Global Value Chain and Policies for Industrial Workforce

Heeseon Choi, Jinkeun Yu, Jong-ki Kim, Mi-kyung Jung

Chapter 1. Introduction

A defining characteristic of twenty-first-century globalization has been the intensification of global value chains (GVCs)—that is, their fragmentation and international reorganization. The globalization of value chains has expanded consistently since it first began to accelerate in the first decade of the twenty-first century. The purpose of this study is to analyze the effects of these intensifying GVCs on Korean employment and wages, and to consider their implications for future workforce policy.

A central aim of this research is to verify whether GVC intensification is in fact creating a skill-biased effects in Korean employment and wages. The concept of stages of value chains is also introduced in order to examine structural changes in the labor market amid GVC intensification. To this end, Chapter 2 will review GVC indicators, the general concept, and the classifications of skill level. Chapter 3 applies the methodology of Timmer et al. (2013)

to analyze the GVC income (value-added) and GVC jobs (employment) from a general equilibrium theory standpoint. We use the World Input-Output Database (WIOD) for the period from 1995 to 2011. Chapter 4 analyzes Korea's manufacturing industry in terms of skill-biased wage effects from GVC using data from the 2009 Survey Report on Labor Conditions by Employment Type and the Local Area Labor Force Survey. To understand the effects of GVC expansion on wages and skill structure in the context of the overall labor market, we analyze the manufacturing industry and the manufacturing value chains. In this case, we introduce the concept of stages of value chains. This paper identifies six groups according to value chain stage and skill level. Additionally, we discuss about the German manufacturing labor market amid ongoing GVC intensification. Chapter 5 analyzes the IT industry as a case study from a GVC standpoint.

Based on the analyses, we draw the implications for workforce policy. Each chapter mentions relevant implications, while Chapter 6 puts all of these implications together. The focus of the implications on workforce policies are for high-skill workers at the pre-production stage and for middle-skill workers at the production stages, with an examination of the implications for the post-production stage workforce.

While the category of workforce encompasses workers both in manufacturing and in manufacturing-related services, the term will be understood to refer primarily to the former for the purposes of this study. The discussion of implications for workforce policy in Chapter 6 will focus on IT manufacturing, which is adopted for a case study in the study. We focus the implications of the educa-

tion and training policies of IT manufacturing, which is the main content of the workforce policy of IT manufacturing. Because of this focus on IT manufacturing, the research cannot address issues such as displacement amid the structural changes resulting from GVC intensification. In a ship-building industry, for example, many skilled-workers lose their jobs because of expanding foreign investments.

Chapter 2. GVC Indicators and Skill Level

This chapter includes an explanation of the indicators and concepts that will be applied in the study. As GVC indicators, the offshoring index and GVC participation index will be used. Between 1995 and 2009, Korea's GVC index underwent a continued increase. The index for the IT manufacturing industry reached its highest point in 1995, but remained largely the same as those for areas such as chemicals, non-ferrous metals, fibers, and shoes. In 2009, IT manufacturing alone achieved a high index, while chemical non-ferrous metals and transport machinery ranked next highest. The offshoring index also underwent a sharp increase in the middle of the first decade of the twenty-first century. The value chain is classified into pre-production, production, and post-production stages, with the pre-production stage encompassing design, R&D, and planning and the post-production stage including marketing, sales, and after-sales service. As technology advances, the curvature of "smiling curve" that indicates added value in different stages of the value chain, increases. Skills are classified into three categories—"high," "middle," and "low"— according to the

schooling years or profession. In terms of the schooling years, the "high-skill" category encompasses workers with vocational college or university degrees. This classification follows the ISCED (International Standard Classification of Education) and WIOD (World Input-Output Database) also uses this rule. This criterion applied for the GVC income and job analysis in Chapter 3. Because this standard is ill-suited to analysis of the Korean labor market, however, the analysis in Chapter 4.2 uses a four-year university degree as a standard to identify high-skill labor. Middle-skill labor is identified as labor performed by individuals possessing a high school or vocational college diploma, while low-skill labor represents qualifications below the high school level.

Occupation-based value chains/skill level categories have been introduced in order to link skill level with value chain stages. The high-skill group found at the pre-production stage and both middle- and low-skill groups found at the production stage. All levels of skill are found at the post-production stage. These standards will be applied for the analyses in Chapters 4.3 and 5.2.

