The Contribution of Vocational Skills Development to Cambodia's Economy

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List of acronyms and abbreviations

ACFTA	ASEAN-China Free Trade Area
ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
CGE	Computable General Equilibrium
CMT	Cut, Make and Trim
CQF	Cambodian Qualifications Framework
CSES	Cambodia Socio-Economic Survey
E&E	Electrical & Electronic
ECDVT	European Centre for the Development of Vocational Training
EV	Equivalent Variations
FDI	Foreign Direct Investment
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GHE	General Higher Education
GTAP	Global Trade Analysis Project
ICT	Information and Communication Technology
IDP	Industrial Development Policy
ILO	International Labour Organisation
In-VSD	In-employment Vocational Skills Development
IO	Input-Output
ISCO	International Standard Classification of Occupations
JICA	Japan International Cooperation Agency
MEF	Ministry of Economy and Finance
MoEYS	Ministry of Education, Youth and Sport
MoLVT	Ministry of Labour and Vocational Training
NA	Not Available
NEA	National Employment Agency
NGO	Non-Government Organisation
NIS	National Institute of Statistics
NPISHs	Non-Profit Institutions Serving Households
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Square
Pre-VSD	Pre-employment Vocational Skills Development
RGC	Royal Government of Cambodia
SAM	Social Accounting Matrix
SDP	Skills Development Program
SEAMEO	Southeast Asian Ministers of Education Organisation
SMEs	Small- and Medium-sized Enterprises

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STVET	"Strengthening Technical and Vocational Education and Training" Project
TVE	Technical and Vocational Education
TVET	Technical and Vocational Education and Training
TVETSDP	Technical and Vocational Education and Training Sector Development Program
UNDP	United Nations Development Programs
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UNEVOC	International Centre for Technical and Vocational Education and Training
VE	Vocational Education
VET	Vocational Education and Training
VSD	Vocational Skills Development
WTO	World Trade Organisation

Executive summary

In recognition of the importance of a well-trained workforce for socioeconomic development, the Rectangular Strategy Phase IV has put human resource development at the forefront of the Royal Government of Cambodia's (RGC's) development priorities (RGC 2018). The Industrial Development Policy (IDP) 2015-2025 was adopted as a guide to advance Cambodia's manufacturing industry as a key economic sector for sustainable and inclusive high economic growth, and to overcome the skills gaps and shortages in skilled labour that are purportedly a bottleneck to socioeconomic development. Against this backdrop, theoretical and empirical studies have suggested increasing the pool of skilled workers by equipping young people and existing workers with labour market-relevant knowledge and skills as an ideal solution. However, the contribution of this promising skilled labour increment to Cambodia's industrial sector and overall economy has rarely been investigated. Therefore, the main aim of this paper is to study the skills shortage and its effects, as well as the contribution of skills development at both the industrial and national level, by using two separate analytical methods.

Research methods

First, we used the firm-level survey data from 101 firms in Cambodia's manufacturing industries, namely garment, food processing and electronic and electrical assembly (E&E). A structured questionnaire was used to conduct face-to-face interviews with company management, for instance the director, production or factory manager, or human resource manager, by means of KoboToolbox platform via a tablet. We employed descriptive statistics such as median, frequency, and percentage in the form of tables or graphs to show and analyse the survey data. Then two sets of regression analyses were conducted to identify the correlations of vocational skills development (VSD) programs with firms' difficulty to find employees, growth and transformation.

Second, the paper applied the extended standard Computable General Equilibrium (CGE) model of Hosoe, Gasawa, and Hashimoto (2010), utilising a Social Accounting Matrix (SAM) of Cambodia based on the input-output (IO) table of ADB (2018) and the 2017 Cambodia Socio-Economic Survey (CSES). This study adopted a scenario that there was a hypthetical 10-percent increase in the supply of the L4 and L3 occupational categories (managers, professionals, and technicians and associate professionals), to see changes in the economy as a whole and also on the labour market and household welfare conditions. For the purpose of this study, the production factor agent is disaggregated into a capital agent and five labour agents (i.e., L0, L1, L2, L3, L4), where L1 designates no skill, L2 is low skill, and L3 is medium skill and L4 are high skill. Household agents are classified into six categories (i.e., capital better-off, capital poor, urban better-off, urban poor, rural better-off, and rural poor) according to their residence location and economic status so that we can estimate the effects on different household groups.

Skills shortage and its effects

Most companies in the three selected industries encountered some difficulties in finding operators, technicians, and employees for higher management positions. While it was easier to find general workers and supervisors (degree of shortage), there is still a high proportion of companies facing this difficulty (prevalence of shortage). The level of difficulty varies slightly between the sectors and the employee levels. The firms in the garment sector have less problems finding employees than the other sectors.

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Remarkably, the findings emphasise that food processing firms encountered significant difficulties in finding technicians, which exceeded the recruitment difficulties in any of the other employee levels and sectors. The proportion of E&E companies facing difficulties in finding supervisors was 70 percent, the highest among the three sectors.

The observed effects emerging from the recruitment difficulties were rated as "somewhat negative" in regard to firms' operations and growth. The effects are highly prevalent among the firms in the three sectors; when there is a noticeable shortage, there is always an effect felt by the firms.

The contributions of vocational skills development (VSD) programs

The paper points out that the E&E sector had the highest variety of pre-VSD programs; the food processing sector had the second most, followed by the garment sector. General workers in these three sectors lack pre-VSD program opportunities, while technicians are likely to have the highest variety of pre-VSD programs. Conspicuously, supervisors in the garment sector had no pre-VSD programs at all, since most of them are internally promoted from general workers or operators with experience and good working performance. Most pre-VSD programs in the three sectors were related to the fields of mechanical, electricity, electronics and food science. Most companies may have less involvement in sending their employee to get formal in-employment training.

The companies' representatives subjectively reported that VSD contributed significantly to meeting their skills needs, while the statistical analysis seems to indicate that the companies that have employees with more variety of pre-employment vocational skills development (pre-VSD) programs are more likely to experience higher difficulty to find workers, especially operators, supervisors, and technicians, than those with employees having less variety of pre-VSD. The results also suggest that the number of VSD programs had no effects on companies' growth, but there are some positive correlations between the number of pre-employment VSD programs and technological transformation and organisational improvement.

The effects of increment in the skilled labour supply

The CGE simulation has shown that a hypothetical 10-percent increase in the supply of skilled labour would bring about a real GDP growth of 0.83 percent. While the industry and service sectors expand, agriculture would reduce its aggregate value added and the wage structure would also change. Overall, the wage rate decreases by 4.1 percent. Skilled labour would benefit from more job generation but face a decrease in wage rates. The lower-skilled workers would enjoy higher wages, but experience fewer available jobs. This implies that an increment of the skilled labour supply without studying and satisfying the market demand would further worsen the skills mismatch and distort the wage structure and labour market.

Poor households tend to benefit little from the expansion in skilled labour supply (both in terms of income and social welfare), regardless of residence, probably because members of these poor households are rarely employed in such occupations.

Policy implications

Based on the results of the analysis and the available literature, this paper puts forward these recommendations for consideration and further discussion:

- Relevant stakeholders should facilitate job matching events such as job fairs, and improve career guidance in major industrial zones across the country;

- VSD providers should obtain and provide better guidance concerning what skills would meet sufficient labour demand by the private sector;

- Public-private partnership between VSD providers and the private sector should be promoted;

- Relevant government agencies and VSD providers should speed up curricular reforms and promote quality assurance of training programs and institutions;

- The design and development of VSD programs should be based on a skills need analysis, making the content of VSD programs relevant to the industry;

- Relevant government agencies and VSD providers should continue and even accelerate the study of the labour market demand; and

- There should be more encouragement and support for students from poor households with more access to, and participation in, vocational education and training.

1. Introduction

Cambodia has achieved an impressive annual growth rate of about 7 percent during the past two decades. Despite this economic growth, the Royal Government of Cambodia (RGC) needs to further boost its socioeconomic development if Cambodia is to catch up with its regional peers and meet government goals of becoming an upper-middle income country by 2030, and a high-income country by 2050 (Ministry of Education, Youth and Sport [MoEYS] 2014; RGC 2018). To fulfil this ambition, the Cambodian government has embarked on several major initiatives, namely the Rectangular Strategies, the IDP 2015-2025, and the National Technical and Vocational Education and Training (TVET) Policy 2017-2025.

In recognition of the importance of a well-trained workforce for socioeconomic development, the Rectangular Strategy Phase IV has put human resource development at the forefront of the RGC's development priorities (RGC 2018). The IDP 2015-2025 was also adopted as a guide to advance the country's manufacturing industry as a key economic sector for sustainable and inclusive high economic growth. In alignment with the IDP 2015-2025, the TVET Policy 2017-2025 aims to "improve the livelihood and dignity of people and especially to enhance Cambodia's workforce with knowledge, competence, skills, working attitudes, professional ethics, high productivity, and competitiveness for lifelong employability" (RGC 2017, 4).

Cambodia's development partners have also made strong commitments to enhance skills development across Cambodia. For instance, the Japan International Cooperation Agency (JICA) implemented the "Project for Improving TVET Quality to Meet the Needs of Industries" with the Ministry of Labour and Vocational Training (MoLVT)'s TVET institutes from 2015 to 2020 (JICA 2015). In regard to non-formal TVET, the Swiss funded Skills Development Program (SDP) intends to improve the income and employment opportunities for disadvantaged young people in rural Cambodian provinces (Swisscontact 2018). Cambodia also received a grant for the "Strengthening Technical and Vocational Education and Training (STVET)" project from the Asian Development Bank (ADB) (ADB 2016a). This project was then extended with additional loans and renamed the "Technical and Vocational Education and Training Sector Development Program" (TVETSDP) 2016-2020, with the overall aim to enhance access and quality of TVET (ADB 2014). Also, Cambodia is now implementing the "Skills for Competitiveness" project 2019-2023 which intends to develop skilled labour in four priority sectors: manufacturing, construction, electricity, and electronics (ADB 2019).

Yet, Cambodia still faces many challenges in skills development that remain critical to its economic development (Khieng, Madhur, and Chhem 2015; Madhur 2014). Previous studies (Bruni, Luch, and Kuoch 2013; EMC 2014; Kuoch 2015; HRINC 2010) indicated that skilled labour shortages and skills gaps are acute in the Cambodian labour market due to education and training systems that are not responsive to labour market demand. Improving the match between the skills demand and skills supply will need further effort and resources, such as improving the relevance and quality of training, as well as expanding the skills training provisions across the country.

The contribution of skills development to meeting the skills needs and growth of the manufacturing industry and wider economy, as well as its effects on income distribution and social welfare, is little studied in Cambodia. Therefore, the main aim of this paper is to study the skills shortages and their effects, and the contribution of skills development at both the industrial and national level. Specifically, this study has the following objectives:

- To identify skills shortages and their effects on a firms' operations and growth;
- To verify whether VSD programs are a remedy to cope with the skills shortages;
- To identify the effects of VSD programs on companies' growth and transformation;
- To quantify the impacts of increment in skilled labour supply on Cambodia's labour market, economy, and social welfare; and
- To explore possible policy implications.

2. Literature review

2.1 Skills development and socioeconomic development

Human capital has long been viewed as a principal contributor to a country's economic development, according to prominent economists Theodore W. Schultz (1960; 1961), Gary S. Becker (1962; 1992; 1994), and Jacob Mincer (1974). Economists and researchers continue to analyse investments in education and training by estimating return rates at the individual, firm and national level. The results suggest that training substantially increases the wage levels of individuals and the productivity of firms, and thereby accelerates a country's socioeconomic development (OECD 2001; Kwon 2009; Hanushek 2013; Sianesi 2002; Absalyamova et al. 2015). Investment in education, training, and learning provides a solid foundation for economic growth, social inclusion, and personal development (OECD 2001; 2014; Salmi 2017; Mupimpila and Narayana 2009).

The World Bank (2010, 45) used the data from four Asian countries – Cambodia, Thailand, Vietnam, and the Philippines – to estimate and compare the wage premiums of people with different educational achievements. The regression results showed that the rate of return from higher education was the highest, compared to that of secondary and primary education in those four countries. For instance, Cambodian higher education holders could earn 67 percent more than workers without any education, while workers with primary and secondary school education could find jobs but earn lower wages.

The experiences of developed Asian economies like Japan, Taiwan, South Korea, and Singapore have shown that skills development is a key to economic development (Benson, Gospel, and Zhu 2013), with skills being an important factor explaining why these countries are more developed than others. While the significant role of human capital in economic growth and productivity has always been expressed in development priorities, TVET in particular has made a revival and is revisited in theoretical and empirical debates as a tool for the socioeconomic development in the developing world (Nilsson 2010; Allais 2012; McGrath 2012; Kwon 2009), and as enhancement to key drivers of local growth: skills, innovation, transformation, entrepreneurship, and social inclusion (Giguère 2008; Nilsson 2010; Mupimpila and Narayana 2009; OECD 2001).

Mupimpila and Narayana (2009), based on a standard neoclassical growth model with human capital variables, investigated the link between TVET and economic growth in Botswana. Their results showed that there was a positive and significant correlation between economic growth and TVET, compared to higher education. These presumed effects of skills development can be strengthened if informal learning, on-the-job training or lifelong learning is also included in the models, as Acemoglu and Pischke (1999a) observed in their analysis. In an effort to close this gap, Cedefop (2014) observed and compared macroeconomic benefits of different types of TVET in six developed countries – Denmark, Germany, France, the Netherlands, Sweden, and the UK. Similar to the results of Mupimpila and Narayana's (2009) study, Cedefop

(2014) showed that the availability of different levels of education (low, lower- and upper-intermediate and high) contributed to the economic success of a country. These results suggest a strong linkage between TVET of different types and economic growth and productivity in both developed and developing countries. The most recent studies in developed and developing countries by Patrinos and Psacharopoulos (2020) and Gunderson and Oreopolous (2020), reconfirmed and stressed the importance of education and training for a country, regardless of economic estimation methods or procedures applied.

