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Research Report

Wage Inequality: How and Why it has Changed over the Decades

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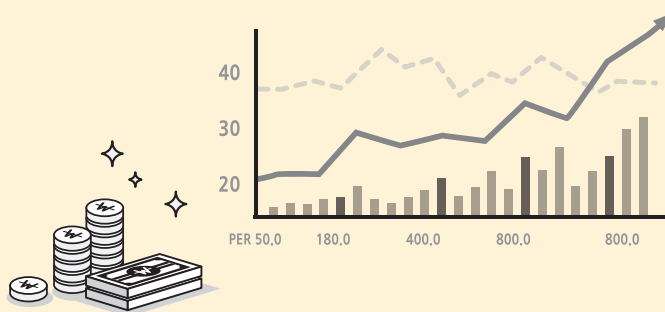
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Wage Inequality: How and Why it has Changed over the Decades

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* Based on Youngsun Koh, *The Evolution of Wage Inequality in Korea*, Policy Study 2018-01, KDI, 2018.

Summary

- From 1980 to 2016, Korea exhibited ups and downs in wage inequality and a slowdown in wage growth.
 - Wage inequality fell in the 1st phase (1980-1994), rose in the 2nd (1995-2007), and fell again in the 3rd (2008-2016).
 - The annual growth rate of the real median wage plummeted from 9.2% in the 1st phase to 4.0% in the 2nd and then to 1.1% in the 3rd.
- So far as wages are a form of compensation for the skills provided, wage inequality is affected by the changes in the supply of and demand for skills.
 - An important indicator of skill is the educational attainment of workers. The demand for high-school graduates rapidly increased in the 1st phase, weakening the wage premium of college graduates and reducing wage inequality. The situation reversed in the 2nd phase with a sharp upturn in the demand for college graduates, in their wage premium, and in wage inequality. In the 3rd phase, the wage premium of the latter dipped again as their supply continued amid the subdued demand for them.
 - The large demand for high-school graduates observed in the 1st phase may derive from the rising demand for mid-skilled workers by the heavy and chemical industry while the growing demand for college graduates observed in the 2nd phase may be the result of an increasing demand for high-skilled workers driven by technological progress.
- To accelerate the wage growth while keeping wage inequality in check, technological progress should be encouraged and the quality of higher education upgraded.

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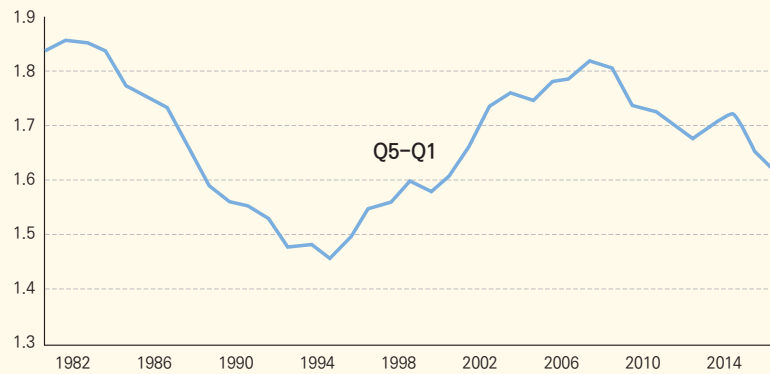
Changing Trends in Income and Wage Inequality

¹ [Figure 1] and the analyses below used data on workplaces with 10 or more employees from the Ministry of Employment and Labor's *Report on Wage Structure Survey*. The scope of the survey has expanded continuously over time to now include workplaces with one or more employees. To maintain time-series

- Korea's income inequality has changed drastically since the 1990s.
 - Income inequality as measured by the Gini coefficient fell in 1990-1992 but surged in 1993-2008; a modest decline was seen thereafter until 2015.
- The trends in wage inequality (Figure 1) are similar to those of income inequality, implying that the former is a main cause of the latter.
 - Wage inequality, estimated by the difference (Q5-Q1) in hourly wages between the top (Q5) and bottom (Q1) quintile, follows closely the fluctuations in income inequality.¹⁾
 - Wage inequality declined during the 1st phase (1980-1994), rose during the 2nd (1995-2007), and declined again in the 3rd (2008-2016).
 - Wage inequality seems to be, therefore, the main driver of income inequality.
 - Wages in effect account for 64% of total household income (Statistics Korea's *Survey of Household Finances and Living Conditions*, 2018).