Table 1. Six Value Chains/Skill Level Groups by Occupation

	Pre-Production	Production	Post-Production
High-skill	Managers and Professionals		Very few of Managers and Professionals
Middle-skill		Technicians, Production workers	Clerks, Sales or service workers
Low-skill		Some Elementary workers	Some Elementary workers

Chapter 3. Analysis of GVC Income and Jobs

Empirical studies of the effects of production globalization on employment fall into two main categories. The first consists of studies that use econometric methodologies to consider the effects of offshoring and/or overseas direct investment on employment. Another trend in research has been to approach the issue in terms of general equilibrium theory through the use of global industry linkage tables. The second approach began in earnest with the recent publication of results for the European Union-sponsored World Input Output Database (WIOD) project. In addition to the World Input-Output Table (WIOT), the WIOD has also provided socio-economic accounts that include statistics on employment in specific countries.

Timmer et al. (2013) proposed the concepts of GVC income and GVC jobs according to a methodology that decomposed end good value in terms of the value added of all labor and capital directly and indirectly implicated in the production process within the GVC. “Income” here refers to value added, while “jobs” refers to employment.

Chapter 3 of this paper applies the methodology from Timmer et al. (2013) to analyze GVC income and jobs since 1999, the distribution of jobs by skill level, and changes in the rate of income distribution according to factors of production. The analysis here will be confined to GVCs in the manufacturing industry, as the high rate of international competition in the production process results in a more active degree of international production segmentation (GVCs) than in other industries. While manufacturing GVCs

remain the focus of analysis in this chapter, the fact that other industries (including services) provide intermediate goods inputs over the production process means that GVC income (value-added) and jobs generated in services and other industries are also considered in the analysis.

(1) Analysis of GVC Income and Jobs in Global Manufacturing

Examination of the proportions represented by different countries of the world in terms of global manufacturing GVC income provides a clear picture of changes in the global economic landscape for the manufacturing industry. Between 1995 and 2011, the percentage of GVC income from the United States, Japan, Germany, and other advanced economies underwent a decline, while the percentage from China nearly quadrupled from 4.2 percent to 16.7 percent, demonstrating the latter's rise to become the "factory of the world." Over this period, the percentage of global manufacturing GVC income from Korea remained relatively constant at around 2 percent. Also noteworthy is the expansion in GVC income for countries falling into the so-called "Rest of the World" (ROW) category, with the ROW market share of GVC income rising by 4.3 percentage points, from 11.3 percent in 1995 to 15.6 percent in 2011.

Global manufacturing GVC jobs for forty countries accounted for 507.75 million positions in 1995, or around 28.1 percent of all employment. As of 2011, the number had increased 9 percent from the 1995 level, but the percentage of all employment had declined to 25.7 percent, a decrease of 2.4 percentage points from 1995. Reasons for the declining proportion of global manufacturing GVC

jobs against overall world employment include advancements in servicitization for the countries in question and the migration of GVC jobs to the ROW category. Apart from some exceptional cases, GVC jobs generally declined for advanced economies and increased for emerging economies over the period of analysis.

Table 2. Global Manufacturing GVC Jobs in Korea by Industry

Unit : 1,000s of jobs, %

	2011		Increase in GVC jobs since 1995
	GVC jobs	% of Employment	
Food/beverage	170.3	67.5	-99.6
Fibers	261.8	78.9	-403.9
Leather/shoes	32.7	78.1	-77.4
Wooden goods	16.6	39.0	0.6
Paper/printing	104.8	44.7	-24.8
Coke/oil refining and nuclear fuel	30.5	43.5	12.0
Chemical products	107.7	47.5	-64.9
Rubber/plastic	172.9	58.7	33.1
Non-ferrous metals	42.8	29.9	-7.4
Ferrous metals	302.4	51.4	54.5
Machinery	363.9	72.4	-25.4
IT manufacturing	629.7	66.3	5.1
Transport equipment	506.7	81.1	63.6
Other manufacturing	77.2	66.5	-33.1
Total (14 areas above)	2,820.1	63.8	-567.5
Wholesale	494.7	33.6	-19.8
Retail sales	248.6	12.3	105.8
Finance	136.7	15.2	-58.7
Business services	618.5	28.9	414.6
GVC jobs for all industries	5,743.5	23.7	-324.4

In Korea, GVC jobs declined by 5.3 percent, or roughly 320,000 positions, over the period of analysis. The percentage of GVC jobs against total employment likewise fell by 6 percentage points, from 29.7 percent in 1995 to 23.7 percent in 2011. The analysis for 2011 showed 2.82 million GVC jobs in Korean manufacturing, representing a decrease of 570,000 from 1995. In contrast, GVC jobs in services experienced an increase over the same period.