The UNDP office in Cambodia (2019) recently used a microeconomic analysis of survey data to estimate the economic returns to investment in education and TVET in Cambodia, and found no significant wage differences between TVET and general higher education (GHE) graduates. Both types of graduates earned higher wages than graduates with lower education or without any education or further training. The study also pointed out that the school-to-work transition of TVET graduates was smoother than that of GHE graduates, implying more job opportunities for TVET students in the labour market. In order to see the effects of TVET on the economy, the study also applied a standard static computable general equilibrium (CGE) model with two simulation scenarios of (1) injecting additional US$10 million of government spending into TVET, and (2) another US$10 million into non-TVET education. The results showed a positive impact on the economy by increasing real GDP, wage rate of labour, and household income.

2.2 Challenges and problems in skills development

The relevance and quality of education and training is critical in many developing countries, in order to avoid weak education and training systems not meeting the skills needs of the industry and provoke employers' distrust in employees' educational or TVET qualifications. Further issues are a poor basic education system and unequal access to quality education (Spaull 2013; Spaull and Kotze 2015; Sam, Zain, and Jamil 2012), which builds a solid foundation for higher education and TVET. Due to scarce resources, governments in the developing world often face the dilemma of investing in general education leading to higher education, or investing in TVET leading to the world of work, while both sectors are equally important for socioeconomic development (Sam, Zain, and Jamil 2012; Pefianco, Curtis, and Keeves 2003).

Despite the noticeable expansion of access to the TVET sector across the developing world, and the corresponding rise in student enrollment rates, there remain many issues and problems in making education and training responsive to the labour market and aligning them with the purpose of industrialisation and economic growth. Linking skills development to the needs of industry requires an effective coordinating mechanism among relevant stakeholders that ensures highly effective linkages among skills development policies, TVET providers and firms (Allais 2012; Akoojee 2012; McGrath 2012). As in other developing countries, Cambodia faces the problem of coordination issues due to overlap among government ministries claiming responsibility of various education and training tasks (Sen and Ros 2013; Sen 2013).

Many employers in Cambodia, as in neighbouring Vietnam and Laos, find it difficult to find suitable employees to fill job vacancies (ADB 2016b; 2020; HRINC 2010, NEA 2018). It is a major challenge for less developed countries to upgrade and deploy new technologies, and the ability to absorb foreign technology rests largely on the availability of a stock of skilled labour and the skillsets required for new technologies (Abbas and Foreman-Peck 2008). Thus, enhancing the capabilities of a workforce through skills training and skills upgrading with essential skills and competence plays a crucial role for industrial development in most developing economies.

As technological development continually advances, the skills of current employees could become obsolete (Kim and Park 2020), and skills shortages and the mismatch could worsen. If simple or routine tasks are replaced by automatisation or moved to other cheaper-labour countries, jobs in Cambodia could be lost at a time when many Cambodian employees are demanding increases in minimum wages.

2.3 Forms of skills training and development for workforce

Initial education and training

TVET is one of the mainstream education and training channels for workforce development, and according to UNESCO's official definition, includes formal, non-formal, informal, and workplace settings, while giving learners a wide range of learning experiences relevant to the world of work (Catts, Falk, and Wallace 2011). More broadly, TVET tends to be termed differently depending on the country or organisation, for example, vocational education (VE), technical and vocational education (TVE), vocational education and training (VET), or workforce education etc. (Hollander and Mar 2009; OECD 2010). But central to all of these terms is the primary goal of equipping learners with knowledge, skills and competencies necessary for particular occupations or industries (ECDVT 2014). It includes initial skills development prior to employment, and also further education and training during or after employment, through various forms of reskilling and upskilling (UNESCO-UNEVOC, 2006; as cited in Catts et al., 2011).

In this paper, the similar term vocational skills development (VSD) is used, which focuses on formal, specific pre- and in-employment education and training programs. The pre-employment programs may cater to lower, medium or higher skilled employees before entering the respective industry. They include short-term training as much as industry-oriented higher education programs, leading to some kind of certification and industry-specific skills, while the in-employment programs may cater to lower, medium or higher skilled employees after joining the respective industry but are offered or certified by third parties, also leading to industry-specific skills.

Initial education and training are seen as a premium asset by employers if skills, qualifications and credentials produced by an education and training system are relevant to the company's skills needs. Employers also use educational qualifications as a screening device (Spence, 1973; as cited in OECD, 2001). Contrarily, employees use their initial education and training as a tool for bargaining over employment conditions, which can explain wage differentials among individuals and across firms (OECD 2001).

Initial education and training are significant to meeting current job requirements and as a foundation on which individual workers' skills are built. Post-education training such as workplace or industrial skills training programs cannot substitute initial education, meaning that initial education can be considered a master key to unlock individual workers' potential for the world of work, complemented by further education and training after entering the labour market (Senker 2000; Wolbers 2005). However, most education and training institutions do not ensure that their training contributes to workplace performance in response to meeting the expectations of employers today. Thus, linking initial education and training to the world of work remains a difficult task. It requires bridging the emerging divergences between educational goals and the goals of the wider society and economy (Senker 2000), resulting from the rapid changes in technologies, demanding new skills and knowledge for work re-organisation and new production chains (Gibson and Sodeman 2015).

On-the-job training and informal learning

When entering companies, most workers receive specific skills training. Such skills training programs are intended to enable employees to acquire or to improve their job-specific skills and knowledge through on-the-job training, off-the-job training and informal learning, as part of employers' corporate strategies or human resource development plans (ECDVT 2014; Selesnick 1981). On-the-job training, a popular form of industrial training, is incorporated into workers' normal work, meaning that they learn particular skills by doing specific jobs or tasks, while off-the-job training usually requires employees to be away from their normal work to participate in designated training programs outside of the firm (ECDVT 2014). The workplace is a significant site of formal and informal learning opportunities, brought about by the nature of work and employees' social interaction within the workplace (Caldwell 2000; Thang, Quang, and Buyens 2010; Nguyen, Truong, and Buyens 2011). However, much workplace learning is informal and low cost (Rainbird 2000), which employers provide for low-skilled employees in low value-added production chains. The main areas of skills development for highly skilled employees are on productivity and competence-building skills areas. This includes technical, management and entrepreneurship skills, with a complex form of skills and knowledge. For low-skilled employees, the focal training is generic, routine, occupational health and safety, and basic information technology (OECD 2013). Manufacturing and service sector firms require not only technical but also life and soft skills, allowing employees to adapt to rapid changes (Froy 2012, Gibson and Sodeman 2015; Nguyen, Truong, and Buyens 2011).

Studies indicate that only a small proportion of employees have access to formal skills training, usually given to high-skilled people in large-sized firms, while small- and medium-sized enterprises (SMEs) limit the number of formal training programs (OECD 2013; Rainbird 2000; Selesnick 1981). SMEs are more likely to train their workers through informal, knowledge-intensive activities in equipping them with (new) necessary skills for the production or operation requirements (OECD 2013; Vermeulen 1981). Companies seem to support specific skills training for employees when the labour market is incomplete and imperfect. The firms may not intend to support the acquisition of generic skills since they may lose employees at a particular time (Acemoglu and Pischke 1999a, 112).

3. Overview of Cambodia and its economy

3.1 Economic and industrial development

Cambodia's GDP has tripled in volume from US$4.1 billion in 2002 to US$13 billion in 2018, resulting in an impressive annual GDP growth rate of around 7 percent over the decade. The expansion in manufacturing (from US$758 million in 2002 to US$3 billion in 2018), construction (from US$233 million to US$1.3 billion) and services (from US$1.5 billion to US$5.1 billion) has benefited from foreign direct investments (FDI) and also the government's efforts in reforming the business environment and attracting foreign investors.

Cambodia's most relevant manufacturing sub-sectors include textile, apparel and footwear; food, beverages and tobacco; rubber; wood, paper and publishing; and other manufacturing (non-metallic manufacturing; basic metal and metal products; and others). These sub-sectors have all increased in value added over the past 15 years (Figure 1), reflecting the overall growth in Cambodian manufacturing, led by the production of textile, apparel and footwear (National Institute of Statistics [NIS] 2020). The sub-sectors of rubber manufacturing; wood, paper and publishing; and other manufacturing are rising but still small in volume.

Figure 1: Share of manufacturing sub-sector, 2002-2018
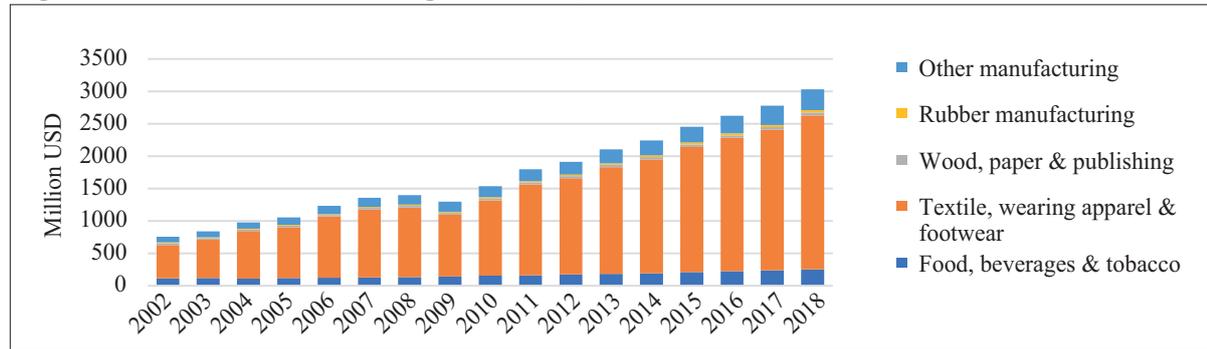
Source: National Account, National Institute of Statistics, accessed in Jan 2020

The textile, apparel and footwear sector has played an important role in creating employment for unskilled and low-skilled workers, especially women from rural areas, and contributed to Cambodia's economic growth via exports to the US and EU over the past two decades. For example, the production of textile, wearing apparel and footwear was worth US$2.4 billion (18.2 percent of GDP) in 2018 (NIS 2020), while the total value of import of textiles and articles was US$5.4 billion and its export was US$13.1 billion in 2018. The exports of these sub-sectors made up over 70 percent of total exports, making a significant jump from 36 percent in 2002.

The production of food, beverage and tobacco amounted to US$254 million (1.9 percent of GDP) in 2018, rising from US$114 million in 2002 (NIS 2020). This sector plays a crucial role in Cambodia's economic diversification, food security and agricultural development, as Cambodia imported US$1.9 billion of related products in 2018, implying that local production capacity remains weak.

Among the sub-sectors of other manufacturing, the E&E sector is a quickly growing nascent sector following a strategic shift in many Japanese firms to move their E&E component productions from China and Japan to Southeast Asia. In 2016, the total capital investment in E&E was valued at US$227 million, while its exports increased from about US$6 million in 2012 to US$458 million in 2016 (Ven and Sry 2017). Cambodia's manufacturing is still a labour-intensive industry with unsophisticated production chains, employing a large pool of unskilled and low-skilled people, especially young women from rural households, illustrating an unsustainable, shallow economic foundation for the country's economic development (ADB 2015). One striking example is that about 60 percent of garment and textile factories in the industry are involved in cut, make, trim (CMT) activities; low value-added production steps requiring fewer worker skills (RGC 2017). In assembly plants, only low-skilled and low value-added jobs, such as assembling of key component parts and screwing, are available for labourers in production lines.

3.2 Skills and employment in the labour market

As in many developing countries, skills gaps and shortages have been chronic issues in Cambodia. Employers criticise the country's education and training system for producing graduates with limited foundational knowledge and lacking the skills necessary for the labour market (HRINC 2010; Khieng, Madhur, and Chhem 2015; Madhur 2014). The low educational attainment and skills among Cambodia's labour force is a bottleneck in its development ambition (UNDP Cambodia 2014). On average, Cambodians have only received 4.8 years of basic education, which is below the mean (8.4) of developing countries (UNDP 2018).

The 2017 Cambodia Socio-Economic Survey indicated that 65.7 percent of the Cambodian population is of working age (15-64 years old), with 84.3 percent of that in the workforce (NIS 2018). While the labour market participation is high, the workforce's education and vocational skills remain low. For instance, 12 percent of the workforce had no education, 31.7 percent had not completed primary education, 26 percent completed primary education, 15.5 percent completed lower-secondary education, 8.2 percent completed upper-secondary education, and only 6.6 percent completed post-secondary education (NIS 2018). This reflects the limited human resources for Cambodia's industrial growth and transformation, making it harder to adjust to rapid changes in technologies and production (RGC, 2017).

As Cambodia's economic structure has changed, the proportion of Cambodia's population working in the agriculture, fisheries and forestry sector declined dramatically from 4,214,000 people in 2002 to 2,999,000 in 2019, while the employment in the manufacturing, construction and services sectors rose sharply from 580,000, 112,000 and 1,347,000 in 2002 to 1,719,000, 902,000 and 3,594,000 in 2019, respectively (see further in Figure 2).

