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Unskilled Migration in ASEAN in the Rise of Digital Technology: Case study of Thailand *

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1. Issues

Issues of labor mobility and unskilled economic migrants are one of the policy challenges in ASEAN community. Within ASEAN community, they are both labor receiving and sending countries. In particular, there are nearly 7 million workforces from lower-income ASEAN members (e.g. Indonesia, the Philippines, Myanmar, and Cambodia) work in higher-income ones (Singapore, Malaysia and Thailand) (Roughneen 2018). So far, unlike trade and investment flows, migrants and unskilled workers in particular have largely been left out of the ASEAN integration process (Testaverde et al. 2017).

The intra-regional workers flows have been driven by various economic fundamentals such as economic disparities within ASEAN members, demographic factors (i.e., aging economies), and culture similarity. This indicates presence of mutual benefit between importing and exporting ASEAN members. Nonetheless, there have been concerns of problems derived from cross-border labor mobility from both importing and exporting countries, one that has not properly addressed so far is labor displacement effect of the automation technology on these migrant workers.

The world is experiencing the 4th Industrial Revolution that allows innovation invented in the three previous industrial revolutions connect to each other. The fourth revolution (often referred as Industry 4.0) have witnessed major advances in technologies, which are likely to transform the structure and dynamics of many industries. Industry 4.0 is the next wave of digital and online transformation as industries are transformed through, for example, further automation, artificial intelligence, robotics, cloud computing, 3D printing, big data analytics and internet of things. Among many, one but rather undesirable consequence is job

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displacement as a wide range of job tasks in many sectors and in many countries would be fully or partially automated. Nonetheless, the remaining debate is about how the displacement takes place and how large its indirect and positive effect from the automation on employment. In fact, labor displacement is not new but yet materialized in the 19th and 20th century as the creation of new jobs usually outran the direct labor displacement effect of the adopt of new technologies and there were sizable costs to fully utilize them up to their potential (Arntz et al., 2016; Frey, 2019)

In the context of regional cooperation like ASEAN, one immense policy-relevant issue is about the effect on the flow of unskilled migrants which is the dominant form of intra-regional worker mobility. Nonetheless, its effect is at best ambiguous. On the one hand, jobs that to be displaced as a result of automation could be largely overlapped with those that unskilled foreign workers take up. These jobs often involve studious and monotonous work processes. The rising importance of automation technology makes these foreign workers vulnerable to be displaced. If so, these foreign workers reversal might be observed. Given the current scale of intra-regional migrants, managing the reversal could be a policy challenge. Policy coordination within ASEAN framework would be needed to minimize adjustment costs that might incur. It becomes more complicated when many of these workers are undocumented (Testaverde, Moroz et al. 2017).

On the other hand, as argued in (Institute 2017) based on the survey of 46 countries and 2,000 work activities, the proportion of occupations that can be fully automated using currently demonstrated technology is actually small (i.e. less than 5 per cent). Despite technically feasible, deployment of automation in the workplace and the automation of jobs depend on the interaction between cost of developing and deploying both the hardware and the software for automation, required skill to work with the automation, and the benefits of automation beyond labor substitution (e.g. higher levels of output, better quality and fewer errors, and capabilities that surpass human ability). Hence, demand for these workers might continue.

Despite immense policy relevance, a systematic analysis of the decision has not received attention in the context of developing countries. Against this backdrop, this paper aims to address this issue using Thailand as a case study. Note that the main emphasis in this study is on unskilled workers which accounted for the lion share of intra-regional workers flows among ASEAN members. Managing massive flows of workers would require inter-country cooperation where ASEAN could play a role. While there are skilled migrant between more developed ASEAN countries,

Thailand would be a good case study for the issue in hand for two reasons. Firstly, Thailand recorded the highest stock of foreign workers in ASEAN in 2017 by 3.5 million, followed by Malaysia and Singapore (2.7 and 2.6 million workers, respectively). The growing migrant stocks were due to the severe labor shortage for more than a decade. Such a trend is expected to continue as the country is fast becoming an ageing society with a rapidly declining fertility rate.[1] Secondly, Thailand is the first runner up in the East Asian economies in terms of activities that have technical potential for automation by currently demonstrated technology after Japan (56%). According to Institute (2017) in Thailand 55% of activities have technical potential for automation by adapting currently demonstrated technology. The other AMS include Indonesia, Malaysia, the Philippines , and Singapore whose percentage of the activities are 52% , 51%, 48% and 44%, respectively. Therefore, how Thai firms respond to the rise of automation technology would provide relevant case study in formulating prudential policy to share mutual benefit among ASEAN members

The core methodology involves analyses of primary data collecting in this. They are firm interview and short questionnaires are undertaken from April to June 2020. In the former, 25 firms were interviewed (8 in processed foods, 10 in garments, 4 in hotels, and 3 experts and SI firms. Note all interviews were undertaken through phone or virtual meeting between April and May 2020. The latter covers 120 questionnaire returns in these three businesses during the same periods, covering all firm sizes.

The paper is organized as follows; the next section lays down the analytical framework of the study. Section 3 provides the issue of migrants in ASEAN. In this section, aggregate data were analyzed together with policy efforts made in ASEAN. The next section (Section 4) provides the core analysis. It begins with research methodology in Section 4.1 and then the analysis is in Section 4.2. The final section provides conclusion and policy inferences.

2. Analytical Framework

The world is experiencing the 4th Industrial Revolution that allows innovation invented in the three previous industrial revolutions connect to each other. The fourth revolution (often referred as Industry 4.0) have witnessed major advances in technologies, which are likely to transform the structure and dynamics of many industries. Industry 4.0 is the next wave of digital and online transformation as industries are transformed through, for example, further

[1] Thailand's workforce is expected to decrease by 11 per cent by 2040 — a rate higher than any other developing country in East Asia (Auethavornpipat, 2017)

automation, artificial intelligence, robotics, cloud computing, 3D printing, big data analytics and internet of things.

The advancing technologies tend to enable and facilitate a broad range of business activities related to the storage, processing, distribution, transmission and reproduction of information. However, there are concerns about impacts of advancing technologies on economic development in both developed and developing countries, especially in an area of labour market outcome. In fact, labor displacement is not new but yet materialized in the 19th and 20th century as the creation of new jobs usually outran the direct labor displacement effect of the adopt of new technologies and there were sizable costs to fully utilize them up to their potential (Arntz et al., 2016; Frey, 2019)

The threat of labor displacement is believed to be particularly strong with emerging industrial robots in the new millennium. A wide range of job tasks in many sectors and in many countries would be fully or partially automated. According to task categorization by Autor et al (2003), risk of labor displacement is high for manual and cognitive routine tasks involving explicit rule-based activities (Autor and Dorn, 2013; Goos et al. 2009).

Technological advances in machine learning (ML) and mobile robotic (MR) enlarged the scope of jobs in high risks of labor displacement including many non-routines such as handwriting recognition, human-translated digitalized text, decision-making to reduce human biases, legal and financial services, condition monitoring (Brynjolfsson and McAfee, 2014; Ford, 2015; Frey and Osborne, 2017; Bessen et.al., 2019).

