284 (0.1232)
<i>Industry: Agriculture is a base group</i>				
Utilities	-0.4661* (0.2398)	-0.4597* (0.2394)	-0.4817** (0.2388)	-0.4788** (0.2389)
Construction	0.7172*** (0.1159)	0.7176*** (0.1157)	0.7147*** (0.1156)	0.7186*** (0.1159)
Low-skill manufacturing	0.0246 (0.1204)	0.0266 (0.1203)	0.0219 (0.1202)	0.0272 (0.1204)
High-skill manufacturing	-0.1758 (0.1314)	-0.1736 (0.1313)	-0.1821 (0.1311)	-0.1765 (0.1314)
Low-skill services	0.1195 (0.1122)	0.1218 (0.1120)	0.1153 (0.1118)	0.1237 (0.1121)
High-skill services	-0.6196*** (0.1215)	-0.6200*** (0.1214)	-0.6222*** (0.1213)	-0.6198*** (0.1216)
<i>Provincial characteristics</i>				
Log of average labour income	-0.0712* (0.0400)	-0.0667* (0.0396)	-0.0281 (0.0417)	-0.0197 (0.0415)
Log of gross provincial product	-0.0467** (0.0216)	-0.0397* (0.0226)	-0.0392* (0.0223)	-0.0336 (0.0222)
Log of work demand	-0.0517*** (0.0147)	-0.0344** (0.0152)	-0.1234*** (0.0185)	-0.0963*** (0.0180)
Log of migrants	0.0188* (0.0102)	0.0194* (0.0105)	0.0045 (0.0107)	0.0101 (0.0107)
Log of government loan credit	0.1015*** (0.0243)	0.0916*** (0.0249)	0.0984*** (0.0249)	0.0862*** (0.0249)

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Constant	-4.3489*** (0.5871)	-4.1928*** (0.6403)	-4.6822*** (0.5363)	-4.5460*** (0.5298)
Pseudo R ²	0.2863	0.2861	0.2880	0.2877
Observations	89,335	89,335	89,335	89,335

Note: Robust standard errors in parentheses. ***, **, * denotes significance at 1% 5% and 10% respectively.

Source: Author's estimation using Thai LFS 2013

Table B2: Detailed model for provincial diversity in 2022

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Diversity index				
Education levels	2.4292*** (0.7535)			
Educational fields		0.0187 (0.5312)		
Occupation types			1.1137*** (0.2910)	
Industry groups				1.0565*** (0.2655)
Individual characteristics				
Age	0.0248** (0.0101)	0.0248** (0.0101)	0.0245** (0.0101)	0.0249** (0.0101)
Age ²	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)
Municipal area	0.1175*** (0.0381)	0.1179*** (0.0381)	0.1207*** (0.0382)	0.1228*** (0.0382)
Household's head	0.3273*** (0.0432)	0.3264*** (0.0432)	0.3253*** (0.0432)	0.3262*** (0.0432)
Female	-0.2228*** (0.0413)	-0.2222*** (0.0413)	-0.2216*** (0.0414)	-0.2230*** (0.0413)
Member	0.0153 (0.0132)	0.0140 (0.0131)	0.0131 (0.0132)	0.0129 (0.0132)
<i>Region: Bangkok is a base group</i>				
Central Region	-0.1175 (0.1502)	-0.0826 (0.1449)	-0.1481 (0.1484)	-0.2208 (0.1512)
Northern Region	-0.1271 (0.1337)	-0.0730 (0.1276)	-0.0892 (0.1303)	-0.1832 (0.1308)
Northeastern Region	-0.2220* (0.1207)	-0.2639** (0.1192)	-0.2024* (0.1222)	-0.2938** (0.1203)
Southern Region	0.1190 (0.1372)	0.1511 (0.1341)	0.1461 (0.1366)	0.0599 (0.1362)
<i>Marital status: Single is a base group</i>				
Married	0.1215** (0.0585)	0.1222** (0.0584)	0.1252** (0.0586)	0.1254** (0.0585)