Figure 2: Employment trend by sector, 2002-2020
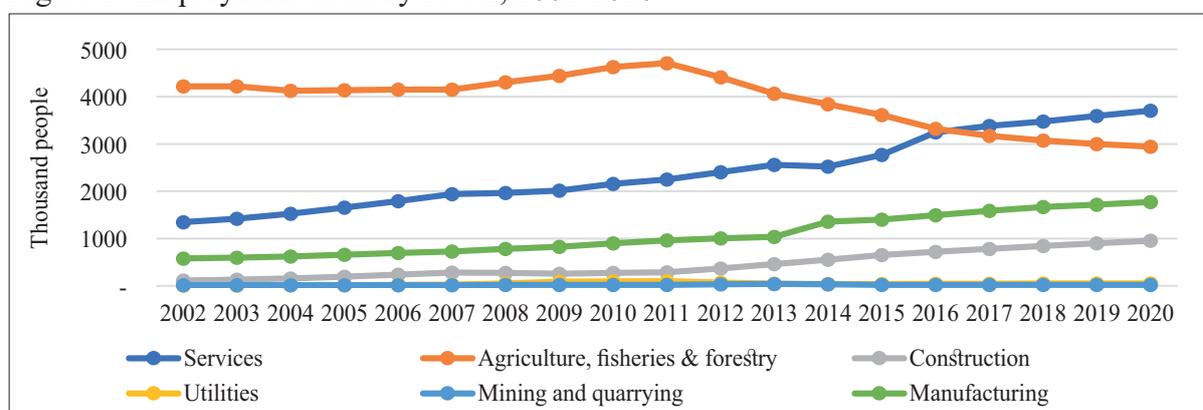
Source: ILOSTAT, accessed in Jan 2020

Figure 3: Employment by occupation, 2002-2020
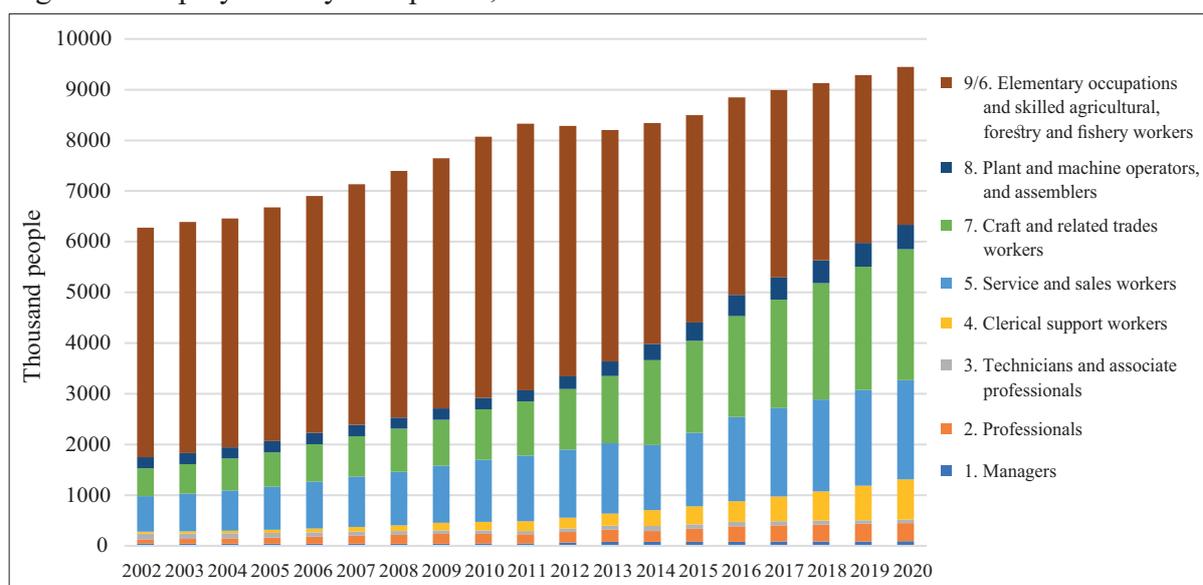
Source: ILOSTAT, accessed in Jan 2020

The labour market in Cambodia is dominated by low-skilled and unskilled employees with low-wage jobs in various economic sectors such as agriculture, manufacturing, construction, and services, while only few high-skilled employees and professionals are available in the labour market. Based on Figure 3, the number of service and sales workers, and craft and related trades workers rose notably from 702,000 and 551,000 in 2002 to 1,888,000 and 2,437,000 in 2019, respectively. The number of clerical support workers went up sharply from 33,000 in 2002 to 678,000 in 2019, while the employment of plant and machine operators, and assemblers also doubled from 222,000 in 2002 to 466,000 in 2019. The employment of managers and professionals maintained the smallest share of total employment, while noticeably, the number of technicians and associate professionals decreased over time from 115,000 in 2002 to 73,000 in 2019.

3.3 Education and training in Cambodia

Cambodia has a 9-year basic education system which is compulsory and free for all children (Figure 4). Students who finish basic education can continue to the next level of education through upper secondary education (general stream) or through a technical and vocational education and training (TVET) (TVET certificates 1-3). Students completing TVET certificate 3 are considered in equivalence to a grade 12 completion and can move up to a level of higher diploma in a related field in the TVET stream. Students with a grade 12 completion can either go on to study at a higher education or at a post-secondary TVET institution, and they have multiple choices of fields of study.

Figure 4: Cambodia's national education and training system

Age	Grade	Stream	General education	TVET	Higher education	Non-formal education
		Governance	MoEYS	MoLVT	MoEYS; other relevant Ministries	MoEYS; other relevant Ministries
26						
25		CGF Level 8		Doctoral degree	Doctoral degree	
24						
23		CGF Level 7		Master degree (technology/business)	Master degree	
22						
21		CGF Level 6		Bachelor degree (technology/business)	Bachelor degree	
20						
19		CGF Level 5		Higher diploma (technology/business)	Associate degree	
18						
17	Grade 12	CGF Level 4	Upper secondary education	TVET certificate 3		
16	Grade 11	CGF Level 3		TVET certificate 2		
15	Grade 10	CGF Level 2		TVET certificate 1		
14	Grade 9	CGF Level 1	Lower secondary education	Vocational certificates		
13	Grade 8					
12	Grade 7					
11	Grade 6		Primary education			
10	Grade 5					
9	Grade 4					
8	Grade 3					
7	Grade 2					
6	Grade 1					
5	High step		Pre-school education			
4	Medium step					
3	Low step					

Note: CQF=Cambodian Qualifications Framework
Source: Adapted from SEAMEO (2017, 37); ADB (2016b, 3)

The MoEYS is responsible for the general education sector, non-formal education and higher education institutions, while the Ministry of Labour and Vocational Training (MoLVT) is responsible for the TVET sector. Nonetheless, the administration and management for higher education is complicated by line ministries' responsibilities of their relevant specialised universities (Un and Sok 2018); for example, the Royal University of Agriculture is under the Ministry of Agriculture, Forestry and Fisheries; the University of Health Sciences is under the Ministry of Health. Thus, the central agency the MoEYS faces problems in monitoring and evaluating the whole system of education, and ensuring consistency and quality of education and training in Cambodia.

There are 325 TVET institutions across 12 different government ministries. Of these, 56 are public institutions (ADB 2016b), while under the supervision of the MoLVT, there are 38 public, 44 private, and 21 NGO institutions across the country (MoLVT 2019a), with most of the non-public training providers are small, family-run organisations relying on student enrolment fees (ADB 2016b). However, most TVET institutions or schools are situated in urban areas, making it difficult for young people from rural households to partake in training.

Table 1: Enrolment at TVET institutions registered with the MoLVT by academic year

Type	Level	2009-2010*	2010-2011*	2011-2012*	2012-2013*	2013-2014*	2014-2015*	2015-2016**	2016-2017**	2017-2018**
Public	Postgraduate degree	57	138	47	106	49	25	52	73	27
	Bachelor's degree	4733	6561	9047	10559	10152	7605	15116	16540	8791
	High diploma	2930	2923	3656	4174	2978	3738	6888	8503	5638
	TVET certificate	898	1298	1159	1308	1374	1259	1990	2674	3215
	Short course	39624	64074	107928	104829	65053	16912	12074	11417	27135
Private	Postgraduate degree	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Bachelor's degree	1023	2451	5594	7003	11676	7959	NA	NA	NA
	Technical high diploma	1102	4244	1239	1250	6558	1293	NA	NA	NA
	TVET certificate	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Short course	3082	13986	7742	7138	10622	12308	NA	NA	NA
NGOs	Postgraduate degree	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Bachelor's degree	NA	110	42	194	314	46	NA	NA	NA
	High diploma	1102	1293	843	1232	1,202	732	NA	NA	NA
	TVET certificate	NA	179	1092	1118	1083	1011	NA	NA	NA
	Short course	609	2711	1450	1056	1756	5940	NA	NA	NA
	Total	55160	99968	139839	139967	112817	58828	36120	39207	44806

Note: * Data from ADB (2016a), ** Data from TVETMIS, MoLVT
Source: ADB (2016a, 25); TVETMIS, MoLVT (2017; 2019b)

The number of student enrolments in TVET is usually lower than that in the academic stream. For instance, the number of TVET students between 2017 and 2018 were 44,806, including all levels from short courses to post-graduate programs in the public institutions (MoLVT 2019b), whereas the enrolment in higher education alone in the same academic year was 211,484 (MoEYS 2019). Among the 44,806 TVET students, only 27 students registered in post-graduate programs, 8,791 in bachelor programs, 5,638 for higher diplomas, and 3,215 in TVET certificate levels, with the rest in short courses. The TVET enrolment in TVET certificate, high diploma, bachelor, and postgraduate levels has improved from 11,479 in 2009-2010 to 17,671

in 2017-2018, a reflection of the push to boost student enrolments and quality in TVET (RGC 2017), and also of the high demand from the industry.

While science and technology subjects are growing in importance for Cambodia's industrial development, these subjects are still valued relatively low in society (Leng 2018). Meanwhile, TVET is also perceived as a low-status option for high school graduates, meaning that most students opt for a major of study in higher education (RGC 2017). This low attractiveness, together with issues of low quality and low labour market relevance, remain major challenges to TVET in Cambodia (RGC 2015; 2017; 2018). Moreover, public post-secondary TVET institutions only offer a few fields of study, giving students fewer options and further increasing the shortage of skilled people and professionals in the labour market.

The commonly registered subjects in the public TVET institutions under the MoLVT include civil engineering, electricity, electronics, mechanics and machinery, information technology, business management, accounting and finance, and marketing. Students can enroll for these subjects on different levels (TVET certificate, high diploma and bachelor degree). Unlike long-term formal TVET programs, short courses are relatively diverse and last between one week and four months, providing people with a wide array of learning choices in subjects including basic agriculture, basic electricity and wiring, electronic equipment repairing, basic computer, basic food processing, masonry and construction, animal feeding and processing, sewing, and other basic subjects (MoLVT 2019b). These courses are intended to teach basic skills as part of non-formal education and training to reduce local poverty through livelihood generation. However, they do not prepare people to be professionals or skilled workers in the long run, and hence limit employment and vocational perspectives (ADB 2016b).

4. Research methods

The paper employed two research methods, analysis with firm survey data and CGE modelling. The analysis on the firm level is an ex-post approach to examine issues at the company level such as skills shortages and their effects, VSD programs as a remedy to deal with the skills shortages, and the effect of VSD programs on growth and transformation. On the other hand, CGE, as an ex-ante approach, can be used to predict both the direct and indirect effects of the simulated increment in skilled labour on all the sectors in the economy, including the effects on social welfare. However, this macro-level approach does not take into account more specific aspects at the company level, for instance companies' skills needs and VSD programs. The combination of both approaches will allow us to have a comprehensive understanding of the effects of skilled labour on the economy both at the national and company level.

4.1 Firm survey

Our firm survey covers three industrial sectors which are among the most significant for the Cambodian economy: garment, E&E assembly, and food processing. Garment manufacturing is a driving force of growth in Cambodia, and is the largest export-oriented sector, accounting for 10.7[1] percent of GDP in 2018 (NIS 2020) and providing 928,638 jobs (ILO 2018), mainly for low-skilled labour. E&E assembly is a fast growing export-oriented sector that is labour intensive and has high potential for productivity growth through skills development as well as export diversification. Food processing is the second largest manufacturing sector, contributing 2.4 percent of total GDP in 2018 (NIS 2020). It may play a significant role in import substitution and has strong backward linkages with the domestic agriculture sector.

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1   This percentage includes the shares of textile and footwear.

Sampling

Proportional stratified sampling was implemented to select a company sample in the garment sector, given the high number of companies dispersed throughout the country. Three regions were selected — capital, border and sea port zones—for sampling.

We selected all E&E assembly and food processing firms on condition that the number of E&E assembly firms is still small, around 30 firms. We selected all food processing firms that could be identified and that agreed to participate in our interview because we did not have a sampling frame for this sector. Table 2 displays the survey response rate. E&E firms had the highest response rate of 66.7 percent, followed by the food processing firms (37.2 percent). The garment firms had the lowest response rate at 35.9 percent.

Table 2: Response rate

Sector	Interviewed	Rejected	Total	Response rate (%)
Garment	65	116	181	35.91
E&E	20	10	30	66.67
Food processing	16	27	43	37.21
Total	101	153	254	39.76

Source: Authors' calculation based on firm's survey

Data collection tools

A structured questionnaire was used to conduct face-to-face interviews with the company management, including directors, production or factory managers, or human resource managers. The questionnaire was designed in a KoboToolbox platform and electronic tablets were used to interview the company representatives, with interviewers completing the questionnaire, and checking the completed questionnaire for accuracy and completeness at the time of the interview. The questionnaire had six parts covering the development of the establishment, skills needs, pre-employment vocational development programs (pre-VSDs), in-employment vocational development programs (in-VSDs), and staff.

For the purpose of this study, pre-employment VSD programs refer to those catering to lower, medium or higher skilled positions in the respective industry and are of shorter or longer duration, thus including short-term training as much as industry-oriented higher education programs, prior to their employment in the companies. The programs might have been started with funding from national authorities, development cooperation, the private sector, or other sources. All the programs must lead to some kind of certification (excluding informal training and education). They are limited to the training programs which lead to industry-specific skills. We asked the companies' representatives to list the three most important pre-VSDs only.

