

## 1. Summary<sup>1)</sup>

Jobless growth in the South Korean manufacturing industry has been observed since 2015. Even as total value added in the manufacturing sector is continuously growing, manufacturing employment levels are decreasing; this pattern first emerged in the 1990s, lasting

growth patterns of the manufacturing industry by comparing the United States and South Korea to address political suggestions. If the jobless growth in the South Korea followed the trace of the United States, then manufacturing employment would not easily increase despite an export revival or an output recovery in future.

# Jobless Growth in the Manufacturing Industry—Decoupling Sectoral Output and Employment in the United States and South Korea

for a decade. The decoupling of output and employment in the manufacturing industry is atypical compared to the commonly stylized facts showing that both employment and output grow together in the long run and decline together during recessions at the aggregate level of an economy. This article analyzes which subsectors account for the jobless growth pattern in the South Korean manufacturing industry. Importantly, a recent cyclical downturn in automotive and shipbuilding manufacturing cannot explain the negative correlation between sectoral output and employment. Instead, the jobless growth pattern is observed within the computers and electronics manufacturing subsector, and it offsets the other sectors' positive correlation between output and employment. I classify the jobless

## 2. Introduction

From the labor market perspective, the manufacturing industry engages a large number of low-education and low- to moderately-skilled workers in one of the most profitable production processes in an economy through a relatively high degree of division of labor. It is also well known that blue-collar manufacturing workers are middle-class income earners, as they either earn relatively high wages or work relatively longer hours. Hence, a decline in manufacturing employment means scarcer moderate-income job opportunities for low-education workers, which is not a favorable event for the Korean government, which aims to reduce inequality through inclusive growth.

1) This article draws heavily on previous research, published as “Which sectors are most responsible for jobless growth in the manufacturing industry?” (Korean).

This paper analyzes growth patterns, the timing of trend switching and the magnitude of changes in manufacturing employment in the South Korea. I elaborate that the current decline in the manufacturing employment shows a jobless growth pattern, which exhibits negative co-movement between output and employment. The pattern is noteworthy in terms of magnitude since the decoupling between output and employment is dominantly visible at the one-digit industry aggregation level: manufacturing output increases while manufacturing employment declines. The negative correlation between output and employment is preserved within minor industries including electronics and computers manufacturing, leather production and the fabrication of primary metals. So jobless growth in the manufacturing sector cannot be accounted for by simple composition change.<sup>2)</sup>

In the second chapter, I explain how United States manufacturing employment has been declined by distinguishing between deindustrialization and decoupling. The third chapter illustrates three concepts of employment reduction and its policy implications. The fourth chapter analyzes the South Korean manufacturing sector to assert that the recent employment decline in the industry can be rightfully called jobless growth. The fifth chapter shows

the subsectors that dominate the entire manufacturing growth pattern. Lastly, I mention the United States government policy dealing with decline in manufacturing employment and the implications it carries for the South Korean manufacturing sector.

### 3. Employment Growth Patterns in the United States Manufacturing Industry

#### (1) Deindustrialization: Lower Share of Manufacturing Employment of Total Employment

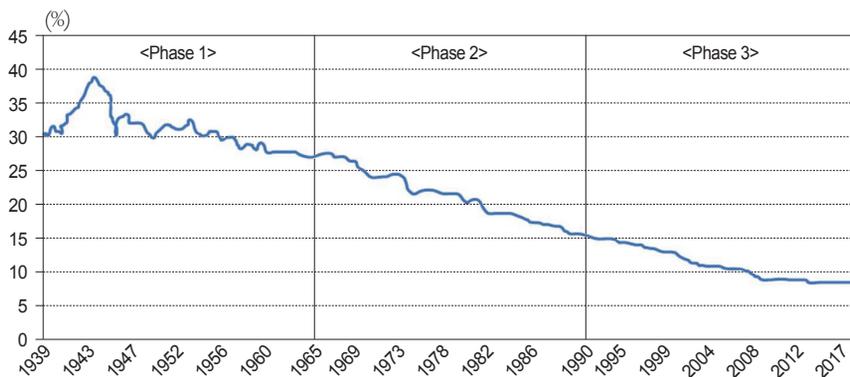
The world's top economies have exhibited deindustrialization since the 20th century, and it is well known that manufacturing industry has come to occupy a smaller share of both GDP and employment.<sup>3)</sup> Narrowing down our focus on the labor market besides the output market, a reduction in manufacturing employment usually refers to an empirical pattern of declining manufacturing employment share compared to total employment, rather than an actual reduction in manufacturing employment levels. Though declining manufacturing employment has been consistently observed for decades in various countries, the fact that details in declining manufacturing employment have changed is yet relatively unknown.

