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Decomposition of Changes in Korean Wage Inequality, 1998–2007

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Abstract South Korea experienced a steep increase in wage inequality between the Asian financial crisis in 1997 and the global financial crisis in 2008. This paper investigates the causes of the sharp change during that time period by looking at the contributions of changes in the distributions of schooling and unionization. The effects are estimated applying two robust distributional function based decomposition methods on Korean Labor and Panel Survey data for the time period 1998–2007. The results suggest changes in the distribution of schooling can explain about 10 % of the changes in the 90/50 percentile wage gap. The declining unionization rate does not have much impact on the upward trend of Korean wage inequality. In addition, aggregate decomposition results suggest that changes in labor force composition can explain a significant proportion of the total wage changes in the upper-tail of the distribution. Based on our findings we provide a list of policy recommendations to address the wage inequality issue in Korea.

Keywords Wage distribution function · Decomposition method · 50/10 and 90/50 percentile wage gaps

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Introduction

Over the last three decades, wage inequality has increased substantially in most developed countries including the US, Germany, and the UK. Patterns of wage inequality vary widely across countries, for example between the US and France. South Korea[1] is also experiencing a similar pattern of changes in wage inequality in developed nations like the US and the UK since mid-1990s. Korea is also one of the few countries experiencing high economic growth and decreasing wage inequality from the early 1980s to the mid-1990s. The left panel of Fig. 1 illustrates this fact by showing that gini coefficient[2] in Korea increases about 17 % over the last two decades. The right panel shows that during the period 1980 to 1995 the Korean average growth rate in per capita income was 9.4 % whereas in post financial crisis area growth rate declines to 4.3 %. There is a downward trend of the Korean growth rate since the late 1990s. The goal of this paper is to provide a meaningful contribution to the wage inequality literature by investigating the causes of recent changes in wage inequality in Korea.

The trend of rising income inequality in Korea is a big concern because the Korean growth rate is negatively associated with rising income inequality. Persson and Tabellini (1994) identified numerous channels through which the adverse effects of inequality operate. By looking at the range of countries over a longer period of time and controlling all other relevant factors, they show that higher inequality is associated with a lower growth rate. Kumhof and Ranciere (2010) and Lebarz et al. (2012) show that increasing concentration of income reduces aggregate demand and undermines growth because the higher income spends a lower fraction of their incomes than middle-income and lower-income groups. Most recently, Ostry et al. (2014) and Berg and Ostry (2011) also find that in OECD countries income inequality affects growth rate negatively. Figure 1 supports the theory that income inequality has a significant adverse impact on the Korean growth rate.

A large literature (Kang and Yun (2008), Chung and Choi (2001), Kim and Topel (1995) and others) investigates the reverse trend of wage inequality in Korea from the early 1908s to mid-1990s and concludes that the pattern of changes in wage inequality is consistent with the Kuznets curve[3] because income inequality in Korea rose rapidly since the early 1960s and then declined during the 1980s until the mid-1990s after reaching it's peak in the mid 1970s.[4] In this study we focus on the post Asian financial crisis era because during that period Korean income inequality has

[1] By following the convention, from hereafter we denote Korea for South Korea.

[2] a measure of inequality ranging from 0 where everyone has identical incomes to 1 where all income goes to only one person.

[3] Kuznets (1955) predicted that in the process of economic development, income inequality first rises, reaches the peak and falls after a certain critical threshold development stage and income level.

[4] Income inequality in Korea reaches it's peak in the mid-1970s when the gini coefficient was more than 0.37.

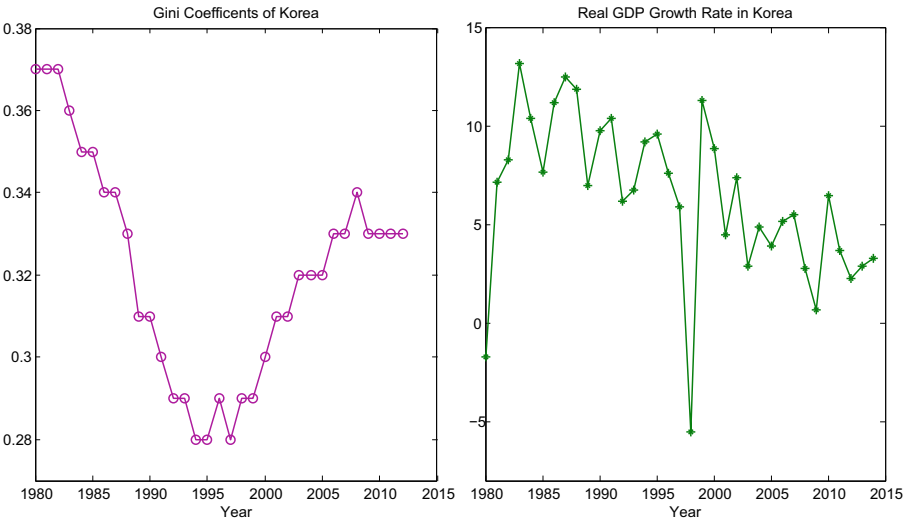

Fig. 1 Korean Gini coefficients from 1980 to 2012 and real GDP growth rate from 1980 to 2014

been purportedly exacerbated. Moreover, Sung (2014a) shows that Korea was ranked third among the OECD countries in terms of rising income inequality in 2011.