In the same vein, in-employment VSD programs refer to the formal programs that cater to lower, medium or higher skilled positions in the respective industry during employment (upskilling or reskilling). We asked the companies' representatives to list the three most important in-employment VSDs.

We classified workers into five categories adapted from ILO's ISCO definitions. General workers (gw) typically perform simple and routine physical or manual tasks. This may require the use of hand held tools, such as shovels, or of simple electrical equipment. This involves tasks such as lifting and carrying materials by hand, and sorting, storing or assembling goods by hand (sometimes in the context of mechanised operations). Operators (op) typically perform tasks such as operating machinery and electronic equipment; maintenance and repair of electrical and mechanical equipment; and manipulation, ordering and storage of information.

Supervisors (sup) typically require an extensive body of factual and procedural knowledge and have oversight of a group of operators and/or general workers. Technicians (tech) typically perform complex technical and practical tasks which require an extensive body of factual, technical and procedural knowledge in a specialised field. The higher management (hm) typically consists of a group of high level executives that actively participate in the daily supervision, planning and administrative processes required by an establishment to help meet its objectives.

Data analysis

We used descriptive statistics such as median, frequency, and percentage in the form of tables or graphs to show and analyse the survey data. Then two sets of regression analyses were employed to identify the correlations of VSD programs with firms' difficulty to find workers, growth and transformation.

The first sets of models aim to identify the bivariate correlations between the numbers of VSD programs by worker categories and the firms' difficulty to find workers. We used regression because we assume that the outcome viariables are continous varabiles although they are mostly measured at the ordinal categorical level. The equations of these models are as below:

$$diff\_find\_gw_i = \alpha + \beta_1 prevsd\_gw_i + \beta_2\ invsd\_gw_i + \ \varepsilon;\ (Model\ a1)$$
$$diff\_find\_op_i = \alpha + \beta_1 prevsd\_op_i + \beta_2 invsd\_op_i + \varepsilon;\ (Model\ a2)$$
$$diff\_find\_sup_i = \alpha + \beta_1 prevsd\_sup_i + \beta_2 invsd\_sup_i + \varepsilon;\ (Model\ a3)$$
$$diff\_find\_tech_i = \alpha + \beta_1 prevsd\_tech_i + \beta_2 invsd\_tech_i + \varepsilon;\ (Model\ a4)$$
$$diff\_find\_hm_i = \alpha + \beta_1 prevsd\_hm_i + \beta_2 invsd\_hm_i + \varepsilon;\ (Model\ a5)$$

Where:

Table 3: Description of variables 1

Short hand	Coding	Description
$diff\_find\_gw_i$	0: not difficult 1: somewhat difficult 2: significantly difficult	Difficulty to find general workers within the last five years (2012-2017)
$diff\_find\_op_i$	The same as diff_find_gwi	Difficulty to find operators within the last five years (2012-2017)
$diff\_find\_sup_i$	The same as diff_find_gwi	Difficulty to find supervisors within the last five years (2012-2017)
$diff\_find\_tech_i$	The same as diff_find_gwi	Difficulty to find technicians within the last five years (2012-2017)
$diff\_find\_hm_i$	The same as diff_find_gwi	Difficulty to find higher management within the last five years (2012-2017)
$prevsd\_gw_i$	Integer (from 0)	Total number of pre-employment VSD for general workers
$prevsd\_op_i$	Integer (from 0)	Total number of pre-employment VSD for operators
$prevsd\_sup_i$	Integer (from 0)	Total number of pre-employment VSD for supervisors
$prevsd\_tech_i$	Integer (from 0)	Total number of pre-employment VSD for technicians
$prevsd\_hm_i$	Integer (from 0)	Total number of pre-employment VSD for higher management
$invsd\_gw_i$	Integer (from 0)	Total number of in-employment VSD for general workers
$invsd\_op_i$	Integer (from 0)	Total number of in-employment VSD for operators
$invsd\_sup_i$	Integer (from 0)	Total number of in-employment VSD for supervisors
$invsd\_tech_i$	Integer (from 0)	Total number of in-employment VSD for technicians
$invsd\_hm_i$	Integer (from 0)	Total number of in-employment VSD for higher management

The second set of regressions were multivariate models which intend to identify the effects of both pre- and in-VSD on the firms' growth and transformation. The regression models had growth and transformation as dependent variables and firms' characteristics including the total number of pre- and in-VSD as independent variables. All models are ordinary least square (OLS) regressions, except the model 3 which is a logistic regression because its outcome variable, organisational change, is a binary variable. The models are articulated in the below equations of Model b1 to Model b6.

We also conducted power analysis to verify whether the sample size has enough power for estimating significant coefficients of our main explanatory variables. For the logistic model, we did not conduct power analysis because we followed the N:q rule (N is sample size and q is the number of dependent varaibles) of Jackson (2003) who suggests that the rule should be an N:q ratio of 10:1 for acceptable maximum likelihood model. This means that if q is 10, a minimal sample size of 10×10, or N = 100.

$product\ change_i = \alpha + \beta_1 t\_prevsd_i + \beta_2 t\_invsd_i + x_{ik} + \varepsilon;$ (Model b1)

$technology\ change_i = \alpha + \beta_1 t\_prevsd_i + \beta_2 t\_invsd_i + x_{ik} + \varepsilon;$ (Model b2)

$organisational\ change_i = \alpha + \beta_1 t\_prevsd_i + \beta_2 t\_invsd_i + x_{ik} + \varepsilon;$ (Model b3)

$sale\ growth_i = \alpha + \beta_1 t\_prevsd_i + \beta_2 t\_invsd_i + x_{ik} + \varepsilon;$ (Model b4)

$salary\ growth_i = \alpha + \beta_1 t\_prevsd_i + \beta_2 t\_invsd_i + x_{ik} + \varepsilon;$ (Model b5)

$employee\ growth_i = \alpha + \beta_1 t\_prevsd_i + \beta_2 t\_invsd_i + x_{ik} + \varepsilon;$ (Model b6)

Where:

Table 4: Description of variables 2

Short hand	Coding	Description
Sale growth	1: declined more than 33 percent 2: declined less than 33 percent 3: not changed 4: increased less than 33 percent 5: increased more than 33 percent	A variable of growth:
Salary growth	1: declined more than 33 percent 2: declined less than 33 percent 3: not changed 4: increased less than 33 percent 5: increased more than 33 percent	A variable of growth
Employee growth	1: declined more than 33 percent 2: declined less than 33 percent 3: not changed 4: increased less than 33 percent 5: increased more than 33 percent	A variable of growth
Product change	1: become significantly simpler 2: become somewhat simpler 3: not changed 4: become somewhat more advance 5: become significantly more advanced	A variable of transformation
Technology change	1: become significantly simpler 2: become somewhat simpler 3: not changed 4: become somewhat more advanced 5: become significantly more advanced	A variable of transformation
Organisational change	1. Yes 2. No	A binary variable of transformation
t_prevsd	Integer (from 0)	Total number of pre-VSD
t_invsd	Integer (from 0)	Total number of in-VSD

x_{ik}	the variables of the firms' characteristics including	
total_emp12	Integer	Total number of employees in 2012
firm_age	Integer	The age of firms
pp_loc	1: location in Phnom Penh 0: otherwise	Firm's location in Phnom Penh
ee_sect	1: E&E firm 0: otherwise	Firm is an electronic and electrical assembly firm
gar_sect	1: garment firm 0: otherwise	Firm is a garment firm
food_sect	1: food processing firm 0: otherwise	Firm is a food processing firm
exports	1: Do not export 2: Less than 33 percent 3: Between 33 percent and 66 percent 4: More than 66 percent	The share of the exported products in total products
fdi	1: None, 2: Less than 33 percent, 3: Between 33 percent and 66 percent 4: More than 66 percent	The extent of foreign sources in the company's investment

4.2 CGE modelling

The study employed an extended standard CGE model, which is an ex-ante and economy-wide approach to quantify the effects of a wide range of policy implementations related to trade, government expenditure, environment, and labour market. CGE takes into account both the direct and indirect effects across sectors and agents of the economy. However, it also has many drawbacks including its extensive data requirements and the model, which is usually considered as a black box.

Model specification

We used the extended standard CGE model of Hosoe, Gasawa, and Hashimoto (2010). The model has the following assumptions: small country assumption which assumes that the economy of the country under study is so small that its trade has insignificant influences on the world trade, even when the country implements export dumping; foreign saving is exogenous where savings are determined first and investment are made within the predetermined size of total savings; and this CGE model is of the neoclassical class, where the wage rate is flexibly adjusted to attain zero unemployment in the labour market. Therefore, it implies that the wage rate is endogenous while the unemployment rate is exogenous and fixed at zero.

Social accounting matrix (SAM)

The CGE model uses the data in the format of SAM, which is a holistic numerical representation of the interrelated economic activities in a single country, several countries, or the world. SAM is a matrix table of double accounting, where its rows and columns contain asymmetric number of economic agents or actors, for example production actors, production factors, households, governments, and the rest of the world. The number of agents or actors to be included in SAM is based on the data availability and purpose of analysis.

For the purpose of this study, we developed the SAM of Cambodia based on the input-output (IO) table of ADB (2018) and the 2017 Cambodia Socio-Economic Survey (CSES). ADB's IO table contains 35 sectors in International Standard Industrial Classification (ISIC) revision 3; with the following accounts: gross value added, tax less subsidy, final consumption expenditure by households, nonprofit institutions serving households (NPISHs), final consumption

expenditure by government, gross fixed capital formation (GFCF), changes in inventories and valuables, and imports and exports.

To construct the SAM for the purpose of our study, we adjusted the IO table in the following ways. The 35 sectors were aggregated to three sectors (i.e., agriculture, industry, and service sectors) for simplicity and due to the lack of relevant data. The tax less subsidy was divided into indirect tax and import tariff to follow Hosoe, Gasawa, and Hashimoto' s (2010) model. Because we could not find detailed data on import tariffs of each sector, we included a rough estimation. Import tariff was estimated using the World Trade Organisation's (WTO) 2017 tariff rate of merchandise goods (WTO 2018). Only the import tariff of final consumption goods for households was calculated using the WTO's tariff rate since we could not find the tariff rate for services. The import tariff for services was calculated by deducting the tariff of imported goods from the total tariff revenue reported in the report of the Ministry of Economy and Finance (MEF 2017). We did not include the tariff of imported intermediate goods and goods for investment because most of these goods might receive tariff exemption under the investment incentives.

Because the standard CGE model cannot accommodate NPISHs, it is incorporated into government agent since NPISHs consume goods and services and provide goods or services to serve the households like a government agent do. Gross fixed capital formation (GFCF) changes in inventories and valuables were combined to represent the investment agent.

For the purpose of this study, gross value added was disaggregated into a capital agent and five labour agents (i.e., L0, L1, L2, L3, L4) (Table 5), where L1 designates no skill, L2 is low skill, and L3 is medium skill and L4 are high-skilled workers. We classified workers in this way to easily introduce the increment of medium- and high-skilled labour supply.

According to NIS (2018), high-skilled labour constitutes only 2.15 percent of total labour, while the medium-skilled workers represented 6.30 percent, low-skilled workers made up 82.41, and unskilled 9.56 percent of the workforce (Table 5).

Table 5: Skill level categorisation

ISCO-08 major groups	Skill level	Our category	Desription	Share (%)*
1. Managers, senior officials, and legislators	3 + 4	L4	High skilled	2.15
2. Prefessionals	4			
3. Technicians and associated professionals	3	L3	Medium skilled	6.30
4. Clerks	2	L2	Low skilled	82.41
5. Service and sales workers				
6. Skilled agricultural and fishery workers				
7. Craft and related trades workers				
8. Plant and machine operators, and assemblers				
9. Elementary occupations	1	L1	Unskilled	9.56
0. Armed forces	0	L0		0.98

Source: adopted from (NEA 2018)
* Authors' calculation based on NIS (2018)

Because one of the research questions is to identify the effect of the increment in skilled labour supply on the poor, household agents are classified into six categories (capital better-off, capital poor, urban better-off, urban poor, rural better-off, and rural poor) according to their residence location and economic status (Table 6), so that we can compare the effects among different household categories. Three main locations are distinguished: Phnom Penh, Rural, and Urban. We defined poor households as those having equity/ID Poor, priority access and/or

other cards which are usually given to poor households, which accounted for 9.37 percent of the households (NIS 2018). The majority of households were rural better-off (50.89 percent), followed by the capital better-off (20.47 percent), the urban better-off (19.27 percent), rural poor (7.97 percent), urban poor (1.3 percent), and capital poor (0.1 percent).

Table 6: Economic status of households by residence

Shortcut	Residence Location	Economic status	Percentage (%)
Capital better-off	Phnom Penh	Better-off	20.47
Capital poor	Phnom Penh	Poor	0.1
Rural better-off	Rural	Better-off	50.89
Rural poor	Rural	Poor	7.97
Urban better-off	Urban	Better-off	19.27
Urban poor	Urban	Poor	1.3
Total			100

Source: Authors' calculation based on NIS (2018)

The CSES 2017 data was used to estimate the distribution of income among factor agents and households, as well as the consumption among household agents. The data contains 10 occupation categories listed in Table 5, which we classified into L0, L1, L2, L3, and L4 categories. Figure 5 demonstrates that workers from better-off households were the majority in all occupations, and there were only few poor. Similarly, Table 7 displays the share of income by occupation and household category, and shows that the majority of income among L1 to L4 labour belonged to the better-off households, where the poor received the minority of income in all occupation categories.