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
Others	0.1040* (0.0571)	0.1051* (0.0570)	0.1048* (0.0572)	0.1056* (0.0572)
<i>Education: Primary is a base group</i>				
Lower secondary	0.1692*** (0.0514)	0.1730*** (0.0514)	0.1703*** (0.0513)	0.1733*** (0.0513)
Upper secondary	0.3903*** (0.0562)	0.3947*** (0.0561)	0.3932*** (0.0563)	0.3943*** (0.0562)
Vocational	0.4088*** (0.0787)	0.4178*** (0.0785)	0.4136*** (0.0783)	0.4179*** (0.0783)
Higher technical	0.4288*** (0.0659)	0.4390*** (0.0657)	0.4327*** (0.0657)	0.4358*** (0.0656)
Bachelor's degree	0.6131*** (0.0583)	0.6206*** (0.0581)	0.6170*** (0.0582)	0.6213*** (0.0580)
Postgraduate	0.5925*** (0.1070)	0.6027*** (0.1067)	0.5960*** (0.1070)	0.6016*** (0.1068)
<i>Main Occupation: Elementary Occupations is a base group</i>				
Managers	1.8828*** (0.1745)	1.8779*** (0.1739)	1.8807*** (0.1749)	1.8844*** (0.1747)
Professionals	0.4138** (0.2000)	0.4091** (0.1995)	0.4093** (0.2002)	0.4116** (0.2000)
Technicians and Associate Professionals	0.4919** (0.1925)	0.4877** (0.1921)	0.4902** (0.1929)	0.4931** (0.1926)
Clerical Support	-0.7712*** (0.2083)	-0.7694*** (0.2077)	-0.7712*** (0.2087)	-0.7625*** (0.2086)
Services and sales	0.5653*** (0.1631)	0.5634*** (0.1626)	0.5640*** (0.1634)	0.5641*** (0.1632)
Skilled Agriculture, Forestry and Fishery	0.3512** (0.1440)	0.3414** (0.1441)	0.3553** (0.1438)	0.3549** (0.1446)
Craft and related trades	0.7392*** (0.1759)	0.7376*** (0.1755)	0.7371*** (0.1763)	0.7383*** (0.1760)
Plant and machine Operators	-0.0454 (0.1819)	-0.0467 (0.1816)	-0.0460 (0.1823)	-0.0459 (0.1821)
<i>Industry: Agriculture is a base group</i>				
Utilities	-1.6601*** (0.3884)	-1.6571*** (0.3911)	-1.6658*** (0.3900)	-1.6551*** (0.3888)
Construction	0.5081*** (0.1594)	0.5034*** (0.1601)	0.5058*** (0.1589)	0.5102*** (0.1591)
Low-skill manufacturing	-0.1667 (0.1501)	-0.1698 (0.1506)	-0.1696 (0.1493)	-0.1676 (0.1497)
High-skill manufacturing	-0.5092*** (0.1756)	-0.5140*** (0.1762)	-0.5097*** (0.1750)	-0.5079*** (0.1752)
Low-skill services	-0.0876 (0.1398)	-0.0930 (0.1404)	-0.0932 (0.1389)	-0.0857 (0.1394)
High-skill services	-0.7919*** (0.1563)	-0.7977*** (0.1570)	-0.7972*** (0.1557)	-0.7914*** (0.1561)
Provincial characteristics				
Log of average labour	-0.1005*	-0.1075*	-0.1173**	-0.1171**

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational fields	(3) Diversity index using occupation types	(4) Diversity index using industry groups
income	(0.0593)	(0.0587)	(0.0589)	(0.0577)
Log of gross provincial product	-0.1553*** (0.0473)	-0.1178** (0.0473)	-0.1330*** (0.0485)	-0.1586*** (0.0481)
Log of work demand	-0.0490*** (0.0178)	-0.0432** (0.0173)	-0.0684*** (0.0186)	-0.0603*** (0.0180)
Log of migrants	0.1352*** (0.0211)	0.1270*** (0.0211)	0.1231*** (0.0215)	0.1446*** (0.0213)
Log of government loan credit	0.0137 (0.0510)	-0.0004 (0.0511)	0.0104 (0.0524)	0.0178 (0.0520)
Constant	-4.0939*** (0.8352)	-2.3970*** (0.8064)	-2.7966*** (0.6946)	-2.6676*** (0.6806)
Pseudo R ²	0.3015	0.3011	0.3019	0.3019
Observations	85,444	85,444	85,444	85,444

Note: Robust standard errors in parentheses. ***, **, * denotes significance at 1% 5% and 10% respectively.

Source: Author's estimation using Thai LFS 2022

Table B3: Marginal effects of provincial skill diversity

Specifications	2013			2022		
	dy/dx	Std. Err.	P> z	dy/dx	Std. Err.	P> z
Education levels	0.048*	0.025	0.054	0.097***	0.030	0.001
Educational fields	0.029	0.029	0.320	0.001	0.021	0.972
Occupation types	0.088***	0.013	0.000	0.045***	0.012	0.000
Industry groups	0.07***	0.012	0.000	0.042***	0.011	0.000

Note: Robust standard errors in parentheses. ***, **, * denotes significance at 1% 5% and 10% respectively.