consistency, this study utilized only the samples with 10 or more employees. This appears to have no material impact on the conclusions of the study. See Appendix 1 of Koh (2018) and pages 8-9 for further details. Many preceding studies have limited their samples to specific groups, e.g. male workers or full-time workers, when necessary (Katz and Murphy, 1992; Juhn, Murphy, and Pierce, 1993).

[Figure 1] Inequality in Hourly Wages



Note: Q1 is the average of the log hourly wages in the bottom (1st) quintile and Q5 is that of those in the top (5th) quintile. Calculated by the author using data from the Ministry of Employment and Labor's *Report on Wage Structure Survey* (establishments with 10 or more employees).

Source: Koh (2018).

■ Meanwhile, the entire period witnessed a gradual moderation in wage growth (Table 1).

- The annual growth rate of the real median wage (P50) plummeted from 9.2% in the 1st phase to 4.0% in the 2nd and 1.1% in the 3rd.
- That of the top 10% (P90) similarly dropped to 1.1% in the 3rd phase while that of the bottom 10% (P10) stayed relatively steady at 3.0%.

<Table 1> Real Hourly Wage Growth

(%)

	1980-1994	1994-2007	2007-2016
Top 10% (P90)	6.6	5.6	1.1
Median (P50)	9.2	4.0	1.1
Bottom 10% (P10)	9.2	3.1	3.0

Note: Calculated by the author using data from the Ministry of Employment and Labor's *Report on Wage Structure Survey* (establishments with 10 or more employees). Real wages were calculated using the headline CPI.

■ The majority of advanced economies have experienced a continued deterioration in wage inequality since the 1980s while Korea has exhibited ups and downs.

- In the US, the deteriorating wage inequality is believed to have come from skill-biased technical change (SBTC) (Juhn, Murphy, and Pierce, 1993; Katz and Autor, 1999; and Goldin and Katz, 2007).
 - The increasing supply of college graduates could not match the increasing demand for high-skilled workers on the back of rapid technological progress, widening the wage gap between college and high-school graduates, and deepening income inequality.
 - The phenomenon was tagged as a 'race between education and technology' by Goldin and Katz (2007) who argued that to reduce wage inequality, college education should be actively expanded.
- In Korea, not only did wage inequality rise (in the 2nd phase) but also fell (in the 1st and 3rd). This study examines the causes of the fluctuation from the perspective of labor supply and demand and draws policy implications.

Decomposition of Wage Inequality

- Workers' wages are determined by the amount of skill they have and the price of skill; changes in wage inequality are determined in turn by the changing distribution of skill among workers and the changing price of skill.
 - A worker's skill is often represented by such traits as educational attainment, work experience, age, gender, etc.
 - In the case of educational attainment, for instance, a college graduate generally commands a higher wage than a high-school graduate.
 - When nobody (or, for that matter, everybody) has a college degree, or when the college wage premium is nill, the wage inequality that derives from educational attainment would be nill.
 - Wage inequality changes as the share of college graduates increases or decreases (i.e. the distribution of educational attainment changes) and as the college wage premium rises or falls (i.e. the price of educational attainment changes).

- An analysis of the 1980-2016 data reveals that the change in wage inequality can be mostly attributed to the changing price of skill.
 - In <Table 2>, the contribution of each trait to the changing wage inequality is divided into 'total effect' (=changing distribution + changing price) and 'price effect' (=changing price).²⁾
 - As shown in the bottom row, the sums for the 'total effect' and 'price effect' are nearly equal to each other.
 - They marked -0.022 and -0.021, respectively, in 1980-1982, 0.012 and 0.013 in 1995-2007, and -0.008 and -0.015 in 2009-2016.
 - It appears that the price effect plays a dominant role in explaining the overall movement in wage inequality.
 - Analyses of the American labor market using a different methodology reached a similar conclusion (Juhn, Murphy, and Pierce, 1993).