Figure 5: Share of household categories among occupation categories
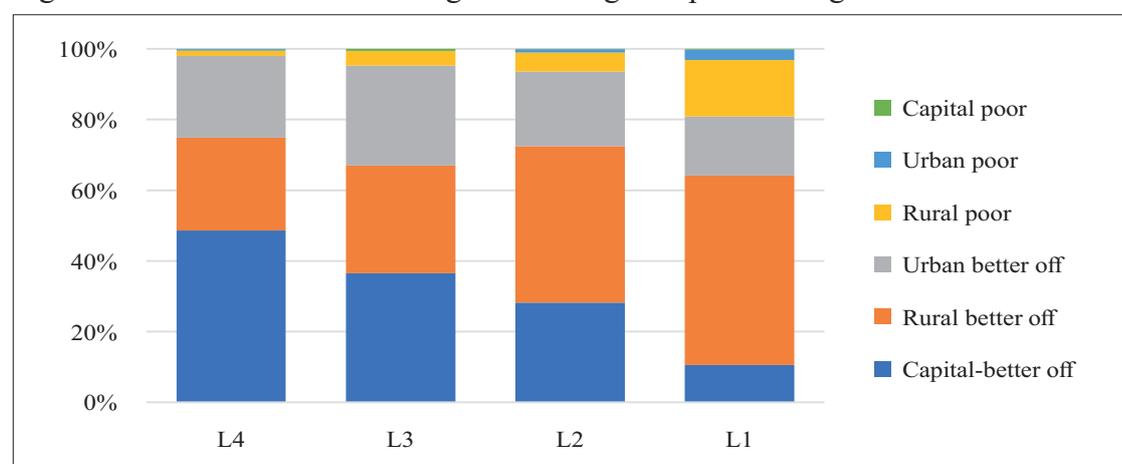
Source: Authors' calculation based on NIS (2018)

Table 7: Distribution of income by labour and household categories

Household category	Distribution from wage income to households (%)			
	L1	L2	L3	L4
Capital better-off	11.8	33.2	44.9	47.2
Capital poor	0.2	0.4	0.5	0.2
Rural better-off	53.8	39.4	25.8	26.8
Rural poor	17.3	5.0	1.6	2.0
Urban better-off	14.7	21.2	27.3	23.7
Urban poor	2.2	0.8	0.0	0.1
Total	100%	100%	100%	100%

Source: Authors' calculation based on NIS (2018)

Estimation of elasticity of substitution and transformation of Cambodia's trade

Elasticity of substitution and transformation are exogenous variables in the CGE model of Hosoe, Gasawa, and Hashimoto (2010). The value of these varibles can be collected from previous literature and the Global Trade Analysis Project (GTAP) database, or be estimated using national account data. The later option is the most recommendable methods if sufficient relevant data are available. We used the latter methods because we could collect enough data from the national account published by NIS. For our paper, the regression models adopted from Devarajan (1999) and Khin and Kato (2010), were used to estimate these parameters. The equation A1 in the Appendix is employed to estimate the elasticity of substitution between domestic and imported products, and equation A2 is for estimating the elasticity of transformation of domestic products into exported products.

The result of the estimation elasticity of substitution (σ) and transformation (ψ) in Cambodia's trade is displayed in Table 19 in the Appendix. These values are used in the calibration of other relevant paramenters in the CGE model. The signs and magnitudes of the two coefficients are similar to those estimated by Khin and Kato (2010).

Scenario for increment in skilled labour supply

The results of our firm survey indicate that most companies in the three sectors assessed their difficulty to find operators, technicians, and high management employees as "somewhat", which is in line with the National Employment Agency (NEA) (2018). NEA has been regularly conducting a firm survey on skills shortages and skills gaps in the Cambodian labour market since 2013. The 2018 NEA report stated that 47.5 percent of firms with vacancies claimed to face difficulties to find workers. The top four most difficult-to-fill occupations were technicians and associate professionals, managers, professionals, and service and sales workers. The number of applicants with the required skills was low. Although service and sales workers were among the top four hard-to-fill occupations, they were quite abundant in the labour market as shown in Figure 3. Figure 3 also underlines that the proportion of managers, professionals, and technicians and associate professionals was quite small, accounting for only 0.93 percent, 3.56 percent and 0.92 percent respectively.

This skills shortage suggests the need to increase high-skilled labour to match the increasing demand in the labour market. Therefore, this study adopted a scenario that there was a 10 percent increase in the supply of the L4 and L3 categories (managers, professionals, and technicians and associate professionals) (Table 8), to see changes in the economy as a whole and also on the labour market and household welfare conditions. We choose the 10 percent increase because Figure 3 shows that the employment of the three occupations changed by 8 percent for managers, 12 percent for professionals, and 17 percent for technicians and associated professionals between 2017 and 2020.

This scenario hypothetically assumes that there was a 10 percent increase in the supply of L3 and L4 per se. This increase could be a result of growth of the number of new graduates from university or VSD institutes who would have the same capacity as the existing L3 and L4, but was not derived from upgrading the lower-skilled workers (L1 and L2) to higher-skilled workers (L3 and L4).

Table 8: Scenario of 10 percent increment of the supply of L3 and L4

ISCO-08 major groups	Our category	Increment in CGE model (percent)
1. Managers, senior officials, and legislators	L4	10
2. Professionals		
3. Technicians and associated professionals	L3	10

Source: Authors' concept

5. Results

5.1 Skills shortage and its effect on firms' operation and growth

Figure 6 displays the difficulty that companies faced in finding employees, including general workers, operators, supervisors, technicians, and higher management (see description of the five occupation levels in section 4.1). During the interview, we asked the companies' representatives whether it was difficult to find the type of employees listed above. The possible answers were 0 which refers to "not difficult at all", 1 designating "somewhat difficult", and 2 representing "significantly difficult". Figure 7 shows the percentage of companies, which faced difficulty in finding employees. To simplify, the scores of 1 (somewhat difficult) and 2 (significantly difficult) were combined and coded as "difficulty to find workers" in this graph.

The median scores were zero for general workers, in all the three sectors (Figure 6), indicating that most firms in all sectors did not have difficulty to find gerneral workers. Reflecting this result, only 46 percent of garment, 40 percent of E&E, and 38 percent of food processing firms found it difficult to recruit general workers (see Figure 7). However, the median scores for operators were 1 for all three sectors, signifying that most companies rated their difficulty to find operators as "somewhat". Fifty-two percent of garment, 58 percent of E&E, and 81 percent of food processing firms had difficulties in finding operators.

For the difficulty to find supervisors, the medium score for the garment sector was 0, meaning that most garment firms did not face any difficulty in recruiting supervisors. Supervisors in this sector were usually promoted internally from general workers and operators if they showed outstanding performance. Although the median level of difficulty was low, the percentage of firms facing difficulties was quite high at 49 percent.

The share of firms in the food processing industry encountering difficulty was exactly 50 percent, resulting in a median score of 0.5. It was also somewhat difficult for E&E firms to find supervisors (median score: 1). Supervisors in this industry might be required to obtain higher technical skills than those in the other sectors. The proportion of E&E companies facing difficulties in finding supervisors was 70 percent, the highest among the three sectors.

The firms in the garments and E&E sectors encountered some difficulty in finding technicians (median: 1), while the firms in the food processing sector found it significantly difficult to fill this position (median: 2), which makes it the most difficult position to fill in all the sectors. As illustrated in Figure 7, the proportion of the firms encountering difficulty to find technicians was again higher than in any of the other occupational levels. Sixty-six percent of garment firms, 80 percent of E&E, and 88 percent of food processing firms faced difficulty.

Companies in all three sectors found it somewhat difficult to fill vacancies at the higher management level (median: 1). The percentage of companies facing difficulty was also relatively high. In the garment sector, 59 percent of firms had difficulty to fill this position, compared to 74 percent in E&E and 75 percent in the food processing sector.

Comparing the three industries, the garment industry has a similar level of skills shortage on all five occupational levels. In food processing and to a certain degree E&E, however, there is a large difference in skills shortages between occupational levels (Figure 7). This is both due to higher difficulty in finding technicians and less difficulty when hiring general workers in these two industries. The observation could be a result of technical requirements, regulatory reasons and/or wage negotiations. In food processing, for instance, a higher degree of automatisation and mechanisation than in the garment industry can be observed, which might necessitate particular technical training and hence lead to a skills shortage. In E&E, wages were relatvely higher early on, and less subsequent wage growth can be observed compared to the garment industry; this could have led to more skills shortages.

Figure 6: Difficulty to find workers
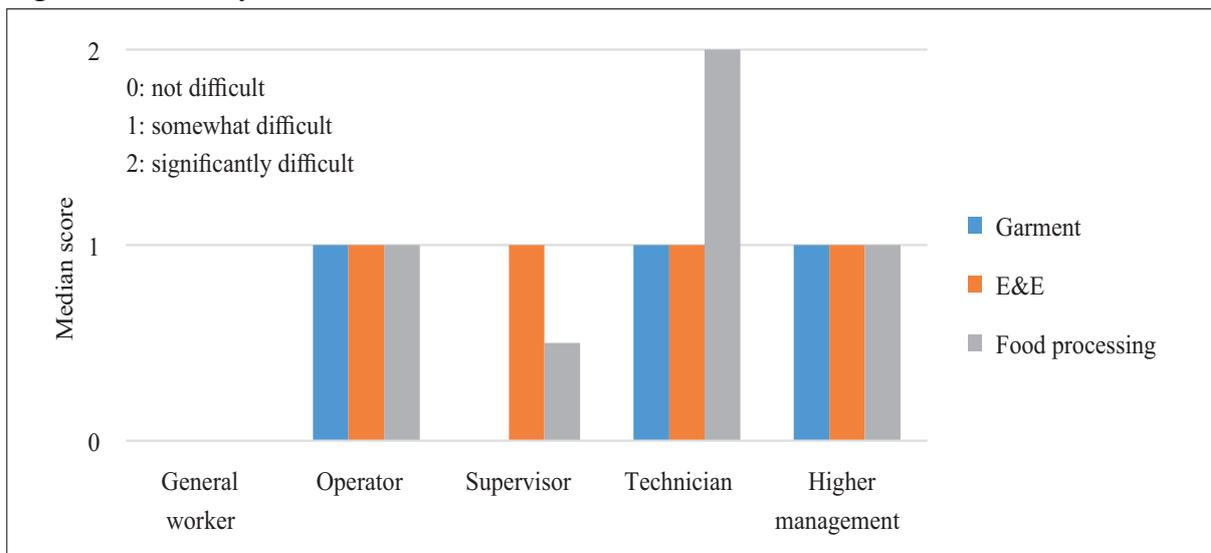
Source: Firm-level survey, Skills for Industry research project

Note: n=101 for difficulty to find general workers, supervisors, and technicians; n=100 for difficulty to find operators; n=98 for difficulty to find higher management.

Figure 7: Percentage of companies facing difficulty to find workers
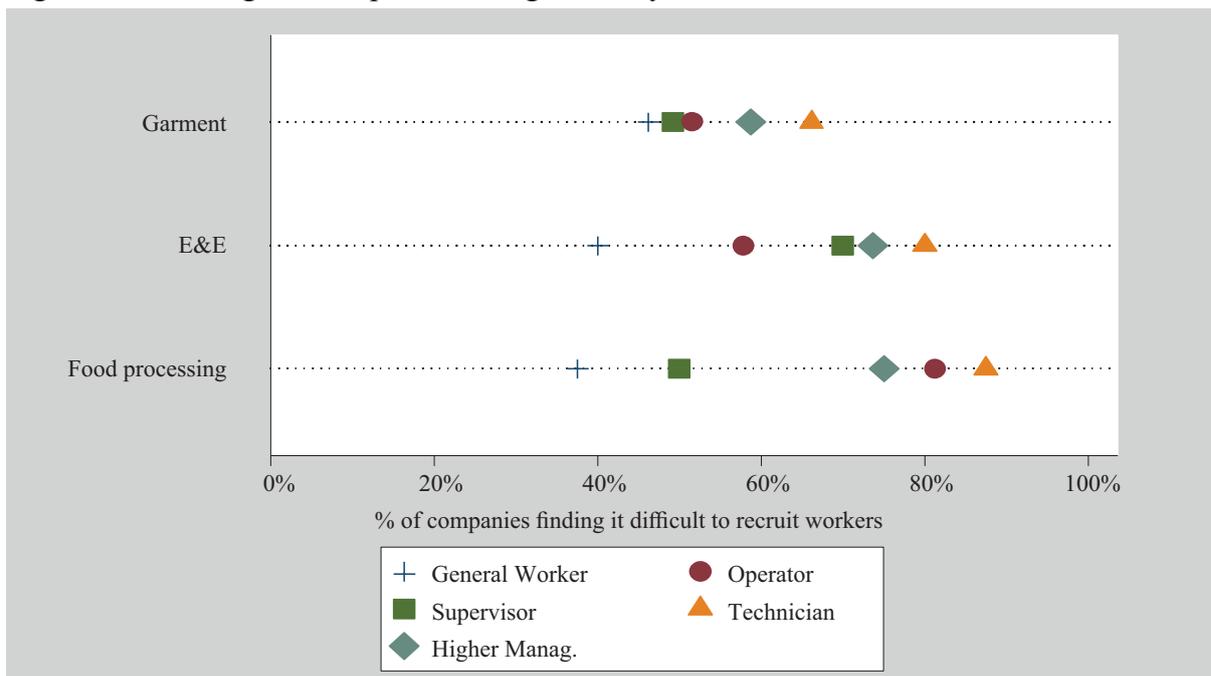
Source: Firm-level survey, Skills for Industry research project

Figure 8 presents the effects of the difficulty in finding workers on firms' operations, while Figure 9 illustrates the percentage of firms observing an effect on firms' operations (the categories "some effects" and "significant effects" were again aggregated). On average, the companies in all sectors that reported difficulty in finding workers indicated that they faced some negative effects on the firms' operations (median: 1). For higher management in the food processing sector, the median value is larger still, at 1.5.