Lee et al. (2013) argue that income inequality has rebounded sharply around the late 1990s when Korean economy faced the Asian financial crisis. Kim (2013) also claims that after 1997 financial crisis the trend of Korean income inequality has become similar to the US-UK worsening income equality since the early 1980s. The right panel of Fig. 2 shows that in 2008 the share of Korean top 10 % income earners crossed the UK and in recent years; it is close to the US. Moreover during the period 1995 to 2010, the top 10 % income earners share in Korea rose about 15 % which is almost 3 times the changes in both US and UK.[5]

This steep increase in income inequality is evident, not only widening the gap between the top and bottom percentiles of income distribution but also changing the gini coefficient. The left panel of Fig. 1 shows the gini coefficient decreases from 0.38 to 0.28 since the early 1980s to mid 1990s and then increases from 0.28 to 0.33 from 1995 to 2010. Most recently, Sung (2014b) shows that the rising trend of Korean wage inequality becomes flatter after the global financial crisis in 2008 mainly because of the expansion of redistributive policies such as transfer payments in-kind, subsidized housing, and health and education benefits for poor from the Korean government. Sung (2014b) finds that the decreasing effect of income inequality by the expansion of public expenditures has increased from 10.7 % in 2006 to 14 % in 2013.

To overcome the shock of Asain financial crisis in 1997 the Korean government also expanded the public safety net including social security and social assistance.

[5]The data source of 10 % income share is 'The World Top Incomes Database'.

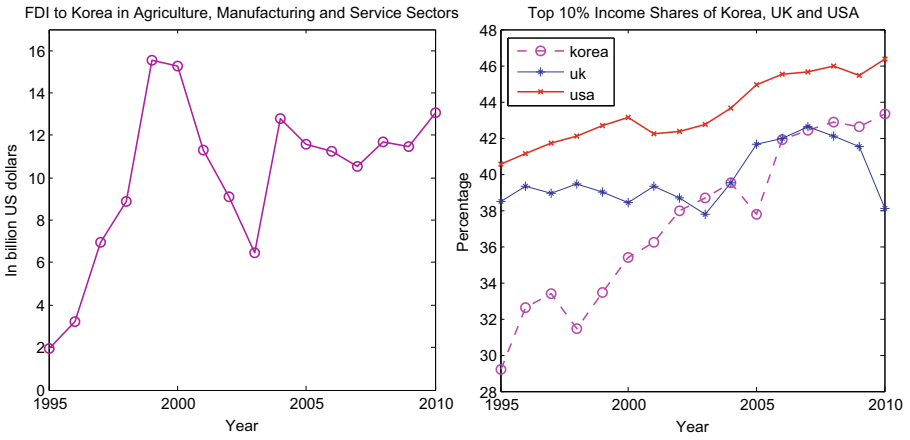

Fig. 2 FDI to Korea in agriculture, manufacturing and service sectors and top 10 percent income shares of Korea, the UK and the US from 1995 to 2010

According to the 2008 OECD factbook,[6] the ratio of public social expenditure to total GDP was about 3 % during 1990-1997, 5.8 % during the period 1998 to 2008 and has been about 9 % since 2009. However, compared to other OECD countries, the social expenditure is still ranked second lowest at about 40 % of rest of the OECD average. Kim (2009) points out that there is a significant dead zone for people to receive this social safety net benefit and about 40 % of the total temporary workers were included in public safety net programs. Further, only 34 % of poor income group was covered by the national basic living security act. The social safety net and other public assistance programs were unable to protect marginalized workers.

Figure 3 illustrates the trends of wage inequality across different income groups from 1980 to 2010. As shown, over the last three decades the 90/10, 90/50 and 50/10 percentile wage ratios follow a U-shaped pattern. This is consistent with the previous findings in the Korean wage inequality literature. Figure 3 also shows that during the period 1980 to 1995 both the 90/10 and 90/50 percentile wage ratios have decreased about 30 and 27 % before increasing about 25 and 14 % respectively from 1995 to 2012. These results imply that since the mid-1990s wage gaps across different groups widened. Consistent with Sung (2014b), Fig. 3 also shows a stabilizing trend of wage inequality since the post global financial crisis in 2008. This sharp changes in wage inequality within a decade motivate us to investigate what causes such a steep increase in Korean wage inequality during the period 1998 to 2007?[7]

Previous studies including Yoo (1998), Choi and Jeong (2003), Cho (2008) and Kim (2008) focus on the changes in workers characteristics, the impact of labor unions, the financial crisis and other factors and come up with different explanations

[6]The report is available at http://www.oecd.org/publications/factbook/

[7]We mainly focus on wage inequality in this paper because according to the 2011 OECD report about two thirds of the overall income inequality at household level can be explained by the changes in wage inequality.

Fig. 3 Korean 90/10, 90/50 and 50/10 percentile wage ratios from 1980 to 2012

such as Skill-biased Technological Change (SBTC), an aging population, and the changes in the labor market demographic structure to explain the recent changes of wage inequality. Kim (2013) also shows that the changes in wage gaps across different income groups are magnified in the post Asian financial crisis period because of the expansion of incentive wage schemes among large business enterprises and concludes that the driving force of the changes in 90/50 and 90/10 percentile wage gaps is the rapid wage growth of high skilled workers.

Park and Mah (2011) argue that some of the economic policies implemented to overcome the Asian financial crisis such as pro-FDI policies and labor market reform contributed to rising income inequality and show that the massive FDI inflow and revision of the labor law in 1998 widened wage inequality by allowing employers to terminate workers more easily than before. The sharp decline in job stability during the financial crisis never goes back to the previous level. This policy has only favored the high income groups in post financial crisis era. Furthermore, it has been a well accepted hypothesis in the Korean wage inequality literature that the roles of labor unions in the labor market have been weaker since the late 1990s.[8]

However, one of the major drawbacks of previous studies is that empirical evidences are based on the mean based estimation methods. As shown in both the panels of Fig. 3, wage gaps at different parts of the wage distribution function have changed asymmetrically over time. As a result, any mean based estimation method underestimates the effects of different factors especially at the two tails of the wage distribution function. To overcome this problem, we have used two distribution function based wage decomposition methods that can explain the changes in wage gaps at different percentiles of the distribution function and also across different income groups. Over the last two decades distributional parameter based decomposition methods have been widely used to explain the changes in wages distribution functions over time across different countries. (See DiNardo et al. (1996), Autor et al. (2008) for

[8]See Yoo (1998), Kang and Yun (2008), Sung (2009), Kim and Kim (2012) among others.

the US, Fitzenberger and Kutz (1997) for Germany, Gosling et al. (2000) for the UK, Gonzalez and Miles (2001) for Uruguay, and Machado and Mata (2005) for Portugal among others.)