Source: Author's estimation using Thai LFS 2013 and 2022

Table B4: Variance inflation factors (VIFs) for the provincial diversity model in 2013

Diversity index using education levels	VIF	Diversity index using educational fields	VIF	Diversity index using occupation types	VIF	Diversity index using industry groups	VIF
Age	34.19	Age	34.22	Age	34.18	Age	34.18
Age ²	32.40	Age ²	32.42	Age ²	32.39	Age ²	32.40
Low-skill services	10.01	Low-skill services	10.01	Low-skill services	10.01	Low-skill services	10.01
Skilled Agriculture, Forestry and Fishery	8.36	Northeastern Region	9.03	Skilled Agriculture, Forestry and Fishery	8.37	Skilled Agriculture, Forestry and Fishery	8.37
High-skill services	7.31	Skilled Agriculture, Forestry and Fishery	8.36	High-skill services	7.31	Central Region	7.91
Low-skill manufacturing	6.04	High-skill services	7.31	Central Region	6.70	High-skill services	7.31
Central Region	5.76	Northern Region	6.51	Log of work demand	6.50	Low-skill manufacturing	6.04
Northeastern Region	5.58	Central Region	6.47	Occupation types	6.07	Northeastern Region	5.68
Northern Region	4.99	Low-skill manufacturing	6.04	Low-skill manufacturing	6.04	Northern Region	5.33
Log of work demand	3.95	Southern Region	4.87	Northeastern Region	5.71	Log of work demand	5.14
Southern Region	3.90	Educational fields	4.48	Northern Region	4.82	Southern Region	4.13
Log of gross provincial product	3.64	Log of gross provincial product	4.01	Southern Region	3.84	Log of gross provincial product	3.72
Construction	3.29	Construction	3.29	Log of gross provincial product	3.70	Construction	3.29
High-skill manufacturing	3.23	High-skill manufacturing	3.22	Construction	3.29	High-skill manufacturing	3.23
Services and sales	3.19	Services and sales	3.19	High-skill manufacturing	3.23	Services and sales	3.19
Education levels	2.92	Log of work demand	3.14	Services and sales	3.19	Industry groups	3.12
Log of average labour income	2.82	Log of average labour income	2.81	Log of migrants	2.98	Log of average labour income	2.95
Log of migrants	2.79	Log of migrants	2.81	Log of average labour income	2.90	Log of migrants	2.86
Professionals	2.61	Professionals	2.61	Professionals	2.61	Professionals	2.61
Craft and related trades	2.41	Craft and related trades	2.41	Craft and related trades	2.41	Craft and related trades	2.41
Bachelor's degree	2.28	Plant and machine	2.28	Plant and machine	2.28	Plant and machine	2.28

Diversity index using education levels	VIF	Diversity index using educational fields	VIF	Diversity index using occupation types	VIF	Diversity index using industry groups	VIF
		Operators		Operators		Operators	
Plant and machine Operators	2.28	Bachelor's degree	2.27	Bachelor's degree	2.27	Bachelor's degree	2.27
Technicians and Associate Professionals	2.01	Log of government loan credit	2.03	Technicians and Associate Professionals	2.01	Technicians and Associate Professionals	2.01
Managers	1.94	Technicians and Associate Professionals	2.01	Managers	1.94	Managers	1.94
Log of government loan credit	1.91	Managers	1.94	Log of government loan credit	1.91	Log of government loan credit	1.92
Clerical Support	1.73	Clerical Support	1.73	Clerical Support	1.73	Clerical Support	1.73
Married	1.58	Married	1.58	Married	1.58	Married	1.58
Lower secondary	1.47	Lower secondary	1.47	Lower secondary	1.47	Lower secondary	1.47
Household's head	1.45	Household's head	1.45	Household's head	1.45	Household's head	1.45
Municipal area	1.44	Municipal area	1.44	Municipal area	1.44	Municipal area	1.44
Upper secondary	1.39	Upper secondary	1.38	Upper secondary	1.38	Upper secondary	1.38
Postgraduate	1.36	Postgraduate	1.36	Postgraduate	1.36	Postgraduate	1.36
Others	1.34	Others	1.34	Others	1.34	Others	1.34
Utilities	1.29	Utilities	1.29	Utilities	1.29	Utilities	1.29
Higher technical	1.28	Higher technical	1.27	Higher technical	1.27	Higher technical	1.27
Member	1.23	Member	1.23	Member	1.23	Member	1.23
Female	1.22	Female	1.22	Female	1.22	Female	1.22
Vocational	1.17	Vocational	1.17	Vocational	1.17	Vocational	1.17

Source: Author's estimation using Thai LFS 2013

Table B5: Variance inflation factors (VIFs) for the provincial diversity model in 2022

Diversity index using education levels	VIF	Diversity index using educational fields	VIF	Diversity index using occupation types	VIF	Diversity index using industry groups	VIF
Age	45.55	Age	45.55	Age	45.54	Age	45.55
Age ²	43.70	Age ²	43.69	Age ²	43.69	Age ²	43.70
Log of government loan credit	31.03	Log of government loan credit	30.80	Log of government loan credit	30.60	Log of government loan credit	30.86
Log of gross provincial product	27.73	Log of gross provincial product	25.13	Log of gross provincial product	25.32	Log of gross provincial product	26.84
Central Region	21.92	Central Region	21.98	Central Region	22.23	Central Region	23.60

