Changes in Economic Activity, Skills and Inequality in the Service Economy*

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This paper aims to understand how wage inequality is associated with different level and kind of skills in service economy. Our logic of argument, changes in economic activity and skills in the service economy, is suggested following our observation on changes in skill by examining the International Standard of Industrial Classification of all Economies (ISIC) and the International Standard Classification of Occupations (ISCO). Then we examine how the service sector contributes to total income inequality since the 1980s through conducting a MLD (Mean Logarithmic Deviation) based decomposition analysis with four selected countries, Germany, United States, Sweden and Taiwan, using the Luxembourg Income Study (LIS) Database. Overall, the findings suggest that inequality within the service sector contributes most to total inequality. Among the three skill levels in service sector, inequality within the middle skill level contributed most to the total service sector inequality in all four selected countries.

Keywords: *Wages, Inequality, Skills, Service Sector*

Introduction

The investigation of inequality is not a new topic. Moreover, there have been a wide range of hypotheses regarding the changes in inequality although most literature produced from the 1990s primarily focused on the impact of globalization, either referring it to trade or financial integration (Krugman and Lawrence 1993). Two distinctive theses on inequality in advance economies are the Kuznets curve and the great U-turn theses. Kuznets (1953, 1955) suggests that inequality and economic development create an inverted U-shape relationship. That is, in the course of long-term economic development, inequality first increases to its peak and then declines. Then followed the suggestion by Harrison and Blustone (1988), termed as the great U-turn, which highlights a radical reversal of the Kuznets' curve, particularly examining the increase of inequality around the 1970s in the United States. Increasing the number of cases to 16 OECD countries, Alderson and Nielsen (2002) further attested the upswing in inequality in OECD countries, suggesting that direct investment affects income inequality. However, the literature above has paid less attention as to how structural changes, such as transition towards a service economy, are associated with inequality.

With the decline of the 'golden age' of the welfare state and economic development, numerous scholars began to focus more on the changes as well as explain the challenges experienced by most advanced economies, using notions such as the great transition (Polanyi 1944), the global transformation (Standing 2009) and deindustrialization (Esping-Andersen, 1993, 1999; Iversen and Wren 1998; Pierson 2001; Emmenegger et al. 2011). Among these, the literature related to deindustrialization highlights the effect and consequences of the structural changes. While there has been comparatively less attention placed on deindustrialization compared with the effect of globalization in inequality studies, more recently, scholars have been focusing on the causes and implication of deindustrialization in developed economies (Iversen and Wren 1998; Pierson 2001; Emmenegger et al. 2011).

Literature focusing on the transition to service economy and inequality examines the changing labor market, suggesting that deindustrialization is accompanied by an increase in long-term unemployment, non-standard employment and female workers (Hacker 2002; Scruggs and Allan 2004; Bonoli 2007; King and Rueda 2008; Standing 2009; Häusermann and Schwander 2011). One of the recent studies on inequality and deindustrialization successfully elaborates the process of how institutions

deepen the inequality in selected European states with the thesis of 'dualization' (Emmenegger et al. 2011). They assert that "dualization stresses political changes and the politics of change" (Emmenegger et al. 2011, p. 13), highlighting that policy matters. In other words, they view dualization and inequality as a consequence of policy change rather than that of a structural change.

This paper aims to understand how a transition to a service economy is associated with inequality. We examine horizontal and vertical changes in skills and wage inequality in the service economy, suggesting that the two changes contribute to the overall inequality. In addition, by examining the two, we can enhance our understanding of the service economy.

First, we discuss the previous studies, which link service economy and wage inequality. Our logic of argument, changes in economic activity and skills in the service economy, is suggested by examining the International Standard of Industrial Classification of all Economies (ISIC) and the International Standard Classification of Occupations (ISCO). Next, we examine how division in economic activity contributes to the total income inequality by conducting a decomposition analysis of four selected countries. Using the MLD (Mean Logarithmic Deviation) based decomposition analysis, we examine how inequality within and between sectors contributes to the overall income inequality, first in a static sense (static decomposition analysis) and second, in a dynamic sense (dynamic decomposition analysis), through examining the changes in inequality in relation with changes in sectors since the 1980s. Lastly, we analyze how vertical skill division matters in explaining wage inequality in the service sector. We utilized LIS (Luxemburg Income Study) data when exploiting MLD and the selected countries of investigation are the United States, Germany, Sweden and Taiwan.

Characteristics of the Service Economy and Inequality

Post-industrialized economy is generally defined as an economy with a labor market which has gone through a decline in the manufacturing industry (Saeger 1997; Esping-Andersen 1999; Bonoli 2005) and the service economy is where a majority of workers are participating in service sector. This transition in the labor market with tertialization is explained first by the difference in productivity between the two sectors led by technology advancement. Productivity rate increases much more rapidly in the

manufacturing sector than in the service sector and when the demand for both manufacturing goods and services is stable, large differences in productivity will shift labor from the manufacturing to the service sector (Rowthorn et al. 1997; Pierson 2001). The second argument is related to the increase in the demand for services. Increasing income and improvement in the living standard have enabled people to consume more services (Rifkin 1995). An increase in the demand for services is also related to the increasing number of women in the labor force, given that many of the domestic work previously completed by women are now externalized. This argument is also linked with the discussion that majority of women are participating in low skill and low income jobs in service economy.