Although the median score of the effects on operations was 1 (somewhat negative effects), the proportion of firms that faced a negative effect was quite high among the firms that reported difficulty in finding workers (Figure 9). The percentage of firms that faced negative effects from difficulties to find general workers were 88 percent of the firms that reported difficulty to find workers in the garment sector, 83 percent in the E&E sector, and 86 percent in the food processing sector. The proportions of firms facing a negative effect due to difficulty to find operators were 64 percent in garment, 85 percent in E&E, and 77 percent in food processing. The proportions of firms facing a negative effect of the difficulty to find supervisors were 86 percent in garment, 88 percent in E&E, and 81 percent in the food processing sectors. The proportions of firms facing a negative effect of the difficulty to find technicians were 75 percent in garment, 86 percent in E&E, and 75 percent in the food processing sector. The proportions of firms facing a negative effect of the difficulty to find higher management were 86 percent in garment, 83 percent in E&E, and 76 percent in the food processing sector.

Overall, the proportion of companies reporting an effect does not vary much between occupational levels or industries; if skills shortages are observed, it is considered a problem. It is interesting that skills shortages on the general worker level, while not as common, are considered just as bad as shortages on other levels, if not worse. Both in the garment industry as in E&E, the negative effect of a shortage on the general worker level was assessed as more severe (compared to all other levels). In the long run, automatisation and mechanisation will be likely tools to deal with a skills shortage of general workers, but such tools (or the financing of such) did not seem available to companies, at least not in the short-run.

Figure 8: Effect of difficulty in finding workers on firms' operations
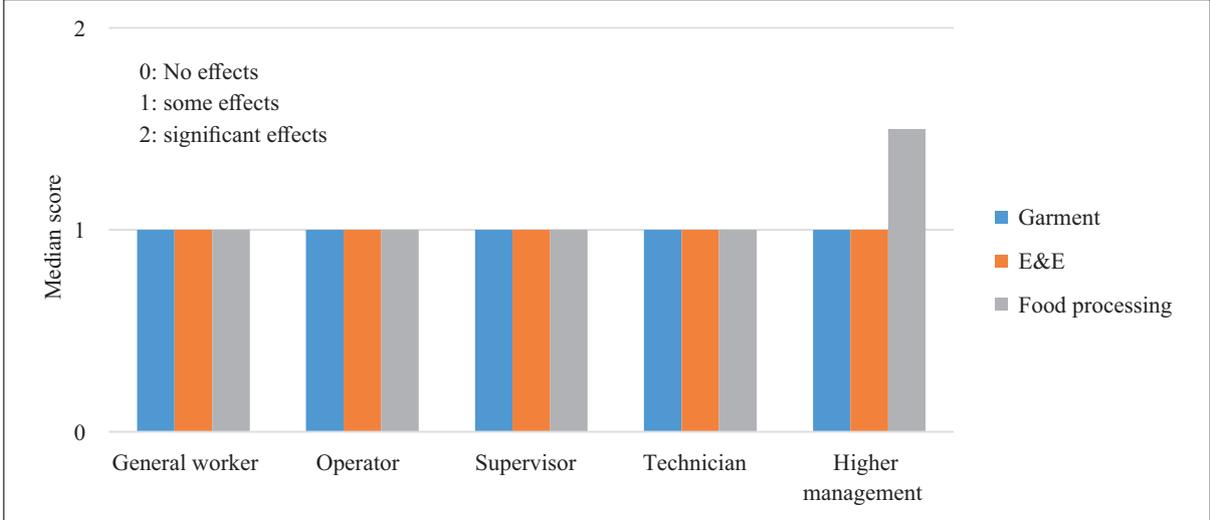
Source: Firm-level survey, Skills for Industry research project
Note: This variable is set as missing value when the companies did not report any difficulty.
N=44, 56, 53, 72, and 61 for effects of difficulty in finding general workers, operators, supervisors, technicians, and higher management, respectively.

Figure 9: Percentage of firms facing effects of skills shortages on firms' operations
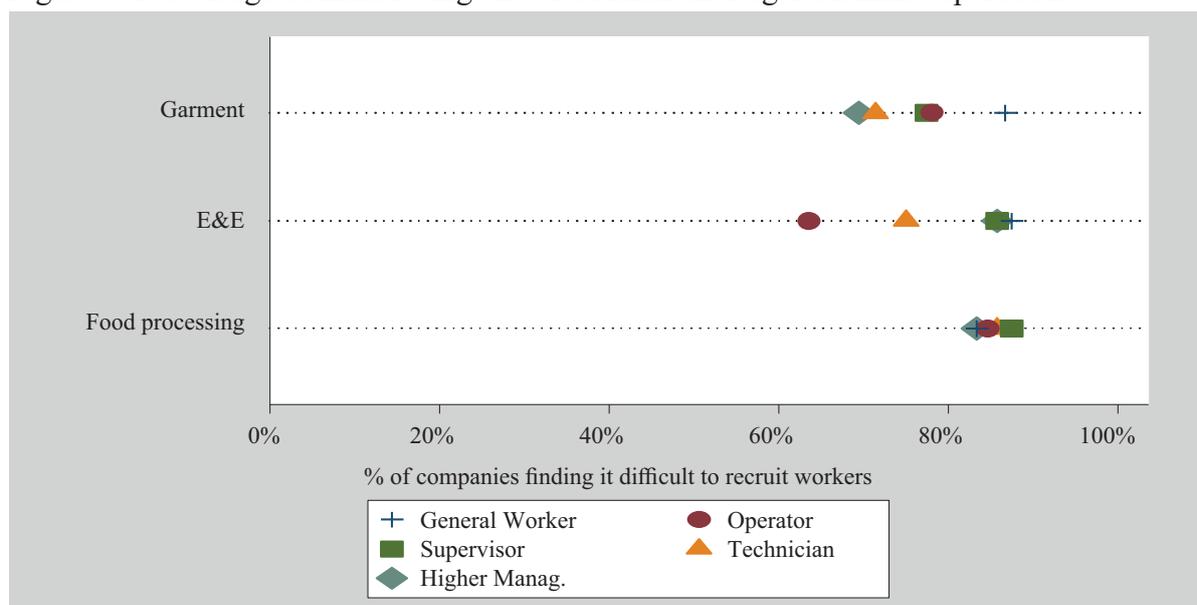
Source: Firm-level survey, Skills for Industry research project

As shown in Figure 10, similar to the effects on operations, on average, the firms that reported difficulty to find workers in the three sectors encountered somewhat negative effects on their companies' growth (median:1) as a result of the difficulty presented in Figure 6.

Similar to the effects on operations, the proportion of firms reporting a negative effect of skills shortages on the companies' growth was quite high (see Figure 11), albeit the median score was 1 for all occupational levels. The results show that if there is an effect of a skills shortage on company operations, there is also likely an effect on its growth outlook. This is particularly true for the garment industry; the two effects are rated very similarly, at about 80 percent, and there is not much spread between the occupational levels. In E&E, the level of impact is also similar, no matter if operations or growth is assessed, but some occupation levels are interchanged. For example, a skills shortage on the supervisor level has a comparatively higher impact on operations but not so much on growth, possibily due to skills shortages presenting a problem in the short run, but there are medium-run remedies such as promoting and training more internal employees. Finally, for the food processing industry, the effect of skills shortages is very different, being very high on all occupational levels when it comes to operations, and much less so when it comes to growth. Particularly on the operator level, the view that such a shortage will not impact growth seems to be common. This might be because the shortages can be dealt with in the medium term, through applying different technology and transforming processes.

The percentage of firms that faced negative effects on their growth from difficulty to find general workers were 83 percent in the garment sector, 75 percent in the E&E sector, and 67 percent in food processing sector. The proportions of firms facing a negative effect of difficulty to find operators were 81 percent in garment, 73 percent in E&E, and 46 percent in the food processing sector. The proportions of firms facing a negative effect from the difficulty to find supervisors were 77 percent in garment, 64 percent in E&E, and 75 percent in the food processing sector. The proportions of firms facing a negative effect of the difficulty to find technicians were 71 percent in the garment, 75 percent in the E&E, and 64 percent in the food processing sector. The proportions of firms facing a negative effect of the difficulty to find higher management personnel were 77 percent in garment, 86 percent in E&E, and 75 percent in food processing.

Figure 10: Effects of difficulty in finding workers on firms' growth
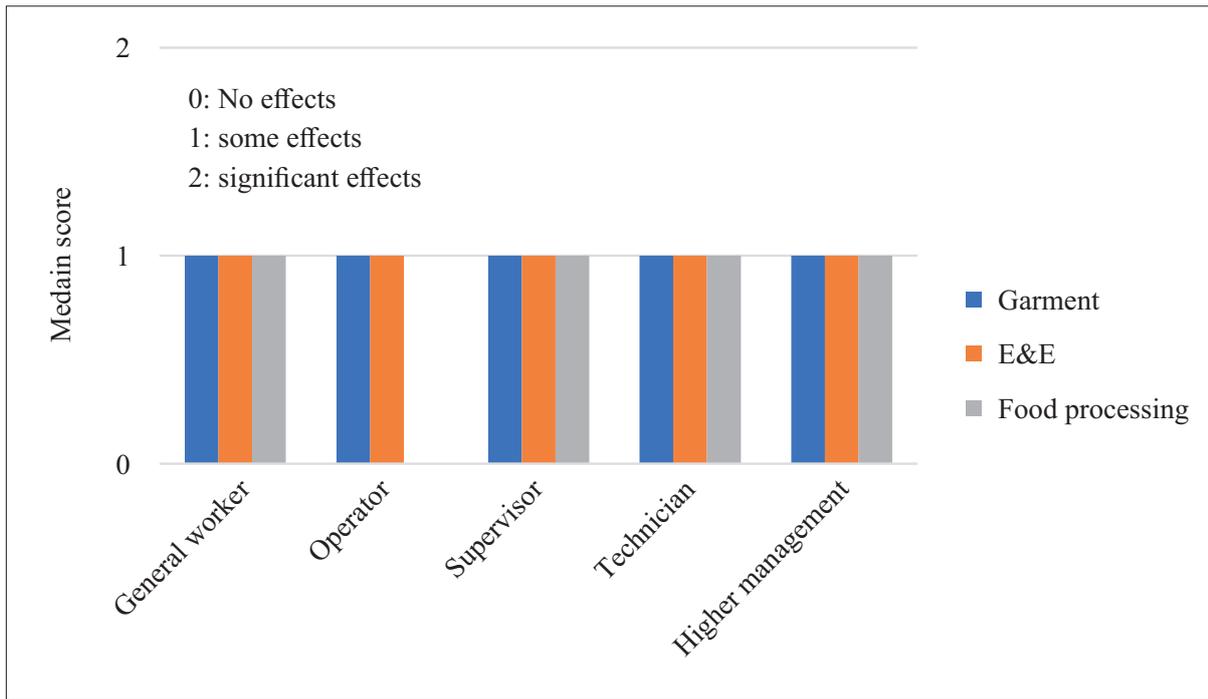
0: No effects
1: some effects
2: significant effects

Source: Firm-level survey, Skills for Industry research project

Note: This variable is set as missing value when the companies did not report any difficulty.

N=44, 56, 53, 72, and 61 for effects of difficulty in finding general workers, operators, supervisors, technicians, and higher management, respectively.

Figure 11: Percentage of firms facing the effect of difficulty in finding workers on firms' growth
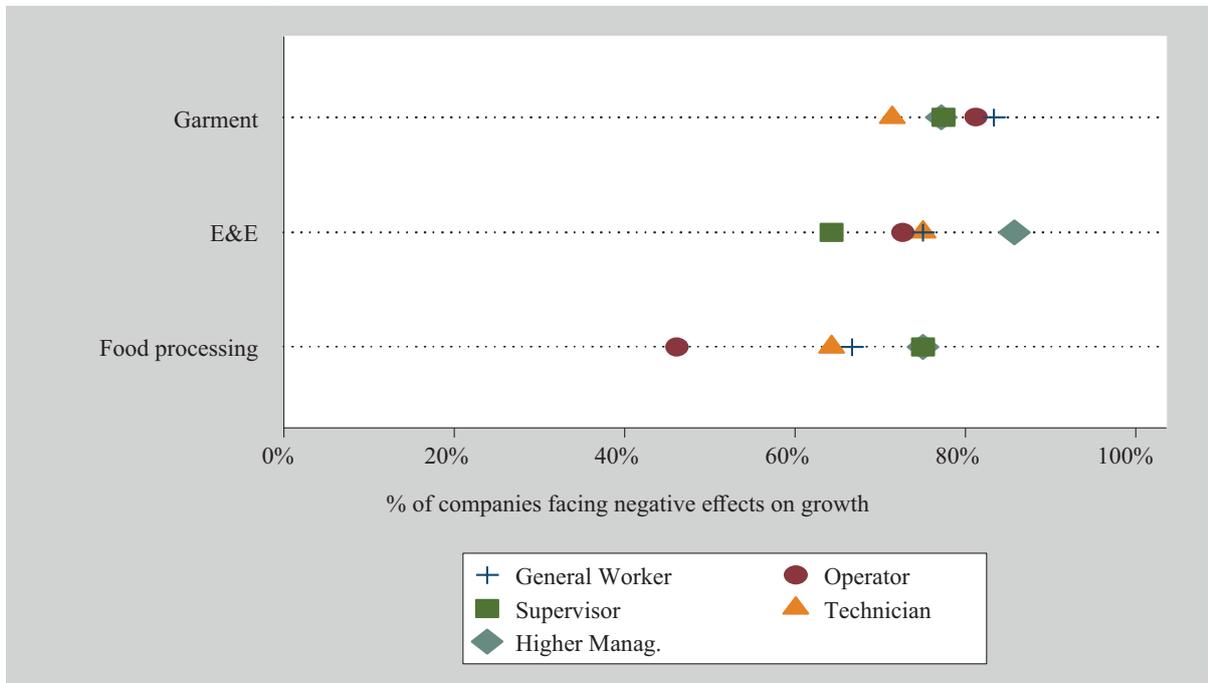
Source: Firm-level survey, Skills for Industry research project

5.2 The contribution of VSD

Table 9 illustrates the number of pre- and in-VSD programs (see the definitions in Section 4.1) as well as the companies' assessments of how much the programs have contributed to meeting their skills needs.