Interestingly, there are a number of empirical studies pointing to the overclaim on the labor displacement effect mentioned above. For example, Arntz et al (2016) point to methodological problems in Frey and Osborne (2017) resulting over-estimation of magnitude of labor displacement. In particular, Frey and Osborne (2017), 47% per cent of jobs at the risk[2] is far overestimated whereas that in Arntz et al (2016) was 9 per cent. Among many counter-arguments made in Arntz et al. (2016), one is about an assumption imposed on the labor displacement effect. In particular, Frey and Osborne (2017) implicitly assumed that the whole occupation can be completely replaced by automation. In fact, automating takes place in certain tasks instead of the whole occupation, usually consisting of performing a bundle of tasks. Some may not be automatable (Autor, 2014 & 2015). Hence, the net effect of technological advances on labor demand within a given occupation could not be massive.

[2] Work by Frey and Osborne (2017) is based on the early working paper version in 2013. Such estimation triggered the policy debate about labor displacement, reaching 2,565 citations in academic works.

Outcomes found in Bessen et al. (2019), Acemoglu and Restrepo (2017), and Autor and Salomons (2018) also raise similar conclusion about the pessimistic view in Frey and Osborne (2017). In particular, difference-in-difference estimation of the impacts of automation on individual workers in Bessen et.al (2019) using Dutch micro-data from 2000 to 2016, suggests that despite the found labor displacement, the magnitude is rather small, and its adverse effect took place gradually.

According OECD (2019) documenting how robots are adopted using industrial robots statistics by International Federation of Robotics (IFR), robots uses in factories are highly concentrated in three industries, i.e. transport equipment (45 % of total stocks of robot uses), electronic, electrical and optical equipment (30%) and rubber and plastics as well as metal products (5-10%). Tasks robots are often used include handling operations, machine tending, welding and soldering, and assembling and disassembling.

Another relevant argument is about cost of installing and effectively utilizing automation system. In fact, installing robots or automation system incur sizable fixed costs. Despite the observed declining prices of robots, there are other costs incurred as a robot unit is usually just one component in a wider system composed of other robots, software, computer-controlled machine tools and other numerically controlled equipment. As revealed in OECD (2019) even when a robot unit is the central piece of equipment in a system, its cost usually accounts for one-third or one-quarter of the total cost of the system.

Despite presence of direct labor displacement, such technological advancement could benefit firms in interest thereby the net effect on labor demand ambiguous. According to Acemoglu and Restrepo (2019), benefit includes productivity gains firms experience from automation technology (referred to as productivity effect). The displacement effect of automation has been counterbalanced by technologies that create new tasks in which labor has a comparative advantage. Such new tasks generate not only a positive productivity effect, but also a *reinstatement effect*- they reinstate labor into a broader range of tasks and thus change the task content of production in favor of labor. The reinstatement effect is in line with the argument made above that only some not all tasks within an occupation are displaced mentioned above.

In addition, the productivity effect proposed in Acemoglu and Restrepo (2019) could be enlarged when productivity benefit is shared with upstream and downstream industries (linkage effect) as well as consumers (Autor and Salomons, 2018). Such inter-industry productivity spillover is empirically found in Dauth et.al (2018). Therefore, the net effect depends on the mixture of new technologies and how these change the task content of

production. It could vary across countries as decision to adopt automation technology could be altered by ethical and or legal obstacles as well as people preferences (Arntz et al, 2016)

Whether tasks to be displaced by automation system are the same as tasks performed by foreign unskilled workers remain open empirical question. On the one hand, tasks that are at the high risk ones to be displaced by automation technology of Frey and Osborne (2017) are not much overlapping with works categorized an unwanted ones in labor receiving countries (3-D jobs). In particular, tasks consist of finger dexterity (the ability to make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate or assemble very small objects), manual dexterity (the ability to quickly move your hand, your hand together with your arm, or your two hands to grasp, manipulate or assemble objects) and cramped work space, awkward positions (how often does this job require working in cramped work spaces that requires getting into awkward positions). This skill is often found in garment and food industries which are the key destination of foreign unskilled workers for Thai manufacturing (Kohpaiboon and Jongwanich, 2015). Hence, the demand for foreign unskilled workers would continue amidst the rise of automation technology.

On the other hand, given the speed of technological advance, automation and digitalization are increasingly penetrating the domain of tasks that until recently used to be genuinely human such as reasoning, sensing, and deciding. The growing adoption of automation in textile and apparel in the US points to risks of the labor displacement on these foreign workers (Clifford, 2013). Moreover, all tasks are at risk but those involving these foreign workers are riskier because of presence of policy hesitation in labor receiving countries. Despite realizing need to import these workers, policy measures are likely to allow what really needs by locals, be on temporary basics and be subject to frequent changes. This could create uncertainty to firms and make importing foreign workers the last option to be used to cope with the ongoing structural changes. Hence, when technologies are feasible, decision to adopt automation would be easier to reach.

This remains empirical question to be answered. Such a question is immense policy relevant. If they are largely overlapped, migrant flow reversals could be unavoidable and result painful adjustment. In fact, there are fixed costs a worker must pay to work aboard. Such costs would be sizable for them. In many cases, they borrow money to cover the costs and pay back with higher income earning from abroad over years. When the work duration is shortened, this could result in several undesirable outcomes. The undesirable outcomes would be enlarged when these workers illegally enter the host country.

3. Migration in ASEAN

Cross-border migrants play an important role of AMS in both labor-service sending and receiving countries. AMS played an increasing role in sending workers abroad. Migrant stocks from AMSs increased from 7.5 million workers in 1990 to 21 million workers in 2017. Their share to global migrant stocks nearly doubled during the considering period. By 2017, their share was 8.2 per cent of total migrant stocks, from 4.9 per cent in 1990 (Table 1). The major AMSs sending workers abroad in 2017 were the Philippines, Indonesia, Myanmar, and Vietnam, all of which accounted for 75 per cent of total AMS migrant stocks. Since 2000, Myanmar has gained her relative importance as labor sending countries. Her share to total migrant stocks from AMS increased from 10.6 per cent in 2000 to 13.8 per cent in 2017.

Some AMS increasingly relied on foreign workers to enlarge their labor pool. A number of foreign workers working in AMS increased from 2.9 million workers in 1990 to nearly 10 million workers in 2017. Since 2000 Thailand has become the largest destination of foreign workers in AMS, accounted for one third of total foreign workers in AMSs. It was followed by Malaysia (25%) and Singapore (25%) (Table 2).

<< INSERT TABLES 1 & 2 ABOUT HERE>>

Flows of workers from AMS have shifted their destination toward AMS (Figure 1). A number of AMS migrants to AMS quadrupled from 1.3 mil workers in 1990 to 6.7 mil workers in 2017. Hence, their intra-regional share increased from 45.9 per cent to 68.8 per cent from 1990 to 2017. Intra-regional migrants were originally from Myanmar, Malaysia, and Indonesia. Their destinations were for neighbours, i.e. Thailand, Singapore and Indonesia. Note that the other two important labor-service exporting AMS are the Philippines and Vietnam where more than 75 per cent of the migrants from were destinated for developed countries. They are likely to be semi-skilled workers. By contrast, the pattern was just opposite for Myanmar and Indonesia whose workers are destinated to their richer neighboring AMS, Thailand and Malaysia, respectively (Table 3).