Regards to the relation between transition in the labour market (where majority participates in service sector) and inequality, the association is theoretically explained in three ways. First, during the period in which low skilled workers were predominantly employed in the manufacturing industry, strong mobilization among these workers enabled them to sustain their wage through trade unions. However, the solidaristic wage policy, e.g., the Rehn-Meidner model, which functioned successfully for the manufacturing sector by shifting the production to where the productivity was the highest, is not as effective for the service sector. In a service based economy where products are less tradable, a solidaristic wage policy leaves those with the lowest skills out of the market without creating a compensatory expansion in the overall level of employment (Iversen and Wren 1998). However, in the service economy, wage compression has a different impact. While wage compression can lead less productive companies to vanish shifting the labor force to more competitive companies in the manufacturing sector, wage compression in the service sector implies a layoff of the low skilled and/or pushes them to the lower end of the wage spectrum. Krugman (1996) also stresses the decline in unskilled wages and the growing inequality of earnings between skilled and unskilled labor.

Secondly, stagnant productivity of the service sector is suggested to hinder wage increase. Baumol et al. (1989) utilize the terms "technologically progressive" and "technologically stagnant" in order to help express the nature of manufacturing and service sectors. They suggest that manufacturing is "technologically progressive," as production in this sector can be standardized and information for production can be formalized, thereby easily replicated. However, services are "technologically stagnant" as they cannot easily be standardized for mass-production, as is the case for manufacturing. Since services are less likely to be standardized, traded and

replicated, it is difficult for the service sector to generate increases in productivity (Rowthorn et al. 1997). Hence, it is suggested that low-skilled workers in the service economy tend to work in low wage service jobs where productivity is low, such as retail sale, cleaning, catering, etc. Since the service sector offers a high premium to the high skilled and the highly educated, there is a wider wage-gap between the skilled and the low skilled (Esping-Andersen 1999; Bonoli 2005). A majority of literature link low-skill and inequality during the deindustrialization period, arguing that the service economy provides a higher premium to knowledge and skill compared to the industrial period. Iversen and Wren (1998) also stress that service economy presupposes a more inegalitarian wage structure, as the solidaristic wage policy does not work efficiently for the service sector due to its low productivity. However, the high wage level on the better end of the service sector cannot be explained simply by its productivity. These lead us to reconsider the discussion of skill in the service sector.

Against this background, in this study, we examine the association between changes in skill and inequality in service sector. In addition, previous studies paid less attention to the diversification in economic activities which is also more prominent in service sector. In this study, we examine first how diversification in economic activities in service sector is associated with the total inequality and secondly, we investigate more specifically how skill level and inequality associated. Before our empirical analysis, in the following section, we descriptively examine the changes in economic activity and skill level in service economy by reviewing ISIC (International Standard Industrial Classification of All Economic Activities) and ISCO (International Standard Classification of Occupation).

Diversification of Economic Activity and Skill Level in Service Economy

When we examine the diversification in economic activities, categories has increased and the types of work people participate in have become more heterogeneous. Diversification in economic activities has been taking place in the service sector, making the sector more heterogeneous than the agriculture and manufacturing sectors. In the service economy, working activity is divided into a number of fine categories and each category requires a specialized skill, whether it be either a general skill of a low level or a highly specialized skill for experts.

This diversification in economic activities is concentrated in the service sector. This can be examined by comparing the International Standard Industrial Classification of All Economic Activities[1] from 1968 to 2008. In ISIC Revision 2 (1968), all economic activities are divided into 10 divisions. However, the number of categories increases to 18 in ISIC Revision 3 (1990) and to 21 in ISIC Revision 3 (2008). When examining the number of categories in each sector (table 1), the service sector stands out for its expansion in category numbers, while only small changes are noticeable in the manufacturing and agriculture sectors. In ISIC 2, the number of categories of economic activities in the service sector is 4, whereas it expands to 15 categories in 2008. In ISIC 3 (1990), new categories, such as real estate, renting activities and financial intermediation, are created. In ISIC 4, more categories are further included, such as arts, entertainment and recreation, and human health, and social work activities, information and communication have been created. However, in the manufacturing sector, only the 'electricity, gas and water supply' category has been further divided into two (table 1).

Compared to ISIC, which focuses on employment by sector[2], the International Standard Classification of Occupation (ISCO) pays more attention to *skill level*. According to the Resolution Concerning Updating ISCO (2007), an occupation is 'a set of jobs whose main tasks and duties are characterized by a high degree of similarity'. The basic criteria used to group occupations as the "skill level" and "skill specialization" which are required to competently perform the tasks and duties of the occupation. While ISIC is useful in examining the diversification in economic activities, ISCO is more related to the level of skills, as the occupational information is particularly important for the identification of changes in skill levels. Similar to ISIC, ISCO has been revised from ISCO-1968 to ISCO-88 and to ISCO-08 with an expansion in some categories in service related occupations. Managers have been separately categorized in ISCO-08 from the category of 'Legislators, senior officials and managers' in ISCO-88. Also, in ISCO-08, occupations

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[1] International Standard Industrial Classification of all Economic Activities by the United Nations and ILO is arranged so that entities can be classified according to the activity they carry out. The groups and divisions, which are successively broader levels of classification, combine the statistical units according to character, technology, organization and production financing.