By using the DiNardo et al. (1996) decomposition method Sung (2014b) shows that although skill distributional effects and wage structure effects can not explain the changes in 90/50 male wage gap over the period 1995 to 2008, it can explain about 80 % of changes in 90/50 female wage gap. Sung (2014b) uses only education and age for skill distribution effects because the DiNardo et al. (1996) method becomes practically infeasible when there are too many continuous variables. Frolich (2004) shows that the re-weighting method can have some undesirable properties in small samples when there is a problem of common support. That is why we have chosen a robust decomposition method proposed by Machado and Mata (2005) and also distribution regression based another decomposition method introduced by Chernozhukov et al. (2013).[9]

Our aggregate decomposition results from both these methods suggest that changes in labor force composition can explain a significant portion of the total changes in wages in the upper-tail of the distribution. However for skilled sector workers price effects dominate composition effects. Both decomposition methods also show that changes in the distribution of education can explain about 10 % of the changes in the 90/50 wage gap during the period 1998 to 2007. Consistent with the previous findings in the literature we also find that a small decline in the unionization rate does not have much impact on the wage distribution function.

The paper is structured as follows. "Concerns and Consequences of Rising Inequality" provides a discussion about why the rising income inequality is a big concern in Korea and what are the consequences of this growing inequality in Korean economy. In "Identification Strategy", we discuss our identification strategy and give an overview of the two robust decomposition methods we used for identification. We also include a comparison between these two decomposition methods. In "Data and Results", we discuss Korean Labor and Income Panel Survey data and explain results obtained from these two decomposition methods. We conclude in "Conclusion".

Concerns and Consequences of Rising Inequality

Rising inequality is a widespread concern for Korean policy makers since high and sustained levels of inequality have many serious consequences on the economy and as well as the social life of individuals. Galor and Moav (2004) and Aghion et al. (1999) show that higher inequality lowers growth by depriving the ability of lower-income households to stay healthy and accumulate physical and human capital. In a similar context Stiglitz (2012) argues that inequality can significantly undermine optimal choices of education and occupation. There is incentive to divert effort toward securing favored treatment and protection, resulting in resource misallocation, corruption,

[9]The details of these two decomposition methods are discussed in the next section.

and nepotism with adverse social and economic consequences. In extreme cases, citizens may lose confidence in institutions, eroding social cohesion and confidence in the future.

Cingano (2014) shows that inequality leads to under investment in education as poor children end up in lower-quality schools and are less able to go to college. As a result, labor productivity becomes lower than it would have been in a more equitable world. In the same vein Corak (2013) finds that countries with higher levels of income inequality tend to have lower levels of mobility between generations, with parent earnings a more important determinant of their children's earnings. Ravallion (2013) argues that income inequality affects the pace at which growth enables poverty reduction. Stiglitz (2012) also argues that growth is less efficient to reduce poverty in a country where inequality is very high or in which the distributional pattern of growth favors the non-poor. To the extent that economies are periodically subject to shocks of various kinds that undermine growth, higher inequality makes a greater proportion of the population vulnerable to poverty.

A growing body of income inequality literature including Stiglitz (2012), Kumhof et al. (2012) and Kumhof and Ranciere (2010) among others suggests that rising influence of the rich and stagnant incomes of the poor and middle class have a causal effect on crisis, and directly hurt short-term and long-term growth. Rajan (2010) shows that a prolonged period of higher inequality in advanced economies was associated with the global financial crisis by intensifying leverage and credit overextension and relaxing mortgage-underwriting standards. Dabla-Norris et al. (2015) show that financial deepening is associated with rising inequality in emerging markets and developing countries.

Stiglitz (2012) argues that inequality brings economic instability in a country by reducing aggregate demand, lowering growth and raising the higher unemployment rate. While high inequality creates instability in an economy, the instability itself gives rise to more inequality. Thus inequality creates a vicious circle. Kumhof et al. (2012) show that rising income inequality are associated with substantially larger external deficits creating financial instability in a country.

Income inequality also makes an economy less efficient and productive by creating inequality of opportunities attributed to differences in circumstances beyond the individuals control such as gender, ethnicity, location of birth, or family background and income. Inequality of outcomes arises from a combination of differences in opportunities plus effort and talent. Inequality creates lack of income mobility and opportunity, reflecting persistent disadvantage for particular segments of society. This lack of income mobility for the economically vulnerable groups has adverse consequences on growth and efficiency. In this context Rawls (1971) argued that the distribution of opportunities and outcomes are equally important and informative to understand the nature and extent of inequality.

Dabla-Norris et al. (2015) argue that rising inequality has important consequences on political decision power and public policy. Rising inequality can create economic inefficiency and macroeconomic instability. High and sustained levels of inequality can lead to a suboptimal use of human resources, cause investment-reducing political and economic instability, and raise crisis risk. Putnam (2000) and Bourguignon and Dessus (2009) show that enhanced power by the elite creates a very limited provision

of public goods and that reduces social productivity and benefit the poor. Alvaredo et al. (2013) analyse how changes in the taxation rate over the last three decades are affected by the concentration of power of the top 1 % in US.

Identification Strategy

We use the distribution function based Oaxaca decomposition method to identify the effect of changes in the distribution of education and unionization on Korean labor wage inequality. The main advantage of using the distribution function based decomposition method over mean and variance decomposition is that it allows us to decompose the change in any distributional statistic such as mean, quantile, skewness, kurtosis and gini coefficient. We can also estimate the effects our variables of interest on different wage gaps across the distribution function such as 90/10, 90/50 and 50/10 percentile wage gaps.