<Table 2> Decomposition of Wage Inequality (Q5-Q1) of Worker Traits (annual average)

	1980-1992		1995-2007		2009-2016	
	Total effect	Price effect	Total effect	Price effect	Total effect	Price effect
Gender	-0.008	-0.003	-0.006	-0.003	-0.002	-0.003
Age	-0.010	-0.004	0.001	0.003	0.000	-0.001
Educational attainment	-0.010	-0.009	0.004	0.003	-0.004	-0.005
Work experience	0.007	0.002	0.003	0.001	-0.002	-0.003
Firm tenure	0.003	-0.001	0.002	0.002	-0.002	-0.003
Establishment size	0.002	0.000	0.007	0.004	0.002	0.001
Occupation	-0.003	-0.008	0.004	0.003	0.000	0.002
Industry	-0.002	0.002	-0.002	0.001	-0.002	-0.003
Sum	-0.022	-0.021	0.012	0.013	-0.008	-0.015

Note: The time frames (1980-1992, 1995-2007, and 2009-2016) differ from the aforementioned three phases to maintain consistency in occupation and industry classifications.

Source: Koh (2018).

- 2 There is little doubt that occupations are closely related to workers' skill, but questions could arise on whether establishment size or industry reflects their skill level. Wage gaps do exist in reality between different sizes of establishments and industries. One potential reason is the sorting of workers by skill (Groschen, 1991; Abowd *et al.*, 1999); highly skilled workers with some unobservable traits may sort into large establishments or certain industries. In this case, establishment size or industry can be used as indicators for these unobservable traits.

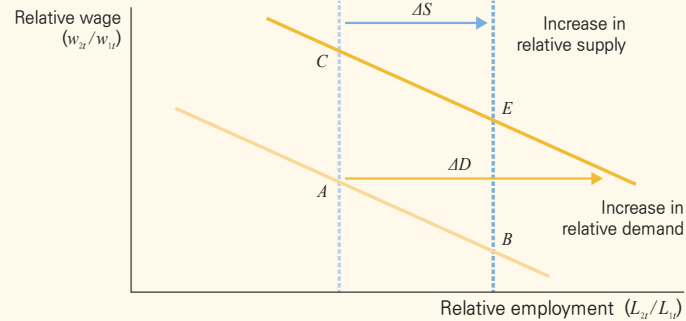
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Changes in the Relative Labor Supply and Demand by Educational Attainment

■ Changes in the price of skill are now examined in a supply and demand framework (Figure 2).

- Suppose that worker group 1 consists of high-school graduates and group 2 of college graduates. The relative wage (w_{2t} / w_{1t}) would then represent the wage premium of college education over high-school education.
- The relative wage (w_{2t} / w_{1t}) is determined by the interaction between the relative demand for and the relative supply of college graduates over high-school graduates.
 - Relative demand is depicted by the downward-sloping line and relative supply (L_{2t} / L_{1t}) by the vertical line under the assumption that the latter is fixed during short periods.
- Starting from the initial equilibrium achieved at point *A*, an increase in the relative supply by ΔS would move the equilibrium to point *B* and reduce the relative wage.
- Similarly, an increase in the relative demand by ΔD would move the equilibrium from point *A* to point *C* and raise the relative wage.
- Increases in both relative supply and demand would move the equilibrium to point *E*. In [Figure 2], the relative wage rises since the increase in relative demand (ΔD) is larger than that in the relative supply (ΔS).

[Figure 2] Relative Supply and Demand of Labor



Source: Acemoglu (2002, p.20).

■ Focusing our attention on educational attainment, which is presumably the most important determinant of skill, a relative demand function was estimated for each of the three phases.

- Specifically, the following equation was estimated.³⁾

$$\log \frac{w_{2t}}{w_{1t}} = \alpha_k + \beta_k t - \gamma \log \frac{L_{2t}}{L_{1t}} + \epsilon_t, \quad t = 1980, \dots, 2016, \quad k = 1, 2, 3.$$

- The period from 1980 to 2016 was divided into 1st, 2nd, and 3rd phases and β_1 , β_2 , and β_3 were estimated.⁴⁾
- This specification assumes that the relative demand increases or decreases every year by the same margin in each phase; if $\beta_k > 0$, the demand curve moves to the right by $\frac{1}{\gamma} \beta_k$ every year, while if $\beta_k < 0$, it moves to the left by $\frac{1}{\gamma} \beta_k$ every year.