<< INSERT FIGURE 1 & TABLE 3 ABOUT HERE>>

While data from *ILO Migration Report* are composed of skilled and unskilled workers, intra-regional migrants are more likely dominated by the latter (Sugiyarto and Agunias, 2014; Testaverde et al, 2017). Interestingly, such flows of migrants have not been addressed in the

regional forum despite its increasing importance. Most of policy effort was taken place on the bilateral basics between sending and receiving countries. For example, Thailand signed memorandum of understanding (MOU) with Myanmar, Lao and Cambodia to govern flows of unskilled workers.

So far, the efforts to govern the flows of these workers in the ASEAN framework have been on-off for the past decade. Most of the efforts were to provide basic rights to these foreign workers as well as to prevent any illegal migrants. For example, in the 12th ASEAN Summit on 13 January 2007 ASEAN members signed the ASEAN Consensus on the Protection and Promotion of the Rights of Migrant Workers ASEAN (2018). To a large extent, it is quite similar to the 2007 declaration that was to ensure fundamental rights as stipulated in the applicable international and regional treaties, which ASEAN member states are parties to in accordance with the prevailing national laws, regulations and policies of ASEAN member states. Unified standards that are needed to handle these flows of workers and to address the problems of mistreating undocumented migrants have not been offered so far although there are rising concerns from labor sending countries.[3]

So far there have been policy attempt to facilitate skilled workers even though it has been relatively weak as opposed to trade and investment flows (Testaverde et al., 2017). To do so, two agreements were signed to streamline the movement of select individuals within the region. The first is ASEAN Agreement on the Movement of Natural Persons (MNP), which provides the legal framework to facilitate temporary cross-border movement of people engaged in the conduct of trade in goods, services, and investment. Procedures for business visitors, intra-corporate transferees, and contractual service suppliers to apply for immigration formalities are streamlined and transparent . Another agreement, the ASEAN Comprehensive Investment Agreement (ACIA) is to grant entry, temporary stay and work authorization to investors, executives, managers, and board members of corporations in the process of committing a substantial amount of capital or other resources (ASEAN, 2012 and 2014).

In addition, 7 MRAs were signed. They are (1) MRA on engineering services (9 December 2005), (2) nursing services (8 December 2006), (3) architectural services (19 November, 2007)[4], (4) medical practitioners (26 February, 2009), (5) dental practitioners (26

[3] Governments of exporting countries raise concerns about the decent work condition of their workers. The case of Indonesian worker that was mistreated and then died in Penang, Malaysia (i.e. Adelina Sao Case) on February 2018 is the example of the ongoing concern. See more examples are reported in Roughneen (2018)

[4] Framework agreement for the mutual recognition of surveying qualifications was also signed.

February, 2009), (6) tourism professions (9 November, 2012), and (7) accountancy services (13 November 2014). They are to recognize qualifications and skills thereby facilitating movement of skilled workers within AMS.

Nonetheless, the efforts at best offer ways to facilitate rather than truly liberalize flows of skilled workers among AMS (Sugiyarto and Agunias, 2014). For example, MNP and ACIA do not apply to individuals seeking employment, citizenship, residence, or permanent residence in another AMS. It is quite clear, for instance, that ACIA applies only to individuals employed by a registered company in the country of origin. Also, each MRA just provides specific provisions to guide implementation instead of ensuring the mutual recognition. For example, in the MRAs, minimum years of experience are still required, varying from professionals (e.g. 5 years for dental and medical practitioners, 10 years for architects, 3 years of active practice for nurses). This is far different from what was implemented elsewhere to free flows of people Europe (i.e. European Union-EU and European Economic Area-EEA).

Note that low-skilled workers which are now the major component in intra-regional worker flows, are not covered by formal agreements. Informal labor issues develop. Some migrant workers desperately seek out informal channels to avoid procedural processes and costs. These migrants are prone to experience exploitation that can deprive them of social protection benefits and minimum wage coverage. According to the ILO, the existing MRAs cover only 1.5 per cent of the region's labor force. Despite the November 2017 Manila Consensus's renewed commitment to protecting migrant rights, recent revelations of the torture and death of an Indonesian maid in Malaysia have cast doubt over the efficacy of ASEAN's efforts. Sceptics have claimed the death of Adelina Lisao as evidence for the ephemeral nature of ASEAN's commitments (Koh, 2018). Cooperation among AMS would allow ASEAN member states to address labor shortages in labor-receiving AMS whereas alleviate poverty and unemployment in labor-sending ones, thereby further strengthening the regional economic integration. Hence, there would be plenty room for improvement to govern intra-regional flows of workers so that AMS would share economic prosperity and achieve cohesive economic community.

4. Firm-level Analysis

4.1 Methodology

To gain better understanding on how firms hire foreign workers and unskilled ones in particular as well as whether their tasks are at risk to be displaced by automation, primary data from firm interview and short questionnaires are undertaken from April to June 2020.

This study's firm interview covers two groups of samples. The first group is the academic experts on mechatronic as well as system integration (SI) outsourcing firms to gain the state of arts on automation and to assess economic feasibility in adopting automation for firms. The second group is firms in both manufacturing sector and hotel industries to evaluate the risk of migrant reversal hypothesis proposed above. In the manufacturing sector, garment and food processing industries are the prime focus as they heavily rely on foreign workers. 25 firms were interviewed (8 in processed foods, 10 in garments, 4 in hotels, and 3 experts and SI firms. Note all interviews were undertaken through phone or virtual meeting during the COVID-19 pandemic and lockdown measures imposed.

This study uses 'purposive' rather than 'probability' sampling techniques (Patton 1990). The latter refers to the method that achieves samples by random selection amongst all units of the population and permits confident generalization for a larger population. In the former method, samples are purposively chosen from information-rich cases for in-depth analysis related to the central issues under study. The main objective here is to qualitatively examine the behaviour of particular groups of firms, i.e. decision to adopt automation and the effect on currently hired foreign workers. Firms with certain characteristics of individual industries were selected to address and examine the issue in hand. This cannot be achieved by probability sampling that uses a variety of sample characteristics to draw quantitative inference. For example, firms, which have not been in a position to make automation decision (e.g. micro enterprises, hand-made ones) might not be relevant to an examination of the issues involved.

A flexible interview guide was used, requesting respondents to relate their experience in their own words and their own sequence. The main advantage of this flexible approach is that it minimizes the likelihood that important aspects of the story will be missed. The main disadvantage is that some respondents whose experience may be limited to a particular interest cannot always be asked all of the questions in the interview guide. Second-round interviews with different interviewees (Morawetz 1981) could mitigate this disadvantage in several cases.

Two different interview guides are used for these two groups of samples. The guide for these interviews in the first group is related to the nature of automation deployment that might take place (State of Arts, Mass Production, Import Content, and the complementary between workers and capital). In addition, direct costs of automation installation as well as other indirect costs including re-arranging existing facilities, hiring appropriate skill workers, maintenance cost, etc. Potential samples include academic experts on mechatronic and outsourced firms to install automation system. The second group is factories in three industries (garment, processed foods, and hotels). The question begins with the general company profile, i.e. size, ownership production process, product destination, product covers, etc. And then, a set of questions related to decision to automation deployment will be addressed.

In addition, short questionnaires were sent to processed food, garment and hotels from April to May 2020. The questionnaire begins with basic information (size, ownership, number of workers—local vs foreign workers). Two main questions were addressed through questionnaire survey. The first is about how firms have adopted automation system and which position in the supply chain whereas the second is firm responses in the covid-19 with emphasis on how firms treat foreign workers. There are 120 questionnaire returns. Table 4 provides composition of questionnaire returns.