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Diversity index using education levels	VIF	Diversity index using educational fields	VIF	Diversity index using occupation types	VIF	Diversity index using industry groups	VIF
Log of migrants	11.73	Northeastern Region	11.89	Log of migrants	11.74	Log of migrants	11.85
Low-skill services	10.87	Log of migrants	11.67	Low-skill services	10.87	Low-skill services	10.87
Northeastern Region	10.81	Low-skill services	10.88	Northeastern Region	10.75	Northeastern Region	10.85
Southern Region	10.35	Southern Region	10.37	Southern Region	10.30	Southern Region	10.81
Northern Region	9.94	Northern Region	9.90	Northern Region	9.73	Northern Region	10.41
Skilled Agriculture, Forestry and Fishery	8.11	Skilled Agriculture, Forestry and Fishery	8.10	Skilled Agriculture, Forestry and Fishery	8.12	Skilled Agriculture, Forestry and Fishery	8.11
High-skill services	7.70	High-skill services	7.70	High-skill services	7.70	High-skill services	7.70
Low-skill manufacturing	5.77	Low-skill manufacturing	5.77	Low-skill manufacturing	5.77	Low-skill manufacturing	5.77
Log of average labour income	3.45	Log of average labour income	3.44	Occupation types	3.77	Log of average labour income	3.43
Construction	3.25	Construction	3.25	Log of average labour income	3.43	Construction	3.25
High-skill manufacturing	3.24	High-skill manufacturing	3.24	Log of work demand	3.28	High-skill manufacturing	3.24
Services and sales	3.11	Services and sales	3.11	Construction	3.25	Services and sales	3.11
Log of work demand	2.98	Log of work demand	2.87	High-skill manufacturing	3.24	Log of work demand	3.10
Education levels	2.89	Educational fields	2.78	Services and sales	3.11	Bachelor's degree	2.46
Bachelor's degree	2.47	Bachelor's degree	2.46	Bachelor's degree	2.46	Professionals	2.42
Professionals	2.43	Professionals	2.42	Professionals	2.42	Industry groups	2.38
Plant and machine Operators	2.23	Plant and machine Operators	2.23	Plant and machine Operators	2.23	Plant and machine Operators	2.23
Craft and related trades	2.21	Craft and related trades	2.21	Craft and related trades	2.21	Craft and related trades	2.21
Married	2.09	Married	2.09	Married	2.09	Married	2.09
Technicians and Associate Professionals	1.89	Technicians and Associate Professionals	1.89	Technicians and Associate Professionals	1.89	Technicians and Associate Professionals	1.89
Clerical Support	1.78	Clerical Support	1.78	Clerical Support	1.78	Clerical Support	1.78
Others	1.75	Others	1.75	Others	1.75	Others	1.75
Upper secondary	1.62	Upper secondary	1.62	Upper secondary	1.62	Upper secondary	1.62
Lower secondary	1.60	Lower secondary	1.59	Lower secondary	1.59	Lower secondary	1.59

Diversity index using education levels	VIF	Diversity index using educational fields	VIF	Diversity index using occupation types	VIF	Diversity index using industry groups	VIF
Managers	1.58	Managers	1.58	Managers	1.58	Managers	1.58
Municipal area	1.42	Municipal area	1.42	Municipal area	1.42	Municipal area	1.43
Household's head	1.40	Household's head	1.40	Household's head	1.40	Household's head	1.40
Higher technical	1.39	Higher technical	1.39	Higher technical	1.39	Higher technical	1.39
Member	1.38	Member	1.38	Member	1.38	Member	1.38
Postgraduate	1.36	Postgraduate	1.36	Postgraduate	1.36	Postgraduate	1.36
Vocational	1.23	Utilities	1.23	Utilities	1.23	Utilities	1.23
Utilities	1.23	Vocational	1.22	Vocational	1.22	Vocational	1.22
Female	1.19	Female	1.19	Female	1.19	Female	1.19

Source: Author's estimation using Thai LFS 2022

Appendix C: Ten-year lagged instrumental variables (IV) results**Table C1: Detailed model of ten-year lagged instrumental variables (IV) probit in 2013**