■ Based on the estimated equation, changes in relative demand, relative supply, and relative wages were calculated as follows.

- Relative demand change = $\frac{1}{\gamma} \beta_k \Delta t$
- Relative supply change = $\Delta \log \frac{L_{2t}}{L_{1t}}$
- Relative wage change = $\Delta \log \frac{w_{2t}}{w_{1t}} = \gamma \left(\frac{1}{\gamma} \beta_k \Delta t - \Delta \log \frac{L_{2t}}{L_{1t}} \right)$

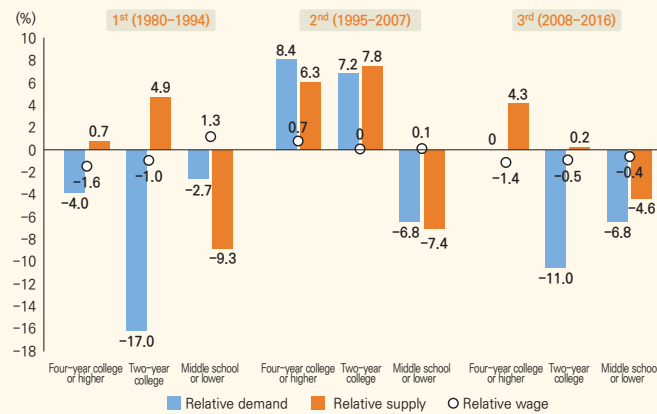
3 An alternative to estimating the regression equation is to calculate the demand shift assuming a specific value for γ . As noted in footnote 17 on page 22 of Shin (2007), one can choose between estimating and assuming a value for γ . The commonly assumed value for elasticity of substitution, $\alpha=1/\gamma=1.4$, was initially obtained from the estimation.

4 Preceding studies (Katz and Murphy 1992, p.89; Katz and Autor, 1999, p.1519; Acemoglu, 2002, p.27) assumed a single value for β for the entire period, but this study estimated different values for respective phases to accommodate the possibility of β changing significantly over the phases.

■ The relative demand for workers has changed across different phases (Figure 3).

- 1st phase: The relative demand for high-school graduates increased rapidly.
 - The annual change in the demand for four-year college graduates relative to high-school graduates recorded -4.0%, that for two-year college graduates -17.0%, and that for middle-school graduates -2.7%.
- 2nd phase: The relative demand for four-year college graduates increased rapidly (8.4%), as did that for two-year college graduates (7.2%).
- 3rd phase: The relative demand for four-year college graduates stagnated (0.0%) and that for two-year college graduates declined (-11.0%).

[Figure 3] Changes in the Demand, Supply, and Wage Relative to High-School Graduates by Educational Attainment (annual average)



■ Meanwhile, on the labor supply side, all phases exhibited a continuous upgrading in educational attainment (Figure 3).

- 1st phase: Middle-school graduates were replaced rapidly by high-school graduates following an upsurge in the supply of the latter.
 - The share of high-school graduates shot up from 29.4% to 50.1% while that of middle-school graduates plunged from 59.8% to 26.1% (Table 3), resulting in a rapid drop (-9.3%) in the relative supply of middle-school graduates.
 - The supply of four-year college graduates (0.7%) and two-year college graduates (4.9%) relative to high-school graduates increased at a fast pace.

<Table 3> Share of Working Hours by Educational Attainment

	(%)					
Phase	1 st		2 nd		3 rd	
Year	1980	1994	1995	2007	2008	2016
Middle school or lower	59.8	26.1	24.3	8.3	7.4	3.8
High school	29.4	50.1	50.0	43.0	42.8	38.9
2-year college	2.3	7.7	8.3	17.5	18.0	16.7
4-year college or higher	8.6	16.1	17.4	31.1	31.9	40.6

- 2nd phase: The relative supply of four-year college graduates (6.3%) and two-year college graduates (7.8%) increased rapidly.
 - This increase owes much to the adoption of the graduation quota system in the early 1980s and the partial liberalization of the college establishment regulations in the mid-1990s.
- 3rd phase: The relative supply of four-year college graduates (4.3%) and two-year college graduates (0.2%) continued to grow albeit at a slower pace.