4.2 Results

In the questionnaire returns, there are 42 out of 120 firms reporting a number of foreign workers hired. Note some firms left blank on this question so that the number reported here might be underestimated. Out of 42 firms, 20, 7 and 15 firms are in the processed foods, garment, and hotels. While the average share of foreign to total workers of all firms was 10.9 per cent whereas the maximum share was 81.3 per cent. This implies behavior of firms in hiring foreign workers are either hire or not. There are few firms mixing locals and foreign workers (i.e. hollowing out the middle).

4.2.1 Who hire foreign workers and what types of jobs

Those hiring foreign workers tend to be large in size. 25 out of 42 firms hiring foreign workers are large defined as those with more than 200 workers (Table 5). This finding is consistent with previous studies based on 50 Thai garment firms interviewed in 2013 (Kohpaiboon and Jongwanich, 2014). These large firms are in a better position to attract native workers as they can offer relatively higher wages and better working condition to the natives. Their better performance makes their working hour longer, i.e. running over-time (OT)

operation on a regular basic. They are also likely to benefit from better working condition in terms of job security, fringe benefits,and social life.

Most of these foreign workers are at the production process whose dexterity is needed but shunned by the locals. Tasks requiring dexterity require more complex perception and manipulation. They often involve long and successive working hours of standing in the production line. All samples in the proceeded food industry points to the role of foreign workers as the current stage of technology does not make it economically feasible to perform peeling activities. Human has comparative advantage over machine when finger dexterity is concerned. Raw materials are unlikely to be uniformed and waste reduction is crucial for the export competitiveness in the thin margin like export-oriented frozen/processed shrimp industry. This type of works has long shunned by locals. Similar comments are found in other samples in the processed food firms such as sweet corn, pineapple, and canned tuna.

In the case of garment industry, the relative importance of hand dexterity is addressed. One sample whose product lines are rather complicated and not in the mass production category argued that the firm invests as much as possible for automation.

This is different from hotel sector where foreign workers are on typical 3-D jobs like dish washing, cleaning, repairing, and gardening. When it comes to hotel services, they prefer locals. This is because hotel services are social interaction in nature. In this type of services, locals have comparative advantage over the foreign workers. As revealed in the interview by all hotel samples in this study, Thais have a great soft skill and this skill largely attributed to the return customers. Such tasks are not shunned by the locals as they are often with fringe benefits including tip/gratuity and getting to know customers and some other better job opportunities.

Note that interview evidence suggests that hiring these foreign workers is not the first option for them to be chosen in all cases. In fact, it is virtually the last as hiring these workers incurs costs. They have different cultures and language so that there are various administrative challenges to be deal with. Given presence of cumbersome in government procedure and frequent changes in policy stance, it incurs substantial costs to firms. Many urge that it becomes unavoidable to keep business going.

4.2.2 Automation on Supply Chain

As argued in UNCTAD (2017), there are 7 positions in supply chain automation can be used in manufacturing, including (1) inputs sourcing; (2) product design/development; (3) business planning; (4) controlling and monitoring; (5) production line; (6) selling; and (7)

supply chain networking. These seven positions can be grouped into pre-production consisting of (1)-(3), production covering (4) and (5) and post-production. When applying these seven questions to hotel business, they are slightly changed to suit the nature of business.[5] Online inputs sourcing

Tables 6 -8 present firms' decision to adopt automation in processed food, garment and hotel. In processed food industry, automation was adopted largely in post- and pre-production (Table 6). In post-production positions, many processed food firms have begun offering their product online. Particularly, 28 out of 57 firms did adopt automation technology whereas 8 more are considering to adopt it. This result is not surprised as the interview period was in the period where lockdown measures were in place and uncertainty was high. Activities with lumpy fixed costs like installing automation technology are likely to be stalled.

Product development is another area where firms adopted automation technology. As revealed in the interview, product development in the processed food industry is rather capital intensive and involves a set of tools and equipment in order to ensure product hygiene. It is more likely to make use of the emerged automation technology.

Interestingly, when it comes to production processes, automation technology played a rather limited role. In this part of supply chains, finger dexterity is important as raw materials (shrimp, tuna, fruits, and vegetables) are not uniform. This is even these raw materials are under contract farming. These workers can make precisely coordinated movements of the fingers of one or both hands to grasp, manipulate or assemble these raw material together. As revealed in our interview, there was an effort to automate the processed food's production line by a global leading processed food firm. In particularly, the firm in interest worked with global leading technology developers in the United Kingdom for tailor-making a production system. Nonetheless, labor displacement that might occur is rather small. Even though the tailor-made machines were actually used and enhanced workers per output, its productivity gain from the machines creates off-set demand for workers instead. In other word, despite presence of labor displacement, its effect was small and overshadowed by the productivity effect from the automation. Virtually this made the overall demand for workers unchanged.

Note that the option of tailor-made machines incurs huge fixed costs so that it is unlikely for smaller firms to follow suit. Hence, workers are still needed to be in the production line,

[5] In particular, (1) inputs sourcing; (2) product design/development; (3) booking registering and billing; (4) offering services ; (5) customers' satisfactory assessment; and (6) networking with other hotels locally and abroad.

working on semi- automated system (i.e. conveyor belt production line) to prepare for processing step.

The similar pattern of automation technology adoption is also found in the garment industry (Table 7). Product design/development (pre-production) as well as offering products online purchase (post-production) are two areas where firms were actively adopted automation technology. Production design and development has been long involved with automation technology known as computer-aided design (CAD) and computer-aided manufacturing (CAM).

Production process is the less likely to adopt automation technology as hand dexterity still matters. Evidence from interview across products in this study suggests that adoption of automation technology will be limited and it is rather complement to workers instead of displacing them. So far, automation has been used to entirely produce the simple garment, T-shirt, revealed in the interview and also claimed in Graham-Rowe (2011).[6] Although reasonable progress has been made in the sewing machine settings and stitching quality to change with the fabric quality, there are areas of complexity such as needle-fabric interaction while sewing. Such areas are the niches for Thai garment manufactures, including outwears, sportwears, and complicated uniforms[7] (revealed in the interview). Even though multinational buyers like Nike, Adidas, have been working with their suppliers for years to automation system, little progress has been made so far.[8] Automation technology adoption in the developed countries like the US is rather limited to textile industry, not the garment. The argument about the nature of skilled labor intensive garment industry made in 2000s (Mirza and Giround, 2004; Yue, 2005; Manchin and Pelkmans-Balaoing, 2008) still holds in the next decade. All in all, the above discussion suggests that it is unlikely for garment industry that labor displacement effect of the automation technology that might have would be strong and dominated its corresponding productivity effect.

Samples from the hotel business in this study also suggests the very limited role of automation technology in their supply chain. As shown in Table 8, automation technology and

[6] Sewbo, the robot developed by Jonathan Zornow, can sew T-shirt from start to the end 100%. Note that the fabric need to be stiffened by the application of a water-soluble and non-toxic polymer (plyvinyl alcohol) which makes the handing operation easier(Graham-Rowe, 2011, insight success, 2017)

[7] There are growing demands for high-quality uniforms from big cooperates. These uniforms are expected to fulfill certain requirements. For example, the garment's color is expected to remain unbleeded for certain times of washing.