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2) If an industry produces a high value-added product with relatively few workers, while other industries produce low value-added products using a large number of workers, then growth in high value-added industries exhibits a seemingly jobless growth pattern at the aggregate level. The South Korea manufacturing industry shows a persistent jobless growth pattern in some subsectors.

3) Blueston and Harrison (1982) summarizes the deindustrialization phenomenon.

**Figure 1. Share of Manufacturing Employment in the United States**



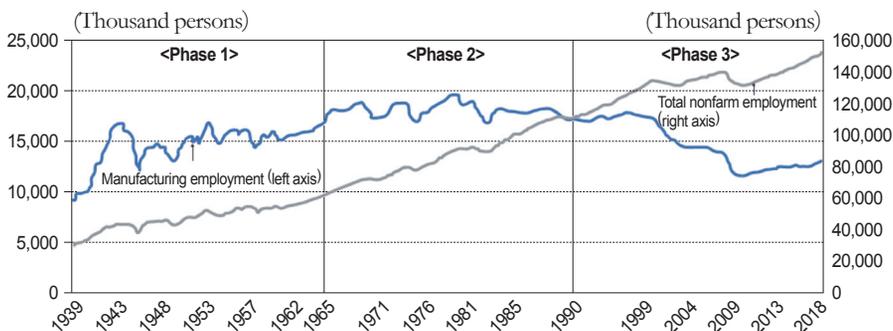
Source: United States Bureau of Labor Statistics, Current Employment Statistics, Jan. 1939 – Jan. 2019 (Seasonality adjusted).

I explain the historical changes in United States manufacturing employment from 1939 to 2018 by dividing the time horizon into three phases. Figure 1 shows that in all time periods the share of manufacturing employment of total employment has declined from 38 percent in 1943 to 8.5 percent in 2018. Though the share of manufacturing employment has continuously declined for 80 years, the changes in manufacturing employment levels are qualitatively different in each of the three phases.

As we can find in Figure 2, the reason of declining share of manufacturing employment in the first phase (before 1965) is a lower employment growth rate in the manufacturing industry compared to other industries. During the first phase, the manufacturing employment level still increased.

The second phase — from the late 1960s to the 1990s — shows a declining manufacturing employment share having an apparently positive growth on total employment despite a

**Figure 2. United States Manufacturing Employment and Total Nonfarm Employment**



Source: United States Bureau of Labor Statistics, Current Employment Statistics, All Employees: Total Nonfarm Payrolls and All Employees: Manufacturing, Jan. 1939 – Jan. 2019 (Seasonality adjusted).

**Table 1. Phases in United States Manufacturing Employment**

Phase	Years	Changes in share of manufacturing employment (%)	Changes in manufacturing employment levels (Thousand persons)	Correlation between manufacturing employment and total employment
1	1939~1965 (27 years)	-2.98	7,974	0.81
2	1966~1990 (25 years)	-11.48	252	0.01
3	1991~2018 (28 years)	-7.38	-4,508	-0.71

Source: United States Bureau of Labor Statistics, Current Employment Statistics, Jan. 1939 – Jan. 2019 (Seasonality adjusted).

flat long-term trend in manufacturing employment. The last phase exhibits an actual decline in manufacturing employment levels in spite of an increase in total employment.