An examination of changes in the distribution of GVC jobs between 1995 and 2009 by skill level for forty countries shows an increase in the percentage of high-skill and low-skill positions and a decline in the percentage of middle-skill positions. For Korea,

Table 3. Global Manufacturing GVC Jobs by Skill Level, 1995 and 2009

Unit : %, 1,000s of jobs

	High-Skill	Middle-Skill	Low-Skill	GVC Jobs
1995				
Korea	23.3	49.0	27.6	6,067.8
Germany	18.4	63.5	18.1	10,086.5
U.S.	22.6	63.6	13.8	21,483.9
Japan	16.6	63.0	20.4	15,083.0
China	1.4	22.6	76.0	215,948.8
Total (40 countries)	5.3	30.7	64.0	507,751.5
2009				
Korea	40.6	48.8	10.6	5,308.2
Germany	24.6	60.4	15.1	10,016.8
U.S.	29.0	60.5	10.5	15,147.8
Japan	23.0	66.5	10.5	10,036.4
China	3.8	26.5	69.7	250,194.8
Total (40 countries)	8.0	33.8	58.2	554,280.5

high-skill positions accounted for 40.6 percent of all GVC jobs as of 2009, the highest level for any country analyzed.

For 2009, the distribution of GVC income for capital and high-skill labor for forty countries stood at 44.1 percent and 17.3 percent, respectively, representing increases of 5.5 and 2.3 percentage points from 1995. In contrast, distributions for middle- and low-skill labor respectively fell by 4.8 and 3.0 percentage points over the same period.

(2) Analysis of GVC Income and Jobs for Korean IT Manufacturing

The period after 1995 saw major changes in terms of the portion of income and jobs for actors in Korea's IT manufacturing GVC. Notable with regard to GVC income portion are declines for Korea (from 70.6 percent to 61.8 percent) and Japan (from 8.7 percent to 4.8 percent) and increases for China (from 1.2 percent to 8.9 percent) and the ROW (from 4.3 percent to 8.1 percent) over the period examined. This can be attributed to a decline in dependence on Japan for intermediate goods over that period and an increase in offshoring to China and the ROW.

The analysis for Chapter 3.2 shows an increase of 5,100 global manufacturing GVC jobs in domestic IT manufacturing over the period from 1995 to 2011 (a rise from 624,600 to 629,700 positions). In Chapter 3.3, the increase in GVC jobs for corresponding areas in domestic IT manufacturing is calculated at 41,500. Viewed together, these findings lead to the conclusion that jobs associated with other domestic manufacturing from domestic IT manufacturing and overseas GVC participation by manufacturing accounted for an increase

in 46,600 positions over this period. An examination of these Korean IT manufacturing GVC positions according to skill level shows a sharp increase in the percentage of positions requiring high levels of skill. Specifically, this figure rose from 23.6 percent in 1995 to 43.0 percent in 2009, an increase of no less than 19.4 percentage points. In contrast, the ratio of low-skill positions out of all GVC positions fell by 12.9 percentage points, from 20.6 percent to 7.7 percent, and that of middle-skill positions fell by 6.5 percentage points over the same period. In terms of factors of production, the relative importance of high-skill labor in the distribution of Korean IT manufacturing GVC income increased, while that of middle- and low-skill labor declined. China accounted for the highest percentage of GVC income among other countries involved in Korea's IT manufacturing GVC. Distribution ratios for labor factor inputs in 2009 stood at 4.3 percent for high-skill jobs, 14.7 percent for middle-skill jobs, and 14.1 percent for low-skill jobs, indicating that offshoring to China is an area that chiefly draws upon middle- and low-skill labor.

(3) Implications

With employment structures around the world becoming increasingly skewed in favor of high-skill labor, human resource policies have focused on encouraging workers to acquire technical skills. It is necessary to consider, however, how long these policy measures will remain relevant. In particular, policy efforts are necessary to overcome the so-called "high-skills trap," which either leaves highly skilled workers unable to find employment or forces

them into relatively poor positions with worse compensation and conditions than they might have commanded in the past.