[2] Categories in ISIC are based on the inputs of goods, services and factors of production, the process and technology of production and the characteristic of outputs, while ISCO is classified as the basis of the type of work performed. The primary unit of ISCO classification are jobs (ISIC revision 4, 2008).

TABLE 1

Specialization in the Service Industry: Changes in the International Standard of Industrial Classification of all Economic Activities (ISIC)

	ISIC 2 (1968)	ISIC 3 (1990)	ISIC 4 (2008)
1	Agriculture, hunting, forestry and fishing	Agriculture, hunting and forestry	Agriculture, forestry and fishing
2	Mining and quarrying	Fishing	Mining and quarrying
3	Manufacturing	Mining and quarrying	Manufacturing
4	Electricity, gas and water	Manufacturing	Electricity, gas, steam and air conditioning supply
5	Construction	Electricity, gas and water supply	Water supply; sewerage, wasted management and remediation activities
6	Wholesale and retail trade and restaurants and hotels	Construction	Construction
7	Transport, storage and communication	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	Wholesale and retail trade; repair of motor vehicles, motorcycles
8	Financing, insurance, real estate and business services	Hotel and restaurants	Transportation and storage
9	Community, social and personal services	Transport, storage and communications	Accommodation and food service activities
10		Financial intermediation	Information and communication
11		Real estate, renting and business activities	Financial and insurance activities
12	Activities not adequately defined	Public administration and defense; compulsory social security	Real estate activities
13		Education	Professional, scientific and technical activities
14		Health and social work	Administrative and support service activities

TABLE 1
(CONTINUED)

ISIC 2 (1968)	ISIC 3 (1990)	ISIC 4 (2008)
15	Other community, social and personal service activities	Public administration and defense; compulsory social security
16	Private households with employed persons	Education
17	Extra-territorial organizations and bodies	Human health and social work activities
18	Activities not adequately defined	Arts, entertainment and recreation
19		Other service activities
20	Not classifiable by economic activity	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
21		Activities of extraterritorial organizations and bodies

associated with information and communication technology (335 according to the ISCO-08 three digit codes) and occupation concerned with the provision of health services (332 according to the ISCO-08 three digit codes) have been expanded.

The ten major groups in ISCO-08 and ISCO-88 are associated with four broad skill levels, which are defined in relation to the levels of education specified in the International Standard Classification of Education (ISCED) (table 2). The first skill level of ISCO corresponds to the primary education group in ISCED, which usually begins at the ages of 5-6 and lasts for approximately 5 years. The second skill level corresponds to secondary education, which begins at the ages of 11-12 and lasts for 5-7 years. The third skill corresponds to tertiary education, which begins at the ages of 17-18 and lasts for 3-4 years without providing an equivalent of a university degree. The fourth skill level corresponds with tertiary education leading to university

TABLE 2

International Standard Classifications of Occupations: Major groups

Occupational classification	ISCO skill level
ISCO-2008-Major groups	
1 Managers	3+4
2 Professionals	4
3 Technicians and associate professionals	3
4 Clerical support workers	2
5 Service and sales workers	2
6 Skilled agricultural, forestry and fishery workers	2
7 Craft and related trade workers	2
8 Plant and machine operators and assemblers	2
9 Elementary occupations	1
0 Armed forces occupations	1+2+4
ISCO-1988-Major groups	
1 Legislators, senior officials and managers	—
2 Professionals	4
3 Technicians and associate professionals	3
4 Clerks	2
5 Service workers and shop and market sales workers	2
6 Skilled agricultural and fishery workers	2
7 Craft and related trades workers	2
8 Plant and machine operators and assemblers	2
9 Elementary occupations	1
0 Armed forces	—

Source—ILO (KILM)

with a degree or an equivalent.

ISCO groups starting with digit number 1, 2, 3, 4, 5 and 9 are most related to the service sector (table 2). For example, 'professionals' (1-digit code) has four subgroups (2-digit code); 'physical, mathematical and engineering science professionals' (21), 'Life science and health professionals' (22), 'teaching professionals' (23), and 'other professionals' (24). ISCO 1-digit code 6 (Skilled agricultural, forestry and fishery workers), 7 (Craft and related trade workers) and 8 (Plant and machine operators and assemblers) correspond with skill level 2. Occupational groups with service sector jobs, such as legislators, senior officials and managers, professionals, clerks and service and sales workers, correspond to both higher skill and low skill levels skill (skill level 4, 3 and 2) (ISCO-08). Here, the skill level is more

TABLE 3

Proportion of workers in the service sector and its changes (categorized by ISIC) in the four countries (1981-2008)

		1981	1991	2001	2008
Germany	Proportion (%)	n.a	55.0	64.6	67.9
	Change (%p)	-	-	9.6	3.3
Sweden	Proportion (%)	63.1	68.3	73.8	76.1
	Change (%p)	-	5.2	5.5	2.3
United States	Proportion (%)	66.2	71.6	75.0	78.6
	Change (%p)	-	5.4	3.4	3.6
Taiwan	Proportion (%)	n.a	n.a	54.9	57.1
	Change (%p)	-	-	-	2.2

Note.—United States 1981, 1991, 2001 and Sweden 1981 from ISIC-1968, otherwise from ISIC-1990.

heterogeneous.

