

Have We Reached Our Potential?

A Perspective from Worker- and Firm- Level Data

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Abstract

While several factors drive *a country's competitiveness*, human capital is at the heart. Thailand has invested heavily in education over the past three decades, hoping that it will raise both the well-being of its people and the country's productivity. This article asks whether *we have reached our potential* by exploring the intertwining relationship of education and intermediate outcomes, such as changes in occupational composition, wage profiles, and labor force capacity. Our results suggest that Thailand still has untapped potential within its workforce. While average years of schooling have increased, high-skill and middle-skill jobs have not grown sufficiently, most likely due to a lack of demand, mismatches in skills, and education quality. For earnings, both the Labor Force Survey and Social Security Office data provide consistent evidence that a majority of the workforce has not reaped the benefits of economic growth despite being more educated. The expanding formal sector and its institution have also likely created more unused productive capacity over time. We also see higher concentration of employment in large firms in the labor market. And while the market is shown itself to be quite flexible, low-skilled and older workers still face limited mobility. Lastly, policy implications for unlocking the full potential of our workforce are discussed.

I. Introduction

The World Economic Forum defines “competitiveness” as the set of institutions, policies, and factors that determine the level of productivity of a country. Higher productivity implies high sustainable economic growth and high-income levels (Sala-i-Martin *et al*, 2007). The main drivers of productivity are many, complex and intertwining. The recent Global Competitive Indicator (World Economic Forum, 2018) identifies twelve pillars that determine countries’ competitiveness. They can be clustered into four groups: (i) enabling the environment (institution, infrastructure, ICT adoption, macroeconomic stability); (ii) human capital (health, skills); (iii) markets (product markets, labor markets, financial systems, market size); and (iv) innovation ecosystem (business dynamism, innovation capacity). The main focus of this paper is on human capital and the labor market. A country’s workforce and labor force capacity are vital to its competitiveness. Without efficient and innovative workers, favorable environment and innovation ecosystem alone will be unable to drive up productivity.

The Thai labor market has gone through significant transformations over the past three decades. The real wage, which partly reflects a country’s productivity, peaked in the mid-1990s and only slowly recovered after the 1997 crisis. The agricultural sector, once the country’s backbone, has largely declined while the shares of the manufacturing, trade and service sectors have both risen. This trend makes the formal sector more crucial to the economy. The country’s low fertility rate and increased proportion of educated workers have also changed the Thai workforce composition.

One important area within public policy in Thailand since the 1970s is education reform. A massive amount of public spending has been channeled into the education sector. Spending increased from 50,000 million Baht in 1988 to 450,000 million Baht in 2012 (Sagarik, 2014). Investment in education is not only expected to raise the country’s productivity and economic growth, but also improve individuals’ standard of living which encompasses labor market outcomes, health outcomes and household financial status. In addition to the government heavily investing in upgrading our human capital stock, Thai people have also invested more time in schooling. Thus, this paper asks: “*have we reached our potential?*” in the sense of to what extent have we seen commensurate returns on these investment. Should we expect better outcomes in terms of enhanced skills and productivity?

We explore the relationship between our workers’ skills, education, real wages and employment patterns. While we do not have a perfect measure of workers’ abilities, workers’ skills should be partly captured by their particular jobs, reflecting the complexity of the tasks

involved. Do the majority of Thai workers move up the job-skill ladder as they become more educated? Another measure of firms' and workers' productivity is wages. Do younger cohorts earn more given they are more educated? What happens to wages and jobs when the changes concern not only rising levels of education, but also the other transformations mentioned above occurring simultaneously? Does our labor market feature any efficiency aspect? These outcomes represent intermediate steps in the country's long-term journey to prosperity. Most results suggest that we have not reached our potential yet. Consequently, possible explanations are discussed.

In addition, we also explore how education and institutions each play a role in shaping our labor force capacity. Health is an integral aspect of human capital influencing a country's productivity because individuals with poor health condition are unable to work efficiently. Thai citizens' life expectancy at birth increased from 69.7 in 1988 to 75.5 in 2017 (United Nations Population Division, 2017). This wellness measure indicates that our people are healthier, but do they work more or has the unused productive capacity just increased over time? The country's workforce is expected to shrink due to low fertility rates. Thus, the implications in terms of retirement outcomes are not trivial. Finally, we explore the formal labor market from a larger perspective by examining the role of firm size and employment concentration.

The paper is organized as follows. The next section describes the two data sets used in our analysis, the Thai Labor Force Survey and the Social Security data. Section III documents how wages, occupation composition, and education are intertwined. Section IV provides a dynamic picture of work patterns and assesses their relationship with wages. The retirement outcome is discussed in Section V. Section VI explores the dynamics of employers and labor market concentration. The last section provides conclusions and a discussion.

II. Data

Our analysis relies on two key data sources. The first data set is the Thai Labor Force Survey (LFS), which is administered on a quarterly basis by the National Statistical Office (NSO) of Thailand. The third quarter (July–September) rounds of the survey covering the years 1988–2017 are used. The LFS is a national representative sample, collecting detailed information about individuals' education, work status, employment sector, industry, and earnings. The number of observations in each year is approximately 100,000. In terms of the Thai prime age population (aged 25–54), it shows that our potential workforce has increased in size from

about 19 million in 1988 to 26 million in 2002 and 30 million people in 2017. As LFS is a cross-sectional household survey, a dynamic picture of the labor market is limited.

Our second data set, the Social Security Office (SSO) records, provides additional insight into more dynamic aspects. The Thai Social Security Act was enacted in 1990 and originally required employers in non-agricultural sectors with 20 or more employees to register for, and contribute to, the Social Security (SS) fund.⁴ It was later extended to cover employers with ten or more employees in 1993 and then employers with at least one employee in 2002. This compulsory mandate, also known as Article 33, requires contributions from three parties (5% of the monthly wage from the employee, 5% of the monthly wage from the employer, and 2.75% of the monthly wage from the government). The minimum monthly wage base has been 1,650 Baht and the maximum SS taxable wage has been 15,000 Baht since the fund started. The current benefit compensation include sickness, maternity, disability, death, old-age pension, child allowance and unemployment insurance.

Our sample includes the employers and employees registering under Article 33 during the full coverage period (2002-2018). The SSO data also includes some information about informal workers who voluntarily contribute to the fund (Article 39 for those who used to work in the formal sector, and Article 40 for those who have never worked in the formal sector). Because the presence of informal workers in the SS data was predicated on their participating on a voluntary basis, in our current analysis we did not incorporate such incomplete information. During the sample period, the number of employees insured increased from six to almost 11 million people. The number of employers increased from approximately 200,000 firms in 2002 to more than 400,000 in 2018. While the SSO data lacks details of some demographic information, such as education or occupation, its advantages are that (i) we can track individual employees and firms over a long period of time; (ii) administrative data is not subject to the measurement error problem; and (iii) monthly data is more effective for the purpose of understanding job entry and exit information. These two datasets, hence, complement each other, allowing us to explore different dimensions of the Thai labor market.⁵

⁴ Government, state enterprise and school staff are excluded as they are covered by other social insurance schemes.

⁵ Industry information is partially available for about 70% of registered firms, and the missing cases were unlikely to be *missing at random*. Therefore, we decided not to use the industry information from SSO data.

III. Education, wages and occupation

Education

The average education levels for Thai men and women have been rising over time.⁶ Figure 3.1 presents details of the levels of education of Thai men and women aged 25-54 from 1988 to 2017. In 1988, most of our prime age men and women were primary school graduates (66% for men and 69% for women). Moving forward to 30 years later, 56-57% of men and women had obtained a secondary education level or higher. It is notable that while the shares of primary-educated men and women remain similar (42% versus 43%), the share of women with a college degree is now higher (20% versus 14%).

The increasing trend in the average level of schooling over time has been likely driven by educational wage differentials in the late 1980s, and the Thai governments' emphasis on education provision and promotion. The top panel of Figure 3.2 plots the kernel densities of the log real hourly wages of Thai men and women during 1988-1990 by education. It is apparent that, in general, the wage density of the higher educated group is to the right of the lower educated group. The patterns for women and men are quite similar, the wage densities of vocational and secondary graduates are located relatively closer to the wage density of college graduates.⁷

Given the relationship between levels of education attained and wages, it is not surprising that parents are willing to invest in their children's education, and the government views education as a way to improve the country's human capital. The average year of schooling increased significantly after the compulsory reform enacted in 1978, which helped Thailand attain universal primary education in the late 1980s (Hawley 2004; Liao and Paweenawat 2019). The next major educational reform involved the 1999 National Education Act, which required nine compulsory years and provided 12 years of free education (up to completing secondary level). Such free education was then extended to include three years of pre-school in 2009.

⁶ See Table A3 for education classification.

⁷ We will not attempt to explain the gender-wage differentials here. The labor supply decisions of women, especially married women, are known to be different from men's decisions. When having a child, women normally take some time out of the market. When returning, their wages are likely to be lower, not only because of the lost labor market experience, but also because women may choose a job with flexible hours, rather than one with the highest pay.

Changes in educational wage differentials

The middle and bottom panels of Figure 3.2 plot wage densities by each education group in 2002-2004 and 2015-2017, respectively. Figure 3.3 shows the evolution of real median wages from 1988 to 2017 for male and female employees with potential experience of 10-20 years. There are four key observed patterns to be taken from these two figures.

First, while the median wage of the secondary educated group was clearly higher than the primary or lower educated groups in the late 1980s, this gap has reduced over time. During 2015-2017, the secondary wage density lay just slightly to the right of the primary wage density. This pattern is similar for both men and women.

Second, college graduates experienced a relatively higher increase in their median and average wages, leading to a larger wage gap existing between college and vocational graduates. While the gap used to be only approximately 20 Baht per hour three decades ago, it has increased to 60 Baht per hour. This difference may also reflect the fact that the college group includes a progressively higher proportion of post-graduate workers over time. Third, changes of within-group wage dispersion can be observed. Over time, the within-group wage dispersion for college graduates has increased. In contrast, the wage densities for all non-college groups have been less dispersed.

Finally, similar to findings documented in related studies (e.g., Lathapipat, 2008), median real wage rates for all groups peaked in 1996-1997 and then fell after the Asian economic crisis. During 2001-2008, real wages remained quite stable. The real wages of workers having finished vocational and secondary levels of education declined between 2008 and 2011 before starting to rise again subsequently. The real wages of the bottom three education groups rose after 2012, but stayed fairly stable between 2014 and 2017. This is likely due to the minimum wage policy during 2012-2013 where minimum wages across all provinces increased by at least 40%.

Wages in a competitive labor market reflect a combination of the productivity of workers and the productivity of firms. Education, potential experience, ability (often unobserved), industry, occupation, geographical concentration, agglomeration have been shown to influence wages. Given that we have more educated workforce, do more workers work in high-skilled jobs? This is the dimension we explore next.

Occupation

In each year, we categorize detailed occupations into 13 categories. The criteria of our categorization are to ensure compatibility with the three versions of codes, and that occupations within the same group reflecting a similar complexity of tasks and duties and education requirements (similar to Autor 2019, ISCO 1988, ISCO 2008, Lathapipat 2008). The Thai LFS surveys have encompassed two major changes in the classification of occupations in 2001 and 2011. Since 2011, the classification has been based on the International Standard Classification of Occupations (ISCO)-2008. Between 2001 and 2010, the occupational codes were based on the ISCO-1988. The classification is based on the Thai NSO standards prior to 2001.

The thirteen categories are further clustered into three broad occupational groups: (1) high-skill occupations including managers, professionals, technicians and associated professionals; (2) middle-skill occupations including clerical and sales/service workers; and (3) low-skill occupations including agricultural workers, craft and manual workers, machine operators, assemblers, drivers and laborers. The *high-skill* jobs normally require both the sufficient ability to perform complex problem-solving tasks and a degree in a specialized field. The *middle-skill* jobs often require medium-level literacy and numeracy skills to enable keeping written records and performing simple arithmetic calculations. The *low-skill* jobs typically involve routine physical tasks and needed skills can be acquired by on-the-job training. Tables 3.1 and A4 provide more details about our classification.

To investigate whether this occupational grouping reflects the different skills required, Figure 3.4 presents real hourly wages at the 10th, 25th, 50th, 75th and 90th percentiles by occupation in 1988-1990 and 2015-2017 for men and women. The plot clearly demonstrates that most of the high-skill jobs, except artists and journalists, pay higher wages than the middle-skill jobs. The middle-skill jobs pay higher wages than low-skill. However, the higher skill the job requires, the wider its wage dispersion. The median occupational wages in 2015-17 remain similar to their levels in 1988-90. Surprisingly, the median wages of the same occupations for men and women are also similar, suggesting gender wage differentials are partly driven by the different occupations held by men and women.

Table 3.2 illustrates the occupational shares of workers aged 25-54 years in 1988-1990 and 2015-2017. Overall, the proportions of high-skill and middle-skill groups increased by +6.1 and +9.6 percentage points, respectively, whereas the share of low-skill occupations fell by 15.6 percentage points, but still accounting for the largest occupational share at 63%.

Among high-skill jobs, the shares of technicians and associated professions rose the most by 2.2 percentage points. Other professional groups also recorded a larger share, except teachers. With middle-skill jobs, the increase is largely driven by the doubling of the shares of service and sales workers. Jobs in low-skill categories have diverse patterns. While the share of agricultural jobs fell by 31 percentage points, the proportions of other low-skill jobs rose, especially the machine operator group.

We have shown that the Thai labor market has seen a rise in the number of high-educated workers, together with high-skill and middle-skill employment, but the former seems to have grown faster. Tables 3-4 further investigate how the within-group occupation composition has changed for each education level. The left and right panel shows the composition for the periods 1988-90 and 2015-17, respectively. In the past, it is quite apparent that college graduates worked in high-skill occupations (80% for men and 78% for women) and vocational group employment was split between high-skill and middle-skill occupations, approximately 30-40% each.

For secondary educated workers, the patterns are different for men and women. Men had more chance to work in high-skill jobs (22% versus 14%) but at the same time also had a higher share of low-skill jobs. The majority of secondary-educated women tended to be employed in middle-skill jobs. The pattern of men taking low-skill jobs with women securing middle-skill jobs is revealed when looking at the primary or lower education groups. This is not too surprising because many low-skill jobs are more physically demanding, and some middle-skill jobs, like secretary or clerk, traditionally belong to women.

The picture dramatically changed in 2015-17. The shares of college men and women employed in high-skill jobs were greatly reduced by 28 and 26 percentage points, respectively. For men, the fall was compensated by in the equal rise of the shares of middle-skill jobs and low-skill jobs by 14 percentage points each. For women, the share of middle-skill jobs rose more (+18 percentage points), but also the fraction of women who chose not to work increased (+4 percentage points). This pattern is consistent with Paweenawat and Vechbanyongratana (2015) who uncovered the incidence of what they called “overeducation” among male college graduates as the number of college graduates has grown faster than the number of high-skilled jobs, especially among the younger cohorts.

In terms of vocational degree workers, the chance of being employed in a high-skill job has reduced from approximately 40% to 15% for both men and women. The share of middle-skill jobs rose by seven percentage points among women but fell by five percentage points with men. The pattern of moving down the occupation-skill ladder for secondary

graduates is similar to that of the vocational group, except that the fall in the share of middle-skill occupations is even more substantial. It is notable that secretaries and clerks belonged to the secondary and vocational graduates in the past, whereas they now belong to the vocational and college graduate groups. This change especially affects women.