Analysis of GVC jobs in IT manufacturing shows a decrease in positions related to production of final goods as a result of offshoring, but one that is more than offset by positions related to the supply of intermediate goods to other domestic manufacturing businesses and overseas manufacturing businesses. This shows that the ongoing government policy focus on fostering the parts and materials industries has been effective in terms of GVC employment.

Germany represents an exceptional instance of an advanced economy that saw GVC positions increase over the period examined. This increase in overall GVC jobs was largely due to the creation of 1,179,600 new positions in business services, but another 95,600 jobs were also created in three manufacturing industries. As such, the German increase in GVC jobs is worth considering as a benchmark for Korea's workforce policy. While some 1,179,600 jobs were created in the business services area from 1995 to 2011 in addition to manufacturing GVC jobs. In Japan, total GVC jobs decreased by 500,000 over the same period, but 198,000 new jobs appeared in business services. Korea also showed a notable increase of 414,600 business service jobs.

Increased competitiveness in the service sector is important for that sector's development, but it also helps to increase competitiveness for manufacturing areas in which services are input as intermediate goods. This is especially true for business services: in particular, policy focus is required to center on the area of software, which is expected to be a determining factor in manufacturing competitiveness in the future.

Chapter 4. GVCs and Labor Market Changes

Chapter 4.1 examines previous studies on changes in GVC intensification. Fragmentation of the manufacturing value chain, and the resulting migration to low-wage countries in the production stage, have affected mainly middle- and low-skill workers. Accordingly, GVC intensification has resulted in a bias toward high-skill work in the skill structure for advanced economies. While demand for high-skill workers is increasing and wages continue to rise, the opposite effect is observed for middle- and low-skill workers. As the German example in Chapter 3.4 shows, however, the scope of this bias is not identical for all advanced economies. Since 2004, Germany has experienced both a sharp increase in exports and offshoring and growth in its economic scale, while high-skill positions have increased greatly and almost no decline has been observed for middle-skill positions. Moreover, the wage gap between skill levels there has also remained relatively small.

In Chapter 4.2, data from 2009 surveys of working conditions for different occupations and regional employment studies are used to estimate the wage effects from the GVC skill bias. Analysis of the two sources showed GVC effects on wages to differ by skill level, with more of a positive effect on high-skill workers. Middle-skill workers were also positively affected, albeit to a lesser degree. As in Germany, Korea has experienced significant economic growth as a result of globalization, with little negative effect on the wages of middle-skill workers. In contrast, the effects of GVCs were found to be negative (survey of working conditions by employment type) or virtually nonexistent (regional employment study) for low-skill

workers.

Chapter 4.3 includes an analysis of changes in employment and wages for six groups in the manufacturing chain according to manufacturing value chain stages and skill levels, for the years from 2008 to 2014. Previous GVC-related studies have not attempted to link duties or skill level to stages in the value chain. The GVC analysis in Chapter 3 was linked to the value chain by way of trade, with stages of the chain identified in the units of analysis for country/industry level in terms of macro-level methodology. In contrast, Chapter 4.3 adopts a professionally based linkage of value chain stage and skill level to identify six groups, with an analysis of

Table 4. Percentage of Jobs in Each Value Chain Stage and at Each Skill Level and Changes in Employment Rates

	Manufacturing				Manufacturing Value Chain			
	Pre-Production	Production	Post-Production	All	Pre-Production	Production	Post-Production	All
High-Skill	26.2% ↑		2.2% ↑	28.5% ↑	32.2% ↑↑		1.5% -	33.7% ↑↑
Mid-dle-Skill		52.6% ↑	9.6% ↓	62.2% ↓		29.1% ↓	29.6% ↓↓	58.7% ↓↓
Low-Skill		8.2% ↓	1.1% -	9.3% ↓		4.6% ↓	3.0% ↑	7.6% ↑↑
Total	26.2% ↑	60.8% ↓	13.0% ↓	100.0%	32.2% ↑↑	33.7% ↓↓	34.1% ↓↓	100.0%

Source : The Local Area Labor Force Survey.

Note : 1) Two groups (Post-production high- and low-skilled Groups) are very small groups, which accounted for 3 percent or less of employment, respectively.

2) The symbol ↑ indicates an increase of less than 2 percentage points from the 2008 employment rate; the symbol ↑↑ indicates an increase of 2 percentage points or more; the symbol ↓ indicates a decrease of less than 2 percentage points; the symbol ↓ indicates a decrease of 2 percentage points or more; and the symbol – indicates no change.