Alternatively, the qualitatively different changes in manufacturing employment across three phases can be highlighted when we calculate the time correlation between manufacturing employment and total employment. Table 1 shows that two variables show a very high positive correlation in the first phase, almost no correlation in the second phase, and then a strong negative correlation in the third phase.

## (2) Decoupling: Negative Correlation between Manufacturing Employment and Output

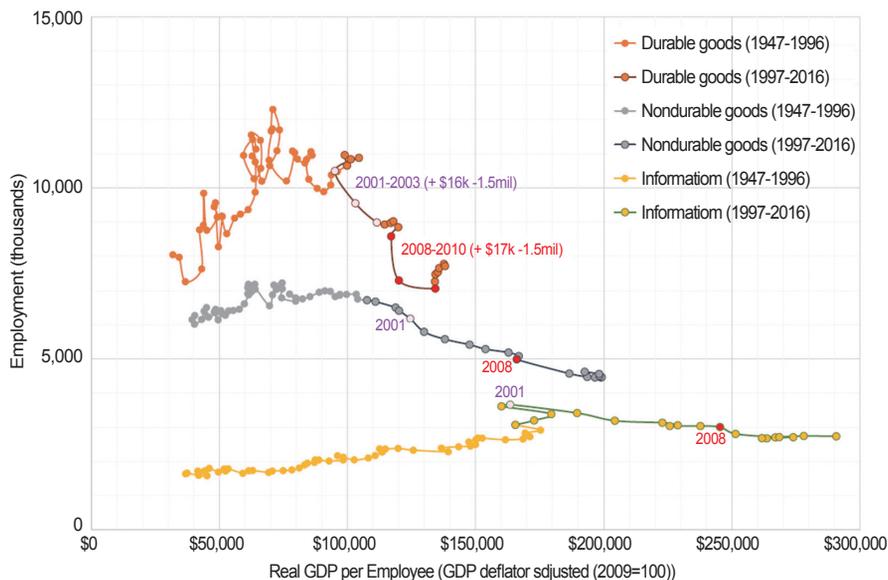
During the third phase, where the United States manufacturing employment level shows a decline, a decoupling between output and employment has been observed since 2000. This is a qualitatively important pattern of considerable significance. Neither manufactur-

ing employment nor output had been notably growing during 1990s. However, output grew rapidly as employment shrank since 2000, this is literally the definition of jobless growth. According to Gil (2017)<sup>4)</sup>, who analyzes the time trajectory of United States industries in the output-employment space, three industries began to exhibit jobless growth starting in the year 2000: the information, durable goods manufacturing, and non-durable goods manufacturing sectors.

According to Gil (2017), “a sharp decline in employment despite a higher output per worker is a new trend rather than ordinary industrial idiosyncrasy.” Figure 3 shows employment and output per employee from 1947 to 2016 in the United States, during which only three sectors had shown growth in both sectoral output and employment over the first 50 years (1947 to 1996). Since 2000, all three industries exhibited reduced employment despite higher real output per worker and greater total sectoral output. In conclusion, jobless growth is a new trend in these three industries. In addition, the

4) Gil, Eunsun (2017), “Technological Job Destruction and Labor Reallocation on a Job Ladder”, Mimeo.

Figure 3. Job-loss Growth Industries in the United States



Source: Figure 3 is an excerpt from “Technological Job Destruction and Labor Reallocation on a Job Ladder”, Gil, Eunsun (2017), Mimeo, p. 22.

magnitude and speed of sectoral employment adjustments are also strikingly large, especially in the durable goods manufacturing sector. Within four years of the recent two recessions, from 2001 to 2003 and from 2008 to 2010, durable goods manufacturing employment decreased by three million, which coincided with an increase by 33,000 USD in real output per worker. The changes in the durable goods manufacturing sector are quantitatively the same, with two percent of 2017 total employment and three percent of 2017 total real output, respectively.