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational levels	(3) Diversity index using occupation levels	(4) Diversity index using industry levels
Diversity index				
Education levels	-0.9550 (0.6492)	-0.8110 (0.6564)	-0.9310 (0.6498)	-1.0363 (0.6527)
Individual characteristics				
Age	0.0428*** (0.0053)	0.0428*** (0.0053)	0.0428*** (0.0053)	0.0428*** (0.0054)
Age ²	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)	-0.0003*** (0.0001)
Municipal area	0.1252*** (0.0223)	0.1257*** (0.0223)	0.1253*** (0.0223)	0.1247*** (0.0224)
Household's head	0.4063*** (0.0233)	0.4062*** (0.0233)	0.4062*** (0.0233)	0.4048*** (0.0233)
Female	-0.2384*** (0.0233)	-0.2385*** (0.0233)	-0.2384*** (0.0233)	-0.2377*** (0.0233)
Member	0.0117** (0.0057)	0.0118** (0.0057)	0.0117** (0.0057)	0.0116** (0.0058)
<i>Region: Bangkok is a base group</i>				
Central Region	-0.1003* (0.0574)	-0.1055* (0.0573)	-0.1009* (0.0574)	-0.1063* (0.0578)
Northern Region	-0.1815*** (0.0641)	-0.1855*** (0.0641)	-0.1819*** (0.0640)	-0.1873*** (0.0641)
Northeastern Region	-0.3976*** (0.0675)	-0.3941*** (0.0680)	-0.3968*** (0.0675)	-0.4009*** (0.0678)
Southern Region	0.0790 (0.0580)	0.0766 (0.0581)	0.0788 (0.0580)	0.0710 (0.0584)
<i>Marital status: Single is a base group</i>				
Married	0.1140*** (0.0310)	0.1140*** (0.0310)	0.1140*** (0.0310)	0.1137*** (0.0311)
Others	0.1623*** (0.0454)	0.1624*** (0.0454)	0.1623*** (0.0454)	0.1618*** (0.0455)
<i>Education: No education is a base group</i>				
Lower secondary	0.2170*** (0.0297)	0.2167*** (0.0297)	0.2170*** (0.0297)	0.2168*** (0.0298)
Upper secondary	0.3297*** (0.0315)	0.3293*** (0.0315)	0.3296*** (0.0315)	0.3290*** (0.0315)
Vocational	0.4106*** (0.0467)	0.4094*** (0.0467)	0.4104*** (0.0467)	0.4100*** (0.0468)
Higher technical	0.4355*** (0.0416)	0.4345*** (0.0416)	0.4353*** (0.0416)	0.4346*** (0.0417)
Bachelor's degree	0.6775*** (0.0334)	0.6767*** (0.0334)	0.6773*** (0.0334)	0.6757*** (0.0335)
Postgraduate	0.4751*** (0.0662)	0.4742*** (0.0662)	0.4749*** (0.0662)	0.4738*** (0.0663)
<i>Main Occupation: Elementary Occupations is a base group</i>				
Managers	1.6929***	1.6927***	1.6927***	1.6885***

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational levels	(3) Diversity index using occupation levels	(4) Diversity index using industry levels
Professionals	(0.0674) 0.3720*** (0.0872)	(0.0674) 0.3714*** (0.0872)	(0.0674) 0.3719*** (0.0872)	(0.0675) 0.3704*** (0.0874)
Technicians and Associate Professionals	0.3970*** (0.0827)	0.3968*** (0.0827)	0.3970*** (0.0827)	0.3955*** (0.0829)
Clerical Support	0.1639 (0.1106)	0.1637 (0.1106)	0.1639 (0.1106)	0.1631 (0.1106)
Services and sales	0.5407*** (0.0682)	0.5406*** (0.0682)	0.5407*** (0.0682)	0.5388*** (0.0683)
Skilled Agriculture, Forestry and Fishery	0.5413*** (0.0921)	0.5416*** (0.0921)	0.5413*** (0.0921)	0.5399*** (0.0924)
Craft and related trades	0.7455*** (0.0677)	0.7453*** (0.0677)	0.7454*** (0.0677)	0.7427*** (0.0678)
Plant and machine Operators	0.0623 (0.0838)	0.0619 (0.0838)	0.0623 (0.0838)	0.0621 (0.0840)
<i>Industry: Agriculture is a base group</i>				
Utilities	-0.7882*** (0.1621)	-0.7878*** (0.1621)	-0.7881*** (0.1621)	-0.7865*** (0.1628)
Construction	0.5927*** (0.0839)	0.5925*** (0.0839)	0.5926*** (0.0839)	0.5914*** (0.0840)
Low-skill manufacturing	-0.0339 (0.0844)	-0.0345 (0.0845)	-0.0340 (0.0844)	-0.0329 (0.0846)
High-skill manufacturing	-0.1406 (0.0977)	-0.1416 (0.0977)	-0.1407 (0.0976)	-0.1400 (0.0978)
Low-skill services	-0.0042 (0.0804)	-0.0043 (0.0804)	-0.0042 (0.0804)	-0.0040 (0.0805)
High-skill services	-0.9876*** (0.0861)	-0.9876*** (0.0861)	-0.9875*** (0.0861)	-0.9847*** (0.0862)
Provincial characteristics				
Log of average household income	-0.0747** (0.0321)	-0.0751** (0.0321)	-0.0747** (0.0321)	-0.0752** (0.0320)
Log of gross provincial product	0.0308* (0.0170)	0.0313* (0.0170)	0.0310* (0.0171)	0.0310* (0.0172)
Log of work demand	-0.0208 (0.0131)	-0.0231* (0.0131)	-0.0211 (0.0131)	-0.0224* (0.0130)
Log of migrants	-0.0082 (0.0081)	-0.0086 (0.0081)	-0.0083 (0.0081)	-0.0081 (0.0081)
Log of government loan credit	0.0044 (0.0187)	0.0044 (0.0187)	0.0043 (0.0187)	0.0039 (0.0189)
Constant	-2.9107*** (0.5770)	-2.9957*** (0.5823)	-2.9257*** (0.5777)	-2.8136*** (0.5796)
Observations	88,341	88,341	88,341	88,341