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Discussion

- Changes in the relative supply and demand lead to changes in relative wages and wage inequality.
 - 1st phase: The wage gaps between high-school graduates and other groups declined, contributing to an improvement in wage inequality.
 - The relative demand for four-year college graduates and two-year college graduates decreased (-4.0% and -17.0%, respectively) and their relative supply increased (0.7% and 4.9%), reducing their relative wages (-1.6% and -1.0%).
 - For middle-school graduates, the relative supply (-9.3%) dropped more than the relative demand (-2.7%), resulting in an increase (1.3%) in the relative wage.
 - 2nd phase: Wage inequality deteriorated following an increase in the relative wage of four-year college graduates.
 - The relative supply of four-year college graduates (6.3%) increased but their relative demand (8.4%) increased even more, raising their relative wage (0.7%).
 - 3rd phase: Wage inequality improved with decreases in the relative wage of four-year and two-year college graduates.
 - While the relative demand for four-year college graduates stagnated (0.0%), their relative supply continued to grow, pulling down their relative wage (-1.4%).
 - The relative demand for two-year college graduates tumbled (-11.0%) and their relative wage dropped (-0.5%).
 - The sluggish growth of the top and median wages appears to be due to the decrease in the relative wage of college graduates (Table 1).
- For the 1st phase, the changes in labor demand by educational attainment imply the following two possibilities:
 - Shift in industrial structure: The industrial promotion policy in the 1970s drove the growth of the heavy and chemical industry in the 1980s, possibly triggering a strong demand for mid-skilled workers.
 - Change in skill demand across all industries: The demand for mid-skilled workers may have strengthened not only in heavy and chemical industry but also in other industries.
 - For instance, in light of Acemoglu's (2002) endogenous technical change theory, the high demand for high-school graduates in the 1980s may have been due to the increased supply of high-school graduates following the surge in the high-school enrollment rate in the 1970s.
 - In any case, the increasing demand for high-school graduates appears to have been an important part of falling wage inequality in the 1st phase.
- For the 2nd phase, several studies point to SBTC as the cause of the rising demand for high-skilled workers (Kwon and Kim, 2002; Shin, 2007).
 - According to these studies, the widespread use of ICT stimulated the demand for college graduates equipped with new skills and knowledge.
 - Even without ICT, the demand for high-skilled college graduates may have increased in the 2nd phase as the Korean economy was graduating from a catching-up stage and attaining a leading position in many sectors on the back of accumulated technological achievements.
- For the 3rd phase, the stagnant demand for high-skilled workers indicates that SBTC was slowing.
 - If the increased demand for high-skilled workers in the 2nd phase was driven by the strengthening of SBTC, the stagnant demand in the 3rd phase may have been due to the weakening of SBTC.

Policy Implications

- In this sense, the improved wage inequality in the 3rd phase may have been a mixed blessing, partly reflecting a slower pace of technological progress and a weaker demand for high-skilled workers.
- **Innovation and technological progress need to be accelerated to improve productivity and boost real wage growth.**
 - The stagnant growth of the median and 90th percentile wages in the 3rd phase indicates that policy attention should not be confined to low-wage earners.
 - To strengthen the overall wage growth, multi-faceted efforts are needed aimed at accelerating technological progress and productivity improvement through deregulation, industrial restructuring, and institutional reforms in education, labor market R&D, and other areas.
- **Proactive efforts are also needed to improve income distribution.**
 - Income distribution may deteriorate, as in the 2nd phase, if the accelerated technical progress raises the demand for high-skilled workers.
 - In response, first, the overall skill levels of the workforce should be enhanced. Given that the quality of higher education has been declining since the 1990s (Lee *et al.*, 2014), efforts should be geared towards improving the quality, not quantity, of education at colleges, particularly for those lagging behind.
 - Second, redistribution policies should be reinforced and their effectiveness improved.

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