What has happened to our primary and low-educated men and women? While Figures 3.2-3.3 suggest that these groups are slightly better off as their real wages have caught up with secondary graduates, the last rows of Tables 3.3 and 3.4 reveal a different picture. A larger fraction of primary or lower educated men and women aged 25-54 did not work compared to their counterparts three decades ago.⁸

Which explanations are consistent with the observed changes in education, real wages and occupational compositions?

The mismatch between labor demand and labor supply?

If we assume that “education” truly reflects workers’ skills, in which college graduates are trained for high-skill jobs; secondary graduates are supplied with middle-skill jobs; and the primary or lower educated groups are allocated the low-skill and more labor-intensive employment, the analysis so far reveals a picture of a prevailing excess supply of college and secondary educated workers. The increase in the employment shares of high- and middle-skill jobs suggests that the labor demand for such employment must have increased. However, the stagnant wages of the secondary educated group implies that the labor supply for those jobs has increased faster than its demand.

Note that the labor supply for middle-skill jobs not only comes from the 20 percentage point increase in workers possessing a secondary education, but also the excess supply of college graduates unable to secure employment in high-skill jobs and the larger number of women participating in the labor market (because women in younger cohorts generally obtained a higher education and have fewer children). In the US, Heckman et al. (1998), also explained that a national tuition-reduction policy that simulates substantial college enrollment has a general equilibrium effect which reduces college skill prices.

⁸ LFS also asked individuals who do not work on why they were not ready to work. For the primary or lower education, reports of disability as the reason increased over time. Since LFS is a cross-sectional survey, we cannot distinguish whether disability led them to obtain less education or led them to exit the workforce.

What are the roles of the changes in industry structure and technology?

It has been well documented that the relative importance of the Thai agricultural sector has largely declined over time, given the boom of the manufacturing, trade and service sectors. Table 3.5 confirms this fact. It illustrates employment shares by industry from the LFS data and employer shares by industry from the Corporate Profile and Financial Statement dataset.⁹ By comparing the two datasets during the 2000-2015 period, two common patterns emerge. First, while the shares of the manufacturing and trade sectors declined slightly, both sectors still accounted for significant employment shares (26% for manufacturing and 21% for trade) and employer shares (14% for manufacturing and 33% for trade). Second, the areas of rapid growth principally lie in service-related sectors, especially finance, real estate and other services, such as health, social work activities and public administration. New firms (last column) are mostly found in these sectors.

Another factor that has received concerns changes in technology brought by the computer revolution in the 1990s. It has long been predicted that computers will strongly complement the non-routine cognitive tasks inherent in the high-skill jobs held by college graduates, directly substituting for the routine tasks of many middle-skill jobs, and will have little direct impact on non-routine low-skill jobs (Autor et al., 2006). This means computers potentially help boost the productivity, and hence wages, of college graduates. Over time computers are also becoming ever more powerful and less expensive. The empirical findings in industrialized countries support this prediction where employment has been polarizing into high-wage and low-wage jobs at the expense of middle-wage employment.¹⁰

To investigate the role of these changes in the structure of industry and production technology, we perform a simple counterfactual exercise where we ask what would happen if only the industry structure changed, but the occupational shares in each industry remained at their 1988-90 levels (see Table A1 for details of occupational shares by industry in 1988-90 and 2015-17). The first column of Table 3.6 reports the actual changes in occupational shares, While the second column demonstrates the difference between the “counterfactual” and the 1988-90 actual occupational shares, reflecting the between-industry shift effect. The

⁹ The agricultural employment share in the LFS survey on the one hand could be overestimated because the third quarter is the harvest season. On the other hand, it could be underestimated because our sample consists of people aged between 25-54 years old. The agricultural workers tend to be the young and the old. The CPFS data consists of corporations required to submit their financial statements, covering the 2000-2015 period. Less than 1% of firms in the formal sector are in the agricultural, fishery and mining sector.

¹⁰ Autor (2019) notes that the rise in the supply of college workers could be beneficial to non-college workers if their skills were complementary.

difference between the 2017-15 and “counterfactual” shares, which reflects the changes in production technology, is reported in the last column.

Without the decomposition, middle-skill occupations in Thailand do not seem to be being replaced by the rising automation. However, once we account for the changes in industry structure, a different picture is revealed. The increase in middle-skill jobs is mainly driven by the growing shares of the trade and service sectors. If there were no technical changes, middle-skill jobs would have risen by +12.5, instead of +9.5 percentage points, suggesting a negative impact of technology, especially on clerical and service workers. In terms of low-skill jobs, the industry effect implies a large reduction from agricultural-related jobs at -31 percentage points and a large increase in craft and manual worker groups as these jobs used to comprise major tasks in the manufacturing industry. The technical change implies that many craft or manual task jobs are now substituted by jobs in the machine operator group.

The explanations above assume that the tasks for the same “occupation” in the present and past did not change, and workers with the same “education” label have obtained similar sets of skills. The next explanation provides some evidence that these assumptions may not accurately reflect reality.

Does “same occupation” mean performing the same tasks? Does “same education” signal possessing the same skills?

Technological progress has made computer-based technologies essential tools for many businesses. Globalization has also given workers able to master complex English literacy more opportunities and advantages. These two forces imply that particular occupations in the present may require higher skills than in the past.¹¹ For instance, in the past secretarial jobs only required the ability to use a typewriter and professional interpersonal communication skills in Thai. Presently, qualifications for secretarial positions often include a range of computer skills and effective communication in both Thai and English. The self-assessment of skills from the SES panel 2005 survey suggests that English literacy among Thai workers remains relatively low. Only approximately 31-37% of college graduates reported that they could read and write English well. The rate is much lower still for non-college graduates (see Table A2 in the appendix).

¹¹ It also implies that for non-English speaking countries like Thailand, the meaning of skills could be different from English speaking countries where English literacy is similar for everyone and is effectively irrelevant.

Table 3.7 presents further evidence that there is a substantial degree of heterogeneity of skills required within each occupational group. For each group, there exists a wage-premium for more educated workers. Even with middle-skill occupations, the median wages of college graduates are higher than those for employees with only a vocational degree. This college-vocation wage gap has grown wider for most occupations in recent years. This evidence supports the skill-biased technology change explanation for the secular increase of the real wages of college workers.

The occupational-wage schedule does raise questions concerning why some college graduates work in middle-skill jobs and why some secondary-educated workers work in low-skill jobs when their peers are able to secure posts in higher paid positions. One possible explanation is that people who have a “college” label possess a wider range of abilities compared to the past. Only those with very high ability can meet the requirements of high-wage roles. Such differences in ability are likely driven by two factors. The first concerns the phenomenon economists refer to as “the selection effect”. Thirty years ago, when education was not free, parents only chose to invest in schooling for children with a greater earning capacity (see e.g., Card, 1999). Now with schooling free for 12 years, workers with the same level of education includes a larger pool of individuals with different abilities. Another factor lies in the wide divergence in the quality of schools in Thailand (Kilenthong 2017, World Bank, 2018).

IV. Work patterns and earnings

The discussion based on the LFS data in the previous section suggests that over the past three decades more Thai workers have moved from the informal to the formal sector. In this section, we explore additional aspects of employment arising from the SSO data. Specifically, we ask three questions. First, what are the work patterns among formal sector employees? Second, concerns whether the Thai labor market is efficient in the sense that workers can easily change positions to find an improved job match (reflected in higher earnings). Finally, do we find similar work patterns and labor market outcomes for two different cohorts?

Understanding work patterns

To characterize the work pattern of more than five million people over a long period of time, we use the k-means clustering technique to group workers with similar employment profiles together. This technique allows us to find natural segmentations of workers based on the

given profiles. Our main sample consists of 5.2 million formal sector employees who were 15-44 years old in April 2002. Six employment-related profiles calculated over 96 months for each worker are used to characterize the employees:

- 1) the number of months since 2002 that a worker was present in Social Security records, including absent months
- 2) the total number of jobs¹²
- 3) the number of unemployment spells (number of times exiting the formal sector)
- 4) the median job tenure (number of months that a worker works consecutively for the same employer)
- 5) the median length of unemployment spell (number of consecutive months that a worker has no record of employment in the formal sector)
- 6) Same firm repetition (the number of times a worker works for the same employer in multiple job spells. Use the maximum number if a worker works for more than one employer).

The k-means clustering technique works as follows: to cluster m employment profiles into C clusters, k-means clustering first randomly picks C cluster centroids and then assigns each employment profile to the cluster with the closest centroid. Once all employment profiles are assigned to clusters, each centroid is recomputed to the mean of the employment profiles within that cluster. Then, each employment profile is reassigned to the cluster it is closest to, based on the newly computed centroids. The process is repeated until all the centroids are stabilized. Euclidean distance is used to measure the similarity between two different employment profiles.

For any two profiles $X = (x_1, x_2, x_3, x_4, x_5, x_6)$ and $Y = (y_1, y_2, y_3, y_4, y_5, y_6)$, the Euclidean distance $d_E(X, Y)$ between X and Y is defined as:

$$d_E(X, Y) = \sqrt{\sum_{k=1}^6 (x_k - y_k)^2}$$

All six characteristics in the employment profile are first standardized to $Normal(0, 1)$, in order to make the difference in each characteristics contribute equally to the distance calculation.¹³

¹² We allow for a maximum of one job per month. Approximately 22% of employees have at least one record showing more than one employer in the same month. Most of these cases arise when workers switch from one job to another job.

To determine the appropriate number of clusters, we use “elbow analysis” to find an optimal point that balances the trade-off between the within-group homogeneity and the simplicity of the model. By increasing the number of clusters, the model can always increase the degree of similarity within each group because the complex model has more freedom in grouping similar data points together. However, after a certain point, the improvement in within-group homogeneity becomes marginal, resulting in an “elbow” shape plot. The typical practice is to select the number of clusters at the “elbow” point.¹⁴

The within-group homogeneity is typically measured by the “within-clusters distance” where a lower number indicates a higher degree of similarity. For a given assignment of m data points to C clusters, the “within-clusters distance” is:

$$\sum_{c=1}^C \sum_{x_i \in C} \|x_i - \mu_c\|^2$$

where μ_c is the centroid of a cluster C_c and $\|x_i - \mu_c\|$ denotes the Euclidean distance between x_i and its cluster’s centroid μ_c .

For our sample, Figure 4.1 shows the plot of “within-cluster distance” against the number of clusters, suggesting that the appropriate number of clusters (at the kink) is four. We label the clusters as “Stayers” (38%), “Movers” (33%), “Seasonal” (14%) and “Shortly Observed” (15%). *Stayers* are people who tend to stay with one job for a long period of time. *Stayers* tend to have 1-2 jobs within the span of eight years and do not have an unemployment period when switching jobs. *Movers* on the other hand tend to have between 2-4 jobs within the span of eight years and typically have at least some periods of unemployment between jobs. The median length of their unemployment is five months. *Seasonal* usually work 3-7 months followed by 2-8 months of unemployment. One unique characteristic of the seasonal group is that they often return to the same employer multiple times. The last group is the shortly observed group. These are people that we only observed for a short period of time, typically for less than two years. Figure 4.2 illustrates their typical employment patterns for each cluster.

The four clusters reveal that among the workers counted as *employees in the formal sector*, only for 38% (the stayers) can we confidently call formal sector employees over the

¹³ Except for the length of observation, other characteristics are also first log-transformed before the standardization.

¹⁴ The concept is analogous to selecting the number of classes for the semi-parametric latent class model. The model selection criteria, such as BIC balances the in-sample fit with the model complexity (the number of parameters).

subsequent 96 months. Workers within the other groups feature a hybrid pattern, switching between the formal and informal sectors (or being inactive).

Is this kind of labor market efficient? Unfortunately, we do not have complete information on how much people earn when they exit the formal sector. If the *seasonal* or *shortly observed* workers are able to obtain higher wages elsewhere compared to staying in the formal sector, the Thai labor market can be viewed as being sufficiently flexible. We do observe that for all groups except *stayers*, of all times exiting their formal sector jobs, approximately 20% of times, the employees claim unemployment benefit. This fact, however, does not rule out the possibility that they may work in the informal sector while also claiming unemployment benefit.¹⁵

We next examine the wage-age profile while workers are employed in the formal sector. Here one would expect real wages to grow as workers age because when workers' labor market experience (formal or informal) increases, their productivity should rise commensurately. Figure 4.3 plots the median of real wages of workers within each cluster against their age. Two patterns emerge. First, median real wages increase with age as expected, suggesting there is a return on labor market experience. Second, the median real wage of *stayers* is always higher than the other three groups and the gap is wider as the workers age.

Figure 4.4 further investigates whether switching jobs helps workers increase their potential earnings (i.e., receiving a higher wage). The sample here comprises *stayers* and *movers* who were observed for the whole 96 months. The evidence shows that *stayers* who switch jobs have a steeper wage path as they get older. In contrast, there is no evidence that switching to a new job assists *movers* in reaching a higher wage level. These two findings suggest that either there exists a high wage penalty for exiting the formal labor market, and/or that the three non-stayer groups represent low-skill workers whose wages would not grow significantly as such low-skill employees are relatively easy to be replaced.

Another pattern that can be seen from Figure 4.3 is that the median real wage only increases with age up until about 39 years old for *stayers*, and 32 years old for the other three groups. Does this imply there is no more return on experience for these workers once turning 32? Or that our labor market becomes less flexible for older workers? From the last section, most of our workers are still employed in low-to-medium skill jobs where skills are acquired through on-the-job training. It is not surprising that the marginal return to experience for this

¹⁵ See more discussion about the Thai Social Security's unemployment insurance in Wasi *et al* (2018).

kind of jobs diminishes after workers have been there for ten years. However, for (presumably high-skilled) stayers, the nature of the Thai labor market could represent the underlying reason. Many public and private sector jobs limit the maximum age of applicants at 30 or 35 (see for example, Lekfuangfu et al, 2016). Figure 4.5 supports this explanation by plotting the switching rate against workers' age. The probability of switching jobs peaks at around the age of 20-25, then it decreases as age increases. However, the switching rate seems to drop significantly at around 30 before subsequently declining at a stable rate.

Do young cohorts behave differently? We perform a similar technique and the same set of variables for a younger cohort who were 15-44 years old in 2010. The aggregate clustering results appear very similar. The elbow analysis still suggests four clusters featuring “Stayers” (42%), “Movers” (30%), “Seasonal” (13%) and “Shortly Observed” (15%). A more detailed breakdown (Figure 4.6) also shows that for both cohorts, the young and low wage workers tend to be *seasonal* and *movers*, while older workers with high wages are likely to be *stayers*. For all age-gender combinations, the *shortly observed* group tends to comprise workers in the bottom wage quartile.

Nevertheless, some differences can be observed. For those aged 35-44 in 2010 across all wage quartiles, the share of *stayers* is about 4-7 percentage points higher, relative to those in the same age group in 2002. For the young worker in the bottom wage quartile, women are more likely to be *seasonal* workers compared to men. The wage-age profiles across the four clusters for the 2010 cohort are similar to the 2002 cohort, except that their slopes are steeper (results are available upon request). This is partly driven by the two significant rounds of increases in the minimum wage which came into effect in April 2012 and January 2013.

V. Labor force capacity and retirement outcome

The proportion of the Thai population aged 65 years or older is projected to increase from 11% in 2015 to 19% in 2030 (United Nations Population Division, 2017). This means that our labor force capacity, counting men and women aged 25-54 years old, is expected to decline. The aging population will unavoidably affect the country's productivity. The aging society is in fact a global phenomenon. The rise in levels of education, medical technological progress and less physically demanding jobs all enable older workers in many countries to continue in employment longer than in the past. Public pension reform also creates incentives for younger cohorts to retire later, thus helping slow down the shrinking workforce.