#### 4. Three Conceptual Types of Declining Sectoral Employment

When sectoral employment declines, the rea-

son for the reduction in labor input can be classified into three empirical concepts. Firstly, consumers demand a specific sectoral output good less intensively relative to economic growth, and thus such an industry diminishes in market share. In this case, the reduction in sectoral employment is visible in both the short-term and long-term, and the correlation between output and employment is positive as they both decline together. The apparel, accessories and fur products industry in South Korea recently shows that both employment and output decline.

Secondly, sectoral employment and output typically declines together in the short-run following typical fluctuations of the business cycle. The cyclical decline in employment usually lasts from a period of several months

**Table 2. Three Concepts of Employment Decline**

	Short-term change in employment	Long-term change in employment	Correlation between output and employment
Declining industry	–	–	+
Cyclical downturn	–	+	+
Jobless growth	–	–	–

up to three years so that employment usually returns to pre-recession levels in the long-run. The employment is simply volatile; a decline in employment does not last in the long-run, but the sector still shows a positive correlation between output and input in all phases of the business cycle. Furniture manufacturing in South Korea was in a boom cycle in 2010, 2015 and 2017, whereas the sectoral economy was relatively slack during other periods.

Third, an industry can produce much more with fewer or the same number of workers, which I call jobless growth. Jobless growth indicates that fewer domestic workers are required as an input despite a steady or even faster growth in output, which implies a change in production technology. In this case, sectoral employment and output shows a negative time correlation.

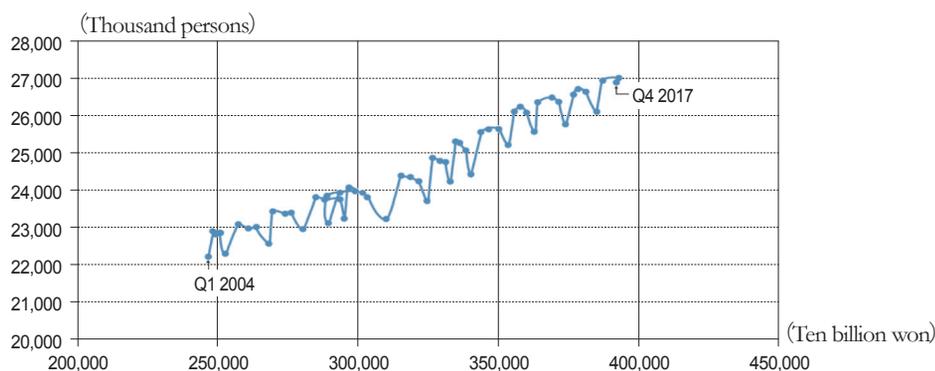
In conclusion, long-term changes in employment and the correlation between output and employment are the key statistics to identify three types of short-term decline in employment. Distinguishing patterns of short-term decline in employment is important especially when we anticipate effects of employment policies. If a sectoral employment declines due to

cyclical fluctuations, then relatively short-term economic expansion policies can naturally lead a recovery in the labor market. Alternatively, if an industry is declining in both output and employment in the long-run, then subsidizing output production or reducing corporate taxes has temporary impact on employment, and the costs of policy can be significant due to the decreasing long-term trend. In the case of a declining industry, it would be more efficient to retrain workers so that they can successfully reallocate themselves to other industries. Lastly, if sectoral employment declines following a pattern of jobless growth, then it is not the right time to consider output boosting policies for employment recovery. In a case of jobless growth, tailored labor market policies considering the discrepancy between the labor market and the output market are required because we might have a trade-off between employment expansion and output growth.