3) Employment rates represent 2014 values; the arrows represent changes during the period from 2008 to 2014.

changes in employment and wages for these groups amid the GVC intensification process. This method, however, does not distinguish between GVC employment and other related employment. If the calculation method in Chapter 3 is applied, a total of 63.8 percent of all manufacturing positions as of 2011 were GVC jobs. It is also possible to calculate GVC exposure level for each group—that is, average GVC participation indices per group. These figures were found to be highest for the high-skill group in the production stage.

Between 2008 and 2014, manufacturing jobs declined from 17.1 percent to 16.4 percent of jobs in all industries; however, jobs in manufacturing value chain areas rose from 29.9 percent to 30.8 percent of jobs in all industries. In other words, manufacturing employment per se declined, but employment connected with the manufacturing value chain did not. Table 4 shows changes in the proportions and kinds of jobs that existed at the different production stages and skill levels both in manufacturing and the manufacturing value chain during the period under examination. The percentage of high-skill jobs in the production stage rose considerably for both manufacturing and the manufacturing value chain. This rise was especially noticeable in the manufacturing value chain. The high-skill, production-stage group also had the highest average monthly wages of all six groups considered. As of 2014, that figure stood at KRW 3.41 million for manufacturing, significantly more than the KRW 3.02 million recorded for the high-skill, post-production-stage group and the KRW 2.27 million for the middle-skill, production-stage group.[1] Employment in the pro-

1) In data from the 2014 survey of working conditions by employment type, aver-

duction stage underwent a decline, with a slight increase observed in middle-skill, production-stage employment for manufacturing alone but a very large drop in low-skill employment, leading to an overall drop in production-stage employment. In terms of manufacturing value chain areas, large declines were seen for both middle-skill and low-skill production-stage jobs. A rise in high-skill, post-production-stage employment was observed for manufacturing alone, but that area accounted for only a very small percentage of employment. Post-production-stage employment experienced a general decline, which was particularly noticeable in the manufacturing value chain area. In terms of skill level, a clear increase was found for high-skill jobs and a clear decrease for middle-skill ones.

The implication of this analysis in terms of workforce policy is that it is important to train and supply high-skill workers, an area where employment has been increasing in relative terms and wages are high. Conclusions regarding middle-skill workers are more controversial. As will be seen in Chapter 5, some have argued in favor of abandoning policy attempts to expand production employment (an area of waning demand in Korea) and focusing instead on increasing employment in high-skill areas. At the same time, it may be argued that middle-skill jobs in the manufacturing production stage are "better" than ordinary service industry jobs. Moreover, employment in post-production-stage services included in the manufacturing value chain has undergone a sharp decline,

---

ages were 4.51 million KRW for the high-skill pre-production group, 3.53 million KRW for the high-skill post-production group, and 3.12 million KRW for the middle-skill production group.

which can be attributed to innovations resulting from computational technologies not only in manufacturing production but also in distribution and after-sales service. While they face the threat of a future decline, middle-skill manufacturing positions remain stable and strong jobs with long periods of service and relatively high average monthly wages.

This indicates a need for a stable supply of middle-skill workers to keep or attract manufacturing plants within Korea's borders. In a sense, the policy implications of this study echo the recent debate over the resurgence of manufacturing. As observed in Chapter 4.4, the stability of middle-skill employment also has an impact on policy considerations. In Germany, the vocational education and training system and labor policy have served as institutional mechanisms for maintaining a diverse middle-skill labor pool. Strategies by individual German companies have also had an impact in this regard: producing relatively high-value-added products within Germany while production plants for low-value-added products migrate overseas. The availability of relatively high-technology processes has contributed to advancements in R&D for German companies and helped to stabilize employment and wages in middle-skill areas within Germany. In short, responding to GVC intensification requires a mixture of increased training of high-skill workers and attempts to supply the necessary middle-skill manufacturing workforce to maintain a suitably scaled production base.

Chapter 5. Global GVC and Workforce for the IT Industry

Korea's IT industry has established itself as competitive and a

leader in all areas of the value chain, including product R&D, design, parts procurement, manufacturing, and sales. As recently as the middle of the first decade of the twenty-first century, the percentage of IT products manufactured domestically remained very high; today, over 80 percent of IT items, including televisions, personal computers, and mobile phones, are produced overseas in optimal production bases outside of Korea, including China and Southeast Asian countries such as Vietnam and Thailand. A GVC for production was formed in the early period of overseas production in the mid-1990s, with the largest bases established primarily in China. Recently, however, a decline in the competitiveness of Chinese sites has resulted in those bases shifting toward India and Southeast Asian countries such as Vietnam.