Education has been shown to influence retirement outcomes where workers with higher levels of education tending to retire later. This is likely because more educated

workers on average are in better health, have a well-paid job in their old age and do not face liquidity constraints (Venti and Wise, 2015). Keane and Wasi (2016) reported that for American men the probability of remaining employed is higher for more educated workers over the life cycle (see Figure 5.1). The probabilities of being employed at age 65 are approximately .2, .3 and .45 for the high school dropouts, high school graduates and college graduates, respectively.

Besides education and declining health, provisions of private and public pensions, the availability of health insurance, social norms and household-related factors, have all been found to explain why older workers decide to retire at a certain age (Lumsdaine and Mitchell, 1999; Blundell et al, 2016). By comparing social security provisions in 11 countries, Gruber and Wise (1999) highlighted that the labor force exits of older workers are concentrated around each country's public pension eligibility and normal retirement ages. Figure 5.2 shows the rates of leaving employment for the US and France. The exit rates spike at 62 (eligibility age) and 65 (normal retirement age) for the US and at age 60 (eligibility age) for France.¹⁶ Consequently, different public policies create divergent levels of “unused labor force capacity” across countries. Pension reforms such as increasing the normal retirement age and enacting benefit adjustment for delayed claiming have been found to increase labor force participation among older workers.

SS legislated age rules do not only provide financial incentives to retire, but can also shape social norms about what the appropriate retirement age should be (Blundell et al, 2016). Labor demand for older workers also influences the employment of older workers. In developed countries, self-employment plays a greater role among older people than among younger. Mandatory retirement ages (determined either by governments or company-specific policies) were common in the early 1990s, forcing people who still wanted to work to turn to self-employment. Many countries have made mandatory retirement ages illegal in recent years. Firms have used other mechanisms to induce their older workers with declining productivity to retire.

How do Thai workers work and retire?

In common with other countries, Thailand's life expectancy has increased, and more educated people are also healthier. Figure 5.3 plots the labor force participation of Thai men and

¹⁶ In the US, the eligibility age is the age when the beneficiary can start claiming their social security benefit, but the benefit is reduced in an actuarially fair rate. The normal retirement age is when the beneficiary can receive full pension benefits. In the US the normal retirement age has slowly increased from 65 to 67 for the younger cohort.

women over the life cycle by their education levels. Between the ages of 25 and 60, the probability of working is greater among more educated workers, especially women, as is the case in many countries. The picture at the end of the work life, however, shows a remarkable contrast in Figure 5.1. There is a tendency for a considerable proportion of college graduates to seek retirement when reaching the age of 60.

To further explore the institutional role, Figure 5.4 provides graphical representations of the employment sector over the life cycle for Thai men and women in the past and the present. For all four figures, it is apparent that self-employment dominates for Thai older workers. Among prime-age workers, the sectoral composition has also changed dramatically over the three decades. In 1988-90, a large proportion of prime age men were self-employed in the agricultural sector. In 2015-17, the private sector accounted for more than 40% of those aged 25-44 years old. For women, the transition from being unpaid family workers to private sector or self-employed, mostly in the retail trade, has emerged. The obvious explanation for retiring at 60 is that it constitutes the existing mandatory retirement age in Thailand. For civil servants, the mandatory retirement age is 60, while in the private sector, companies normally set a benchmark between the ages of 50 and 60.¹⁷

Do Thai social security provisions play any role in retirement outcomes?

In Thailand, the provision of old age pensions started in 1998 (seven years after the Social Security Act). The eligibility age to claim the pension is 55. Eligible workers are required to have contributed to the fund for at least 180 months. For a worker who works for 180 months, their pension benefit is calculated at 20% of their average wages over the preceding 60 working months (recall that the contribution wage is capped at 15,000 Baht). If they contribute for more than 180 months, the benefit increases by 1.5% for each additional year. While adjusting benefits for a longer contribution period should create an incentive for workers to stay in the formal sector, a pension formula that is based on a relatively short working period does not encourage workers to remain in the formal sector. In the US, the pension formula is based on average wages over the maximum 35 earnings years, implying that if a worker leaves SS before 35 years, the wages of those years would be replaced by zero, pulling the average wage and hence pension down.

To investigate whether the eligibility age plays any role in Thailand, in Figure 5.5 we plot the exit rates of leaving the formal sector (hazard rate). Here we can see a small peak at

¹⁷ A recent labor law, effective in 2017, allows workers in companies whose contract did not specify the mandatory retirement to receive additional compensation once workers reach the age of 60 and wish to retire.

the ages of 55 (the eligibility age) and 60 with all four birth cohorts. While exiting at age 55 is likely induced by the Social Security provisions, SS does not create an incentive for workers to retire at age 60. Rather, retirement at 60 is specified in company contracts, as mentioned above. We also observe that those who retired at 55 on average had lower wages than those retiring at 60 (5,649 Baht versus 9,180 Baht). This pattern is now consistent with Figure 5.1 in that employees in high-paid jobs still retire later, but other institutional factors force them to retire at 60.

All above pictures suggest that Thai workers retire sooner than in many other countries. Among the OECD countries studied by Gruber and Wise (1999), the eligibility age is normally set at 60-65 years old with the lowest at age being 57. Our eligibility age is even lower than that. The fact that the estimated national healthy life expectancy is 67 years old and the formal sector is expanding suggests that we have a higher share of *unused labor force capacity* after 60 over time. The forgone *unused labor force capacity* is also likely to be a relatively productive period as a high proportion of high-skill jobs are extant in the formal sector.

VI. Workers and Firms

This section looks at the efficiency of the Thai formal labor market from a larger perspective. Specifically, we focus on the role of firm size and labor market concentration. Large firms are often argued to operate more efficiently and benefit from their size advantages (see e.g., Sexton, 2015). First, large scale operations enable workers to become more specialized, allowing them to thus be more productive. Second, large firms can invest more in mass production technology and equipment to drive higher efficiency. Third, they may be able to purchase inputs at lower costs. In the case of chain stores, large retailers can also share operating and advertising costs among multiple units and have the freedom to experiment in one selling unit without undue risk to the whole operation (Jia, 2008). On the other hand, when only one or a few firms dominate the labor market, they are able to exploit their market power to reduce wages.

Several empirical studies have examined the effects of firm size on labor market outcomes. For employment, while SMEs are conventionally considered to create more jobs, some argue that those jobs are not sustainable because many SMEs are less likely to survive (see e.g., Bigg 2002). Regarding wages, larger firms are often found to pay observationally equivalent workers higher wages (see, e.g., Brown and Medoff, 1989; Abowd et al., 2019).

However, in areas with employment concentration wherein few firms dominate, workers do get paid less (Benmelech et al, 2018).

Is the Thai labor market concentrated in terms of employment?

The top panel of Figure 6.1 provides the shares of firms registered in the SSO by firm size over time. Almost 50% of firms in Thailand comprise micro businesses with fewer than five employees. By using 200 employees as a SME definition, 98% of firms in the formal sector are considered SMEs.¹⁸ Although the total number of firms increased from 237,817 to 385,879 over the period of 16 years, the shares of firms of different sizes remained quite stable. The bottom panel provides the shares of employees by firm size. The picture reveals that more than half of the jobs come from large firms.¹⁹ The extra-large firms with more than 1,000 employees have grown much larger over time. These firms, while accounting for only .3% of all employers, hired 27% of employees in 2002, but this jumped to 35% in 2018.

If we look at the total number of firms by size, small firms, especially those with 1-2 employees have increased more proportionally. Nonetheless, their employment shares remain stable because the survival rates of these small firms are relatively low. Figure 6.2 shows the survival rates of new firms registered in 2002 by firm size. Firms with less than five employees had only 50% survival rates after five years, while the 5-year survival rates of firms with at least 50 employees stood at 75%. This implies that in the formal sector small firms might have created more jobs in the short-run, but large firms create more net jobs in the long-run.

Figure 6.3 plots the median growth rates of surviving firms by firm size and further separates the extra-large firms into four sizes (1000-2000, 2001-5000, 5001-10000 and 10001 or more employees). The resulting picture further reveals that since 2007 only firms with at least 5,000 employees have tended to grow. The surviving small and medium firms tended to reduce in size over time. While competing explanations include the relative lower prices of machines and the higher cost of hiring and firing employees due to labor protection laws and macroeconomic factors, finding the exact reason is beyond the scope of this paper.

¹⁸ The Small and Medium Enterprises Promotion Act B.E. 2543 defines SMEs using the number of employees or the value of the total fixed assets that does not include land and considers the one that is lower. The number of employee cut-off for medium enterprises is 200 for the service and manufacturing sectors, but 50 and 30 in the wholesale and retail trade sectors, respectively. Therefore, the use of a 200-employee cutoff could overestimate the number of SMEs in the two trade sectors.

¹⁹ These shares are only from employment in the formal sector. If we include SMEs from the informal sector, the fraction of employment from SMEs is still higher.

Nevertheless, we can investigate whether the employment growth of the extra-large firms comes at the expense of small and medium enterprises.

We follow individual employees over the 5-year period to calculate the likelihood of a worker from a small or medium firm moving to a large firm, and vice versa. Table 6.1 shows that over the 5-year period, more than one-third of workers tended to stay at the same firms regardless of their company size (around 35% during 2003-2007, increasing to 41% over 2011-2015). In cases involving workers exiting firms, the majority of workers left the formal sector entirely (out-of-SSO). This table also suggests that a non-trivial fraction of workers have a permanent taste for firm size.

Given that the extra-large firms did not attract many workers from small and medium operations, we looked at the composition of their employees in 2015 and found that new recruits (not in SSO in 2011) accounted for 38% of the total employees in the extra-large firms in 2015. Additionally, we see that while in 2003-2007 most of all new workers joining the SSO went to work for small and medium firms, the percentages of new recruits joining small and medium firms steadily declined over time (Table 6.2). On the other hand, the percentages of new recruits joining extra-large firms consistently increased. During 2011-2015, extra-large firms represented the main job creators for new employees.

Do firm sizes influence individuals' labor market outcomes? We have shown that small firms are less likely to survive, even controlling for the age of the organization. This implies that small-firm workers face more uncertainty in terms of employment. Do large Thai firms pay more or less? Figure 6.4 gives a mixed result. Among the *Stayers* of the same age, those working in a large firm earn more. However, for *Movers*, who presumably possess lower skill levels than *Stayers*, their wages do not correlate with firm size.

VII. Conclusions and discussion

While *a country's competitiveness* is determined by several factors, human capital is at its heart. All countries around the world strive to be *competitive* so that they have *a bigger economic pie* to share among their *people*. Thailand has heavily invested in education, hoping that it will both raise the well-being its people and the country's productivity, leading to sustainable economic growth.

This paper asks: "*Have we reached our potential?*" in the sense of to what extent has Thailand utilized its available talent and labor force capacity. Reaching its human capital potential is an intermediate step on the path to long-term prosperity. Over the past three decades, the country has scored well in education and health dimensions. The main question

remains to what magnitude have these improvements translated to better employment prospects, improved jobs and enhanced workforce capacity? We document the intertwining relationships of education, employment, earnings, work patterns, firm sizes, institutions and retirement outcomes and our findings suggest that we still have room to grow.

First, Thai people have invested more time in school, yet the number of high-skill, high-paid jobs has not grown commensurately. In the past, most college graduates held high-skill jobs; and middle-skill jobs largely belonged to secondary or vocationally educated workers. Recently, average workers have moved down the occupation-skill ladder. Presently, an increased proportion of college graduates hold middle-skill jobs and ever more secondary graduates are engaged in low-skill jobs.

Second, while the economic pie is still growing, albeit slowly, a considerable portion of our workforce have not yet reaped the expected benefits. Both LFS and SSO data provide consistent evidence that approximately two-thirds of our workers have been left behind. Those entering the market with the prerequisite skills not only earn more when young, but also have a higher wage growth rate over the course of their working life. The age-earning profiles of low-skill workers are rather flat. This suggests that over a lifetime, accumulated earnings, savings and consumption are even more diverged.

Third, the increasing importance of the formal sector and its institutional factors have likely created the *unused labor force capacity*. College workers, presumably the most productive group, spend the shortest time in the labor market. Social norms, mandatory retirement and Social Security provisions have induced the majority to retire between 55 and 60. In contrast, non-college workers who are self-employed in the agricultural and retail trades represent the employees who continuing to work into old age. The fact that Thailand is an aging society and the formal sector is expanding suggests that if no action is taken, our labor force capacity will unavoidably decline further.

Finally, the flexibility of the Thai labor market can be capitalized further. The Thai labor market offers great flexibility for workers to move in and out of the formal sector easily. The high-skill workers who switch jobs can command an improved wage, reflecting a better match between firms and workers (and hence productivity improvement). However, the mobility declines after workers reach the age of 30. In addition, we find that employment is increasingly more concentrated among extra-large firms, and that such larger firms pay higher wages relative to smaller organizations, but only for high-skill workers.

The Thai government has initiated various programs to address some of these concerns. To ensure that the time invested in school is directed towards needed skills, the

Dual Vocational Training program, launched by the Ministry of Education, enables vocational students to get on-the-job training with prospective employers while completing their degrees. To encourage skills development for professionals, the Ministry of Labor enacted the Skill Development Promotion Act 2002, requiring firms with more than 100 workers to provide skills training for their employees, where the training cost is 100% tax deductible. To incentivize businesses to employ aging workers, the Revenue Department since 2017 has allowed companies a 200% tax deduction of the hiring expense for workers aged 60 or over whose salary does not exceed 15,000 baht.

However, these governmental programs alone seem insufficient. What else can we do then to unlock the full potential of our human capital? One lesson learned is that a one-sided policy such as the education promotion cannot be successful by itself. While increasing the quantity of education in terms of years is important, the quality of education is actually key. Having more years of schooling does not necessarily lead to a higher-skill workforce. Moreover, even for those with higher skills, such abilities may not be used if the appropriate jobs for those skills have yet to be created. However, initiating more demand for high-skill jobs may not come easily since Thailand's growing sectors -- services, trade and finance -- do not offer a high share of high-skill jobs.

The government may consider using economic incentives to make educators accountable for the quality of the workforce they produce, including ensuring skills match demand. Can we allow our education supply for majors to adjust flexibly based on the skills demanded? For example, during the four college years, students should be fully informed about market demand for particular professions and have the chance to train and attain the prerequisite skills. Currently, students have their fixed curriculum after their freshman year determined by their chosen majors. Additionally, the government could allocate fiscal support to different departments based on how much of their graduates achieve a position that matches their majors. This strategy will effectively reduce the number of available seats of low-demand departments in the long run.

In terms of labor force capacity, enabling and incentivizing productive older workers to remain in the labor market should constitute a win-win situation. Given the low income-replacement rate of pensions, continuing to work should be better option for the workers involved. If older employees are still productive, firms can save costs of hiring and training new staff. For the government, having workers employed longer will help reduce the fiscal stress of the pay-as-you-go social insurance system. As people are living longer, the

government needs to prepare to pay more for pensions, healthcare and other old-age assistance programs, which raises concerns about protracted fiscal sustainability.

However, some older workers may not want to work and are opposed to Social Security reforms that shift the eligibility age upwards. In this case, an economic incentive may be used to increase the benefits for those delaying their retirement. Another approach is to slowly adjust the eligibility age to 55 years and two months, 55 years and four months and so on every one or two years. Firms themselves, being afraid to overpay workers declining in productivity and facing high firing costs, may hesitate to remove their set retirement age. For the market to function, firms should be allowed to select who to continue to hire after a certain age threshold. For older workers who are healthy, but with skills now outdated, the government or private sector should then step in to support them with retraining.