Next, we examine the changes in the proportion of workers in the service sector categorized by ISIC. The proportion of workers in the following sectors has increased continuously; wholesale and retail trade, repair of motor vehicles, motorcycles and personal and household goods, hotel and restaurants, transport, storage and communications, financial intermediation, real estate, renting and business activities, public administration and defense, compulsory social security, education, health and social work, social and personal service activities (table 3). Except for Taiwan, the service sector expanded more rapidly during the early periods compared to the 2000s. Particularly in Germany, the proportions of workers in the service sector increased by about 10% between 1991 and 2001.

The proportion of workers in different occupational groups categorized by ISCO has changed as well (table 4). We can examine that in all four countries, ISCO groups 2 (professionals), 3 (Technicians and associate professionals) and 5 (Service workers and shop and market sales workers) have increased its proportion of workers. However, the proportion of workers in occupation groups 4 (clerks), 6 (skilled agricultural and fishery workers), 7 (Craft and related trades worker) and 8 (Plant and machine operators and assemblers) either decreased or increased only slightly. It should be highlighted that while occupational groups with skill level 4 has expanded, groups with skill levels of 3 and 2 also expanded, suggesting that the labor force became more heterogeneous in terms of skill level.

TABLE 4

Differences in shares of major occupational groups during 2000-10 in selected European economies (percentage points)

ISCO-88 Major group	Germany	Sweden	United States	Taiwan
1 Legislators, senior officials and managers	0.1	0.9	0.7	-0.8
2 Professionals	2.5	3.2	0.8	5.8
3 Technicians and associate professionals	1.4	1.2	n.a	3.8
4 Clerks	-0.9	-2.4	-1	1.7
5 Service workers and shop and market sales workers	1	0.6	0.4	3.4
6 Skilled agricultural and fishery workers	-0.3	-0.7	-0.1	-6.2
7 Craft and related trades worker	-3.2	-1.4	-0.8	0.7*
8 Plant and machine operators and assemblers	-0.8	-2	n.a	n.a
9 Elementary occupations	0.2	0.6	n.a	n.a

Source—KILM table 5a. *For the case of Taiwan, group 7 is the shift between 2009 and 2011. Group 8 is between1994 and 2008.

In the next section, we empirically examine how skill in service economy is associated with wage inequality. We first examine which sector contributes to the total wage inequality and then observe how wage inequality is associated with skill levels within the service sector.

Method and data

This section examines how inequality in each sector is related to the explanation of total wage inequality. Our study uses the empirical data from the Luxembourg Income Study (LIS) Database for exploiting the decomposition analysis Total wage in the LIS database includes both regular and casual paid employment income. Basic wage/salaries and wage supplements compose the total wage. The Luxembourg Income Study (LIS) Database is the largest available database of comparable micro data collected from multiple countries (LIS, 2012). We particularly selected the   total wage variable among the LIS individual income data in order to examine income equality before government intervention.

The selected countries are the United States, Germany, Sweden and Taiwan. For the United States and Germany, the data of wave 1 (around 1980) and wave 7 (around 2004) are extracted; for Sweden and Taiwan, that of wave 1 and wave 6 (around 2007) are chosen. The three western countries are selected as representative cases of different welfare regimes (Esping-Andersen 1990) and also for its variation in the industry structure. Taiwan is also included as one of the rapidly developed East Asian countries and for its relatively high proportion of the industrial sector, whereas other East Asian countries, such as Japan or the Republic of Korea, has a labor market with around two thirds of their workers employed in the service sector.

This study exploits the decomposition analysis of inequality using MLD (Mean Log Deviation). A decomposition analysis using the MLD index allows us to decompose the total inequality into 'between group component' and 'within group component'. The MLD index is useful when conducting a decomposition analysis by dividing the total inequality into sub categories. In this paper, the decomposition analysis of inequality is conducted in two parts. First, we examine how inequality in each sector contributes to total wage inequality in order to examine the effect of the increased diversification in economic activities in service sector. Second, we analyze how division of skill level matters in explaining wage inequality in the service sector by conducting a decomposition analysis of inequality in the service sector only. In both analyses, we examine the changes between 1980s and mid-2000s by employing a static decomposition analysis and a dynamic decomposition analysis.

First, the static decomposition analysis exploits the following equation (equation 1). The MLD of total wage inequality can be decomposed into a within-group component and between-group component. The total inequality is the sum of the two components; we can examine how much each component contributes to the total inequality (Mookherjee and Shorrocks 1982).

$$GE(0) = \sum_k v_k GE(0)_k + \sum_k v_k \ln(\frac{1}{\lambda_k})$$
$$\quad\quad (A\ term) \quad\quad\quad (B\ term)$$

GE(0) represents MLD as one of the Generalized Entropy categories (or class). 'Generalized Entropy' category is one of the many indicators representing inequality, where GE(0) is the mean logarithmic deviation

(MLD). In the equation above, $GE(0)_k$ refers to the inequality within group k, and v_k is the proportion of workers in group k among the total working population. λ_k is the level of group k's average income compared to the average wage of the total working population. In the equation above, term A represents the within-group inequality; further, it is a simple weighted sum of each inequality values (Mookherjee and Shorrocks 1982, p. 889). The within-group component refers to the i) inequality within each industrial sector, agriculture, industry and service sectors in the first analysis, and to the ii) inequality within each skill level, low, middle, high skill levels in the second analysis.