Distribution Function Based Decomposition Methods

Over the last three decades the Oaxaca-Blinder decomposition method has become a standard estimation strategy in labor economics because it can be used to decompose the changes in mean of the outcome variable across two countries, time periods or subgroups of population in several factors contributing to those changes.[10] A large number of methodological papers including DiNardo et al. (1996), Machado and Mata (2005), Firpo et al. (2009), Rothe (2012), Chernozhukov et al. (2013) and Ghosh (2014) extend this mean based decomposition method in distribution function based methods by constructing counterfactual distribution functions using different estimation techniques.

Autor et al. (2005) argue that the Machado and Mata (2005) decomposition provides a precise link between the 'full variance accounting' technique for analyzing inequality introduced by (Juhn et al. 1993) and the kernel re-weighting proposed by DiNardo et al. (1996). To decompose the changes in wage distribution function, Machado and Mata (2005) estimate a counterfactual wage distribution ($F_W(w)$) of the form,

$$F_W(w) = \int F_{W|X}(w|x) dF_X(x)$$

where $F_{W|X}(\cdot)$ is the conditional Cumulative Distribution Function (CDF) of wage (W) given the covariates (X) in period $t = 0$ and $F_X(x)$ is the unconditional CDF of X in period $t = 1$. Machado and Mata (2005) estimate the inverse of $F_{W|X}(\cdot)$ (which is known as the conditional quantile function, $Q_\tau(w|x) = F^{-1}_{W|X}(\cdot)$ for a given quantile (τ)) through a linear quantile regression model and estimate the integral through a simulation method for a large number of quantiles.

[10]The seminal work by Oaxaca (1973) and Blinder (1973) is known as Oaxaca-Blinder decomposition method.

In contrast, Chernozhukov et al. (2013) use the following empirical distribution function,

$$\widehat{F}_X(x) = \frac{1}{n}\sum_{i=1}^{n} 1\{X < x\}$$

to estimate the the unconditional distribution $F_X(x)$ at period $t = 1$. To estimate the conditional distribution function $F_{W|X}(\cdot)$ Chernozhukov et al. (2013) consider the following distribution regression model

$$F_{W|X}(w|x) = \Lambda(P(x)'\beta(y))$$

where $\Lambda(\cdot)$ is a known link function[11] and $\beta(\cdot)$ is an unknown functional parameter. $P(x)$ is a vector of transformations of x such as polynomials or splines and thus $P(x)'\beta(y)$ is a location function such as the conditional mean. The estimators based on the distribution regression method take the form:

$$\widehat{F}_{W|X}(w|x) = \Lambda(P(x)'\widehat{\beta}(y))$$

Let α denotes any distributional statistics such as quantile, skewness, kurtosis or gini coefficient. The change in the wage distribution functions between the period $t = 0$ to period $t = 1$ is:

$$F_\alpha(w_{t=1}) - F_\alpha(w_{t=0}) = \underbrace{[F_\alpha(w_{t=1}) - F_\alpha(w_{t=1}; x_{t=0})]}_{\text{Composition Effect}} + \underbrace{[F_\alpha(w_{t=1}; x_{t=0}) - F_\alpha(w_{t=0})]}_{\text{Wage Structure Effect}} + Residual$$

The residual effect is defined as the unexplained part of the total changes in the wage distribution function.[12] Similarly, the (Machado and Mata 2005) method measures the impact of individual covariate, say $\tilde{x}_t$ by considering the following equation,

$$Impact\ of\ \tilde{x}_t \equiv F_\alpha(w_{t=1}) - F_\alpha\left(w_{t=1}; \tilde{x}_{t=0}, x^\star_{t=1}\right),$$

where $x_t = \left[\tilde{x}_t \quad x^\star_t\right]$ and $x^\star_t$ are all the other covariates except $\tilde{x}_t$. The counterfactual distribution function $F_\alpha\left(w_{t=1}; \tilde{x}_{t=0}, x^\star_{t=1}\right)$ can be recovered from $F_\alpha(w_{t=1}; x_{t=0})$ by assuming that $x^\star_t$ follows an independent distribution.

[11] For example, if $\Lambda(\cdot)$ is a logistic function, $\beta(y)$ can be estimated by creating a dummy variable $1\{Y_i < y\}$ indicating whether the value of Y_i is below y and running a logit regression of $1\{Y_i < y\}$ on X_i to estimate $\beta(y)$. Similarly the link function is the identity function the probability model is a linear probability model and the probability model is probit when the link function is normal CDF.

[12] Note that alternatively we can also define a counterfactual distribution function as $F_\alpha(w_{t=0}; x_{t=1})$. In that case the composition effect is $F_\alpha(w_{t=0}; x_{t=1}) - F_\alpha(w_{t=0})$ and the wage structure effect is $F_\alpha(w_{t=1}) - F_\alpha(w_{t=0}; x_{t=1})$. The (Machado and Mata 2005) decomposition method gives qualitatively similar results by using either counterfactual distribution function.

Decomposition Methods Comparison

The Machado and Mata (2005) decomposition method is based on the fundamental assumption that the conditional quantile function ($Q_\tau(y|x)$) is linear in parameters. The linearity assumption is commonly used in quantile-based decomposition methods (see Albrecht et al. (2003), Autor et al. (2005), Melly (2006) and others). The Chernozhukov et al. (2013) distribution regression based decomposition method does not require such linearity assumption. A generalised specification test is proposed by Rothe and Wied (2013) for model specification in the class of conditional distribution models such as quantile regression and distribution regression. Chernozhukov et al. (2013) point out that the distribution regression based decomposition method works better than the Machado and Mata (2005) method when the outcome variable is discrete or consists of mass points.

Ghosh (2014) proposes an extension of the Machado and Mata (2005) method when the distribution function of the outcome variable is skewed and the linearity assumption on parameters is not satisfied. To consistently estimate the counterfactual distribution function Ghosh (2014) uses Chamberlain's two stage Box-Cox quantile regression model. However this method is computationally intensive and practically infeasible for a large number of simulation. Chernozhukov et al. (2013) argue that the distribution regression is an alternative to quantile regression for large sample. Both approaches asymptotically provide similar results when the support of X is sufficiently rich and the linearity assumption holds.