Note: Robust standard errors in parentheses. ***, **, * denotes significance at 1% 5% and 10% respectively.

Source: Author's estimation using Thai LFS 2003 and 2013

(1) use ten-year lagged education levels diversity as the IVs

(2) use shift-share education levels diversity as the IVs

(3) use ten-year lagged and shift-share education levels as the IVs

(4) use ten-year lagged and shift-share education levels, occupation types and industry group

Table C2: Detailed model of ten-year lagged instrumental variables (IV) probit in 2022

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational levels	(3) Diversity index using occupation levels	(4) Diversity index using industry levels
Diversity index Education levels	0.2892 (1.0199)	2.2994** (1.0886)	0.9009 (1.0275)	2.1678** (0.9545)
<i>Individual characteristics</i>				
Age	0.0282*** (0.0066)	0.0283*** (0.0066)	0.0282*** (0.0066)	0.0282*** (0.0067)
Age ²	-0.0001* (0.0001)	-0.0001* (0.0001)	-0.0001* (0.0001)	-0.0001* (0.0001)
Municipal area	0.1169*** (0.0237)	0.1201*** (0.0237)	0.1178*** (0.0237)	0.1197*** (0.0237)
Household's head	0.3757*** (0.0254)	0.3766*** (0.0254)	0.3756*** (0.0254)	0.3759*** (0.0254)
Female	-0.2078*** (0.0246)	-0.2076*** (0.0246)	-0.2076*** (0.0247)	-0.2073*** (0.0247)
Member	0.0088 (0.0079)	0.0095 (0.0079)	0.0089 (0.0079)	0.0094 (0.0079)
<i>Region: Bangkok is a base group</i>				
Central Region	-0.1551 (0.1112)	-0.1847* (0.1113)	-0.1583 (0.1113)	-0.1804 (0.1111)
Northern Region	-0.1485 (0.1036)	-0.1782* (0.1036)	-0.1526 (0.1035)	-0.1732* (0.1032)
Northeastern Region	-0.2577*** (0.0984)	-0.2041** (0.0988)	-0.2360** (0.0983)	-0.2052** (0.0985)
Southern Region	0.1139 (0.1061)	0.1130 (0.1061)	0.1189 (0.1060)	0.1145 (0.1066)
<i>Marital status: Single is a base group</i>				
Married	0.1670*** (0.0358)	0.1672*** (0.0358)	0.1670*** (0.0358)	0.1670*** (0.0359)
Others	0.1377*** (0.0347)	0.1362*** (0.0347)	0.1371*** (0.0347)	0.1359*** (0.0348)
<i>Education: No education is a base group</i>				
Lower secondary	0.2065*** (0.0359)	0.2011*** (0.0359)	0.2049*** (0.0359)	0.2012*** (0.0360)
Upper secondary	0.3425*** (0.0357)	0.3367*** (0.0356)	0.3405*** (0.0357)	0.3366*** (0.0357)
Vocational	0.4792*** (0.0526)	0.4670*** (0.0526)	0.4753*** (0.0527)	0.4668*** (0.0527)
Higher technical	0.5078*** (0.0449)	0.4963*** (0.0449)	0.5036*** (0.0449)	0.4959*** (0.0449)
Bachelor's degree	0.7147*** (0.0374)	0.7058*** (0.0374)	0.7114*** (0.0374)	0.7050*** (0.0373)
Postgraduate	0.7388*** (0.0667)	0.7250*** (0.0667)	0.7341*** (0.0667)	0.7247*** (0.0667)
<i>Main Occupation: Elementary Occupations is a base group</i>				
Managers	2.1292*** (0.0796)	2.1317*** (0.0796)	2.1282*** (0.0796)	2.1286*** (0.0795)