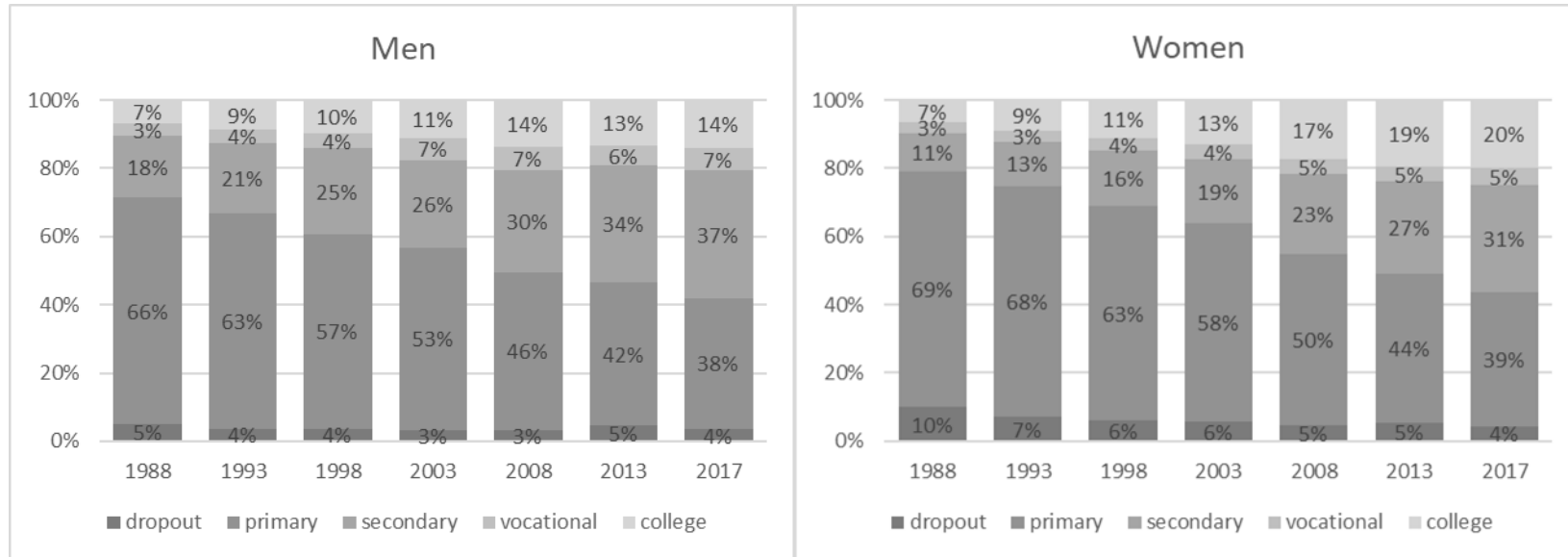
Based on our findings, it seems that we have not (yet) reached our potential. How to fully utilize our resources, especially our human capital, remains a key unresolved question. It should not only be the task of the government, but the responsibility of all parties ranging from parents, educators, businesses and regulators to the workers themselves. Parents and society as a whole should place more emphasis on ensuring our children learn and acquire the necessary skills to match the demand of the labor market, rather than merely earning a diploma. Businesses should focus on innovation to remain competitive, while also creating high-skill jobs for higher educated workers. Playing the role of an enabler, the government needs to create a fertile ecosystem for advancement by providing incentives for innovations, both for firms and individual workers, through transparent rewards, innovation promotion policies, tax schemes and patent laws.

References

- Abowd, J., Abramowitz, J., Levenstein, M. C., McCue, K., Patki, D., Raghunathan, T., ... & Wasi, N. (2019). Optimal Probabilistic Record Linkage: Best Practice for Linking Employers in Survey and Administrative Data. *US Census Bureau, Center for Economic Studies*.
- Autor, D. (2019). Work of the past, work of the future. Working Paper 25588. *National Bureau of Economic Research*.
- Benmelech, E., Bergman, N., & Kim, H. (2018). Strong employers and weak employees: How does employer concentration affect wages? Working Paper 24307, *National Bureau of Economic Research*.
- Biggs, T. (2002). Is small beautiful and worthy of subsidy? Literature review. *International Finance Corporation (IFC)*. Washington, DC.
- Blundell, R., French, E., & Tetlow, G. (2016). Retirement incentives and labor supply. In *Handbook of the economics of population aging, 1*, 457-566. North-Holland.
- Brown, C., & Medoff, J. L. (1989). The Employer Size-Wage Effect. *Journal of Political Economy*, 97, 1027–1059.
- Card, D. (1999). The causal effect of education on earnings. In *Handbook of labor economics*, 3, 1801-1863. Elsevier.
- David, H., Katz, L. F., & Kearney, M. S. (2006). The polarization of the US labor market. *American economic review*, 96(2), 189-194.
- Gruber, J., & Wise, D. A. (1999). Introduction to " Social Security and Retirement around the World". In *Social Security and Retirement around the World*, 1-35. University of Chicago Press.
- Hawley, Joshua D. (2004). Changing returns to education in times of prosperity and crisis, Thailand 1985-1998. *Economics of Education Review*, 23(3), 273-286. Elsevier.
- Heckman, J., Lochner, L., & Taber, C. (1998). General-Equilibrium Treatment Effects: A study of Tuition Policy. *American Economic Review*, 88(2), 381-386.
- International Standard Classification of Occupations (ISCO). (1988). ISCO-88. Retrieved from: <https://www.ilo.org/>.
- International Standard Classification of Occupations (ISCO). (2008). ISCO-08. Retrieved from: <https://www.ilo.org/>.
- Jia, P. (2008). What happens when Wal-Mart comes to town: An empirical analysis of the discount retailing industry. *Econometrica*, 76(6), 1263-1316.
- Keane, M. P., & Wasi, N. (2016). Labour supply: the roles of human capital and the extensive margin. *The Economic Journal*, 126(592), 578-617.
- Kilenthong, W. T. (2017). The situation of Education in Thailand 2015/2016: the need of competition and decentralization in the Thai educational system.
- Lathapipat, D. (2008). The changing educational distribution and its impact on the evolution of wages in Thailand, 1987-2006. Available at SSRN 1484649.
- Lekfuangfu, N. W., Nakavachara, V., & Sawaengsuksant, P. (2016). Labour Market Insights: the Power of Internet-Based Data. The Bank of Thailand symposium paper.

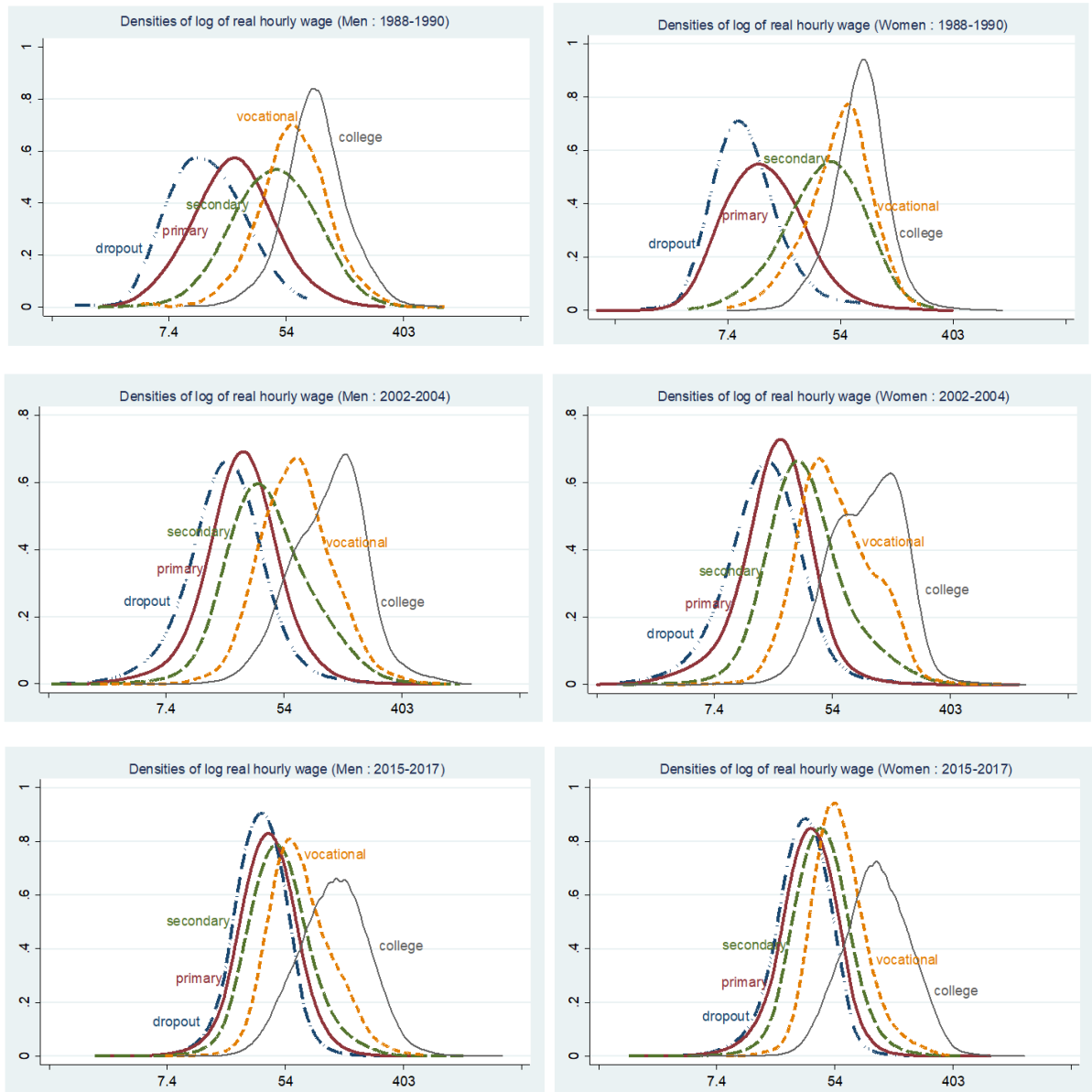
- Liao, L., & Paweenawat, S. W. (2019). "Gold Miss" or "Earthy Mom"? Evidence from Thailand. *PIER Discussion Papers* 110, Puey Ungphakorn Institute for Economic Research, revised Jul 2019.
- Lumsdaine, R. L., & Mitchell, O. S. (1999). New developments in the economic analysis of retirement. *Handbook of labor economics*, 3, 3261-3307.
- Paweenawat, S. W., & Vechbanyongratana, J. (2015). Wage Consequences of Rapid Tertiary Education Expansion in a Developing Economy: The Case of Thailand. *The Developing Economies*, Institute of Developing Economies, 53(3), 218-231.
- Sagarik, D. (2014). Educational Expenditures in Thailand: development, trends, and distribution. *Citizenship, Social and Economics Education*, 13(1), 53-66.
- Sala-i-Martin, X., Blanke, J., Hanouz, M. D., Geiger, T., Mia, I., & Paua, F. (2007). The Global Competitiveness Index: Measuring the Productive Potential of Nations. The Global Competitiveness Report 2007-2008. The World Economic Forum.
- United Nations, Department of Economic and Social Affairs, Population Division. (2017). World Population Prospects: The 2017 Revision. Retrieved 24 April 2018.
- Venti, S., & Wise, D. A. (2015). The long reach of education: early retirement. *The Journal of the Economics of Ageing*, 6, 133-148.
- Wasi, N., Chandrasakha, J., & Sessomboon, P. (2018). No one want to be unemployed? : some evidence from the Thai Social Security data. aBRIDGED article, *Puey Ungphakorn Institute for Economic Research, 2018 (in Thai)*.
- World Bank. (2018). Enhancing Efficiency and Value for Money of Public Expenditures in the Education Sector. (Thailand Education RAS). Washington, DC. World Bank.
- World Economic Forum. (2018). Insight Report: The Global Competitiveness Report 2018. *The World Economic Forum*.

Figure 3.1: Education of Thai Men and Women Age 25-54



Source: Authors' calculation from LFS

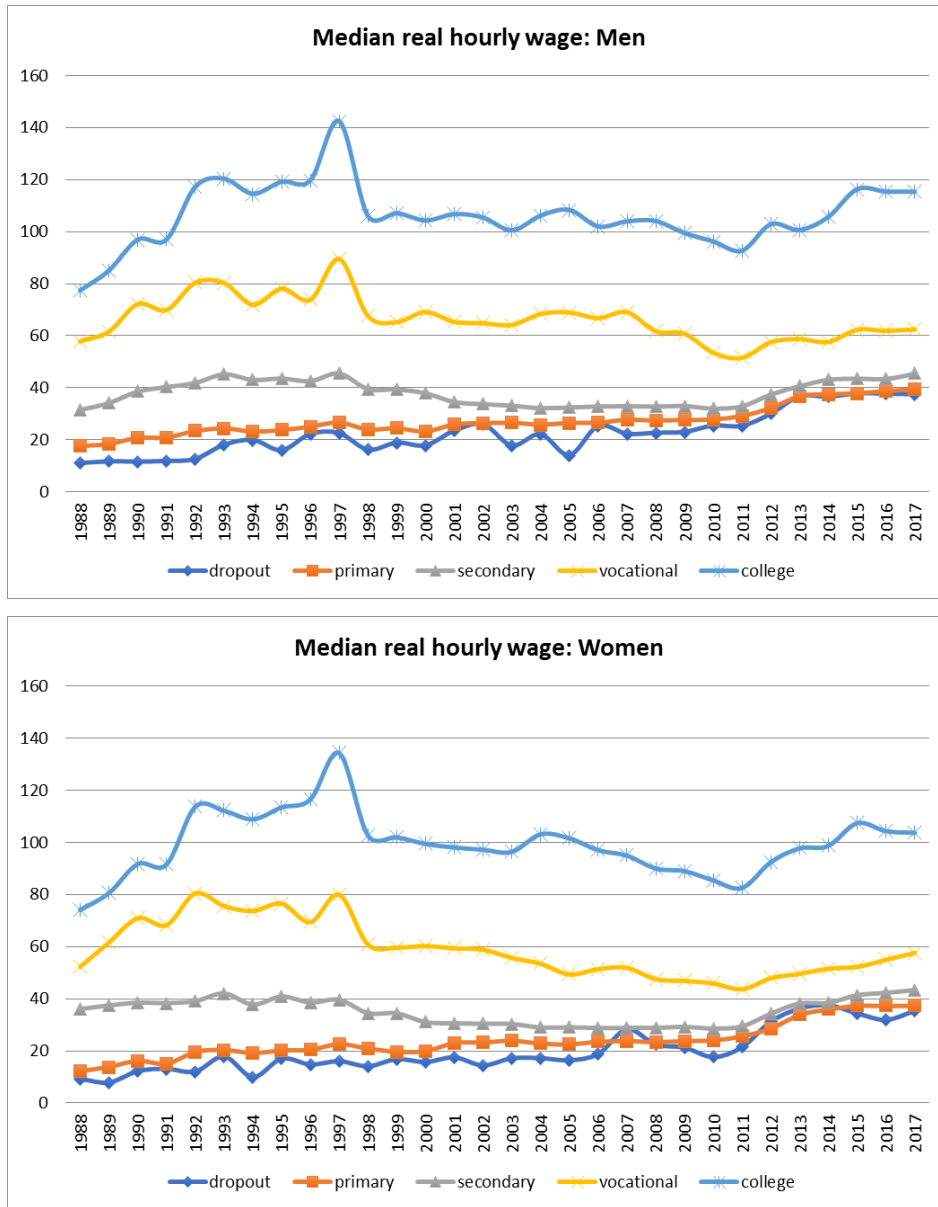
Figure 3.2: Densities of Log Real Hourly Wages by Education



Note: The real wages are adjusted by the headline CPI (base = 2015).