## 5. Jobless Growth in the South Korean Manufacturing Industry

According to the Economically Active Population Survey data in 2018, total employment

Figure 4. Total Output and Employment in South Korea



Source: Bank of Korea, National Account, Quarterly Total real GDP (Seasonally-adjusted, horizontal axis); Statistics Korea, Economically Active Population Survey, Quarterly Employment Level (Not seasonally-adjusted, vertical axis).

in South Korea exceeds 27 million persons, and manufacturing employment comprises about 17 percent of the total. Figure 4 shows a time trajectory of the South Korean economy with real GDP on the horizontal axis and employment as vertical axis. The South Korean economy has grown since 2004 in both total output and total employment in the long-run, excepting only a short-term retreat during the 2008-2009 global financial crisis. If seasonality is eliminated, the economy shows a relatively steady long-run growth pattern in both output and employment, which fits the canonical concept of economic growth.

### (1) Decoupling Timing in the Manufacturing Sector

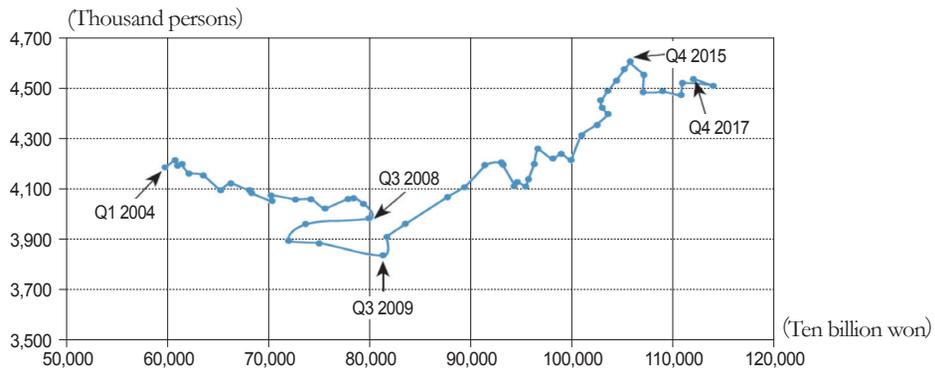
Unlike the entire economy, the South Korean

manufacturing employment and output trajectory shows a mixed pattern between jobless (or even job-loss) growth and typical economic growth. Figure 5 indicates five segments in the historical growth pattern of the South Korean manufacturing industry: four years of jobless growth (Q1 2004-Q3 2008), a half-year of recession (Q3 2008-Q1 2009), another half-year of jobless recovery (Q1 2009-Q3 2009), six years of typical economic growth (Q3 2009-Q4 2015), and then two years of jobless growth (Q4 2015-Q1 2009).<sup>5)</sup>

The magnitude of job-loss growth in the manufacturing sector cannot be ignored. The manufacturing industry produced output worth 97.9 trillion KRW with 4.3 million workers in Q3 2013, followed by annual growth in sectoral output and employment of 3.98 percent and 4.49 percent annually up

5) Kang, Duyong (2016) highlights that the share of manufacturing employment is consistently declining since 1988, and the manufacturing employment level has been decreased since 1991. Therefore, Kang explains that the increase in manufacturing employment from 2010 to 2015 is rather exceptional when we focus on statistical and historical trend.

**Figure 5. Jobless Growth in the Manufacturing Industry of South Korea — Individual Survey**



Source: Bank of Korea, National Account, Quarterly real GDP in Manufacturing Industry (Seasonally-adjusted, horizontal axis); Statistics Korea, Economically Active Population Survey, Quarterly Employment Level in Manufacturing Industry (Not seasonally-adjusted, vertical axis).