Term B represents the between-group inequality component. This value assumes that every individual in group k earns an average income of group k. Here, the within group variance is removed and we can examine the level of inequality caused only by the difference between each group's average income. In this study, the between-group component refers to the i) inequality between different sectors in the first analysis and ii) between skill levels in the second analysis.

Next, we decompose the MLD index into the following equation (equation 2) (Mookherjee and Shorrocks 1982), which enables us to examine the changes in the inequality across sectors (or skill level) as well as its effect over time.

$$\Delta GE(0) = \sum_k \overline{v}_k \Delta GE(0)_k + \sum_k \overline{GE(0)}_k \Delta v_k + \sum_k [[(\overline{\lambda}_k) - [\overline{\ln \lambda}_k]] \Delta v_k$$

$$\text{(A term)} \qquad\qquad \text{(B term)} \qquad\qquad \text{(C term)}$$

$$+ \sum_k [\overline{\theta}_k - \overline{v}_k] \Delta \ln(\mu_k)$$

$$\text{(D term)}$$

Δ indicates the changes between year_t to year_{t+1} and $\overline{v}_k$ is the average between the value at time t and t+1. $\overline{GE(0)}_k$ and $\ln \overline{\lambda}_k$ are similarly defined as in the static decomposition analysis explained above. θ_k is the product of v_k and λ_k ($\theta_k = v_k \lambda_k$). In the equation above, term A represents how much the change in the within inequality of each group k contributes to the total income inequality change.

Term B and term C indicates the effect of changes in the working population shares of each group to the within group and between group components, respectively (Mookherjee and Shorrocks 1982, p. 897). In the

case of term B, the average of within-group inequality of two different time points is considered and term C is calculated by including the average of the between-group inequality at two time points. Hence, this term indicate the effect of changes in the population shares of each group on the change in total inequality. Term D represents the level of contribution to $\Delta GE(0)$ attributable to relative changes in the means of each group.

Empirical Analysis and Results

Effect of each sector on total inequality

First, we examine the effect of each sector on inequality by investigating how the inequality of each sector contributes to the total inequality. The outcome of the static decomposition analysis of wage inequality related to different sector groups is as follows (Table 5).

The numbers in parentheses indicate the relative contribution toward total inequality. The within-group inequality explains more than 85% of the total inequality in all four selected countries. However, when examining the inequality since the mid-2000s, the within-group inequality explains approximately 99% of the total inequality in all four selected countries. This indicates that income inequality within each sector group is the main contributing factor (rather than the inequality between sectors) to the total income inequality; this trend has been more intensified since the 1980s.

In the case of the manufacturing sector, contribution of the within-group inequality in the manufacturing sector to the total inequality decreases substantially in the 2000s in all four countries. For example, in Germany, inequality within the manufacturing sector contributed to 33.6% of the total inequality in 1984. However, this decreases to 12.7% in 2007 from 33.6% in the 1980s, which means that income inequality within the manufacturing sector contributes less in the 2000s to the total income inequality when comparing with the 1980s.

On the other hand, the contribution of income inequality within the service sector to the total income inequality increases in the later period in all countries except for the United States. For example, income inequality within the service sector explained about 64% of the total income inequality in the mid-1980s, which increased to 86% in 2007. Differing from other countries, the relative contribution of inequality in the service sector to the total income inequality slightly decreases in the case of the United States from 87.6% in

TABLE 5

OUTCOME OF STATIC DECOMPOSITION ANALYSIS: EFFECTS OF EACH SECTOR ON INEQUALITY WITH TWO TIME POINTS (AROUND 1980 AND MID-2000S)

Country	Industry Sector	Aggregated inequality: GE(0)		Within industry group component: A term		Between Industry effect: B term	
		1980s	2000s	1980s	2000s	1980s	2000s
Germany	Agriculture	0.007 (2.41)	0.006 (1.47)	0.004	0.003	0.003	0.003
	Manufacturing	0.093 (33.56)	0.051 (12.69)	0.116	0.099	-0.023	-0.047
	Service	0.177 (64.03)	0.347 (85.84)	0.155	0.296	0.022	0.051
	All	0.277 (100)	0.404 (100)	0.275 (99.4)	0.398 (98.5)	0.002	0.006
Sweden	Agriculture	0.017 (12.74)	0.004 (2.13)	0.007	0.003	0.010	0.001
	Manufacturing	0.043 (32.97)	0.008 (4.09)	0.054	0.032	-0.011	-0.024
	Service	0.071 (54.29)	0.174 (93.78)	0.068	0.149	0.003	0.025
	All	0.131 (100)	0.186 (100)	0.130 (99.1)	0.184 (99.1)	0.001	0.002
Taiwan	Agriculture	0.080 (40.02)	0.010 (6.86)	0.021	0.002	0.059	0.008
	Manufacturing	0.145 (72.36)	0.086 (57.23)	0.088	0.054	0.057	0.032
	Service	-0.025 (-12.38)	0.054 (35.91)	0.062	0.090	-0.087	-0.036
	All	0.200 (100)	0.150 (100)	0.171 (85.2)	0.146 (97.1)	0.030	0.004
USA	Agriculture	0.008 (2.64)	0.031 (4.70)	0.003	0.019	0.005	0.011
	Manufacturing	0.031 (9.76)	0.087 (13.40)	0.075	0.110	-0.045	-0.023
	Service	0.274 (87.61)	0.534 (81.89)	0.228	0.518	0.046	0.017
	All	0.313 (100)	0.653 (100)	0.307 (98.3)	0.648 (99.2)	0.005	0.005

( ) indicates the relative contribution toward total inequality in Germany (1984, 2007), Sweden (1981, 2005), Taiwan (1981, 2005) and USA (1979, 2007).