Source: Authors' calculation from LFS

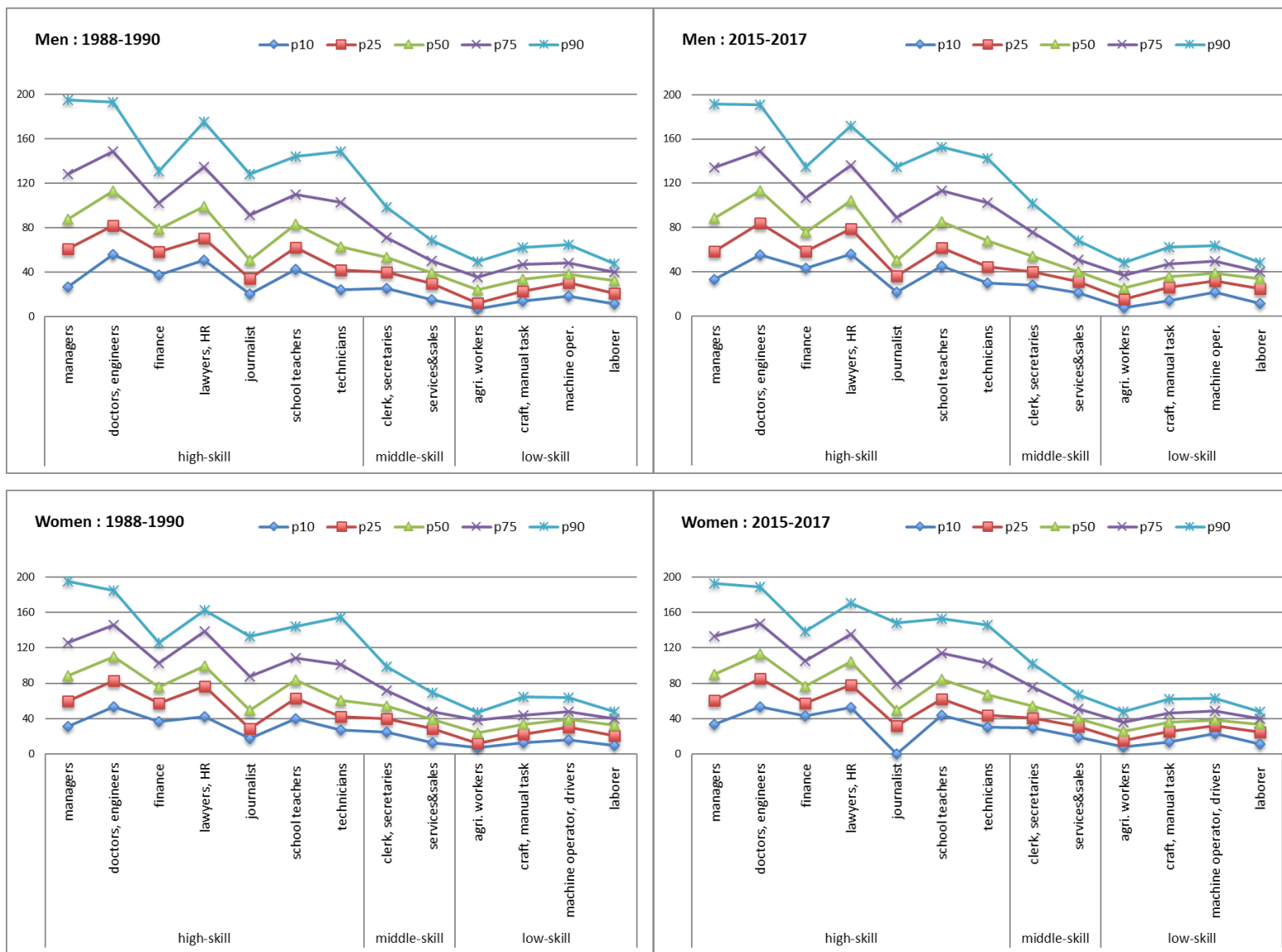
Figure 3.3: Median Real Hourly Wages by Education



Note: The real wages are adjusted by the headline CPI (base = 2015). The sample includes only those with 10-20 years of experience.

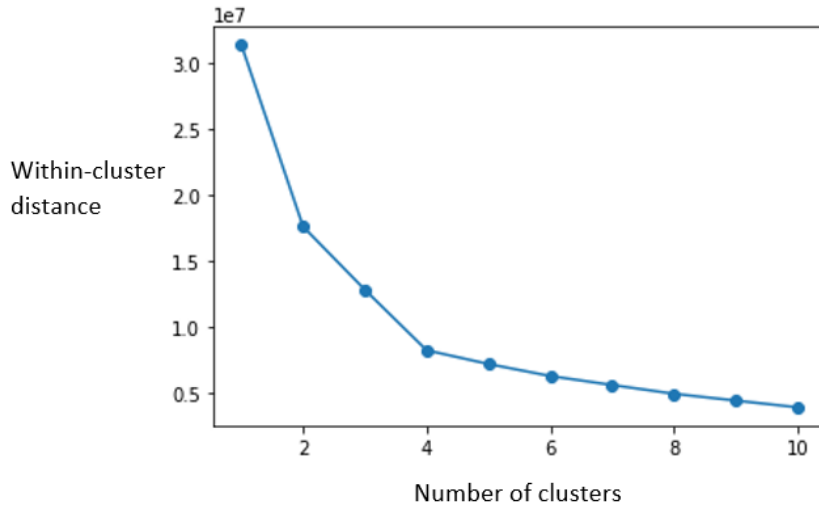
Source: Authors' calculation from LFS

Figure 3.4: Median Real Hourly Wages by Occupation (Unit: Baht, Base in 2015)



Source: Authors' calculation from LFS

Figure 4.1: The Total Within-Cluster Distance of the Resulting Clusters for Different Number of Clusters



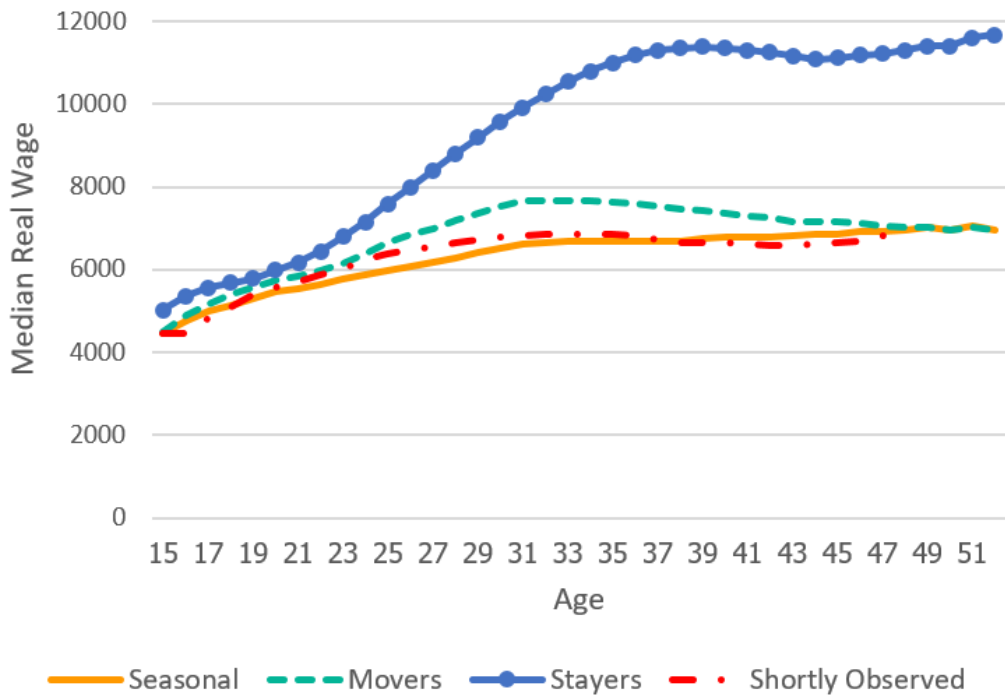
Source: Authors' calculation from SSO data

Figure 4.2: Examples of Employment Patterns for Different Types of Workers in SSO

	2002	2003	2004	2005	2006	2007	2008	2009	
<i>Stayers</i>	Job A	Job A	Job A	Job A	Job A	Job A	Job A	Job A	
	Job A	Job A	Job A	Job A	Job A	Job B	Job B	Job B	
<i>Movers</i>	Job A	Job A			Job B	Job B	Job B	Job B	
	Job A	Job A		Job B	Job C	Job C	Job D	Job D	
<i>Seasonal</i>	Job A		Job A		Job A		Job B	Job C	Job C
<i>Shortly Observed</i>	Job A	Job A							

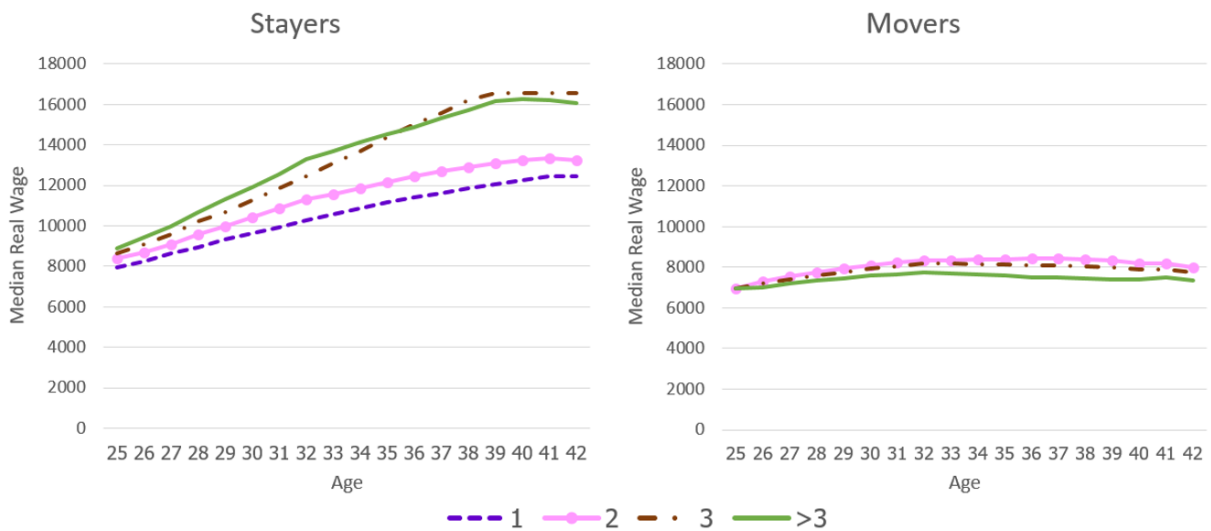
Source: Authors' calculation from SSO data

Figure 4.3: Median Real Wages for Different Types of Workers at Various Ages



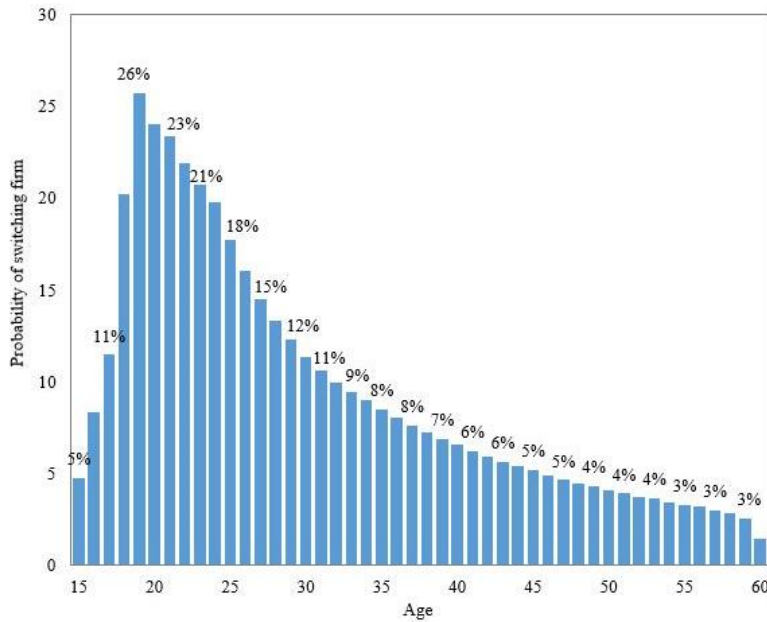
Source: Authors' calculation from SSO data

Figure 4.4: Median Real Wages of Stayers and Movers that Have 1, 2, 3, or More Jobs



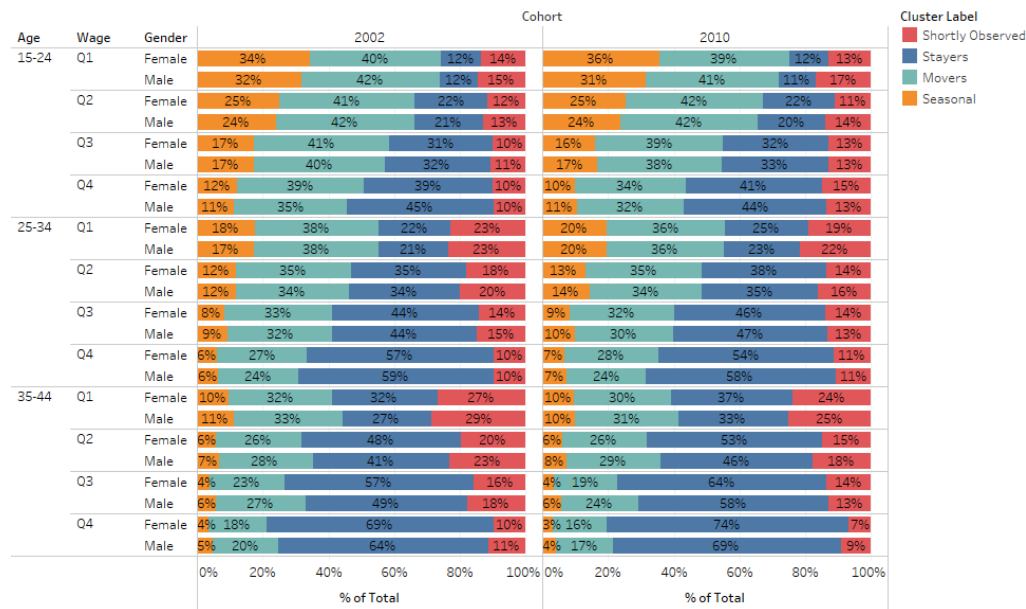
Source: Authors' calculation from SSO data

Figure 4.5: The Probability of Switching Firms at Different Ages for Stayers and Movers