The E&E sector had the highest variety of pre-VSD programs (58) since this sector requires labourers to perform technical tasks. The food processing sector had the second most variety of pre-VSD (54) followed by the garment sector (50). The results also suggest that general workers in these three sectors lack pre-VSD program opportunities, while technicians are likely to have the highest variety of pre-VSD programs catering to them in all sectors. Noticeably, supervisors in the garment sector had no pre-VSD programs at all as most supervisors in this sector are internally promoted from general workers or operators with experience and a good working performance.

Most pre-VSD programs in the three sectors were related to the fields of mechanical, electricity, electronics and food science. These programs were perceived to be applicable in many other sectors as foundations on which additional skills could be built. The companies in the garment and food processing sectors evaluated that on average, pre-VSDs significantly contributed to meeting skills needs (median: 2), but those in the E&E sector rated the contribution of their pre-VSDs only as "somewhat" (median :1). A reason could be that the E&E sector in Cambodia is quite a new industry which also requires new technical skills that VSD providers in Cambodia have not delivered yet.

Table 9: Most frequent VSD programs and their contributions to meeting firms' skills needs

Sector/Position	Pre-VSD programs		In-VSD programs	
	Number*	Contribution to meeting skills needs (median)**	Number*	Contribution to meeting skills needs (median)**
E&E	**58**	**1**	**7**	**2**
General workers	0	-	0	-
Operators	5	1	1	1
Supervisors	16	1	1	2
Technicians	30	1.5	3	1
Higher management	7	2	2	2
Garment	**50**	**2**	**30**	**2**
General workers	0	-	0	-
Operators	4	2	1	2
Technicians	44	2	8	2
Supervisors	0	-	14	1
Higher management	2	2	7	2
Food processing	**54**	**2**	**16**	**2**
General workers	0	-	0	-
Operators	9	2	0	-
Supervisors	8	2	5	2
Technicians	27	2	7	2
Higher management	10	2	4	2
Grand Total	**162**	**2**	**53**	**2**

Source: Firm-level survey, Skills for Industry research project
Note: * the variety of VSD programs refers to the simple count of 1st most, 2nd most, and 3rd most frequent VSD programs in companies. It represents the variety of the VSD programs in a company, and not the actual number of VSD programs or the proportion of employees undertaking those programs.
** Median score of contribution of VSD programs to meeting skills needs; 0 designates not at all, 1 somewhat contributed and 2 significantly contributed.

The companies in the garment sector reported the highest variety of in-VSD programs (30), followed by those in the food processing (16) and E&E sectors (7). These in-employment programs were pertinent to supervisory skills, electricity, and quality management and control. They are offered as short courses and are usually given to high-skilled workers. Since in-employment programs tend to focus on industry-specific skills and are mostly company-financed, the companies assessed that their in-employment programs significantly contributed to meeting their skills needs.

As shown in Table 9, general workers had no VSD programs available to them at all. A reason could be that they are generally employed to perform low value-added tasks such as CMT in the garment sector; mainly assembling in E&E; and mostly packaging in the food processing sector. General workers and operators are generally offered a few weeks of work orientation and on-the-job training with support from supervisors and/or production heads.

Noticeably, the number of pre-employment programs (162) was higher than that of in-employment programs (53) which reflects that most companies may have less involvement in sending their employee to get formal in-employment training, which is in line with the previous literature indicating that only a small proportion of employees have access to formal skills training (OECD 2013; Rainbird 2000; Selesnick 1981).

Table 10: Results of multiple regression analysis between the number of VSD and difficulty to find workers.

	Model a1	Model a2	Model a3	Model a4	Model a5
	Diff_find_gw	Diff_find_op	Diff_find_sup	Diff_find_tech	Diff_find_hm
gw_invsd	-				
	-				
gw_prevsd	-				
	-				
op_invsd		-0.105			
		(0.552)			
op_prevsd		0.188			
		(0.121)*			
sup_invsd			-0.031		
			(0.154)		
sup_prevsd			0.266		
			(0.102)***		
tech_invsd				-0.028	
				(0.157)	
tech_prevsd				0.183	
				(0.078)*	
hm_invsd					0.015
					(0.218)
hm_prevsd					0.138
					(0.157)
N	101	99	101	101	98
r2	0.000	0.035	0.069	0.032	0.021

Source: results of multiple regression analysis
Note: Standardised beta coefficients; Standard errors in parentheses; "* p<0.10, ** p<.05, *** p<.01"

In addition, we ran five regression models to identify the correlations between the number of VSD programs mentioned per worker level and the difficulty in finding the respective workers at this level. The results for model 1 (Table 10) are omitted given that there are no pre- and in-VSD programs for general workers. The models 2, 3, and 4 show that the number of pre-VSD programs for the operator, supervisor, and technician levels, and the difficulty to find the corresponding workers have positive correlations with standardised coefficients[2] of 0.188 (weak), 0.266 (medium), and 0.183 (weak) respectively. This indicates that the companies, which mentioned more pre-VSD programs for operators, supervisors and technicians, are also the ones which were more likely to face higher levels of difficulty when recruiting new employees. The number of pre-VSD programs catering to higher management and all in-VSD program factors were not significant in explaining the difficulties in finding employees at the respective levels.

5.3 The effect of VSD programs on firms' growth and transformation

Next, the effect of VSD variety on growth and transformation is assessed (Table 11). The results of the regression analyses show that the total number of pre-VSD programs had a significantly moderate positive relation (standardised coefficient = 0.34) with technological change and a positive relation with (odd ratio=1.69) organisational change. None of the other coefficients were statistically significant. This result suggests that the companies that have access to employees trained in a bigger variety of pre-VSD programs are more likely to have a moderately higher level of technological transformation, for example by introducing more modernised machinery in a production line. Maybe companies with a wider array of (formalised) skills are more willing or ready to initiate change. We did not identify statistically significant coefficients of the number of in-VSD programs in any of the models explaining growth and transformation. This could mean that there is no correlation between the provision of in-VSD and the level of growth and transformation.

Table 11: Results of multiple regression analysis with the total number of VSDs as independent variables

	Model b1	Model b2	Model b3	Model b4	Model b 5	Model b 6
	Product change	Technology change	Organisational Change[a]	Sale growth	Salary growth	Employee growth
t_prevsd	0.041	**0.34**	**1.69[b]**	-0.023	-0.102	0.160
	(0.043)	**(0.037)****	**(0.481)***	(0.722)	(0.003)	(0.068)
t_invsd	0.186	0.077	0.672	0.101	-0.041	0.062
	(0.098)	(0.084)	(0.306)	(1.645)	(0.008)	(0.155)
ee_sector	0.000	0.000	0.303	0.000	0.000	0.000
	(.)	(.)	(0.603)	(.)	(.)	(.)
gar_sector	-0.096	0.081	0.221	0.127	-0.768	-0.005
	(0.203)	(0.175)	(0.400)	(3.424)	(0.016)***	(0.322)
food_sector	-0.180	0.449	1.000	-0.005	-0.569	-0.080
	(0.390)	(0.335)**	(omitted)	(6.544)	(0.030)***	(0.615)
total_emp12	0.311	0.285	1.001	-0.060	0.091	-0.495
	(0.000)**	(0.000)*	(0.001)	(0.003)	(0.000)	(0.000)***
firm_age	0.061	0.021	1.039	-0.168	-0.518	0.084
	(0.020)	(0.017)	(0.103)	(0.335)	(0.002)***	(0.032)

2   The standardised coefficients < 0.2 designate weak, between 0.2 and 0.5 mean moderate, >0.5 is strong correlation (Acock 2008). The standardised coefficients < 0.2 designate weak, between 0.2 and 0.5 mean moderate, >0.5 is strong correlation (Acock 2008).

fdi	0.024	0.206	1.000	0.026	-0.095	0.109
	(0.214)	(0.184)	(omitted)	(3.599)	(0.017)	(0.338)
exports	-0.178	0.183	1.779	0.021	-0.004	-0.046
	(0.126)	(0.107)	(1.098)	(2.091)	(0.010)	(0.196)
pp_loc	-0.124	-0.156	0.452	0.188	-0.005	-0.097
	(0.161)	(0.138)	(0.312)	(2.700)	(0.012)	(0.254)
N	87	88	84	88	88	88
r2	0.147	0.218	0.117c	0.061	0.728	0.239

Source: results of multiple regression analysis
Note: Standardised beta coefficients; Standard errors in parentheses; "* p<0.10, ** p<.05, *** p<.01"
  a: logistic regression because organisational change is a binary variable; b: odd ratio, c: Pseudo R2

Table 12 illustrates the result of power analysis used to verify whether the sample size has enough power for estimating the significant coefficients of t_prevsd in model b2. It indicates that the minimum sample size required for the acceptable minimum power is 82. Thus our sample of 101 has enough power to estimate the significant coefficient of t_prevsd in the Model b2.

Table 12: Power analysis for Model b2 for estimating t_prevs

Nominal power	Actual power	Sample size
0.9	0.8993	138
0.8	0.8041	105
0.7	0.6987	82

Source: results of analysis
Note: alpha=.05 number of variables = 10 ntest=1; R2-full=.2181 R2-reduced=.1578 R2-change=0.0603

5.4 The effects of increase in the high-skilled labour supply

This section describes the results of CGE modelling with the scenario that there is a 10-percent increase in the labour supply of L3 and L4 (see section 4.2 for details). We examine the effects of this increase on the labour market, economic growth, and household welfare.

The effect on the labour market

In term of nominal change, there would be labour movment of L1 and L2 from the service to the agriculture and industry sectors, however there is no change in the overal labour input of L1 and L2. As the demand for L1 and L2 in the service decreases, those of the agriculture and industry sector increase (Table 13). As expected, the labour input of L3 and L4 would increase by 10 percent, overall, as we introduce a hypothetical 10-percent increase of these labour categories. All this additional labour would be absorbed by the three sectors, however their wage rate, as well as those of L1 and L2, would have to adjust to attend zero unemploymnet as assumed. It should be noted that the changes in the wage rate are likely to account for the nominal value changes of labour inputs in production which does not reflect the real change.

In terms of real change, due to increase in the wage rate of L1 and L2 and the oversupply of L3 and L4 in the labour market, firms in all sectors are likely to reduce their inputs of L1 and L2, and increase the input of L3 and L4. Overall the input of L1 would drop by 0.4 percent compared to the initial period, L2 would decrease by 0.30 percent. L3 and L4 input would rise by 20.61 percent and 20.88 percent, respectively.

Table 13: Percentage changes in labour inputs (%)

Labour	Nominal change				Real Change			
	AGR	IND	SER	Overall	AGR	IND	SER	Overall
L1	0.15	0.05	-0.32	0.00	-0.25	-0.34	-0.72	-0.40
L2	0.19	0.10	-0.28	0.00	-0.11	-0.20	-0.58	-0.30
L3	10.25	10.14	9.72	10.00	20.88	20.76	20.31	20.61
L4		10.39	9.98	10.00	0	21.31	20.85	20.88
Overall	0.18	0.62	2.93		-0.18	0.89	6.12	

Source: Result of CGE modelling

Table 14 shows that the wage rates of L3 and L4 categories declined by 8.82 percent and 9.03 percent, respectively, while the wages of L1 and L2 categories increased slightly by 0.37 percent and 0.33 percent respectively. Overall, the wage rate decreases by 4.10 percent. The wage rate decline in the L3 and L4 categories may result from the oversupply of skilled workers in the labour market.

Table 14: Wage changes

Skill level	Changes (%)
L1	0.37
L2	0.33
L3	-8.82
L4	-9.03
Overall	-4.10

Source: Result of CGE modelling

The effect on economic growth

Based on the simulation and the applied assumptions (see section 4.2), real GDP would grow by 0.83 percent from the intial period to US$21,528.96 million (based on initial price). However, the agriculture sector would decrease its value added by about US$3.32 million (0.07 percent compared to the initial value), while the industry and service sector would increase their value added by about US$41.25 million (0.62 percent) and about US$137.21 million (1.63 percent), respectively. In total, the value added would increase by about US$175.14 million, a total of 0.87 percent compared to the initial value (Table 15). The imputed tax revenue would expand from US$1,271.78 million in the initial period to US$1,274.92 million after the simulation, a 0.25 percent increase.

Table 15: Changes in value added, million USD at constant price

Sector	Initial value	New value	Real value changes	Real percentage change (%)
AGR	5055.27	5051.95	-3.32	-0.07
IND	6621.44	6662.68	41.25	0.62
SER	8402.19	8539.40	137.21	1.63
Tax revenue	1271.78	1274.92	3.14	0.25
Total	21,350.68	21,528.96	178.28	0.83

Source: Result of CGE modelling
Note: Based price is the intial price

The effects on households welfare

Table 16 shows slight changes in households' income by economic status and residence. In terms of income changes, the better-off households would be able to increase their income by the largest margins. Better-off households in the capital would have an additional income of US$56.11 million, while rural better-off households would receive an extra US$31.98 million, and urban better-off would receive US$29.87 million. The rural, urban, and capital poor would increase their income by US$2.24 million, US$0.12 million, and US$0.30 million, respectively. Comparing the income increase among different groups of households can be misleading since the different income changes can be due to the sizes of groups in the population. The larger the size of a household category is, the larger their total income is. Therefore, a household category that has a large proportion also has larger income changes. The percentage change in income and the Social Welfare Index are better options for comparing the benefit distribution. When we examine the percentage change, only the income increases of the capital poor households would be higher than rural and urban better-off, whereas the income changes of the rural and urban poor are situated at the bottom.