TABLE 6

OUTCOME OF THE DYNAMIC DECOMPOSITION ANALYSIS: EFFECTS OF EACH
SECTOR ON INEQUALITY WITH TWO TIME POINTS (AROUND 1980 AND MID-2000S)

	Contribution to ΔGE(0) due to changes in				
	Change in aggregated inequality: $\Delta GE(0)$	Within industry group inequality: term A	Population shares		The average of industry group's income: term D
			term B	term C	
Germany (1984-2007)	0.127	0.108 (85.4)	0.014 (11.2)	-0.001 (-0.5)	0.005 (3.7)
Sweden (1981-2005)	0.055	0.048(87.2)	0.006(11.8)	-0.001(-1.9)	0.001(2.2)
Taiwan (1981-2005)	-0.050	-0.023(45.2)	-0.002(4.2)	-0.010(20.3)	-0.015(29.4)
U.S. (1979-2007)	0.340	0.321(94.5)	0.019(5.7)	-0.001(-0.2)	0.000(0.1)

1979 to 81.9% in 2007. However, the contribution of inequality within the
service sector to the total income inequality was already substantially higher
than other countries, being over 80% around the 1980s. Therefore, we suggest
that a slight decrease in the proportion of contribution is not significant.

Again, the numbers in parentheses indicate the relative contribution
toward total inequality. The outcome of the dynamic decomposition analysis
of wage inequality is presented in table 6. When examining the changes in
total income inequality, we notice that income inequality decreases in Taiwan
between 1981 and 2005, while inequality increases in the United States,
Germany and Sweden. The changes in income inequality can be further
dissected by observing the decomposed terms: the net effect of the within
group inequality change (term A), the effect of changes in the share of
population in each sector (term B and term C) and the effect of changes in
each group's average income (term D). In the case of Germany, Sweden and
the United States, the net effect of within group inequality change explains
85% of change in total inequality, whereas only 45% is explained in the case
of Taiwan.

The outcome from the dynamic decomposition analysis suggests that
changes in total income inequality are mostly explained by changes in within-
group inequality, specifically, changes in the inequality of each sector.

Moreover, similar to the outcome of the static decomposition analysis, in which the inequality within the service sector primarily explained the total inequality, the dynamic decomposition analysis confirms that an increase in the income inequality within the service sector contributes most to the increase in total income inequality.

Effects of skill levels on service sector inequality

Findings from both static and dynamic decomposition analysis above suggest that wage inequality within the service sector contributes most to the total wage inequality in all four countries compared to other sectors. This part of the analysis investigates how wage inequality among different skill levels contributes to inequality within the service sector.

The results from the static decomposition analysis on skill levels and inequality are presented in table 7. Skill level is categorized into three groups; low, middle and high level. Low skill corresponds to ISCO first skill level and the middle level corresponds to ISCO second skill level. Lastly, high skill level corresponds to ISCO third and fourth skill levels.

Inequality in the service sector increased more in the mid-2000s compared to the 1980s. Moreover, inequality within middle skill level explained more than 70% of the total wage inequality of the service sector (table 7). In other words, wage inequality within each skill level, low, middle and high skill, contributes most to the total wage inequality in the service sector. Especially when examining each skill group's degree of contributions to total wage inequality in the service sector, the results suggest that wage inequality within the middle skill level contributes most to the overall wage inequality in the service sector. The effect of inequality within the group of workers with middle skill level slightly decreases in Germany, Taiwan and the USA, but not in Sweden. However, the contribution of the low skill group increases in most countries, particularly in Taiwan (from 8.8 to 28), with a slight decrease only in the United States. Wage inequality among high skill workers contributes more to inequality within the service sector in the mid-2000s in Germany and the United States compared to the 1980s. However, the contribution of wage inequality within high skill workers decreases by around 20% in Sweden and in Taiwan.

Findings from the static analysis on wage inequality within the service sector suggest that wage inequality in the service sector has increased

TABLE 7

OUTCOME OF THE STATIC DECOMPOSITION ANALYSIS: EFFECTS OF SKILL LEVELS
ON INEQUALITY IN THE SERVICE SECTOR WITH TWO TIME POINTS (AROUND 1980
AND MID-2000S)