The main advantage of Machado and Mata (2005) is that quantile regression permits covariates to impact the outcome by changing not only the location or scale of the distribution but also its entire shape. Koenker (2005) points out that by considering a rich enough $P(x)$ one can approximate the true conditional quantile function arbitrarily well when the outcome variable has a smooth conditional density. Ghosh (2014) shows that the Machado and Mata (2005) method consistently estimates the counterfactual distribution function when the linearity assumption is valid.

In the wage inequality literature, popular decomposition methods include the plug in procedure of Juhn et al. (1993), the reweighing procedure of DiNardo et al. (1996) and the quantile regression based decomposition method of Machado and Mata (2005). However, one of the drawbacks of these popular decomposition methods is they cannot be used to divide the composition effect into the role of each covariate. As a result, the sum of the individual covariate effects is not equal to the composition effect. To overcome this problem, Firpo et al. (2007) propose a two stage procedure to perform Oaxaca-Blinder decomposition on any distributional measure by using Recentered Influence Function (RIF) Regressions.[13]

[13] RIF regression consists of running a regression of a transformation, namely the recentered influence function. See (Firpo et al. 2009) for details.

Data and Results

The data are drawn from the Korean Labor and Income Panel Survey for the years 1998 and 2007. The Survey consists of around 5000 representative households from the urban area. Within each household, all members above 15 years old are surveyed for individual specific questionnaires. The sample sizes are 4106 in 1998 and 5,563 in 2007. The wage measured is monthly earnings in Korean Won. The regressor consists of years of schooling, union status, and other basic controls[14] as shown in the summary statistics table. Annual income is expressed in Won using the consumer price index of 2000.

Table 1 shows the summary statistics. The female labor force participation rate has increased from 33 to 40 %, a trend that can be observed elsewhere in the world. The fall in the mean education level is accompanied by an increase in female education and a decrease in years of schooling for males. The average education level for the unskilled sector male workers decreased from 10.5 to 10.2 years leading to a fall in overall male education level in our sample time period. Since the mid-1990s the female college graduation rate in Korea has gone up compared to males, similar to other developed countries. Although this is a panel survey data, for this specific application we treat them as two separate cross section data sets which explains why the the average age in our sample has gone up about 5 years.[15] Consistent with the recent trend in Korea the data also show that divorce rate increased.

Changes in Korean Wage Distribution Functions

Table 2 shows the changes in the Korean wage distribution function and other inequality measures over the period of 1998–2007. From the left vertical panel we see that wages increased about 5 to 10 % from the 10th to the 75th quantile whereas in the upper-tail of the distribution wages increased about 67 %. As shown in the second and third panels of Table 2, the dispersion is even more in the skilled sector occupations compared to unskilled. These results suggest that the asymmetric changes in the wage distribution function have favored only high skilled workers. Unskilled sector workers have become worse off over time. To the contrary, Field and Yoo (2000) show that the wage inequality trend was exactly opposite from 1971 to 1992 since the wage ratio of skilled to unskilled workers fell from 2.5 to 1.5 during the 1970s and 1980s.

[14]The basic control variables are age, square of age, household size, dummy variables for sex, married or not, types of workers and industry dummies. These standard control variables are used by Ghosh (2014), Chernozhukov et al. (2013), Firpo et al. (2009), Firpo et al. (2007), Autor et al. (2008), Machado and Mata (2005), Card (1998) and DiNardo et al. (1996) among others.

[15]The average age does not go up exactly 10 years because of the inclusion of additional observations in 2007 and also due to the small attrition rate.

Table 1 Summary statistics (mean and standard deviation) of Korean labor and income panel survey data for all and by male and female

		All		Male		Female	
Variable	Stats	1998	2007	1998	2007	1998	2007
Log wage	Mean	7.329	7.493	7.309	7.750	7.368	7.123
(Monthly)	SD	0.484	0.621	0.476	0.642	0.498	0.339
Female	Mean	0.339	0.409				
	SD	0.474	0.492				
Married	Mean	0.811	0.649	0.862	0.793	0.712	0.440
	SD	0.392	0.477	0.345	0.405	0.453	0.497
Household size	Mean	3.687	3.642	3.760	3.688	3.546	3.576
	SD	1.091	0.762	1.031	0.721	1.188	0.813
Education	Mean	11.553	10.860	11.940	10.375	10.801	11.559
	SD	3.172	3.789	2.775	4.140	3.717	3.086
Age	Mean	40.227	45.674	40.990	49.740	38.739	39.811
	SD	10.655	12.153	11.535	10.757	8.496	11.648
Experience	Mean	22.673	28.814	23.051	33.365	21.938	22.252
	SD	13.060	14.220	13.614	12.400	11.878	14.115
Union workers(%)							
All occ		8.950	6.455	12.710	10.201	1.662	1.054
Unskilled occ		8.458	6.041	12.188	9.744	1.228	0.702
Skilled occ		0.492	0.414	0.522	0.457	0.434	0.351
No of obs		4,106	5,563	2,713	3,285	1,393	2,278

The skilled occupation category is consists of (i) Legislators, Senior officials and Managers (ii) Professionals (iii) Associate Professionals and Technicians (iv) Service Workers (v) Skilled Agricultural, Forestry and Fishery Workers and the unskilled occupation is the combination of (i) Clerks (ii) Sales Workers (iii) Craft and related Trade Workers (iv) Plant, Machine Operators and Assemblers (v) Elementary Occupations

Scale, skewness, kurtosis and gini coefficients are other inequality measures.[16] The difference between the scale inequality measure in 1998 and 2008 suggests that the wage gap between the 75th and 25th percentile workers marginally decreases for combined workers but increases for skilled workers. Similarly the difference between the skewness coefficients at two periods implies that wage distribution function has become more skewed since the Asian financial crisis. In the sample data, the gini coefficient increased from 0.37 to 0.45 for the combined skilled and unskilled workers which implies that Korea is one of the most unequally distributed nations in the

[16]Scale measures the percentage change in wage at 75th qunatile compared to the 25th quantile workers. Skewness is a measure of the asymmetry of the probability distribution. For symmetric distribution tje mean is equal to the median and hence the distribution will have zero skewness. The peakedness of the probability distribution function is measured by kurtosis. Gini coefficient is a measure of inequality of income distribution where 0 means no income inequality and 1 corresponds to perfect inequality.