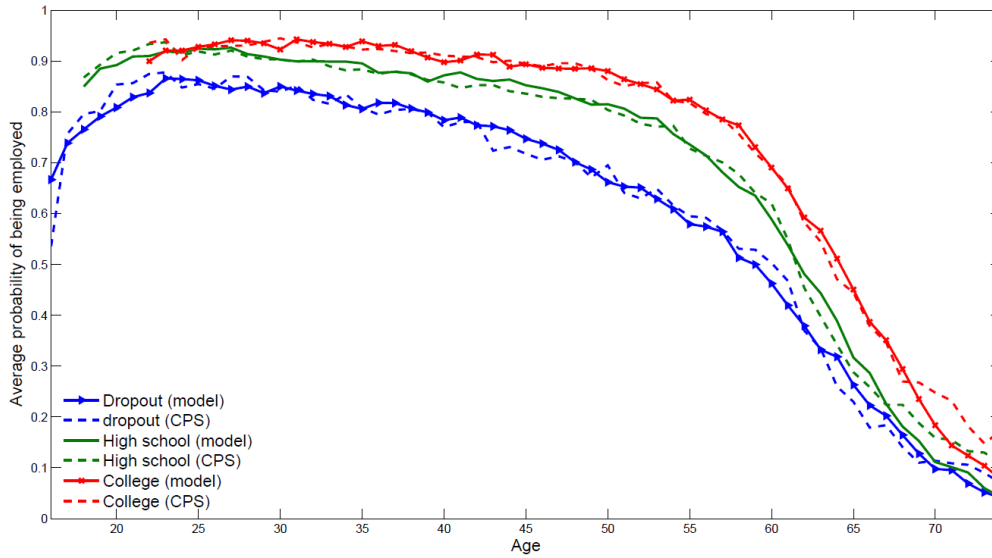
Source: Authors' calculation from SSO data

Figure 4.6: The Percentage of Different Types of Workers (*Shortly Observed, Stayers, Movers, and Seasonal*) Separated by Age, Wage Quartile, and Gender for Two Different Cohorts (2002 and 2010)



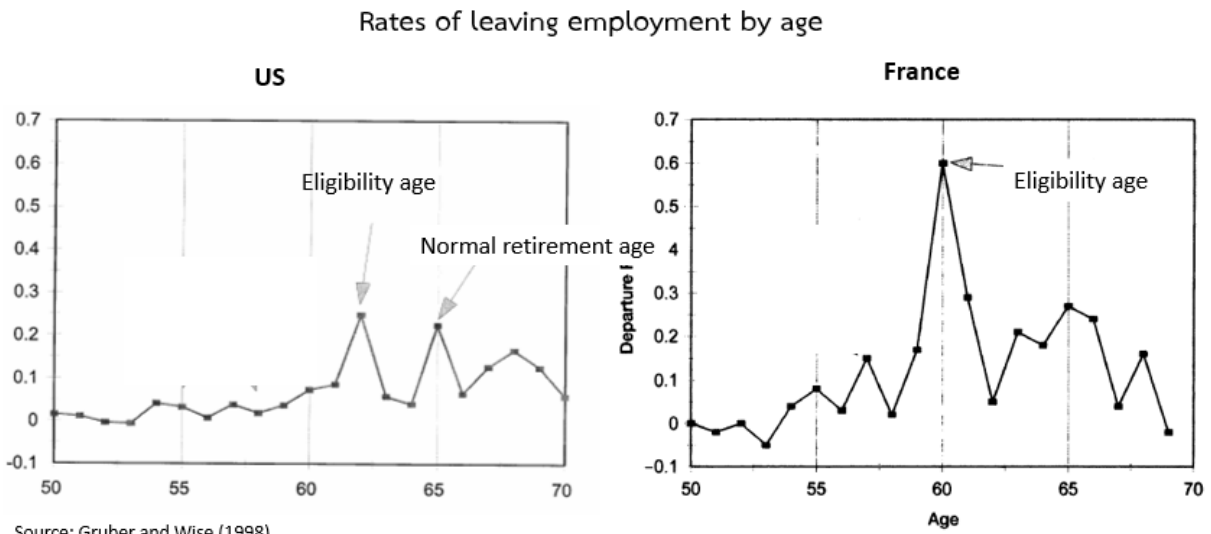
Source: Authors' calculation from SSO data

Figure 5.1: Labor Force Participation of US Men



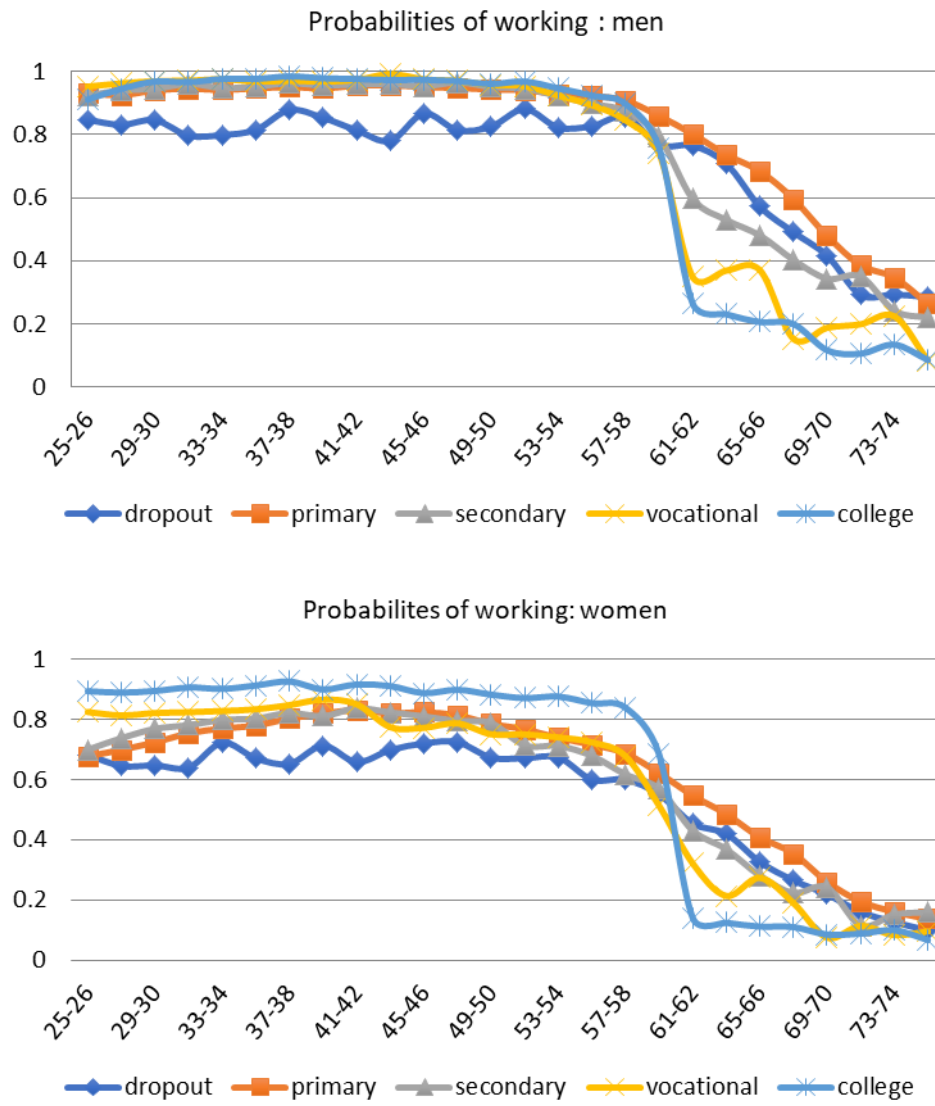
Source : Keane and Wasi (2016)

Figure 5.2: Rates of Leaving Employment for the US and France



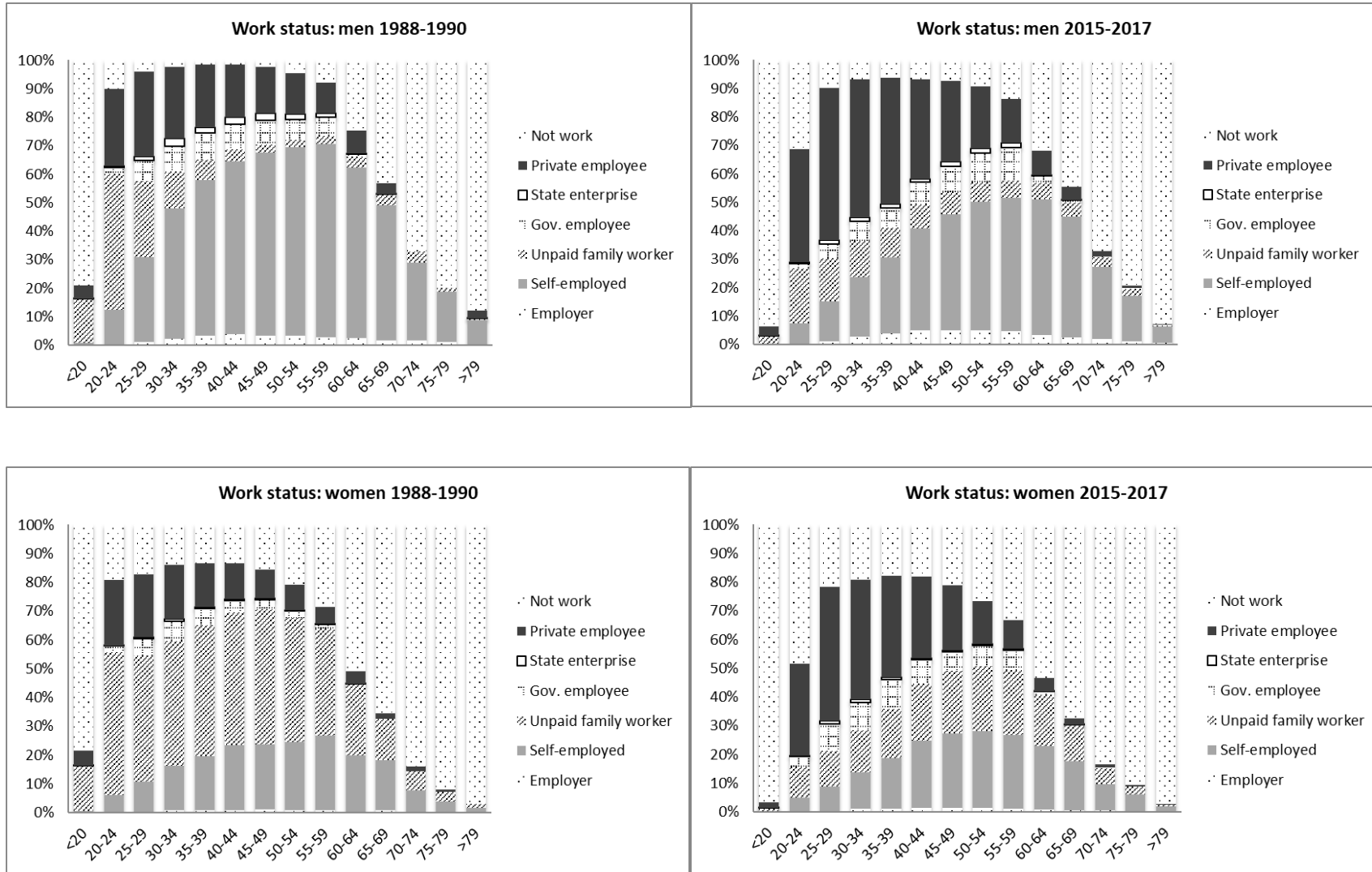
Source: Gruber and Wise (1998)

Figure 5.3: Probability of Working by Age for Thai Men and Women



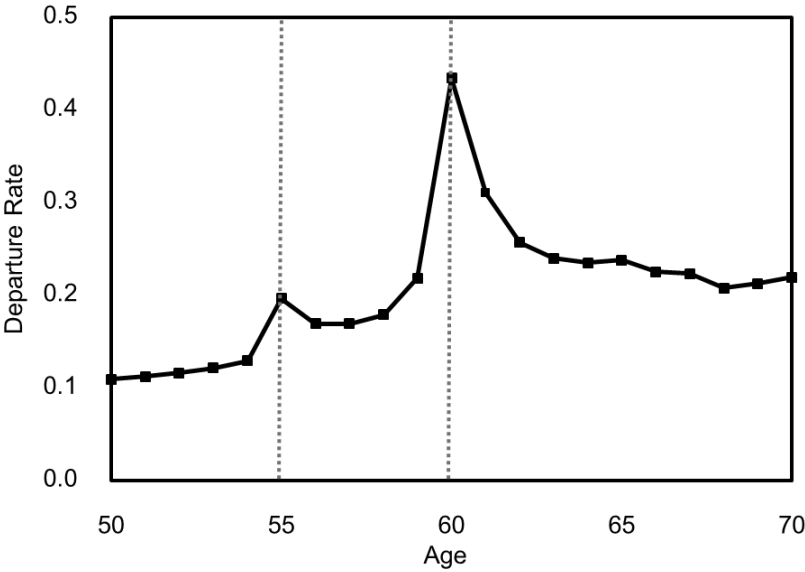
Source: Authors' calculation from LFS

Figure 5.4: Life-Cycle Work Status of Men and Women



Source: Authors' calculation from LFS

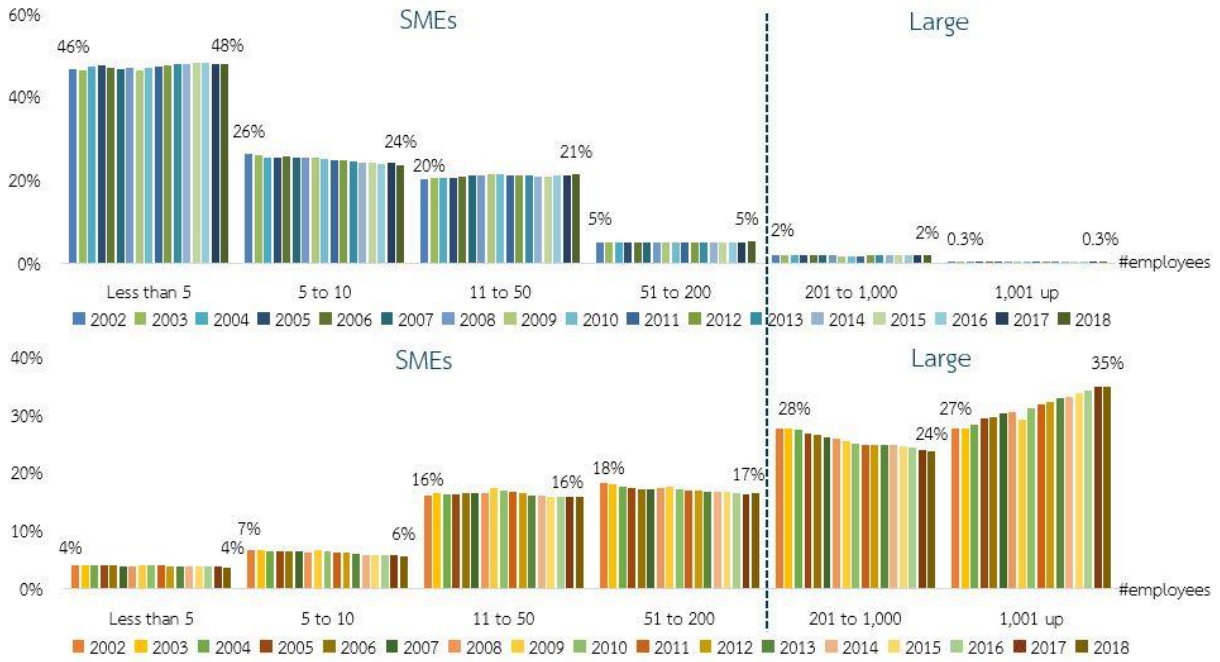
Figure 5.5: Exit Rates from the Formal Sector Employment by Age



Source: Authors' calculation from SSO data

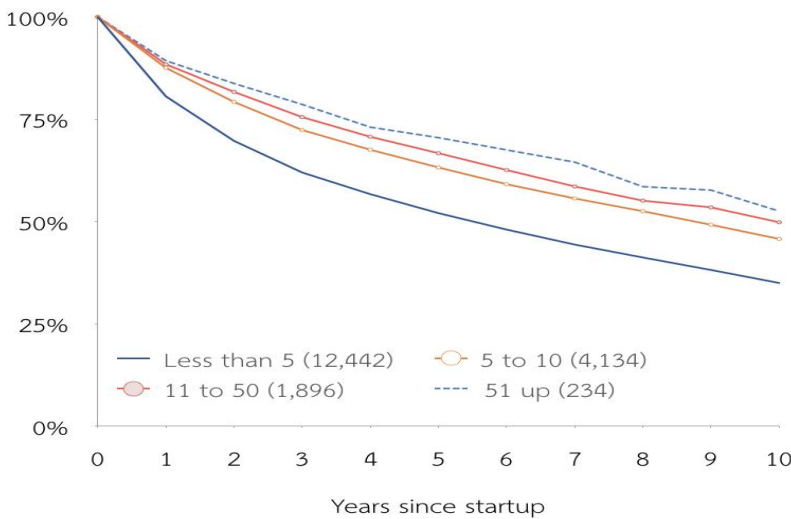
Note: The exit rates at a given age are calculated as the ratio of people that are last seen employed in Social Security at that age divided by the total number of people at that age.