While Korea's IT industry has not reached the highest stage in terms of GVC development, it is viewed by some as occupying the next-highest stage (Kim Jung-gi et al., 2014). Despite falling short of the level in the United States, which may be termed the world leader in the IT industry GVC, it has a high level of GVC participation and generally exceeds the middle technology level. It possesses the highest levels of technology in major domestic items such as semiconductors, displays, smartphones, and DTV and occupies a large portion of the world IT export market.

For this chapter, the IT manufacturing industrial workforce is separated into six groups by value chain production stage and skill level, with the analysis focusing on trends in employment structure changes and wages between 2008 and 2014. IT manufacturing is an innovation-centered industry with a high percentage of production-stage employment: pre-production-stage positions accounted

for 38.5 percent of jobs in 2014, as compared with 26.2 percent for pre-production-stage groups in all manufacturing. Examination of employment structure changes for IT manufacturing over the same period shows respective increases of 13,000 and 43,000 positions in the pre-production and production stages, as well as a decline in post-production employment. The rise in production-stage IT manufacturing employment owes largely to SMEs. For example, the globally recognized S Electronics has experienced an average annual rise of 3.5 percent in total employment (1990–2014) and 0.4 percent in production employment (1990–2008). Even as IT manufacturing industry offshoring rose in 2010, middle-skill domestic employment in domestic IT manufacturing experienced a rise. This was due largely to growing employment in the parts industry, offering proof of the effectiveness of government policy to foster the parts and materials industries. In contrast, employment has declined in the IT finished product industry: as the Korean IT manufacturing industry has grown amid GVC intensification, employment in middle-skill positions has experienced an increase, but demand for associated workers is expected to decline amid plans by the Korean semiconductor industry to greatly expand overseas plants from 2014 onward.

In terms of its wage structure, IT manufacturing workers at the pre-production stage are paid more than those for manufacturing as a whole. In contrast, wages for middle-skill production-stage workers are no higher than the average for all manufacturing. One reason for this is the fact that the specific production skills associated with IT manufacturing are not particularly high. Duties involve assembly and product inspection and testing; assembly in particu-

lar has experienced a decline in employment and low wages as a result of automation. Even so, wage levels in Korea remain much higher than those in low-paying countries such as Vietnam.

As a matter of IT workforce policy, measures affecting middle-skill workers have been the subject of much debate. In this study, it was found that demand for middle-skill IT manufacturing workers has not changed significantly amid GVC intensification, a fact which suggests a need for a stabilized training and supply system for workers in this class. In particular, a system is required for the stable training and supplying of workers at various levels to maintain a certain level of production base. In contrast, policy for high-skill workers is an area of little disagreement.

Quantitative and qualitative upgrades in the high-skill workforce are necessary as part of the Korean response to GVC intensification. In particular, the domestic IT industry requires improvements in its pre-production-stage capabilities in order to advance to the same level as the leading GVC countries. Indeed, GVC gap index levels were highest for the domestic IT industry in pre-production-stage areas such as planning, design, and R&D. First, IT businesses need to build their planning and design capabilities through an improved understanding of new trends and efforts to ensure that innovative ideas reflecting consumer demands are incorporated from the earliest product stages. In human resources terms, efforts are needed to ensure the training of creative, convergence-oriented workers with high skill levels and the global mindset necessary to improve capabilities at the planning and design stages. Also essential are historic improvements in research capabilities for basic and source technology in Korean IT, where

R&D capabilities are viewed as particularly weak. At the same time, concerns about a potential decline in the demand base for high-skill workers should also be noted, with companies such as S Electronics attempting a shift in R&D internalization strategy toward technology purchasing. The current juncture requires policies geared toward expanding the workforce demand base as much as policies for training workers.

Chapter 6. Conclusions and Policy Suggestions

Workforce policy in response to GVC intensification can be approached from two main perspectives: a neoliberal perspective and a "manufacturing renaissance" perspective. One implication of the general equilibrium theory methodology based on WIOD concerns the importance of eliminating trade barriers to promote GVC performance. Los, Timmer, and de Vries (2015) note that the numerous measures taken to protect domestic employment in the early days of the financial crisis in 2008 did not prove particularly effective; in other words, industrial policies aimed at protecting domestic employment do not work. This study admits this perspective to increase GVC performance. At the same time, the recent example of manufacturing renaissance policy in the United States and other countries is worth noting in reference to the need to maintain a certain domestic production base even amid the GVC expansion process.