Table 2 Changes in Korean wage distribution function and other inequality measures from 1998–2007

	All workers			Skilled sector workers			Unskilled sector workers		
Stats	2007	1998	Δ	2007	1998	Δ	2007	1998	Δ
10th quant	6.787	6.741	0.046	6.904	6.453	0.451	6.787	6.964	−0.177
			(0.095)		(0.046)			(0.000)	
25th quant	7.059	6.977	0.081	7.059	7.146	−0.088	7.010	6.977	0.033
			(0.027)			(0.073)			(0.003)
50th quant	7.346	7.252	0.095	7.415	7.211	0.204	7.105	7.657	−0.552
			(0.020)			(0.001)			(0.001)
75th quant	7.703	7.657	0.046	7.926	7.252	0.674	7.415	7.945	−0.530
			(0.089)			(0.039)			(0.167)
90th quant	8.619	7.945	0.674	8.619	7.514	1.105	7.703	8.127	−0.424
			(0.002)			(0.001)			(0.001)
Scale	0.084	0.089	−0.005	0.109	0.015	0.095	0.055	0.122	−0.067
			(0.010)			(0.010)			(0.021)
Skewness	0.660	−0.054	0.714	0.434	−0.635	1.069	0.660	−0.121	0.781
			(0.093)			(0.012)			(0.342)
Kurtosis	3.169	2.829	0.340	2.537	4.046	−1.509	7.465	1.966	5.499
			(0.302)			(0.604)			(1.287)
Gini Coeff	0.450	0.370	0.800	0.480	0.290	0.190	0.290	0.350	−0.060
			(0.011)			(0.012)			(0.011)
No of Obs	5,563	4,106		3,384	1,809		1,678	2,258	

The definitions of Skilled and Unskilled sectors are given in Table 1. The numbers in the parenthesis represent the bootstrap standard errors which have been generated through 500 replications. The τth quantile is defined as $q_\tau = inf\{x : F(x) \geq \tau\}$, scale is $(q_{0.75} - q_{0.25})/q_{0.75}$, skewness and kurtosis are third and fourth order central moments defined as $E(X-\mu)^3/\sigma^3$ and $E(X-\mu)^4/\sigma^4$ respectively. For a cumulative distribution function $F(y)$, gini coefficient is given by, $G = 1 - \frac{1}{\mu}\int_0^\infty (1 - F(y))^2\, dy$

world.[17] Moreover, Kwon (2001) claims that in the post financial crisis era Korean income distribution function has changed asymmetrically because the proportion of temporary and daily workers has increased to a greater extent during 1995 to 2000 and some of the poorly designed social policies fail to protect these workers.[18]

The top panel of Fig. 4 provides a graphical illustration how the Korean wage density function changes from 1998 to 2007. The wage density function in 2007 has a thicker right tail and thinner left tail, and also a mass shifting out from the center as the economy recovered from the Asian financial crisis. Compared to 1998, the area from log wage 8.3 to 10 under the 2007 wage density function has increased while the area over the region log wage 5 to 8.3 decreased. Shaded regions in Fig. 4 represent

[17]The Korean Labor and Income Panel Survey consists of only urban population implying the gini coefficient for the entire population may differ from our sample.

[18]Kwon (2001) focuses on a subsidy for unemployed workers and redesigned national pension and health care system.

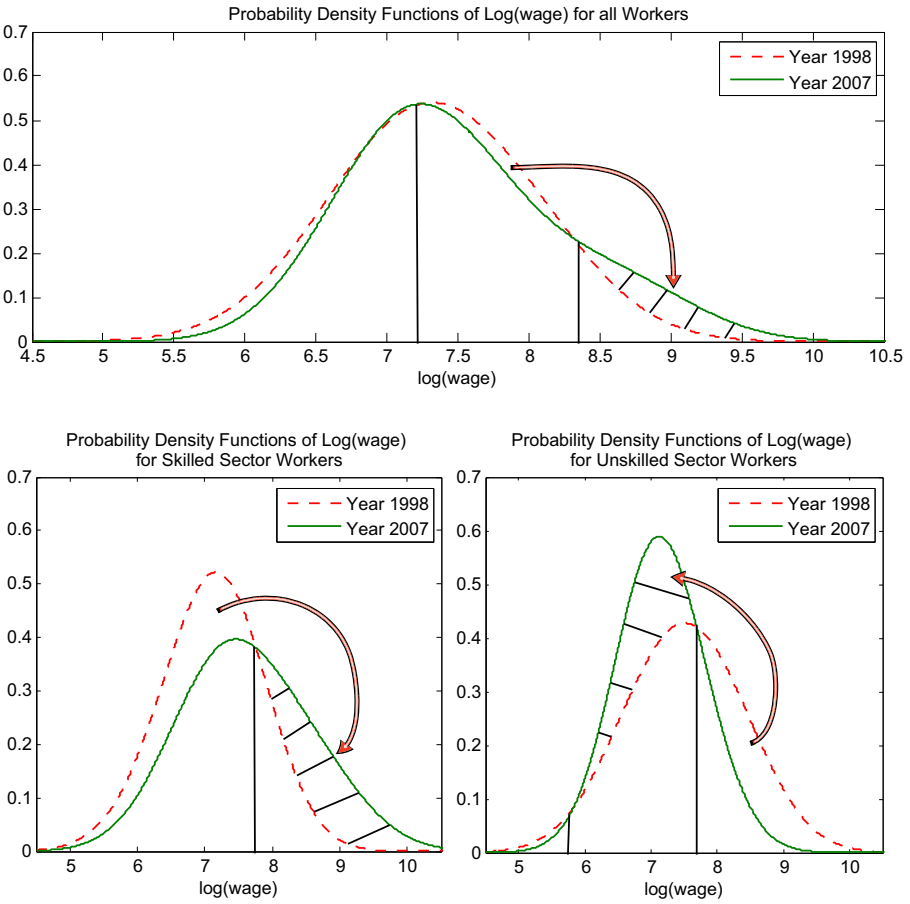

Fig. 4 Log(wage) probability density functions of 1998 and 2007 for all, skilled and unskilled sector workers