Figure 6.1: Shares of Firms by Firm Size (top) and Shares of Number of Employees by Firm Size (bottom) in 2002-2018



Source: Authors' calculation from SSO data

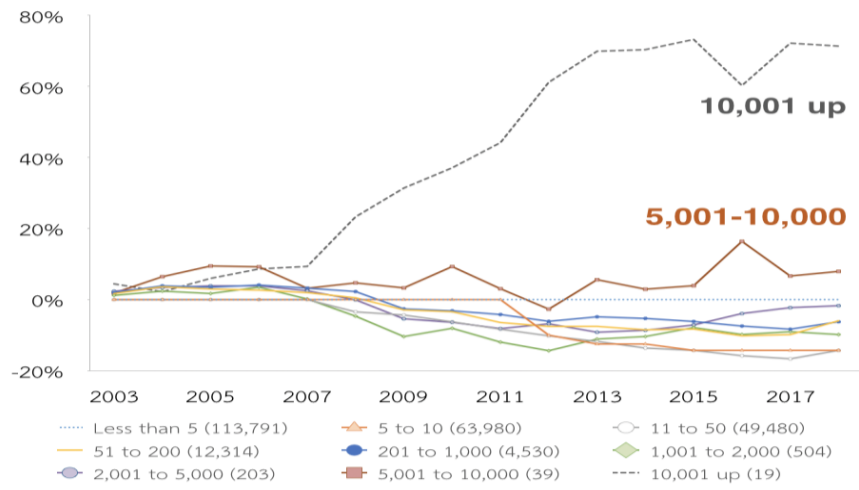
Figure 6.2: The Survival Rates of Firms by Years since Establishment



* The values in parentheses are sample size for each group

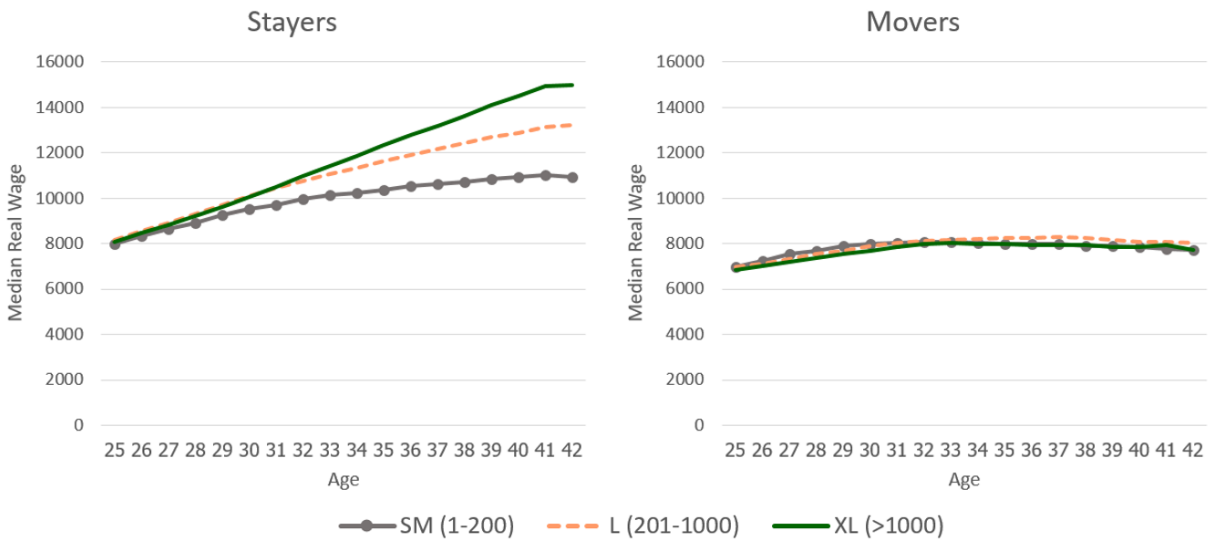
Source: Authors' calculation from SSO data

Figure 6.3: Median Employment Growth of Firms of Different Sizes from 2003 to 2017 Compared with Their Number of Employees in 2002



Source: Authors' calculation from SSO data

Figure 6.4: Median Real Wages of Stayers and Movers at Different Ages



Source: Authors' calculation from SSO data

Table 3.1: Occupation Classification

Occupation	Job examples	Likely skills and education required
High skill		
1	Managers, legislators, senior officials Professionals	managers, school principals
2	Sciences, doctors, engineers, college professors	physicians, engineers, architects, biologists
3	Business/finance related professionals	business analysts, economists,
4	Lawyers and other social science professionals	lawyers, HR-related professionals
5	Artists and journalists	movie directors, journalists, composers
6	School teachers and associates	
7	Technicians & associate professionals	medical technicians, health-safety inspectors, associated nurses
Middle skill		
8	Clerical support workers	clerks, secretaries, accountants
9	Service and sales workers	shop sale assistance, hairdressers
Low skill		
10	Agricultural, forestry, and fishery workers	farmers, fishermen
11	Craft and related trade workers	plant sewing workers, craft workers
12	Plant and machine operators, assemblers, drivers	A/C repairers, bus drivers
13	Laborers in non-agricultural sector	cleaners, gardeners, construction workers

Source: Authors' classification based on task similarities and compatibility of classifications across years

Table 3.2: Occupational Shares among Workers

Occupation	1988-1990 (%)	2015-2017 (%)	Change in share (percentage point)
High-skill occupations	8.3	14.4	6.1
Managers, legislators, senior officials	2.8	3.9	1.1
Sciences, doctors, engineers, college professors	0.6	1.7	1.1
Business/finance related professionals	0.5	1.6	1.1
Lawyers and other social science professionals	0.3	1.0	0.6
Artists and journalists	0.2	0.3	0.1
School teachers and associates	2.7	2.5	-0.2
Technician & associate professionals	1.2	3.4	2.2
Middle-skill occupations	12.9	22.5	9.6
Clerical support workers	4.1	4.9	0.8
Service and sales workers	8.8	17.6	8.7
Low-skill occupations	78.8	63.1	-15.6
Agricultural, forestry, and fishery workers	60.1	28.9	-31.2
Craft and related trade workers	9.7	14.2	4.5
Plant and machine operators, assemblers, drivers	3.8	11.3	7.5
Laborers in non-agricultural sector	5.2	8.8	3.6

Source: Authors' calculation from LFS. The sample consists of workers who were 25-54 years old.

Table 3.3: Occupational Shares among Male Workers by Education

Occupation	1988-1990					2015-2017				
	dropout	primary	secondary	vocational	college	dropout	primary	secondary	vocational	college
High-skill	3%	3%	22%	40%	80%	1%	2%	6%	15%	52%
Managers, legislators, senior officials	2.1%	2.7%	7.5%	13.0%	26.2%	0.5%	1.9%	3.9%	5.1%	13.0%
Sciences, doctors, engineers, college professors			0.1%	0.9%	9.2%			0.2%	1.0%	8.0%
Business/finance related professionals			0.2%	1.6%	6.7%			0.1%	0.4%	1.5%
Lawyers and other social science professionals			0.2%	0.7%	6.7%			0.1%	0.3%	4.9%
Artists and journalists		0.2%	0.9%	1.3%	0.8%	0.1%	0.1%	0.4%	0.3%	0.7%
School teachers and associates	0.1%	0.04%	1.7%	17.0%	25.8%	0.02%	0.01%	0.1%	0.2%	10.1%
Technician & associate professionals	0.3%	0.4%	11.5%	5.9%	4.4%	0.2%	0.3%	1.9%	7.7%	13.3%
Middle-skill	11%	11%	35%	31%	13%	7%	10%	21%	26%	27%
Clerical support workers	0.4%	1.1%	15.0%	19.4%	4.8%	0.1%	0.2%	2.2%	5.6%	6.6%
Service and sales workers	10.6%	10.2%	19.8%	11.7%	7.9%	6.7%	9.4%	18.8%	20.9%	20.0%
Low-skill	78.3%	82.9%	38.5%	25.4%	4.2%	75.9%	82.4%	67.5%	55.0%	18.1%
Agricultural, forestry, and fishery workers	57.6%	53.8%	10.5%	5.0%	1.1%	40.1%	50.0%	28.4%	14.3%	6.7%
Craft and related trade workers	8.6%	13.3%	15.3%	16.4%	1.8%	12.4%	14.9%	16.8%	24.0%	6.3%
Plant and machine operators, assemblers, drivers	3.7%	9.0%	8.5%	2.9%	0.5%	8.6%	9.3%	15.7%	14.1%	4.2%
Laborers in non-agricultural sector	8.6%	6.9%	4.2%	1.0%	0.7%	14.8%	8.2%	6.5%	2.6%	0.9%
Not work	8.1%	2.4%	4.5%	3.1%	3.3%	16.6%	5.5%	5.1%	3.5%	3.7%

Source: Authors' calculation from LFS for men who were 25-54 years old.

Table 3.4: Occupational Shares among Female Workers by Education

Women	1988-1990					2015-2017				
	dropout	primary	secondary	vocational	college	dropout	primary	secondary	vocational	college
High skill	1%	1%	14%	40%	78%	0%	1%	4%	15%	52%
Managers, legislators, senior officials	0.4%	0.7%	2.3%	3.8%	11.0%	0.1%	0.5%	1.5%	2.6%	6.3%
Sciences, doctors, engineers, college professors	0.0%	0.0%	1.9%	5.5%	9.9%		0.0%	0.1%	0.5%	8.5%
Business/finance related professionals		0.0%	0.2%	0.5%	8.5%		0.0%	0.6%	5.9%	7.6%
Lawyers and other social science professionals		0.0%	0.2%	0.4%	4.3%	0.0%	0.0%	0.1%	0.7%	4.1%
Artists and journalists	0.1%	0.1%	0.3%	0.1%	0.3%	0.0%	0.1%	0.1%	0.1%	0.4%
School teachers and associates	0.0%	0.1%	4.5%	27.3%	42.1%	0.0%	0.0%	0.3%	0.9%	17.9%
Technician & associate professionals	0.1%	0.2%	4.3%	2.7%	1.9%	0.1%	0.3%	1.4%	4.4%	7.4%
Middle skill	14.6%	18.0%	45.9%	39.4%	14.1%	11.9%	18.3%	33.0%	46.0%	31.6%
Clerical support workers	0.3%	0.7%	23.1%	27.6%	7.6%	0.1%	0.4%	3.9%	16.3%	14.5%
Service and sales workers	14.3%	17.3%	22.8%	11.8%	6.5%	11.7%	17.9%	29.1%	29.7%	17.2%
Low skill	59.5%	62.2%	16.1%	5.8%	1.8%	56.1%	59.8%	41.0%	20.2%	5.8%
Agricultural, forestry, and fishery workers	45.7%	45.7%	5.0%	2.8%	0.4%	34.6%	41.2%	19.6%	7.8%	2.7%
Craft and related trade workers	5.5%	8.7%	6.8%	1.7%	0.6%	5.0%	5.9%	6.1%	4.2%	1.6%
Plant and machine operators, assemblers, drivers	0.7%	1.0%	0.9%	0.5%	0.1%	4.0%	3.5%	7.7%	4.5%	0.8%
Laborers in non-agricultural sector	7.7%	6.8%	3.4%	0.7%	0.7%	12.5%	9.2%	7.6%	3.7%	0.7%
Not work	25.2%	18.7%	24.3%	14.5%	6.0%	31.7%	21.0%	21.7%	18.7%	10.4%

Source: Authors' calculation from LFS for women who were 25-54 years old.

Table 3.5: Industry Shares

Industry	Employment shares in all sectors ^a					Employer shares in the formal sector ^b			
	Employment shares (%)			change in share (percentage point)		Employer shares (%)		change in share (percentage point)	change in no. of firms
	1990	2000	2015	2015-1990	2015-2000	2000	2015	2015-2000	2015-2000
Agricultural, fishery & mining	60%	47%	29%	-31	-18				
Non-agricultural sector	40%	53%	71%						
Shares among non-agricultural sector									
Manufacturing	24%	26%	26%	1.7	-0.3	16%	14%	-2.0%	35,794
Construction & utility	10%	9%	9%	-1.1	-0.7	13%	12%	-1.0%	35,598
Retail trade	22%	21%	14%	-7.5	-6.3	15%	13%	-2.0%	35,099
Wholesale & motor vehicle trade	5%	6%	7%	2.4	1.6	26%	20%	-6.0%	47,954
Hotel & restaurant	5%	8%	10%	5.3	2.6	3%	3%	0.0%	11,921
Transportation & communication	7%	6%	6%	-1.5	0.1	5%	5%	0.0%	14,005
Education	7%	6%	4%	-3.0	-1.3	0%	1%	1.0%	2,917
Finance & real estate	2%	2%	4%	1.9	2.5	12%	14%	2.0%	44,120
Other services	17%	17%	19%	1.8	1.9	10%	16%	6.0%	58,579

Source: ^a Authors' calculation from LFS. ^b Authors' calculation from Corporate Profile and Financial Statement.

Table 3.6: Decomposition of the Changes in Occupation Shares

Occupation	Total change in shares (percentage point)	Change by industry shares	Change by production technology
High skill	6.08	4.43	1.65
Managers, legislators, senior officials	1.13	1.69	-0.56
Sciences, doctors, engineers, college professors	1.08	0.43	0.65
Business/finance related professionals	1.14	0.64	0.51
Lawyers and other social science professionals	0.63	0.28	0.35
Artists and journalists	0.06	0.24	-0.17
School teachers and associates	-0.17	-0.16	-0.01
Technician & associate professionals	2.19	1.32	0.88
Middle-skill	9.56	12.51	-2.95
Clerical support workers	0.84	3.51	-2.67
Service and sales workers	8.72	9.00	-0.28
Low-skill	-15.64	-16.94	1.30
Agricultural, forestry, and fishery workers	-31.23	-31.59	0.36
Craft and related trade workers	4.50	8.85	-4.35
Plant and machine operators, assemblers, drivers	7.46	1.92	5.53
Laborer	3.64	3.88	-0.24

Source: Authors' calculation from LFS. Change by industry shares refers to the counterfactual shares for cases where only the industry structure has changed, but tasks in each industry have remained at their 1988-1990 level. Change by production technology refers to changes in occupation shares holding industry shares fixed at 2015-2017 levels.