[8] This evidence is shared by the repeated sample, covered in this study and in Kohpaiboon and Jongwanich (2014).

digitalization have been used for the booking. 15 out of 24 samples in the hotel subsample adopted the technology on the booking and 4 more to be adopted. The other activities in the hotel supply chain are largely done by human. It is not because of technological feasibility. In fact, it is the choice made by firms as these services performed by workers are the way of service upgrading. The other areas automation technology is feasible are cleaning, laundry, ironing, and gardening (referred to housekeeping services) but they are needed humans to work with. The extent to which automation technology is adopted depends on the cost of automation as opposed to labor availability and wage. Note that the cost of automation covers both direct (high initial cost of installation) and indirect ones (cost of maintenance, lack of flexibility). On the other hand, there is economies of scale in hiring workers for the hotel business. These workers are likely to stay together as a small community. The more a number of foreign workers hiring there, the more likely the others will follow. Hence, the large firms would likely hire foreign workers as opposed to automation system.

When mapping tasks to be automated and those foreign workers attribute to suggests that labor displacement on these workers that might have would be limited in the short run. In fact, the productivity effect associated with adopting automation technology tends to be stronger and make their job less likely to be displaced. In the processed foods and garment industries, the role of dexterity foreign workers provide keeps them safe from the displacement effect from automation. It is the relative cost advantage that keep foreign workers in demand in the hotel business.

This finding seems to be in line with the recent empirical work on labor displacement effect of automation technology that the automation technology would take place in gradual manner and decision to do so does not hinges solely on technological feasibility (Artz et al 2016; Benson et al. 2019). Interestingly, our results here seem to support job polarization thesis postulated in Autor et al. (2006) where it is the mid-skill jobs inherently easier to automate because rich in routine tasks.

4.2.3 Covid-19 and risk of migrant reversals

Interestingly, as the covid-19 crisis remains ongoing challenge, the study further examines whether covid-19 alters economic landscape and makes foreign workers from neighboring countries are at risk. In theory, covid-19 and measures imposed to stop the disease spread (social distancing) would catalyst automation technology. Nonetheless, what found in the questionnaire, the covid-19 and the measures imposed did not speed up adoption of automation technology. While the covid-19 would call for social distancing, it is the demand

contraction effect as well as uncertainty induced made firms in wait and see mode. This is especially true for adoption of automation technology whose investment costs are fixed and sunk. The demand contraction makes firms to breakeven with the lumpy investment even longer.

Two samples which are suppliers installing automation systems in factories point to the sizable fixed installation costs. One sample claimed that it incurs at least 100 million baht (3 million US) to install effective automation technology so that automation technology has been relevant for large corporates. In addition, there are pre-requisites for firms to fully benefit from automation system, many of which require successive effort by firm owners. Examples of pre-requisite include installing enterprises resource planning (ERP) software and turn all paper documents into digital texts. While price of ERP software is moderate, the owner/chief executives must much intensively get involved with their workers to implement it. It is time-consuming processes. Turning massive paper documents into digital texts is now technically feasible but the associated fixed cost is rather considerable.

When the covid-19 crisis hit, decision to install automation was delayed as revealed in the interview. All firms pay attention to business survival, maintain cash flows, instead of heavily investing in innovation-related activities. This points to the demand shock and uncertainty effect induced by the covid-19. This is especially when vaccines to combat COVID-19 were at the early stage when the interview was performing. This made investment breakeven longer. Note that decision to adopt automation technology is similar to other form of investment that hinges not only on technological capabilities, but on the relative price of performing tasks by either human or machines.

One implication from the consequence of the massive demand shock is that foreign workers tend to be vulnerable to the negative shocks like covid-19 induced economic crises. Foreign workers as well as temporary local workers are the first group firms will fire when the sizable economic contraction takes place. It often occurs indirectly. Usually, these workers heavily rely on overtime hours to cover high living costs in cities like Bangkok, and Chonburi (Eastern province). When the crisis like the covid-19 hits, firms cut their operating hours so that these workers experience instantaneously income losses.[9] Such effects would be more severe for foreign workers as opposed to the locals as the former's adjustment option is rather limited. As argued in Iwamoto (2020), thousands of these unskilled foreign workers rushed to leave Bangkok due to layoffs or fears that they would lose their jobs during the covid-19

[9] See also experience of migrants from South Asia working in the middle east at the Economist (2020)

lockdown without a right to receive unemployment benefit. Many workers returned to their home countries.

Interestingly, adjustment option varies according to how these foreign workers entered Thailand. In general, two main processes to facilitate unskilled workers to Thailand have been developed. The first is through the memoranda of understanding (MOU) signed in 2002 with neighboring Cambodia, the Lao People's Democratic Republic, Myanmar and Vietnam which provide migrants a fully legal channel to access job opportunities in Thailand (henceforth referred to as MOU channel in short).[10] The second approach is through the registration system known as the nationality verification (NV) process, which allows undocumented migrants to regularize their status without having to return to their countries of origin (henceforth referred to as NV channel). The NV channel begins for migrants by registering for an identification card at one-stop service centers (OSCC).

The Thai government has sought to encourage greater employment of migrant workers through the MOU channel but its performance has been rather disappointed so far. For example, the numbers through MOU channel by workers from Myanmar, Cambodia and Lao PDR increased from 0.2 million workers in 2014 to 0.5 million workers in 2017. Its share to total migrant workers still accounted for 16.7 per cent in 2017, slightly increasing from 13.7 per cent in 2014. The disappointed performance was due to the costly, time-consuming and complex procedures, and the limited benefit for migrant workers so that most migrants enter the country through irregular channels (Harkins et al. 2017; ILO, 2017). It means that these migrant workers are a vulnerable employment population. For host nations, the potential social cost of excluding vulnerable workers from safety net provisions is much larger than the immediate fiscal burden of protecting them.

Figure 2 illustrates that migrant workers are at the first to be laid off. When the covid-19 crisis hit Thailand, a number of migrant workers from Myanmar, Cambodia and Lao PDR dropped noticeably, from 2.7 million workers to 2.1 million workers. Such a drop was largely due to the suspending operation of OSCC during the lockdown. Whether yet documented foreign workers returns their countries of origin remains open question but pointing to an area for cooperation among AMS. By contrast, those entering MOU slightly declined from 1.1 million in January 2020 to 0.9 million in August 2020.

[10] Since 2002/3, Thai government has signed memoranda of understanding (MOUs) on employment cooperation with the Governments of Cambodia, the Lao People's Democratic Republic and Myanmar which provided a framework for regular labor migration to Thailand from neighboring countries (ILO, 2015).

Insight gathered during the interview with garment firms suggests that these migrants entering through MOU channel have been less vulnerable because it is a requirement under MOU that employers must return all workers under the MOU scheme to their country of origin after the employment contract complete. Nonetheless, firms would respond differently, depending on the demand recovery and firms' strategy. For outwear which is niches for Thailand, firms look after these workers during the lockdown with the expectation of quick rebounding demand after the crisis ended. These firms have to find something for their workers to do while export order was ceased, including producing medical textiles such as medical masks, personal protective equipment (PPE) suites.