Table 16: Changes in households' income, million USD at current price

Households	Initial Income	New Income	Income Change	Changes (%)
Capital better-off	4137.81	4193.93	56.11	1.36
Capital poor	32.66	32.97	0.30	0.93
Rural better-off	8444.99	8476.96	31.98	0.38
Rural poor	832.32	834.56	2.24	0.27
Urban better-off	6501.09	6530.96	29.87	0.46
Urban poor	130.03	130.14	0.12	0.09
Grand Total	20078.90	20199.53	120.63	0.60

Source: Result of CGE modelling

Table 17 indicates sharp differences in the Social Welfare Index, based on Hicksian equivalent variations (EV). EV is used to measure changes of economic welfare arising from a CGE simulation. It aims to quantitatively assess increases in welfare and sum the gains and losses of individual households to identify the total welfare impact for an economy. This welfare change indicator quantifies the variations in the utility level in monetary terms (Hosoe, Gasawa, and Hashimoto 2010).

The better-off groups had EV values of 38.28, 22.41 and 19.44 in rural, capital and urban areas, respectively. In contrast, the poor groups had lower EV values of 3.55, 0.64 and 0.18 in rural, urban and capital areas, respectively. The better-off groups would be able to improve their social welfare values more than the poor groups, regardless of residence.

Table 17: Social Welfare Index, Hicksian equivalent variations (EV), million USD at current price

Households	EV
Rural better-off	38.28
Capital better-off	22.41
Urban better-off	19.44
Rural poor	3.55
Urban poor	0.64
Capital poor	0.18
Total	84.50

Source: Result of CGE modelling

6. Conclusion

This section is devoted to discussing the key findings and describing the conclusion drawn. We will also compare our findings with previous literature including those of NEA, which has regularly conducted firm surveys on skills shortages and skills gaps in the Cambodian labour market since 2013.

6.1 Labour shortage

Most companies in the three selected industries encountered some difficulty in finding operators, technicians, and employees for higher management positions. While it was easier to find general workers and supervisors (degree of shortage), there is still a high proportion of companies facing this difficulty (prevalence of shortage). This finding differs from the 2018 NEA results, which reported that recruitment overall was highly difficult but that only 47.5 percent of the companies faced recruitment difficulties. These reporting differences could arise from the different coverage of sectors; while this paper covers only three sectors – garment, E&E, and food processing – NEA (2018) focussed on ten sectors: garment, footwear and apparel; construction; ICT; finance and insurance; food and beverage; education; health; logistics, warehousing and transportation; and accommodation.

The level of difficulty slightly varies between the sectors and the worker levels, which is similar to the findings of NEA (2018). NEA indicated that some sectors faced higher difficulty in recruitment than others. The finding that firms in the garment sector had less problems finding employees than the other sectors reflects the findings of 2018 NEA results as well, which rated the difficulty to find workers in the garment, footwear, and apparel sector as on the edge between difficult and balanced. However, the percentage of garment firms facing difficulty (46 percent) in this paper is higher than the 29 percent found in NEA (2018), which unfortunately did not cover the food processing and E&E sectors, so we cannot make comparisons for these two sectors.

Remarkably, the findings of this paper emphasises that food processing firms encountered significant difficulty in finding technicians, which exceeded the recruitment difficulty in any of the other worker levels and sectors. This may imply that the number of graduates in the relevant subjects such as food chemistry is still small compared to those of other fields such as mechanics, electronics, and electrical engineering which are required for technicians in the garment and E&E sectors. Additionally, food processing sector also required technicians that had the same qualifications required by the other sectors, especialy E&E factories, which might provide better working conditions and higher wages than the most food processing firms. This can also be a justification of significant difficulty in finding technicians for food processing firms.

The observed effects emerging from the recruitment difficulty were rated as "somewhat negative", both in regards to firms' operations and growth. The effects were highly prevalent among the companies in the three sectors; when there is a noticeable shortage, there is always an effect felt by the companies. According to the companies' representatives, the effects of the shortage is reduced to "somewhat negative" because the companies had prepared well. They recruited qualified workers before they actually needed them, or they informally asked workers to do additional hours in case the companies failed to recruit enough qualified workers. In general, the effects on growth were lower than the effects on operations. The reason for this could be that operations present immediate issues, giving the companies only little time to implement a strategy or deal with the effects, while growth involves issues in the long run, giving companies more time to plan and deal with the effects.

6.2 The contribution of VSD

The companies' representatives subjectively reported that VSD contributed significantly to meeting their skills needs, while the statistical analysis seems to indicate that the companies that have more varieties of pre-VSD programs are more likely to experience higher difficulty to find workers, especially operators, supervisors, and technicians, than those which have fewer varieties of pre-VSD programs. The explanation can be that the companies with more pre-VSD programs requrie more skilled workers than those with fewer or without pre-VSD programs.

Regarding the positive perception of companies' representatives concerning the contribution to fullfilling companies' skills needs, the justifications were that basically, pre-VSD was set as one recruitment criteria for high-skilled positions, and for some medium-skilled positions. These initial VSD programs are generally seen as a foundation, on which in-VSD programs can be built (Senker 2000; Wolbers 2005).

The results of the regression analysis suggests that there are some positive correlations between pre-VSD programs and technological transformation and organisational improvement. Nonetheless, VSD programs had no effects on growth and other variables of transformation, which seems to be inconsistent with those of previous studies that showed a close link between VSD programs (specifically in-VSD) and growth and transformation of firms (Acemoglu and Pischke 1999a; Nguyen, Truong, and Buyens 2011; Thang, Quang, and Buyens 2010). The reason can be that this study did not observe the number of VSD participants, but instead identified the most frequent programs, resulting in an indicator measuring the variety of VSD programs. Also, our study only focussed on formal pre- and in-VSD programs which entail some kind of certification, while excluding informal learning or on-the-job training activities. Nevertheless, the finding regarding the positive effect of VSD (variety) on technological change is supported by previous studies underlining that skills training of employees could raise the productivity and facilitate adopting and using new technologies in firms (Acemoglu and Pischke 1999b; Blundell et al. 1999; Nguyen, Truong, and Buyens 2011; Thang, Quang, and Buyens 2010).

6.3 The effects of increment of skilled labour supply

The CGE simulation has shown that a 10-percent increase in the supply of skilled labour – for instance through growth of the number of new graduates from university or VSD institutes who would have the same capacity as the existing L3 and L4 – would lead to a real GDP growth of 0.83 percent. While the industry and service sectors benefit, agriculture would reduce its aggregate value added. Wage structure would also change, with the wage rate of L3 and L4 decreasing due to oversupply, while that of L1 and L2 would rise.

There would be labour movement of L1 and L2 from the service to the agriculture and industry sector. All of this additional labour would be absorbed by the three sectors; however, their wage rate, as well as those of L1 and L2, would have to adjust to attend zero unemployment as assumed. Overall, the wage rate decreased by 4.1 percent. The skilled labour would benefit from more job generation while the lower-skilled workers would enjoy higher wages, albeit with fewer available jobs.

The simulated increment is quite simple by assuming that there would be a 10-percent increment of L3 and L4 overall, without specifying in which sectors the L3 and L4 would increase. This is the reason why there is a skills mismatch between supply and demand which would distort the labour market structure including a decline in the wage rate of L3 and L4.

The better-off households tend to have higher social welfare values than the poor groups, regardless of residence (capital, urban, or rural). The poor households would receive a very small income increase due to the income and labour distribution among household categories (Table 7). Poor households receive less income than the better-off ones probably because the members of these poor households (all labour categories) have low involvement in employment.

7. Policy implications

This paper is primarily based on a company survey conducted in the first stage of the "Skills for Industry" project which focuses on the demand side (i.e., the firms in the three sectors). Using a structured questionnaire containing mostly quantitative questions, the development of the companies, their skills needs and training programs were discussed. In the second stage, we focus on qualitative questions from which we can gain further insights and gather suggestions and ideas from which policy recommendations can be derived. However, data processing of the second stage is still ongoing at the moment, and we cannot use that data in the current paper to draw policy recommendations. Moreover, in order to provide effective practical policy recommendations, we need to study the supply side which covers the VSD program providers and relevant existing policies which will be investigated in later stages of the project. Therefore, the policy implications in this section are mainly based on the authors' experience and knowledge and can be the subject of further exploration and discussions.

7.1 Skills shortages

Key challenge: Skills shortages, especially in the positions of operators, technicians, and high management employees, are often at moderate severity but high prevalence in the three sectors. Sources of the skills shortages could be manifold, but probably involve the supply of graduates needed for production processes. Exit to other sectors and high turnover rate in those positions can also lead to shortages.

1. Relevant government agencies, labour unions, employer associations, and development partners should help facilitate job matching events such as job fairs, and improve career guidance in major industrial zones across the country, not only in the capital Phnom Penh.

2. VSD providers should obtain and provide better guidance concerning what skills will meet sufficient labour demand by the private sectors, in order to align their training programs. They should also use that knowledge to inform their students.

3. Public-private partnership between VSD providers and the private sector should be promoted. Companies should invest more in improving the skills of their employees and improve the linkages with VSD providers, including providing more internship opportunities and apprenticeship positions, or technical support and materials. The school-industry linkage should ensure mutual understanding and benefits.

7.2 The contribution and quality of VSD

Key challenge: There is little evidence that VSD could contribute to ease the companies' difficulty to find employees, especially the operator, supervisor, and technician level. This result suggests that the labour supply for these positions is still limited and that recruited workers may not have enough qualifications to satisfy the companies' requirements. Despite the fact that the VSD quality is still limited, most companies say VSD is significantly helpful.

4. We support the recommendation of the UNESCO (2013) report, which suggested that the relevant government agencies should speed up curricular reform and promote quality assurance of programs and institutions.

5. The design and development of VSD programs should be based on a skills need analysis, making the content of VSD programs relevant to the industry. More importantly, the development of technology-oriented VSD programs linked to the industry needs, including industry 4.0, seems vital in the current and future context.

6. In addition, the policy suggestions 1, 2, and 3 above will also help to improve the quality of VSD programs.

7.3 The contribution of increment in skills labour supply

Key challenge: An increment of skilled labour supply without studying and satisfying the market demand would further worsen the skills mismatch, distort the wage structure and the labour market.

7. Relevant government agencies and VSD providers should continue and even accelerate the study of the labour market demand side. The estimation of skills labour supply and demand should be done in line with the major national policies and plans in moving Cambodia towards an industrialised economy.

Key challenge: Poor households tend to benefit little from the expansion in skilled labour (both in terms of income and social welfare), regardless of residence, probably because of the fact that members of these poor households are very little involved in employment in all labour categories.

8. There should be encouragement and support for students from poor households to participate in vocational training, for instance by providing scholarships and assistance to find internships and jobs. Free or company-sponsored VSD programs for the low-skilled and poor should be expanded, providing them with training programs which are flexible in terms of time and location and hence aligned with their needs.

Appendix: Technical methods for estimation of elasticity of substitution and transformation of Cambodia trade

$$ln(\frac{m}{d}) = \propto + \sigma ln(\frac{pd}{pm}) + \beta_1 t + \beta_2 wto + \beta_3 asean + \beta_4 acfta + \beta_5 ln(khmgdp) + \varepsilon;$$

(equation A1)

$$ln(\frac{e}{d}) = \propto + \psi ln(\frac{pe}{pd}) + \beta_1 t + \beta_2 wto + \beta_3 asean + \beta_4 acfta + \beta_5 ln(khmgdp) + \varepsilon;$$

(equation A2)

Where:

Table 18: Description of variables in equations A1 and A2

Short hand	Coding	Description	Source
σ	-	Elasticity of substitution	-
ψ	-	Eleasticity of transformation	-
t	Year	Period: 1993-2018	-
m	Constant 2000 KHR bn	Cambodia's goods and service imports	NIS
e	Constant 2000 KHR bn	Cambodia's good and service exports	NIS
d	Constant 2000 KHR bn	Cambodia's output (gross value added + intermdiate consumption – tax less subidy)	NIS
pm	-	Deflator of imports	Authors' calculation
pe	-	Deflator of exports	Authors' calculation
pd	-	Deflator of ouput	Authors' calculation
wto	Equal 1, if year greater than 2004, otherwise 0.	Dummy variable for Cambodia's WTO membership	-
asean	Equal 1, if year greater than 1999, otherwise 0.	Dummy variable for Cambodia's ASEAN membership	-
acfta	Equal 1, if year greater than 2003, otherwise 0.	Dummy variable for Cambodia's ACFTA membership	-
khmgdp	Constant KHR bn, 2000 prices	Cambodia's GDP	NIS

Note: NIS: National Institute of Statistics, Misnistry of Plannaing, Cambodia.

Table 19: Estimation results of elasticity of substitution (σ) and transformation (ψ)

Variable	Substitution elasticity model	Transformation elasticity model
lnpdpm	**1.369 (= σ)**	
	(0.173)*	
lnpeod		**-1.33 (= ψ)**
		(0.213)***
year	-0.047	0.008
	-0.046	-0.054
asean	0.433	0.642
	(0.070)***	(0.100)***
wto	-0.022	0.012
	-0.094	-0.116
acfta	0.156	0.225
	(0.030)***	(0.039)***
lnkhmgdp	0.379	-0.316
	-0.551	-0.654
_cons	89.711	-15.381
	-87.773	-101.079
N	26	26
r2	0.98	0.976
r2_a	0.974	0.968

Source: Result of author's analyses
Note: Standard errors in parentheses; * p < 0.1, ** p<0.05, *** p<0.01

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