the gain in area under the 2007 wage density function compared to 1998 and implies that job opportunities for high skilled workers have gone up at the cost of less job opportunities for semi skilled and low skilled workers since the financial crisis.[19]

These results imply that since the Asian financial crisis the Korean labor market has been polarized. Nahm (2008) provides evidence of a shrinking middle class since the financial crisis by showing that the size of the middle class[20] has decreased from 55.2 % in 1998 to 44.8 % in 2005. Nahm (2008) concludes that the Korean economy becomes bi-polarized because the middles class shrinks during that sample time period. In addition, Nahm (2008) also shows that the income share of the upper class

[19]Since the area under a probability density function represents probability, we interpret the increase in area under a wage density function as more job opportunities in that specific wage range.

[20]Nahm (2008) defines the middle class as those workers whose wages are 75 to 150 % of the median wage of that particular year.

rose from 32.2 % in 1998 to 43.8 % in 2005 whereas that of the lower class remained relatively stable during the period 1998 to 2005.

We find that another reason of bi-polarization is that Korean economy has become highly skilled intensive since 1998. This is illustrated in the bottom two panels of Fig. 4 where we plot the wage density functions separately for skilled and unskilled workers. The shaded area of the left panel shows that compared to 1998 there are more job opportunities for high skilled workers in the skilled sector occupations in 2007. The exact opposite occurs in the unskilled sector occupations. These results imply that relatively skill sector occupations are growing and unskilled sector occupations are shrinking since the Asian financial crisis. The bottom right panel shows that almost the entire wage density function shifts to the left which makes most of the unskilled sectors workers worse off in terms of wage earnings in 2007 compared to 1998.[21]

Aggregate Decomposition Methods Results

Tables 3 and 4 show the aggregate decomposition of wage distribution function for combined and as well as skilled and unskilled workers separately using Machado and Mata (2005) and Chernozhukov et al. (2013) decomposition methods respectively. Both these methods decompose the changes in the wage distribution into three parts, namely composition effect (changes in worker characteristics), wage structure effect (market return of those attributes) and residual effect. To construct an unconditional wage distribution function by following the Machado and Mata (2005) method, we use 3000 quantiles from a uniform distribution. The numbers in the parenthesis represent the bootstrap standard errors which have been generated through 500 replications.

Both Machado and Mata (2005) and Chernozhukov et al. (2013) decomposition methods show that the composition effects can explain about 80 % of the changes in wages in the upper-tail of the distribution and about 10 % of the changes in gini coefficients over the period 1998 to 2007 for the combined skilled and unskilled workers. The left panel of Fig. 5 shows the Machado and Mata (2005) aggregate decomposition results from 5th to 95th quantile. We note that wage structure effects are quantitatively more important in the lower tail of the distribution and composition effects can explain a major fraction of the total changes in wages in the upper-tail of the distribution. The residual effects of the aggregate decomposition account for a relatively small proportion of the total changes in wages in all estimated quantiles. This implies that Machado and Mata (2005) decomposition method works reasonably well to explain the recent changes in the Korean wage distribution.

Table 4 results are illustrated in the right panel of Fig. 5. As shown, wage structure effects are higher than composition effects only in the lower tail of the distribution. The rest of the parts of the distribution composition effects dominate the wage structure effects. Thus the Chernozhukov et al. (2013) aggregate decomposition method

[21] A small part of the left tail of wage density function remains unchanged while the rest of the part of the distribution shifts to the left in 2007.

Table 3 Aggregate decomposition of changes in wage distribution function from Machado and Mata (2005) decomposition method

	Composition Effects			Wage Structure Effects			Residual Effects		
	All	Skilled	Unskilled	All	Skilled	Unskilled	All	Skilled	Unskilled
10th quant.	−0.020*	−0.255*	−0.033	0.094*	0.680*	−0.145*	−0.059*	0.045*	0.001
	(0.008)	(0.013)	(0.019)	(0.018)	(0.009)	(0.019)	(0.008)	(0.018)	(0.001)
25th quant.	0.069*	−0.211*	−0.009	0.030*	0.308*	−0.006	−0.029*	−0.099*	0.036
	(0.011)	(0.016)	(0.019)	(0.008)	(0.015)	(0.004)	(0.008)	(0.032)	(0.018)
50th quant.	0.001	−0.534*	−0.126*	0.135*	0.739*	−0.434*	−0.030*	0.000	0.003
	(0.012)	(0.008)	(0.007)	(0.010)	(0.007)	(0.004)	(0.007)	(0.001)	(0.003)
75th quant.	0.085*	−0.237*	−0.414*	0.077*	1.117*	−0.135*	−0.127*	−0.151*	0.010
	(0.020)	(0.024)	(0.056)	(0.014)	(0.014)	(0.024)	(0.007)	(0.032)	(0.073)
90th quant.	0.534*	−0.050*	−0.455*	0.121*	1.212*	0.036*	0.018	−0.055	0.000
	(0.019)	(0.017)	(0.011)	(0.014)	(0.010)	(0.010)	(0.016)	(0.033)	(0.001)
Scale	0.001	0.000	−0.050*	0.002	0.061*	−0.015*	−0.008*	0.036*	−0.005
	(0.002)	(0.003)	(0.010)	(0.002)	(0.003)	(0.004)	(0.003)	(0.012)	(0.009)
Skewness	0.374*	0.155	1.082*	0.374	1.251*	1.013*	−0.042	−1.041*	−0.851*
	(0.050)	(0.155)	(0.299)	(0.075)	(0.163)	(0.292)	(0.079)	(0.497)	(0.273)
Kurtosis	0.252*	−3.361*	5.895*	−0.962*	2.832*	−1.352	1.050*	−3.812	1.339
	(0.176)	(0.853)	(2.245)	(0.296)	(0.706)	(1.064)	(0.263)	(3.230)	(1.259)
Gini Coeff	0.009*	0.000	−0.012*	−0.003*	0.018*	0.002*	0.002*	−0.001	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)