Employment in and of itself will be an important part of the labor market of tomorrow. As higher education becomes more widespread around the world, a "high-skills trap" arises in which

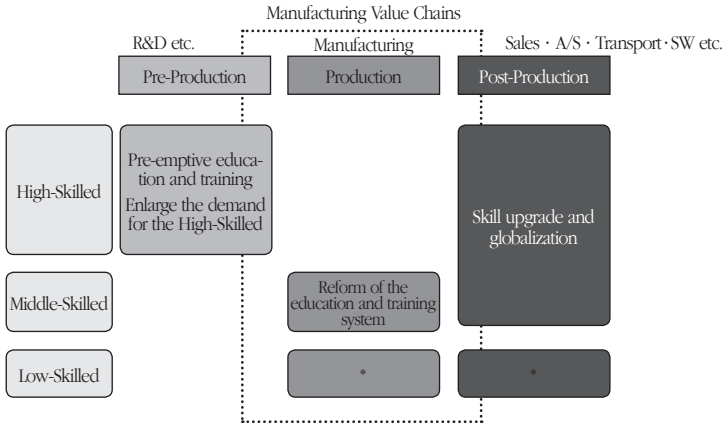
highly educated people are no longer guaranteed high-paying employment. While high-skill positions at home accounted for most of the best jobs at multinational corporations in the past, the situation today is one in which the most talented people are scouted from all over the world. Maintaining a certain level of manufacturing base domestically is also crucial for innovation and R&D. Studies on the importance of information and communications within multinational companies in connection with horizontal overseas direct investment have shown the costs of both overseas R&D and overseas assembly and production to be higher than previously believed (Oldenski, 2011). This is all the more true for SMEs, which are constrained in terms of establishing systematic frameworks for company management. In view of the above points, workforce policy should attempt both an expansion of value chain performance as well as the maintenance of the domestic manufacturing base at a certain scale.

Figure 1 represents workforce policy from a GVC standpoint in terms of value chain stage and skill level. For the purposes of this study, the examination of workforce policy focused specifically on the IT industry. First to note here is workforce policy for high-skill labor at the IT industry's pre-production stage. Because IT is a strategic industry, preemptive education and training of high-skill pre-production workers (e.g., R&D staff) is the key focus of IT workforce policy. While the chief focus of current IT workforce policy has been on workers in the areas of R&D and SW/IT convergence, training of high-level workers in the software areas that are poised to lead future industries (e.g., software, convergence, and systems semiconductors) has been lacking (Ministry of Science,

ICT, and Future Planning & National IT Industry Promotion Agency, 2014). Policies are also needed to train management staff at overseas factories, promote the introduction of a global workforce and expedite Korean workers' advancement in overseas worksites. Another issue is a bias toward large corporations in the employment of government education and training program graduates. This suggests a need to adjust the goals of these projects through, for example, by clearly distinguishing them from R&D programs. A second issue concerns middle-skill workers in the production stage. This workforce policy is the subject of some controversy; while workforce policy has shown consideration for production workers (i.e., middle-skill jobs in the manufacturing production stage), this could hinder efficient GVC expansion. Conversely, strategies to maintain a manufacturing production base at home can also be interpreted as means of securing high-quality jobs for domestic workers. Maintenance of a domestic production base is also essential for R&D and innovation. To date, Korea has been relatively successful in maintaining its manufacturing production base. From this standpoint, it is necessary to ensure a stable supply of middle-skill workers and boost their skill levels to maintain the domestic production base at a certain scale.

A third issue is to improve the productivity of workers at the post-production stage. GVC intensification has greatly increased employment not only at the pre-production stage, but also in post-production. Jobs have grown in areas strongly related to the GVC, including service areas such as business services, transportation, and communications. In terms of IT workforce policy, key areas include increasing the number of IT service positions and

Figure 1. Policy Directions



Note : An asterisk (*) indicates areas where labor market policy measures are viewed as important.[2)]

improving the productivity of workers in IT services. Quantitative increases and qualitative upgrades are also necessary for software workers, as software is a key element determining productivity at every stage of the value chain.