Those producing sport wears and the like (massive volume) prefer ending the working contract and sent them home as required under the scheme instead of holding them until the crisis ended. Even though they expect the quick demand recovery in the post-crisis era, they take it as the opportunity to re-strategize their company by further shifting production to neighboring countries (Vietnam and Cambodia) and keeping Thailand's factories as the headquarter for product development.

Interestingly, those acquired through NV channel were just laid off. Some might return home whereas the others might remain in Thailand. They are excluded from safety net provisions as well as not eligible for assistance measures that might have in the host countries. For host nations, the potential social cost of excluding vulnerable workers from safety net provisions is much larger than the immediate fiscal burden of protecting them. Regional policy coordination is vital given poor border control and interconnected labor markets.

5. Conclusion and Policy Inferences

This paper examines labor displacement effect of the automation technology on unskilled foreign workers. The core methodology involves analyses of primary data collecting in this. They are firm interview and short questionnaires are undertaken from April to June 2020. In the former, 25 firms were interviewed (8 in processed foods, 10 in garments, 4 in hotels, and 3 experts and SI firms. Note all interviews were undertaken through phone or virtual meeting between April and May 2020. The latter covers 120 questionnaire returns in these three businesses during the same periods, covering all firm sizes.

The key finding suggests that labor displacement effect on these foreign workers is rather limited. Most of these foreign workers are at the production process whose dexterity is needed where human labor will still have a comparative advantage. It is finger dexterity

handling raw materials in the processed food industry where foreign workers are positioned. Such works have been long shunned by locals amidst the tightening labor market environment. Given the niches of garment industry in Thailand, hand dexterity remains crucial and makes automation technically infeasible. This is different from hotel sector where foreign workers are on automatable tasks like dish washing, cleaning, repairing, and gardening but decision to hire foreign workers is based on the cost effectiveness. When it comes to hotel services, they prefer locals because hotel services is social interaction by nature and locals have comparative advantage over the foreign workers.

Note that interview evidence suggests that hiring these foreign workers is virtually the last as hiring these workers incurs costs and involves uncertainty largely from cumbersome in government procedure and frequent changes in policy stance. It becomes unavoidable to keep business going.

Automation technology that has been adopted so far is in pre- and post-production. In production processes, automation technology played a rather limited role. In processed food and garment industries, automation technology that has been feasible so far creates the limited labor displacement but its associated productivity effect is larger. Hence, this made the overall demand for workers unchanged virtually. Experience drawn from interview with hotel owners suggests the limited role of automation technology. It is not because of technological feasibility but cost advantage so that this made a bit favor of labor as opposed to automation system.

When mapping tasks to be automated and those foreign workers attribute to suggests that labor displacement on these workers that might have would be limited in the short run. In fact, the productivity effect associated with adopting automation technology tends to be stronger and make their job less likely to be displaced. In the processed foods and garment industries, the role of dexterity foreign workers provide keep them safe from the displacement effect from automation. It is the relative cost advantage that keep foreign workers in demand in the hotel business.

In theory, covid-19 and measures imposed to stop the disease spread (social distancing) would catalyst automation technology but in reality the demand contraction effect as well as uncertainty induced by the covid-19 made firms postpone any lumpy investment like adoption of automation technology. Nonetheless, it is the covid-19 crisis that makes these foreign workers at risk. In particular, the sizable demand contraction by the covid-19 causes these foreign workers to be fired from the current jobs. This seems to be a wake-up call for both AMS to handle flows of unskilled foreign workers. As revealed in local presses in many AMS, foreign workers are vulnerable to both the diseases and impact of economic contraction

induced by it. Interestingly, adjustment option varies according to how these foreign workers entered Thailand. Our result suggests that migrant workers under MOU channel have been treated in a less vulnerable manner as opposed to NV channel which remain popular for migrant workers.

Three policy inferences can be drawn from this study.

Firstly, turning informal/illegal migrants to formal ones is the key for AMS to share mutual benefit from the flows of unskilled workers within the region and to achieve cohesive economic community which is at the center of ASEAN 2025 vision. Experience of firms' responses during the covid-19 points to how vulnerable foreign workers and informal ones in particular are. Governing such flows should be handled efficiently and effectively, using on bilateral policy platform like MOU between labor-sending and labor-receiving AMS in interest. It should not be addressed through the ASEAN-wide approach as the issue itself is rather controversial and each AMS has different interest. Thailand's MOU approach used between Thailand and her 3 neighbors is the example of the bilateral agreement.[11] This should go together with establishing an oversight committee to assess the performance of the platform. The more the efficient the bilateral platform implemented, the less the likely unskilled migrants will enter illegally. Experience of Singaporean immigration policy would be the good example of transparent scheme for other AMS to follow suit.[12]

Secondly, AMS should establish a body within the ASEAN Secretariat to be tasked with designing a migration system as well as setting guidelines to be used in the bilateral policy platform. This is to ensure transparent and fair practices between labor-sending and receiving AMS.

Finally, unified social protection system in the ASEAN bloc will not only protect and nurture its 350.5 million person workforce, but also lower migrants illegally entering. This is evident in the border between Thailand and Myanmar at the north where there are numerous Myanmar workers benefiting from better health care schemes in Thailand (Kohpaiboon, 2019). By contrast, unequal policy provisions across the region may cause an exodus of migrants — the promise of universal care in one country may attract workers from other AMS. A well-coordinated response ensuring basic social safety net provisions can go along way in preparing all member states for post-pandemic recovery.

[11] As revealed in ILO (2016), Malaysia is still fine tuning immigration policy to govern properly the flows of foreign workers.
[12] See the recent review of Singapore's Immigration system in Nowrasteh (2018).

Table 1: Number of AMS migrants working abroad (mil)

Year	Brunei Daurssalam	Cambodia	Indonesia	Lao People's Democratic Republic	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam	ASEAN
1990	0.0	0.4	1.6	0.5	0.6	0.7	2.0	0.2	0.3	1.2	7.5
1995	0.0	0.4	2.0	0.5	0.9	0.9	2.5	0.2	0.4	1.6	9.4
2000	0.0	0.5	2.3	0.6	1.2	1.2	3.1	0.2	0.5	1.9	11.6
2005	0.0	0.7	2.7	0.9	1.4	1.8	3.7	0.2	0.6	2.1	14.1
2010	0.0	1.0	3.5	1.2	1.6	2.5	4.7	0.3	0.8	2.4	17.9
2015	0.0	1.0	4.0	1.3	1.8	2.8	5.4	0.3	0.9	2.6	20.2
2017	0.0	1.1	4.2	1.3	1.9	2.9	5.7	0.3	0.9	2.7	21.0

Source: Migration Report database 2017

Table 2: Number of migrants working in AMS (mil)

Year	Brunei Daurssalam	Cambodia	Indonesia	Lao People's Democratic Republic	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam	ASEAN
1990	0.1	0.0	0.5	0.0	0.7	0.1	0.2	0.7	0.5	0.0	2.9
1995	0.1	0.1	0.4	0.0	0.9	0.1	0.2	1.0	0.8	0.1	3.7
2000	0.1	0.1	0.3	0.0	1.3	0.1	0.3	1.4	1.3	0.1	4.9
2005	0.1	0.1	0.3	0.0	1.7	0.1	0.3	1.7	2.2	0.1	6.5
2010	0.1	0.1	0.3	0.0	2.4	0.1	0.2	2.2	3.2	0.1	8.7
2015	0.1	0.1	0.3	0.0	2.7	0.1	0.2	2.5	3.5	0.1	9.6
2017	0.1	0.1	0.3	0.0	2.7	0.1	0.2	2.6	3.6	0.1	9.9