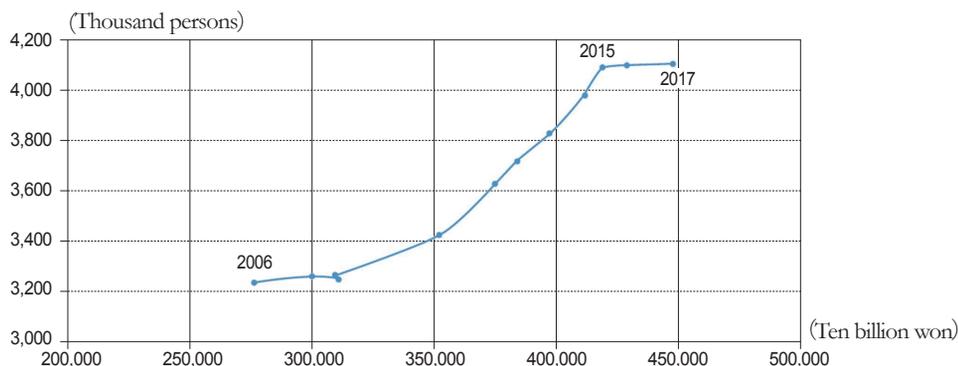
to Q4 2015. However, after Q1 2016, while sectoral output grew by 6.12 percent per year, employment declined by 2.10 percent per year. If employment had moved simultaneously with output, as it did prior to 2015, counterfactual manufacturing employment would have been 5.2 million in Q3 2018, based on a simple linear projection. The actual manufacturing employment was 4.5 million in Q3 2018, and the difference is 750,000 workers, or roughly 2.76 percent of total employment.

In short, the recently re-emerged jobless (or job-loss) growth in manufacturing employment is noteworthy in two respects. Firstly, the stagnation in employment is unignorablely big. Jobless growth could appear at the firm level or at a narrowly defined industry level in any time, however, the decoupling of output and employment is not always observed at the major industry level when we consider other deindustrialized countries. Secondly, the nega-

tive time correlation between output and labor input requires qualitatively different explanations in economic models. Simple trade specialization between labor-intensive countries and capital intensive-countries, or relabeling from the manufacturing industry to the service industry results in declines in both output and employment in the manufacturing industry. Also, cyclical downturns cannot easily generate the negative correlation between output and employment. Therefore, the current decline in manufacturing employment accompanied by output growth implies a high possibility of an expansion in another input instead of domestic labor.

To verify robustness, I use the Census of Establishments, which consists of firm-based data instead of individual data, and draw a trajectory in the manufacturing industry in Figure 6. In this case, we consistently observe that both employment and output had grown

**Figure 6. Jobless Growth of the Manufacturing Industry in South Korea — Mid to Large**



Source: Bank of Korea, National Account, Yearly real GDP in Manufacturing Industry (Horizontal axis); Statistics Korea, Census of Establishment, Yearly Employment Level in Manufacturing Industry (Vertical axis).

from 2006 to 2015, after which we can see that employment stays flat while output keeps growing.

## (2) Decomposition by Subsector

To figure out which minor industry leads jobless growth in the South Korean manufacturing sector, I analyze output and employment growth at a more detailed industry level using Census of Establishment data. Table 3 shows that the real GDP of the entire manufacturing sector increased by 15.5 trillion KRW per year, and employment increased by 93 thousand persons per year from 2006 to 2015. However, from 2015 to 2017, real manufacturing GDP increases by 15.2 trillion KRW per year, whereas employment increased by only eight thousand persons per year.

Focusing on qualitative growth patterns, nine among 13 minor industries continuously show

growth in both output and employment, while the following three industries exhibit jobless growth: textiles, leather and apparel, primary metals, and computer and electronic products. Growth in real GDP has not dramatically changed in the jobless growth industries, however, the change in employment is qualitatively different starting from 2015. For example, a similar amount of real GDP growth is associated with a decline of three thousand workers in the computer and electronic products manufacturing sector, wherein output growth was previously accompanied by an increase of ten thousand workers before 2015. The other industry is transportation equipment manufacturing, which shows a contraction in both employment and output. Besides the direction of growth, the input-output relationship has not changed in this sector, so it is highly likely that the decline in transportation equipment manufacturing employment is derived from a