Country (year)	Skill level	Aggregated inequality: GE(0)		Within skill level component: A term		Between skill level effect: B term	
		1980s	2000s	1980s	2000s	1980s	2000s
Germany	Low	0.063(21.1)	0.117(26.5)	0.023	0.052	0.04	0.066
	Middle	**0.23(77.2)**	**0.285(64.5)**	0.128	0.169	0.101	0.116
	High	0.006(2.0)	0.04(9.0)	0.114	0.169	-0.108	-0.129
	All	0.298(100)	0.442(100)	0.265(88.9)	0.389(88.0)	0.033(11.1)	0.053(12.0)
Sweden	Low	0.017(12.4)	0.045(22.7)	0.008	0.021	0.009	0.023
	Middle	**0.091(66.4)**	**0.159(80.3)**	0.071	0.103	0.019	0.056
	High	0.03(21.9)	-0.006(-3.0)	0.056	0.062	-0.026	-0.067
	All	0.137(100)	0.198(100)	0.135(98.5)	0.186(93.9)	0.002(1.5)	0.012(6.1)
Taiwan	Low	0.013(8.7)	0.046(28.0)	0.012	0.006	0.0003	0.04
	Middle	**0.17(114.1)**	**0.185(112.8)**	0.1	0.058	0.07	0.127
	High	-0.034(-22.8)	-0.067(-40.9)	0.024	0.056	-0.058	-0.124
	All	0.149(100)	0.164(100)	0.137(91.9)	0.121(73.8)	0.012(8.1)	0.043(26.2)
USA	Low	0.066(18.4)	0.08(16.4)	0.031	0.033	0.035	0.047
	Middle	**0.305(85.2)**	**0.386(78.9)**	0.195	0.212	0.109	0.175
	High	-0.013(-3.6)	0.023(4.7)	0.096	0.175	-0.109	-0.152
	All	**0.358(100)**	**0.489(100)**	0.322(89.9)	0.42(85.9)	0.036(10.1)	0.069(14.1)

( ) indicates the relative contribution toward wage inequality in the service sector in Germany (1984, 2007), Sweden (1981, 2005), Taiwan (1981, 2005) and USA (1979, 2007).

recently; this can be mostly explained by increased wage inequality among middle skill workers. It is noticeable that in Sweden and Taiwan, the contribution of inequality among low skilled workers increased (about 10%), whereas the contribution of inequality among high skill workers decreased to about 20%. In the cases of Germany and the United States, there has been only a slight change in the contribution of inequality in the low skill level to the total inequality in the service sector. However, inequality among high skill workers has contributed to the total inequality in the service sector with about a 7% increase in the contribution rate.

Continuing to a dynamic decomposition analysis on inequality, we investigate the factors associated with the changes in the total inequality in the service sector (table 8). The findings suggest that inequality in the service sector increases from about 0.015 to about 0.144% between the two time

TABLE 8

OUTCOME OF THE DYNAMIC DECOMPOSITION ANALYSIS: EFFECTS OF SKILL LEVELS ON INEQUALITY IN THE SERVICE SECTOR WITH TWO TIME POINTS (AROUND 1980 AND MID-2000S)

	Contribution to $\Delta GE(0)$ due to changes in				
	Change in aggregated inequality: $\Delta GE(0)$	within skill level inequality: term A	Population shares		The average income of each skill level: term D
			term B	term C	
Germany (1984-2007)	0.144(100)	0.126(87.5)	-0.002(-1.1)	0.002(1.3)	0.018(12.3)
Sweden (1981-2005)	0.061(100)	0.048(79.5)	0.003(4.2)	0.001(1.4)	0.009(15.1)
Taiwan (1981-2005)	0.015(100)	-0.015(-95.8)	-0.002(-10.3)	0.006(36.5)	0.024(156.2)
U.S. (1979-2007)	0.131(100)	0.11(84.6)	-0.013(-10.2)	0.001(0.8)	0.031(23.7)

( ) indicates the relative contribution toward wage inequality in the service sector in Germany (1984, 2007), Sweden (1981, 2005), Taiwan (1981, 2005) and USA (1979, 2007).

points.

In Germany, Sweden and the United States, the increase in wage inequality within each skill level explains more than 80% of the total increase in the service sector inequality. From this result, we can understand that the increase of inequality in the service sector is mostly affected by the increase in inequality within each skill level. This finding confirms the finding from the static analysis on the service sector inequality above. It should be also highlighted that the proportion of workers in each skill level (term B and term C) has only a small effect on the increase in the service sector inequality. Lastly, we find that changes in the average income of each skill level contribute to the increase in total service sector inequality by 12%, in the case of Germany, and 24%, in that of the United States.

Taiwan presents a distinctively different pattern in the changes of inequality in this dynamic decomposition analysis. Similar to other countries, inequality in the service sector increased; yet, changes in the average income of each skill level (term D) is suggested to contribute the most (about 160%, table 8) to the increase in total inequality. However, in Taiwan, changes in

inequality within each skill level rather negatively affected the increase in the service sector inequality (-95.8 %, table 8).

Conclusion

This study focused on how diversification in economic activities and skill level in service economy are associated with wage inequality. We first discussed on the previous studies which link service economy and wage inequality. Next, we observed the diversification in economic activities and skill level by examining the International Standard of Industrial Classification of all Economies (ISIC) and the International Standard Classification of Occupations (ISCO). Finally, we empirically examined how the changes in service sector are associated with wage inequality. By decomposing the wage inequality, we first examined how inequality within and between each sector contribute to the total wage inequality. The analysis was conducted in both a static and dynamic sense.