Source: Migration Report database 2017

Table 3: Matrix of Intra-regional Migrant Stocks

1990

Country	Origin of migrants (# of migrants)											% of total
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	ASEAN	
Brunei	..	..	3,324	..	40,306	..	7,837	1,499	6,612	..	59,578	81.4
Cambodia	..	..	49	121	80	24	71	57	14,149	16,771	31,322	81.6
Indonesia	..	..	..	..	5,406	..	3,472	4,346	1,458	..	14,682	3.2
Lao	..	1,398	..	..	..	404	..	..	2,277	13,852	17,931	78.4
Malaysia	3,234	747	252,710	..	..	4,568	104,730	31,269	31,127	12,877	441,262	63.4
Myanmar	..	..	..	..	..	..	..	..	..	..	0	0.0
Philippines	106	7,528	3,752	4,321	245	55	..	133	180	18,174	34,494	22.4
Singapore	..	..	21,520	..	195,072	..	1,175	..	1,438	..	219,205	30.1
Thailand	..	73,756	545	165,019	1,293	229,504	1,266	809	..	18,879	491,071	92.9
Vietnam	..	..	4,485	..	134	..	591	57	119	162	5,548	19.7

Note: A number of workers from Cambodia working in Lao accounted in 2000 = AR661

DD = Total – sum (ASEAN)

1995

Country	Origin of migrants (# of migrants)											**% of total**
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	ASEAN	
Brunei	..	..	4,551	..	42,782	..	10,226	1,472	10,047	..	69,078	81.5
Cambodia	..	..	129	317	210	63	186	150	37,488	44,367	82,910	89.9
Indonesia	..	..	..	..	3,577	..	2,297	2,875	964	..	9,713	2.6
Lao	..	1,362	..	..	..	360	..	..	2,060	13,368	17,150	72.9
Malaysia	2,956	1,770	421,423	..	..	10,170	123,116	33,418	29,090	28,668	650,611	69.4
Myanmar	..	..	..	..	..	..	..	..	..	..	0	0.0
Philippines	142	10,130	5,049	5,815	329	74	..	178	242	24,458	46,417	22.4
Singapore	..	..	34,241	..	431,854	..	2,480	..	3,032	..	471,607	47.6
Thailand	..	102,948	495	205,957	1,170	436,777	1,146	730	..	12,336	761,559	94.1
Vietnam	..	..	4,893	..	145	..	629	62	130	176	6,035	11.8

2000

Country	Origin of migrants (# of migrants)											% of total
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	ASEAN	
Brunei	..	..	5,778	..	45,258	..	12,614	1,445	13,482	..	78,577	81.6
Cambodia	..	..	208	513	339	102	301	242	60,844	71,963	134,512	92.1
Indonesia	..	..	..	..	1,748	..	1,122	1,405	471	..	4,746	1.6
Lao	..	1,197	..	..	..	282	..	..	1,648	11,611	14,738	67.1
Malaysia	2,989	2,979	634,380	..	..	16,841	154,427	39,077	30,108	47,469	928,270	72.7
Myanmar	..	..	..	..	..	..	..	..	..	..	0	0.0
Philippines	805	186	4,711	532	316	333	..	231	120	601	7,835	2.5
Singapore	..	..	50,277	..	710,434	..	4,027	..	4,921	..	769,659	56.9
Thailand	..	153,382	549	289,386	1,290	734,129	1,264	803	..	8,340	1,189,143	94.5
Vietnam	..	..	5,337	..	159	..	673	68	143	192	6,572	11.6

2005

Country	Origin of migrants (# of migrants)											% of total
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	ASEAN	
Brunei	..	..	5,907	..	46,267	..	12,895	1,477	13,782	..	80,328	81.6
Cambodia	..	..	162	400	265	80	235	189	47,494	56,174	104,999	92.1
Indonesia	..	..	..	..	1,837	..	2,305	10,537	10,085	..	24,764	8.6
Lao	..	1,119	..	..	..	245	..	..	1,538	10,717	13,619	66.9
Malaysia	4,120	7,714	775,648	..	..	120,771	81,938	53,856	17,786	61,261	1,123,094	65.2
Myanmar	..	..	..	..	..	..	..	..	..	..	0	0.0
Philippines	651	150	3,813	430	255	269	..	186	97	486	6,337	2.5
Singapore	..	..	91,090	..	818,337	..	8,195	..	10,010	..	927,632	54.2
Thailand	..	369,213	564	539,966	1,209	1,150,168	1,195	713	..	7,172	2,070,200	95.7
Vietnam	..	..	5,666	..	169	..	731	73	152	204	6,995	13.5

2010

Country	Origin of migrants (# of migrants)											% of total
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	ASEAN	
Brunei	..	..	6,036	..	47,276	..	13,176	1,509	14,083	..	82,080	81.6
Cambodia	..	..	116	288	191	58	169	136	34,143	40,384	75,485	92.1
Indonesia	..	..	..	..	2,045	..	3,636	20,346	20,346	..	46,373	15.2
Lao	..	2,309	..	..	..	249	..	..	2,449	15,023	20,030	61.7
Malaysia	5,822	13,519	1,024,344	..	..	241,430	20,798	76,095	7,928	83,515	1,473,451	61.2
Myanmar	..	..	..	..	..	..	..	..	..	..	0	0.0
Philippines	80	38	3,253	372	781	415	..	807	335	406	6,487	3.1
Singapore	..	..	136,979	..	971,827	..	12,820	..	15,658	..	1,137,284	52.5
Thailand	..	611,508	621	829,240	1,216	1,648,602	1,213	675	..	6,519	3,099,594	96.1
Vietnam	..	..	5,777	..	173	..	762	75	155	209	7,151	11.6

2015

Country	Origin of migrants (# of migrants)											% of total
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	ASEAN	
Brunei	..	..	6,165	..	48,285	..	13,457	1,541	14,384	..	83,832	81.6
Cambodia	..	..	105	260	172	52	152	123	30,806	36,436	68,106	92.1
Indonesia	..	..	..	..	2,263	..	4,025	22,525	22,525	..	51,338	15.2
Lao	..	3,499	..	..	..	254	..	..	3,361	19,330	26,444	59.3
Malaysia	6,083	14,127	1,070,433	..	..	302,292	101,732	79,519	8,283	87,272	1,669,741	63.0
Myanmar	..	..	..	..	..	..	..	..	..	..	0	0.0
Philippines	82	39	3,304	287	793	421	..	820	340	413	6,499	3.1
Singapore	..	..	163,237	..	1,123,654	..	15,392	..	19,269	..	1,321,552	52.0
Thailand	..	661,275	671	896,727	1,314	1,782,773	1,311	729	..	7,049	3,351,849	96.1
Timor	..	..	5,901	..	176	..	778	76	158	213	7,302	62.0
Vietnam	..	990	7,860	6,956	128	11,187	113	1,751	11,552	..	40,537	55.7