Dependent variable: Being employer	(1) Diversity index using education levels	(2) Diversity index using educational levels	(3) Diversity index using occupation levels	(4) Diversity index using industry levels
Professionals	0.6797*** (0.0984)	0.6855*** (0.0984)	0.6810*** (0.0984)	0.6847*** (0.0983)
Technicians and Associate Professionals	0.7638*** (0.0921)	0.7653*** (0.0921)	0.7640*** (0.0921)	0.7643*** (0.0921)
Clerical Support	-0.0102 (0.1496)	-0.0090 (0.1495)	-0.0088 (0.1496)	-0.0084 (0.1498)
Services and sales	0.7151*** (0.0777)	0.7167*** (0.0777)	0.7150*** (0.0777)	0.7156*** (0.0776)
Skilled Agriculture, Forestry and Fishery	0.4404*** (0.1040)	0.4507*** (0.1042)	0.4437*** (0.1042)	0.4506*** (0.1039)
Craft and related trades	0.9201*** (0.0778)	0.9202*** (0.0778)	0.9194*** (0.0778)	0.9186*** (0.0777)
Plant and machine Operators	0.1993** (0.0961)	0.1957** (0.0962)	0.1984** (0.0962)	0.1956** (0.0961)
<i>Industry: Agriculture is a base group</i>				
Utilities	-1.5220*** (0.2613)	-1.5256*** (0.2615)	-1.5212*** (0.2613)	-1.5225*** (0.2615)
Construction	0.4214*** (0.1013)	0.4209*** (0.1014)	0.4214*** (0.1013)	0.4209*** (0.1012)
Low-skill manufacturing	-0.2413** (0.1031)	-0.2437** (0.1032)	-0.2413** (0.1032)	-0.2427** (0.1030)
High-skill manufacturing	-0.6161*** (0.1266)	-0.6195*** (0.1266)	-0.6161*** (0.1265)	-0.6177*** (0.1265)
Low-skill services	-0.1308 (0.0982)	-0.1308 (0.0984)	-0.1300 (0.0983)	-0.1300 (0.0982)
High-skill services	-1.2240*** (0.1045)	-1.2228*** (0.1046)	-1.2220*** (0.1046)	-1.2206*** (0.1045)
Provincial characteristics				
Log of average household income	-0.1374*** (0.0446)	-0.1424*** (0.0445)	-0.1377*** (0.0440)	-0.1417*** (0.0443)
Log of gross provincial product	-0.0726** (0.0313)	-0.0897*** (0.0313)	-0.0783** (0.0311)	-0.0885*** (0.0311)
Log of work demand	-0.0462*** (0.0144)	-0.0510*** (0.0144)	-0.0474*** (0.0144)	-0.0506*** (0.0143)
Log of migrants	0.1179*** (0.0143)	0.1219*** (0.0143)	0.1193*** (0.0143)	0.1214*** (0.0143)
Log of government loan credit	-0.0423 (0.0327)	-0.0353 (0.0327)	-0.0394 (0.0326)	-0.0356 (0.0328)
Constant	-2.5206*** (0.8660)	-3.9237*** (0.9168)	-2.9670*** (0.8716)	-3.8319*** (0.8363)
Observations	85,444	85,444	85,444	85,444

Note: Robust standard errors in parentheses. ***, **, * denotes significance at 1% 5% and 10% respectively.

Source: Author's estimation using Thai LFS 2012 and 2022

(1) use ten-year lagged education levels diversity as the IVs

(2) use shift-share education levels diversssssssssity as the IVs

(3) use ten-year lagged and shift-share education levels as the IVs

(4) use ten-year lagged and shift-share education levels, occupation types and industry group

Appendix D: Generalised structural equation model (GSEM)

Table D1: Detailed GSEM model using both years

	(1) Employee skill diversity	(2) Entrepreneur skill diversity	(3) Consumption diversity	(4) Entrepreneur
Provincial skill diversity	-0.36*** (0.0018)	1.5671*** (0.0044)	-0.6832*** (0.0361)	0.7337* (0.2865)
Employee skill diversity				-3.1961*** (0.2311)
Entrepreneur skill diversity				1.2048*** (0.1022)
Consumption diversity				-0.0116 (0.0108)
Year	0.0015*** (0.0000)	-0.0061*** (0.0000)	-0.0161*** (0.0003)	-0.0225*** (0.0017)
Region	0.0015*** (0.0001)	-0.0148*** (0.0001)	-0.0516*** (0.001)	0.0985*** (0.0056)
Log of work demand	-0.0053*** (0.0001)	0.0164*** (0.0001)	0.0388*** (0.001)	-0.0471*** (0.0061)
Log of average labour income	-0.0096*** (0.0002)	-0.0423*** (0.0004)	-0.0834*** (0.0031)	0.0336 (0.0179)
Log of government loan credit	-0.0021*** (0.0001)	-0.0074*** (0.0001)	0.6759*** (0.0012)	-0.0214* (0.01)
Log of migrants	-0.0021*** (0.0000)	0.0048*** (0.0001)	0.3335*** (0.0006)	0.0287*** (0.0049)
Age				0.0377*** (0.0029)
Age ²				-0.0003*** (0)
Female				-0.3195*** (0.0124)
Marital				0.0865*** (0.0103)
Education				0.0584*** (0.0016)
Household's head				0.3805*** (0.0134)
Member				0.0225*** (0.0034)
Municipal area				0.1437*** (0.0119)
Constant	1.0423*** (0.0022)	0.1779*** (0.0052)	3.7701*** (0.0433)	-1.8242*** (0.3627)
1. var(e.Employee skill diversity)				0.0006 (0.000002)
2. var(e.Entrepreneur skill diversity)				0.0037 (0.00001)
3. var(e.Consumption diversity)				0.2542 (0.0007)