The first analysis is related to our hypothesis of the association between diversification in economic activities and wage inequality by examining ISIC. Findings from the decomposition analysis, which examined how total wage inequality and heterogeneity of skill is related, using the LIS data, can be summarized as the following. First of all, total inequality increased between the 1980s and mid- 2000s in Germany, Sweden and USA; however, only Taiwan showed a slight decrease. Then, which sector contributed to this increase in inequality and how? The results from both static and dynamic analyses suggest that inequality within each sector contributed mostly to the total inequality (in all selected countries), while inequality between each sector, i.e., difference in the average income of each sector, contributed less to the total inequality change. For example, in Germany, inequality within each sector explained 85.4% of the total inequality, whereas inequality between groups contributed only 3.7% to the total increase in inequality (table 6). Comparing each sector again in Germany, we can examine that the service sector contributed 64% to the total inequality, while agriculture and manufacturing sectors contributed 2.4% and 33.6%, respectively, to total inequality during the 1980s. Also, the contribution of the service sector to total inequality increased in 2000s to 85.8% from 64% in the 1980s (table 5). We can suggest that changes in service sector matters most in understanding the increase in total inequality. The most noticeable finding is that inequality *within* the service sector contributes to the total inequality. Findings from the

dynamic analysis suggest that the increase in total inequality is mostly explained by an increase in inequality in the service sector.

The results in table 6 suggest that changes in population shares contribute only by little to the changes in total inequality. Another finding to highlight is that the share of population in the service sector is not suggested to be a major contributing factor to the total income inequality, while the income inequality within the service sector itself is suggested to be an important factor contributing to the total income inequality. This finding suggests that the share of workers in the service sector is not as important as to the question of what kind of service economy the country has.

The second analysis examined only the service sector, and by examining ISCO, we investigated how the level of skills is associated with wage inequality. At this stage, we attempted to understand as to why wage inequality within the service sector contributes the most to the total wage inequality with a focus on the levels of skills. In search of these questions, we decomposed the service sector into three groups with different skill levels, which are low skill, middle skill and high skill. Then, which skill level contributed to the increase in the service sector inequality and how?

The findings suggest that both in the 1980s and mid-2000s, inequality within each skill level group contributed most, more than 70% to the total service sector inequality. In other words, wage differences within each skill level group matters more than wage differences between different skill levels in explaining inequality in the service sector. For example, in Sweden, an increase in the inequality within the same skill level contributes almost 80% to the total increase in the service sector inequality, while differences in wage between different skill levels explained only 15% of the increase (table 8).

Among the three skill levels, it is noticeable that the inequality within the middle skill level contributed most to the total service sector inequality in all four selected countries (table 7). For example, in the United States, inequality within the middle skill level group contributed about 85% to the total service sector inequality, while inequality within low skill and high skill groups contributed 18% and 3.6%, respectively in 1980s. The relative proportion of inequality within each skill level does not present much change during the 2000s as well.

How can we understand the middle skill groups' large contribution to inequality in the service sector? We find some hints when examining the occupation groups, which correspond to the middle skill level. Occupations in this group are as follows: clerical support workers (4), service and sales workers (5), skilled agricultural, forestry and fishery workers (6), craft and

related trade workers (7) and plant and machine operators and assemblers (8). While all five occupation groups correspond to a middle skill level, the variation in occupation is most wide within this skill level compared to groups with low or high skills. This may suggest that wage compression within the group of middle skill level face more challenges due to its heterogeneousness. Heterogeneity in the service sector is also highlighted as an important factor related to inequality in Galbraith and Garcilazo's study (2005). However, their research only examined the service economy in Europe after 1995 and hence, it has a limitation of examining how inequality is related to the process of structural change, or transition to a service economy.

We also learned that contribution of inequality among low skill workers to total inequality in the service sector increased from 16% to a maximum of 28% recently. This finding suggests that the polarization of skills, particularly among elementary occupation groups, is increasing. Findings from studies on polarization in 27 EU countries also suggest that the proportion of low skill workers decreased about 9%, while medium- and high qualified workers increased by about 9% within the elementary occupation group (CEDEFOP 2011, p. 40). These finding suggest that associating the whole elementary occupation group with a single skill level, as in ISCO, may not sufficiently describe the skill division in the service economy. The heterogeneousness in the middle skill level explained above also suggests that the current skill level classification mainly grounded on education level may need a revision in the service economy due to its limited reflection of the real labor market.

In fact, a reclassification of skills in general skill forming (Fleckenstein 2011, p. 1628) and recategorization of occupations in the postindustrial economy (Esping-Andersen 1993, pp. 24-5) have been discussed in other studies as well. Our empirical study contributes to the literature by suggesting a need for a new matching of occupation and skill levels in the service economy. In particular, occupation categories in ISCO provide limited information on the actual required skill and the skill to carry out the given tasks (CEDEFOP 2011). Therefore, limitation in reflecting the real relationship between skills and inequality in the service economy may remain when we categorize skills and occupations based on ISCO. Specifically, we can suggest that occupation and skill categories by ISCO may not sufficiently reflect the intensified skill division in the service economy. We conclude by proposing the next avenue of research, that is, re-scaling and/or re-categorizing skill, which can better improve our understanding of economic activities and skill in the service economy. In addition,

consequence of the transition to service economy may have larger implication for inequality in the context of globalization as well. Esping-Andersen (1999) suggests that globalization is the culprit engendering a shrink in manufacturing due to the increase of the North-South trade. Most manufacturing goods are produced in newly industrialized countries due to wage competition and hence, advanced economies are shifting to a service economy while manufacturing is concentrated in the South. Hence, inequality in service economy requires further research in both national and international context.

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