2017

Country	Origin of migrants (# of migrants)											**% of total**
	Brunei Darussalam	Cambodia	Indonesia	Lao PDR	Malaysia	Myanmar	Philippines	Singapore	Thailand	Viet Nam	ASEAN	
Brunei	..	..	6,517	..	51,048	..	14,227	1,629	15,207	..	88,628	81.6
Cambodia	..	..	108	268	177	53	156	126	31,791	37,601	70,280	92.1
Indonesia	..	..	..	..	2,315	..	4,117	23,045	23,045	..	52,522	15.2
Lao	..	3,568	..	..	..	259	..	..	3,428	19,716	26,971	59.3
Malaysia	6,204	14,409	1,091,841	..	..	308,337	103,766	81,109	8,448	89,017	1,703,131	63.0
Myanmar	..	..	..	..	..	..	..	..	..	..	0	0.0
Philippines	84	40	3,407	296	817	434	..	845	350	425	6,698	3.1
Singapore	..	..	168,355	..	1,158,890	..	15,874	..	19,873	..	1,362,992	52.0
Thailand	..	680,686	690	923,050	1,352	1,835,106	1,349	750	..	7,255	3,450,238	96.1
Timor	..	..	6,040	..	180	..	796	77	161	218	7,472	61.9
Vietnam	..	1,035	8,217	7,272	133	11,695	118	1,830	12,077	..	42,377	55.7

Source: Migration Report database 2017

Table 4
Basic Information of Questionnaire Returns

Industry	Number of Samples covered				% to total
	Total	S (<50)	M (50-200)	L (>200)	
Food	57	38	8	11	47.5
Garment	17	10	0	4	14.2
Hotel	46	26	10	10	38.3
Total	120	74	18	25	100

Note: S, M and L denote small, medium and large enterprises where number in parentheses are a number of workers used as a criterion.
Source: Questionnaires conducted in this study

Table 5

Establishments hiring foreign workers

	Number of observation	% firms hiring foreign workers to total firms	Average share of foreign to total workers	Maximum share of foreign to total workers
Food	20	33.9	15	81.3
Garment	7	36.8	22.1	80
Hotel	15	31.3	2.8	30
Total	42	33.3	9.4	81.3

Source: Questionnaires conducted in this study

Table 6

Position in supply chain firms adopted automation system: Thai processed foods

(Number of firms replying)

	Already adopted	To be adopted	No
Online inputs sourcing	15	4	38
Product design/development	24	10	23
Business planning	17	9	31
Controlling and monitoring	13	10	34
Production line	18	8	31
Online sales	28	7	30
Strengthening supply chain networking	12	10	35

Source: Questionnaires conducted in this study

Table 7

Position in supply chain firms adopted automation system: garments manufacturers in Thailand (Number of firms replying)

	Already adopted	To be adopted	No
Online inputs sourcing	6	0	13
Product design/development	11	0	7
Business planning	5	2	12
Controlling and monitoring	5	4	8
Production line	3	2	14
Online sales	9	3	7
Strengthening supply chain networking	5	7	7

Source: Questionnaires conducted in this study

Table 8

Position in supply chain firms adopted automation system: hotels in Thailand

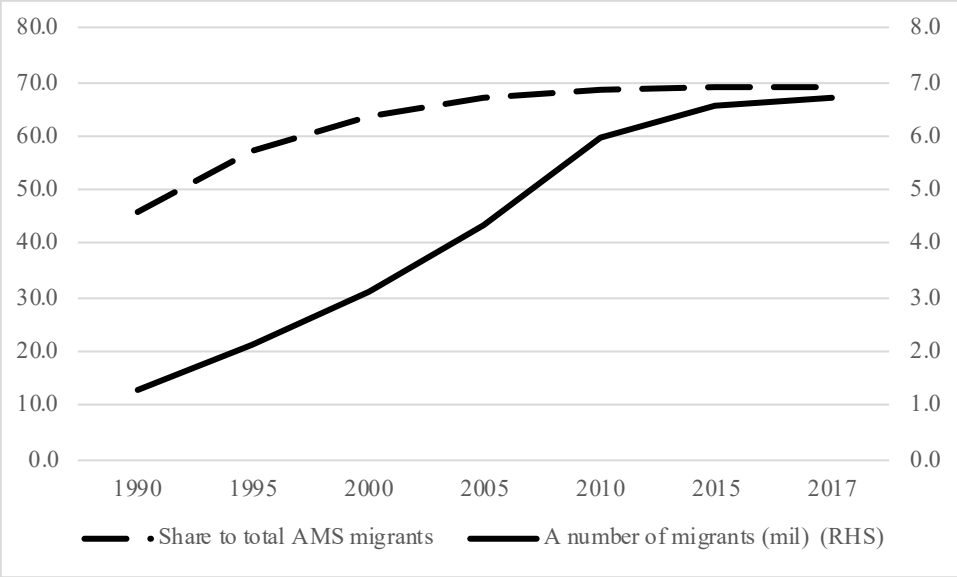
(Number of firms replying)

	Already adopted	To be adopted	No
Inputs sourcing	9	6	9
Product design/development	12	7	5
Booking registering and billing	15	4	5
Offering services	8	4	12
Customers' satisfactory assessment	7	6	9
Networking with other hotels locally and abroad.	4	6	14

Source: Questionnaires conducted in this study

Figure 1

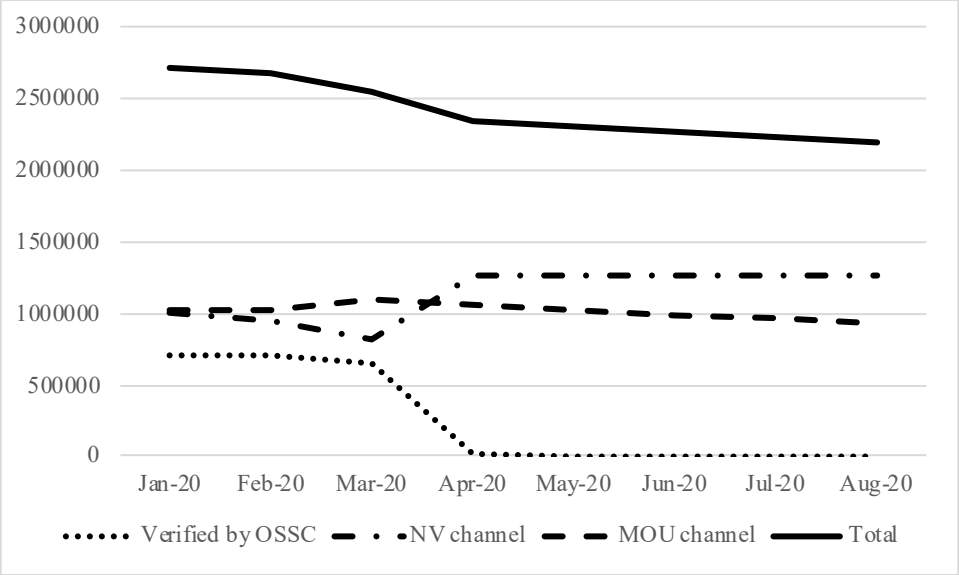
Intra-ASEAN Migrants from 1995 to 2017



Source: Migration Report database 2017

Figure 2

Process for obtaining documentation from January to August 2020



Source: Migrant Statistics (various issues), Department of Employment, Ministry of Labor and Social Welfare

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