	(1) Employee skill diversity	(2) Entrepreneur skill diversity	(3) Consumption diversity	(4) Entrepreneur
cov(e.1,e.2)				0.0023*** (0.00006)
cov(e.1,e.3)				-0.0008*** (0.00003)
cov(e.2,e.3)				0.0005*** (0.000003)
Observations				236,390

Note: Robust standard errors in parentheses. ***, **, * denotes significance at 1% 5% and 10% respectively.

Source: Author's estimation using Thai LFS 2013 and 2022

Table D2: Specific indirect effects of all variables on employer (probit scale), with 95% CIs

the mediated effect	Coefficient	Standard Error	z	P>z	[95% Confidence Interval]	
					lower bound	upper bound
Education levels on employer						
through provincial consumption diversity	0.008	0.007	1.070	0.284	-0.0065743	0.0224369
through entrepreneur skill diversity	1.888***	0.160	11.780	0.000	1.5740320	2.2021520
through employee skill diversity	1.150***	0.083	13.800	0.000	0.9869940	1.3138910
total indirect	3.046***	0.206	14.820	0.000	2.6436480	3.4492830
Work demand on employer						
through provincial consumption diversity	0.000	0.000	-1.070	0.283	-0.0012723	0.0003721
through entrepreneur skill diversity	0.020***	0.002	11.740	0.000	0.0164442	0.0230333
through employee skill diversity	0.017***	0.001	13.710	0.000	0.0144537	0.0192776
total indirect	0.036***	0.002	15.370	0.000	0.0315430	0.0407655
Government loan credit on employer						
through provincial consumption diversity	-0.008	0.007	-1.070	0.283	-0.0221752	0.0064814
through entrepreneur skill diversity	-0.009***	0.001	-11.480	0.000	-0.0104887	-0.0074306
through employee skill diversity	0.007***	0.001	12.840	0.000	0.0056757	0.0077205
total indirect	-0.010	0.007	-1.370	0.171	-0.0245783	0.0043614
Average household income on employer						
through provincial consumption diversity	0.001	0.001	1.070	0.283	-0.0008015	0.0027390
through entrepreneur skill diversity	-0.051***	0.004	-11.730	0.000	-0.0595321	-0.0424813
through employee skill diversity	0.031***	0.002	13.500	0.000	0.0261533	0.0350398
total indirect	-0.019***	0.004	-4.610	0.000	-0.0276991	-0.0111836
Migrants on employer						
through provincial consumption diversity	-0.004	0.004	-1.070	0.283	-0.0109400	0.0031976
through entrepreneur skill diversity	0.006***	0.000	11.600	0.000	0.0047895	0.0067368
through employee skill diversity	0.007***	0.000	13.560	0.000	0.0057506	0.0076937
total indirect	0.009**	0.004	2.420	0.015	0.0016495	0.0155786
Region on employer						
through provincial consumption diversity	0.001	0.001	1.070	0.283	-0.0004954	0.0016943
through entrepreneur skill diversity	-0.018***	0.002	-11.730	0.000	-0.0208084	-0.0148502
through employee skill diversity	-0.005***	0.000	-12.400	0.000	-0.0054286	-0.0039464
total indirect	-0.022***	0.002	-13.090	0.000	-0.0251994	-0.0186354
Year on employer						
through provincial consumption diversity	0.000	0.000	1.070	0.283	-0.0001548	0.0005294
through entrepreneur skill diversity	-0.007***	0.001	-11.770	0.000	-0.0085099	-0.0060795
through employee skill diversity	-0.005***	0.000	-13.730	0.000	-0.0056094	-0.0042076
total indirect	-0.012***	0.001	-15.000	0.000	-0.0135861	-0.0104456

Note: Robust standard errors in parentheses. ***, **, * denotes significance at 1% 5% and 10% respectively.

provincial consumption = ConD, entrepreneur skill = EntD, employee skill = WD

Source: Author's estimation using Thai LFS 2013 and 2022