Table 3.7: Median Wages (1988-1990 vs 2015-2017)

1988-1990	men				women			
	primary	secondary	vocational	college	primary	secondary	vocational	college
Manager, legislator, senior officials	16.2	105.8	97.7	106.7	35.0	91.6	84.8	93.2
Sciences, doctors, engineer, college professors			71.9	108.2			57.8	76.7
Business/finance related professionals			86.8	80.6			73.3	65.8
Lawyers and other social science professionals			70.2	80.6			51.5	75.0
Artists and journalist		42.0	47.9	75.8		44.5	53.2	80.5
School teachers and associate		63.2	65.9	80.4		60.9	64.6	79.3
Technician & associate professionals		44.5	48.3	69.8		45.7	49.8	62.8
Clerical support workers	40.7	55.6	53.6	54.5	26.1	45.1	43.2	50.1
Services and sales workers	25.6	36.7	35.5	52.5	13.2	23.4	22.5	45.1
Craft and related trade workers	23.5	32.0	49.5	62.2	18.8	20.8	21.2	43.7
Plant and machine operators, assemblers, drivers	25.5	34.5	43.2	67.0	17.3	22.8	30.6	74.0

2015-2017	men				women			
	primary	secondary	vocational	college	primary	secondary	vocational	college
Manager, legislator, senior officials	34.4	47.5	81.1	180.8	35.4	46.2	71.5	169.5
Sciences, doctors, engineer, college professors			110.0	158.3			87.5	141.9
Business/finance related professionals			73.3	134.0			66.3	98.9
Lawyers and other social science professionals			98.7	145.4			73.1	126.5
Artists and journalist		67.0	89.7	117.0		47.0	97.8	130.7
School teachers and associate		52.4	88.2	136.0		55.6	62.7	132.7
Technician & associate professionals		75.7	92.8	131.2		57.9	68.6	113.7
Clerical support workers	47.2	58.6	70.8	89.8	46.3	52.3	60.9	86.9
Services and sales workers	41.7	49.1	70.9	93.0	37.8	43.5	47.8	63.6
Craft and related trade workers	43.1	47.0	60.9	80.6	37.4	38.1	42.0	52.5
Plant and machine operators, assemblers, drivers	45.2	49.0	62.8	78.4	37.9	39.8	46.7	61.8

Source: Authors' calculation

Table 6.1: Probabilities that Workers Stay at the Same Firm, Change Jobs and Exit SSO after a 5-year Observation Period, Conditional on their Initial Firm Size

Employment status at the beginning of the period	Employment status 5 years later	2003-2007	2007-2011	2011-2015	
SM (1-200)	Same job	35%	39%	40%	
	Change jobs	SM (1-200)	18%	15%	15%
		L (201-1000)	7%	6%	6%
		XL (>1000)	6%	6%	6%
		out-of-SSO	34%	34%	33%
L (201-1000)	Same job	36%	38%	41%	
	Change jobs	SM (1-200)	12%	11%	11%
		L (201-1000)	12%	10%	10%
		XL (>1000)	11%	11%	11%
		out-of-SSO	29%	30%	27%
XL (>1000)	Same job	35%	37%	41%	
	Change jobs	SM (1-200)	9%	8%	8%
		L (201-1000)	10%	9%	8%
		XL (>1000)	18%	17%	16%
		out-of-SSO	28%	29%	27%

Source: Authors' calculation from SSO data

Table 6.2: Percentages of New Comers to SSO that Join Firms of Different Sizes over Three Periods

	2003-2007	2007-2011	2011-2015
# new recruits	4,549,324	3,879,317	4,599,125
% joining SM	40.92%	40.42%	38.78%
% joining L	23.29%	22.46%	21.97%
% joining XL	35.79%	37.12%	39.25%

Source: Authors' calculation from SSO data

Appendix

Table A1: Occupations Classified by Industry

1988-1990	Manager, legislator, senior officials	Science, doctors, engineer, college professors	Business/finance related professionals	Lawyers and other social science professionals	Artists and journalists	School teacher and associate	Technician & associate professionals	Clerical support workers	Services and sale workers	Agricultural workers	Craft and related trade workers	Plant and machine operator, assemblers, drivers	Laborer (non agriculture)	total
Agricultural, fishery & mining	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	98.7%	0.1%	0.3%	0.3%	100%
Manufacturing	3.9%	0.3%	0.4%	0.4%	0.5%	0.0%	0.2%	6.8%	1.2%	0.0%	72.1%	9.6%	4.5%	100%
Construction & utility	6.4%	0.9%	0.6%	0.3%	0.0%	0.0%	0.6%	8.0%	0.5%	0.1%	66.1%	4.3%	12.1%	100%
Retail trade	8.4%	0.2%	1.3%	1.0%	0.1%	0.0%	0.3%	13.7%	46.3%	0.0%	5.9%	8.5%	14.2%	100%
Wholesale & motor vehicle trade	3.0%	0.1%	0.3%	0.1%	0.1%	0.0%	0.0%	2.4%	76.5%	0.0%	0.9%	1.2%	15.4%	100%
Hotel & restaurant	4.1%	0.0%	0.2%	0.2%	2.0%	0.0%	0.3%	6.7%	79.9%	0.1%	1.0%	0.4%	5.0%	100%
Transportation & communication	3.6%	0.3%	0.7%	1.5%	0.1%	0.0%	1.2%	9.6%	10.1%	0.0%	3.8%	52.5%	16.4%	100%
Finance & real estate	8.2%	0.7%	23.4%	3.8%	0.1%	0.0%	11.7%	40.7%	3.0%	0.2%	0.8%	3.2%	4.2%	100%
Education	6.6%	4.5%	0.1%	0.5%	0.0%	76.0%	0.4%	2.6%	1.8%	0.1%	0.3%	0.8%	6.4%	100%
other services	9.3%	5.5%	0.8%	1.7%	1.4%	0.4%	15.2%	15.6%	15.3%	0.6%	2.8%	3.7%	27.8%	100%

Source: Authors' calculation from LFS

Table A1 (continued)

2015-2017	Manager, legislator, senior officials	Science, doctors, engineer, college professors	Business/ finance related professionals	Lawyers and other social science professionals	Artists and journalists	School teacher and associate	Technician & associate professionals	Clerical support workers	Services and sale workers	Agricultural workers	Craft and related trade workers	Plant and machine operator, assemblers, drivers	Laborer (non agriculture)	total
Agricultural, fishery & mining	0.20%	0.00%	0.00%	0.00%	0.00%	0.00%	0.10%	0.10%	0.10%	98.10%	0.20%	0.90%	0.30%	100%
Manufacturing	3.00%	1.30%	1.70%	0.60%	0.20%	0.00%	2.00%	4.70%	2.60%	0.40%	38.40%	35.20%	9.70%	100%
Construction & utility	8.60%	1.70%	1.00%	0.20%	0.00%	0.00%	1.30%	2.10%	0.70%	0.20%	50.60%	7.70%	25.90%	100%
Retail trade	5.40%	0.20%	3.40%	0.70%	0.00%	0.00%	3.60%	6.80%	23.60%	1.40%	27.40%	8.70%	18.80%	100%
Wholesale & motor vehicle trade	2.70%	0.40%	0.80%	0.20%	0.00%	0.00%	0.90%	1.60%	80.00%	0.20%	2.30%	1.90%	8.90%	100%
Hotel & restaurant	3.10%	0.00%	0.70%	0.10%	0.60%	0.00%	0.40%	2.20%	85.40%	0.60%	1.60%	0.80%	4.40%	100%
Transportation & communication	4.20%	1.00%	1.70%	1.00%	1.10%	0.00%	4.30%	12.20%	5.10%	0.00%	3.10%	61.00%	5.30%	100%
Finance & real estate	12.30%	1.00%	8.80%	2.90%	0.10%	0.00%	22.70%	24.30%	9.00%	2.00%	1.50%	3.60%	11.70%	100%
Education	2.90%	4.00%	0.70%	0.90%	0.00%	71.30%	0.90%	5.80%	10.10%	0.40%	0.20%	1.10%	1.50%	100%
other services	8.80%	8.30%	3.10%	4.50%	0.90%	1.50%	12.30%	11.60%	23.40%	2.10%	4.50%	4.50%	14.40%	100%

Source: Authors' calculation from LFS

Table A2: Percentages of Workers Self-Assessing their English Writing and Reading Skills as “Good or Very Good”

		Male	Female
Primary or lower	Age 25-34	1%	2%
	Age 35-44	0%	0%
	Age 45-54	0%	0%
Middle school	Age 25-34	6%	8%
	Age 35-44	1%	0%
	Age 45-54	1%	0%
High school	Age 25-34	12%	18%
	Age 35-44	3%	2%
	Age 45-54	1%	1%
Vocational	Age 25-34	14%	13%
	Age 35-44	9%	12%
	Age 45-54	5%	5%
College or more	Age 25-34	33%	36%
	Age 35-44	32%	31%
	Age 45-54	37%	32%

Source: Authors’ calculation from SES panel 2005

Table A3: Education Level Classification used for LFS

Education level	Year of schooling
Dropout	<3
Primary	4-8
Secondary	9-13
Vocational	14-15
College	>15

Table A4: Occupation Codes from LFS

Occupations:	Codes:						
1988-2000							
Manager, legislator, senior officials	0680/0682	1010/1019	1100/1199	4016/4019			
Science, doctors, engineer, college professors	0010/0039	0110/0199	0210/0399	0410/0419	0510/0519	0610/0619	
Business/finance related professionals	0Y10/0Y49	0Y95					
Lawyers and other social science professionals	0800/0899	0Y20/0Y39	0Y90/0Y94	0Y96/0Y99			
Artists & journalists	0937	0900/0929	0930/0936				
School teacher and associates	0620/0629	0683/0689	0710/0719				
Technician & associate professionals	0420/0429	0490/0499	0520	0530/0599	0939	9010/9090	0X10/0X99
	6200/6299	6710/6729	6930/6939	7414/7416	3110/3119	9610/9669	9711/9719
Clerical support workers	2010/2019	2100/2999	9910				
Services and sale workers	3010/3090	3210/3299	3320/3319	3320	3390/3399	4417/4418	6510/6519
	6610/6629	6810/6829	6910/6911	6920/6949	9010	9019	9091/9099
	9110/9119	9129/9129	9194/9198	9210/9219	9410/9419	9810/9819	9911/9919
	9196	9811					
Agricultural workers	4010/4015	4110/4113	4119	4210/4219	4310/4319	4410/4415	4419
Craft and related trade workers	5014	5994/5999	7010/7099	7100/7299	7320/7329	7410/7413	7419
	7420/7499	7530/7599	7600/7659	7710/7729	7790/7799	7810/7829	7990/7992
	8010/8099	8110/8149	8220/8299	8351/8359	8390/8399	8410/8499	8510/8519
	9533/8539	8540/8599	7910/7999	6110			
Plant and machine operator, assemblers, drivers	5010/5013	5019	5110/5199	5200/5219	5990/5993	6010/6029	6111/6115
	6120/6129	6300/6339	6410/6419	7310/7319	7330/7359	7418	7500/7529
	7690	7730/7739	8210/8219	8310/8349	8350/8359	8610/8699	8700/8729
	8730/8759	9511/9514	8350				
Laborer (non-agriculture)	3321/3329	4114/4115	4416	5999	6119	6420/6439	6912/6913
	7993/7999	8190/8199	8760/8769	8810/8899	8900/8999	9122	9190/9193
	9195/9199	9310/9329	9510/9519	X200/X300			
2001-2010							
Manager, legislator, senior officials	1000/1999						
Science, doctors, engineer, college professors	2100/2299	2230/2239	2310/2319				
Business/finance related professionals	2411/2419	2441	3411	3434			

Lawyers and other social science professionals	2412	2420/2429	2431/2432	2442/2446			
Artists & journalists	2450/2459	3472					
School teacher and associates	2320/2359	2460	3310/3340				
Technician & associate professionals	3100/3199	3200/3299	3412/3419	3421/3429	3431/3433	3439	3441/3449
	3450	3460	3471/3475	3480			
Clerical support workers	4100/4299	2999					
Services and sale workers	5100/5469	9970	9998	9999			
Agricultural workers	6100/6299	9210/9219					
Craft and related trade workers	7113/7114	7120/7149	7200/7499				
Plant and machine operator, assemblers, drivers	7111/7112	8110/8179	8210/8299	8310/8349			
Laborer (non agriculture)	9111/9112	912/916					
	930/939						
2011-2017							
Manager, legislator, senior officials	1000/1999						
Science, doctors, engineer, college professors	2100/2169	2200/2259	2260/2263	2310/2319	2510/2529		
Business/finance related professionals	2411/2413	2631	3311/3314				
Lawyers and other social science professionals	2421/2424	2431/2432	2610/2629	2632/2635			
Artists & journalists	2640/2659						
School teacher and associates	2320/2359	2636					
Technician & associate professionals	2163	2264/2269	2433/2434	3110/3119	314/315	3210/3259	3312/3315
	3320/3339	3341	3351/3359	3410/3429	3431/3435	3511/3524	0100/0399
Clerical support workers	3341/3344	4100/4499					
Services and sale workers	3434	5100/5499	9411/9412	9970			
Agricultural workers	6100/6399	9211/9216					
Craft and related trade workers	7100/7599						
Plant and machine operator, assemblers, drivers	3121/3123	3131/3139	810/839				
Laborer (non agriculture)	9111/9129	9310/9339	9510/9520	9610/9629			

Source: LFS

Table A5: Industry Codes from LFS

Industry:	Codes:						
1988-2000							
Agricultural, fishery & mining	0111/0309	0411/0489	1101/1999				
Manufacturing	2011/3999						
Construction & utility	5111/5211						
Retail trade	6112/6119	6111	6123				
Wholesale & motor vehicle trade	6121	6122	6124/6129				
Hotel & restaurant	8521/8539						
Transportation & communication	7111/7309						
Finance & real estate	6201/6309	6401/6409	8231/8239				
Education	8211/8219						
other services	8221/8229	5221	8241/8399	8411/8431	8541/8599	8511	8101/8105
2001-2010							
Agricultural, fishery & mining	0/599	1000/1499					
Manufacturing	1500/3999						
Construction & utility	4000/4199	4500/4599					
Retail trade	5100/5199	5000/5099					
Wholesale & motor vehicle trade	5200/5299						
Hotel & restaurant	5500/5599						
Transportation & communication	6000/6499						
Finance & real estate	6500/6799	7000/7199					
Education	8000/8499						
other services	8500/8599	9000/9499	9500/9599	9900/9999	7500/7599		

Table A5 (continued)

2011-2017							
Agricultural, fishery & mining	0/499	500/999					
Manufacturing	1000/3499						
Construction & utility	3500/3999	4000/4399					
Retail trade	4600/4699	4500/4599					
Wholesale & motor vehicle trade	4700/4799						
Hotel & restaurant	5500/5699						
Transportation & communication	6000/6199						
Finance & real estate	6400/6699	6800/6899	7700/7799	8100/8299			
Education	8500/8599						
other services	8600/8899	9700/9899	6200/6399	5800/5999	6900/6999	7000/8099	9000/9699
	9900/9999	8400/8499					

Source: LFS