**Table 3. Changes in Output and Employment in Minor Manufacturing Industries**

	2006–2015		2015–2017	
	Annual changes in real GDP (Billion won)	Annual changes in employment (persons)	Annual changes in real GDP (Billion won)	Annual changes in employment (persons)
Manufacturing	15,503	93,424	15,271	8,373
Food, Beverage and tobacco	170	6,967	346	6,888
Textile, Leather and apparel*	387	508	183	-2,158
Wood, Paper, and printing	148	2,442	122	1,924
Petroleum and coal products	179	141	908	217
Chemical	1,715	14,133	3,800	6,500
Nonmetallic mineral product	373	1,603	437	965
Primary metal*	475	4,401	739	-316
Metal product	373	14,460	-560	769
Machinery	1,247	15,088	1,646	9,147
Computer and electronic product*	7,629	10,577	8,324	-3,499
Precision machine	360	5,037	1,495	95
Transportation equipment	2,363	15,806	-2,214	-15,384
Miscellaneous	86	2,260	48	3,227

Source: Bank of Korea, National Account, Yearly real GDP in Manufacturing Industry; Statistics Korea, Census of Establishment, Yearly Employment Level in Minor Manufacturing Industries; Minor industry divisions is matched and numbers are calculated by author. Asterisks represent jobless growth industries.

decline in output.

To attain robustness, I analyze the Mining and Manufacturing Survey, which gives firm level value added and employment figures, sample is limited to plants with more than ten workers. The result is consistent in the sense that jobless growth is preserved within several minor manufacturing industries, so that the change in composition does not explain the jobless growth in manufacturing at major industries. There are three industries that exhibit growing value added but declining employment from 2011 to 2017. Computers and electronic products, which includes semi-conductors and displays is the primary source

of the jobless growth in terms of magnitude. The printing and copying industry and the leather, bags and shoes manufacturing industry also shows a jobless growth pattern despite a relatively small decline in employment. On the other hand, the automotive industry shows a slowdown in output yet boasts steady employment growth, while the shipbuilding and miscellaneous transportation equipment sector shows a large decline in output with a moderate decline in employment. In conclusion, we identify several jobless growth subsectors and one contraction subsector consistently. It is still true that some other industries — chemicals, nonmetallic mineral products, machinery and

precision machines — show a steady or even higher growth in output with employment growth much lower than before, yielding a quantitative change in employment growth around 2015.

## 6. Concluding Remarks

Jobless growth re-emerged in the South Korean manufacturing industry beginning in 2015. It is uncertain whether this phenomenon is a temporary pattern or a persistent long-term trend, as United States manufacturing employment is still 26 percent lower than it was 30 years ago. The computer and electronic products sector consistently shows jobless growth in both United States and South Korea, whereas automotive industry is a jobless growth sector in the United States and a contraction sector in South Korea. Further research is needed to conclude if the cause of jobless growth in the U.S. and South Korean manufacturing industries is the same or not.

U.S. President Donald Trump's administration emphasizes the importance of manufacturing employment, it blames international

trade with (low-skill) labor-intensive countries for the decline in middle-class employment. They pursue trade policies that protect American workers by implementing high tariffs and providing tax-relief for reshoring companies. Among American economists, scholars consider foreign labor, industrial robots, and higher market concentration as a causal hypothesis for declining manufacturing employment.<sup>6)</sup> Although debate is ongoing, recent empirical research is more favorable to a theory of intensifying automation and increasing reliance on capital over the trade volume expansion hypothesis<sup>7)</sup>, especially in terms of magnitude rather than significance. The question of how to recover manufacturing employment, not only during cyclical downturns in industries such as transportation equipment but also in industries that require increasingly less labor input for further growth — electronic products, leather, printing, and primary metals — should be revisited and highlighted.

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6) This article focuses on the decoupling between output and employment, but a large fraction of papers examine declining manufacturing employment as a change in employment composition, which is called job polarization.

7) See Acemoglu and Restrepo (2017), Brainard and Riker (1997), Hanson, Mataloni & Slaughter (2003), Muendler and Becker (2010), Harrison and McMillan (2011).