(1) Preemptive Education and Training of High-Skill Workers and Strengthening of the Demand Base

SMEs have assumed ever-greater importance as targets for pre-emptive education and training policies. Regardless of this fact, however, it remains important to educate and to train workers in

2) Support for opportunities to improve skill levels through education and training and minimum wage guarantees are needed for low-skill production-stage workers. However, these issues are not addressed in this study because they chiefly rely on labor market policy instead of workforce policy.

promising areas rather than those currently suffering labor shortages.

First, education and training should be expanded for workers in IT planning related to product design. Current IT workforce projects are tied to education and training of high-skill workers in general, while training for IT planning workers in areas such as product design has been neglected. Second, there is a need to train the talented convergence-related workers demanded by SMEs. Demand for convergence-oriented workers has been growing recently amid active convergence between IT and various other business areas. In many cases, SMEs are less in need of highly specialized experts than convergence-oriented workers with a strong knowledge base in several different areas. Third, policies should be oriented not only toward education and training but also toward building the demand base for high-skill workers to circumvent the high skills trap. We should consider the issues of maintaining workforce. "Accelerator projects" are essential as a way of boosting the demand base for high-skill workers in general, and IT specialists in particular. While the goal of an accelerator project lies in encouraging entrepreneurialism and startups in the IT field, it can also be used to promote the influx of high-skill workers in various other industries. It should be noted, however, that accelerator projects alone remain inadequate to perform a strong role in the entrepreneurial ecosystem. One reason is that support budgets have not increased to keep pace with the expectations placed on such projects. Another commonly cited issue with accelerator projects beyond workforce concerns has to do with entrepreneurial ecosystem conditions that make startup success unlikely. Indeed,

many who are concerned about the future of Korea's IT industry have noted the environmental conditions operating against startup success. While an accelerator project is an institutional measure that has helped many U.S. IT startups achieve success, it appears unlikely to produce significant results in Korea.

At present, the Korean government is developing programs geared toward boosting specializations, expanding collaborative systems, and building a base for growth, while working to devise systems for the disclosure and sharing of information about accelerator performance.

(2) Ensuring an Adequate Supply of Middle-Skill, Production-Stage Manufacturing Workers

A number of points can be identified with regard to policies for middle-skill, production-stage workers. First, a sufficient supply of middle-skill workers is needed to sustain the domestic production base at a certain scale. Second, education and training content should be developed so that middle-skill workforce development can meet the needs of the expanded smart factories of the future.

To ensure a stable supply of production-stage manufacturing workers, the Korean government has expended efforts to adjust university entrance rates and expand vocational education at the high school level. Lowering of entrance rates, however, is limited as a means of ensuring a production-stage manufacturing workforce supply. While recent years have seen the establishment of a "Meister high school" system, budget support of the level needed to establish such programs for all vocational high schools appears

insufficient. An adequate supply of middle-and high-skill workers can only be possible through expansion of the Meister system or normalization of vocational college education. In Germany, the need for a sizable middle-and high-skill workforce has become an issue of growing importance. Demand for university education there is rising, alongside demand for "Fachhochschule," or industrial colleges. Changes are also needed in the education and training system to expand the supply of middle-skill workers somewhat, and approaches such as a certification system are necessary to address the issue of training oversupply.

(3) Globalization and Expansion of Training for the Software Workforce

Education and training should be expanded for high-skill workers in the post-production area of IT services, and efforts should be made to increase the workforce supply in the software labor market through retention in view of the rapid rate of exit there. Software is a key element determining productivity at all stages of the value chain and has a large impact on productivity at the post-production stage and in the service industry.

A recent "software-centered university project" offers some encouraging developments in this regard. To address the shortage of professional and convergence-oriented software workers, the Korean government implemented a software-centered university project as of 2015. For this project, the curriculum has been revised to provide the practical education and training needed for industry environments. An even more important aspect concerns the choice

of faculty members. To ensure the project's success as an educational effort rather than one that is research-oriented, it is essential that faculty be selected from a broad base. In addition to the need for professors with ample practical experience, unprecedented incentives are also required, including the use of systems to recruit professors from a broad range of backgrounds (e.g., lecturers, adjunct professors, and industry-academia collaboration faculty) and ensure stability in their employment for a certain period. Another focus of the software-centered university project is on training convergence-oriented students with a background in other disciplines as well as a strong grounding in software; this represents a potential means of increasing productivity at the post-production stage and in the service industry. While non-majors have often been retrained in IT-related business areas after graduation, success in this retraining has been very limited. A more effective approach would be to educate non-majors in the software mindset while they are still university.