Composition effect is $F_\alpha(w_{t=1}) - F_\alpha(w_{t=1}; x_{t=0})$, wage structure effect is $F_\alpha(w_{t=1}; x_{t=0}) - F_\alpha(w_{t=0})$ and the unexplained part is the residual effect. The numbers in the parenthesis represent the bootstrap standard errors which have been generated through 500 replications. The asterisks denote statistical significance at 5 % significance level

gives qualitatively similar results as to the Machado and Mata (2005) method. However unlike Machado and Mata (2005) results, in many cases Chernozhukov et al. (2013) results are insignificant at the 5 % level.

Figure 6 shows both Machado and Mata (2005) and Chernozhukov et al. (2013) decomposition methods results from 5th to 95th quantile separately for skilled and unskilled workers. Qualitatively both decomposition methods again give similar results. Furthermore, in the skilled sector occupations wage structure effects can explain a major fraction of the changes in wages. In the unskilled occupations, composition effects dominate wage structure effects. Once again, unlike Machado and Mata (2005), in many cases Chernozhukov et al. (2013) results are insignificant.

Impacts of Education

The top panel of Table 5 shows the changes in overall wage inequality, summarized by the 90/10 log wage differential; changes in wage inequality in the upper and lower

Table 4 Aggregate decomposition of changes in wage distribution function from Chernozhukov et al. (2013) distribution regression based decomposition method

	Composition effects			Wage structure effects			Residual effects		
	All	Skilled	Unskilled	All	Skilled	Unskilled	All	Skilled	Unskilled
10th quant.	−0.003	−0.162	0.053	0.105*	0.539*	−0.170	−0.056	0.074*	−0.060
	(0.025)	(0.134)	(0.095)	(0.025)	(0.130)	(0.090)	(0.081)	(0.013)	(0.027)
25th quant.	0.171*	−0.230	0.052	−0.135	0.504*	−0.094	0.044*	−0.362*	0.075*
	(0.075)	(0.183)	(0.098)	(0.074)	(0.169)	(0.098)	(0.013)	(0.073)	(0.020)
50th quant.	0.114	−0.128	0.006	−0.013	0.387*	−0.248	−0.007	−0.054*	−0.310*
	(0.121)	(0.117)	(0.166)	(0.128)	(0.110)	(0.189)	(0.024)	(0.021)	(0.058)
75th quant.	0.254	0.001	−0.124*	−0.232	0.802*	−0.507*	0.024	−0.128*	0.101*
	(0.180)	(0.426)	(0.001)	(0.180)	(0.417)	(0.001)	(0.030)	(0.038)	(0.001)
90th quant.	0.674*	−0.104	−0.128	0.057	1.140*	−0.327	−0.003	0.069	0.031
	(0.323)	(0.331)	(0.388)	(0.319)	(0.313)	(0.372)	(0.033)	(0.070)	(0.027)
Scale	0.006*	0.003	0.015*	0.003	0.025	−0.070*	0.005	0.058*	−0.015
	(0.002)	(0.014)	(6.787)	(0.003)	(0.016)	(0.007)	(0.003)	(0.019)	(0.008)
Skewness	0.079	0.135*	−0.276*	0.683*	1.234*	0.757*	−0.180*	0.196*	0.272*
	(0.054)	(0.040)	(0.070)	(0.062)	(0.092)	(0.081)	(0.026)	(0.098)	(0.081)
Kurtosis	−0.030	0.281*	−0.636*	0.691*	−0.088	1.735*	0.029	−1.074	−0.089
	(0.191)	(0.117)	(0.245)	(0.180)	(0.608)	(0.267)	(0.072)	(0.702)	(0.222)
Gini Coeff	0.009*	0.004*	−0.001*	−0.004*	0.012*	−0.011*	0.010*	0.010*	0.002*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.001)

Composition effect is $F_\alpha(w_{t=1}) - F_\alpha(w_{t=1}; x_{t=0})$, wage structure effect is $F_\alpha(w_{t=1}; x_{t=0}) - F_\alpha(w_{t=0})$ and the unexplained part is the residual effect. The numbers in the parenthesis represent the bootstrap standard errors which have been generated through 500 replications. The asterisks denote statistical significance at 5 % significance level

halves of the distribution, summarized by 90/50 and 50/10 log wage gaps (which are referred as upper-tail and lower-tail wage inequality in wage inequality literature), changes in 75/25 log wage gaps, and changes in gini coefficients. Although the 75/25 wage gap falls about 3.5 %, the 90/10 and 90/50 wage gaps increase by 63 and 58 % which imply that the 50/10 wage gap increases by 5 %. These results suggest that the driving force of changing upper-tail wage inequality is the steep increase in wages in the upper-tail of the distribution. Changes in wages are almost same in the rest of the parts of the distribution.

The middle and bottom panels of Table 5 report the contributions of education and unionization to the changes in wage inequality across different income groups.[22] The marginal effects from quantile regressions are biased and inconsistent because years

[22]The third row of each block in the middle and bottom panel shows the percentage change of wage inequality explained by that block variable on the wage gap specified in the column variable.

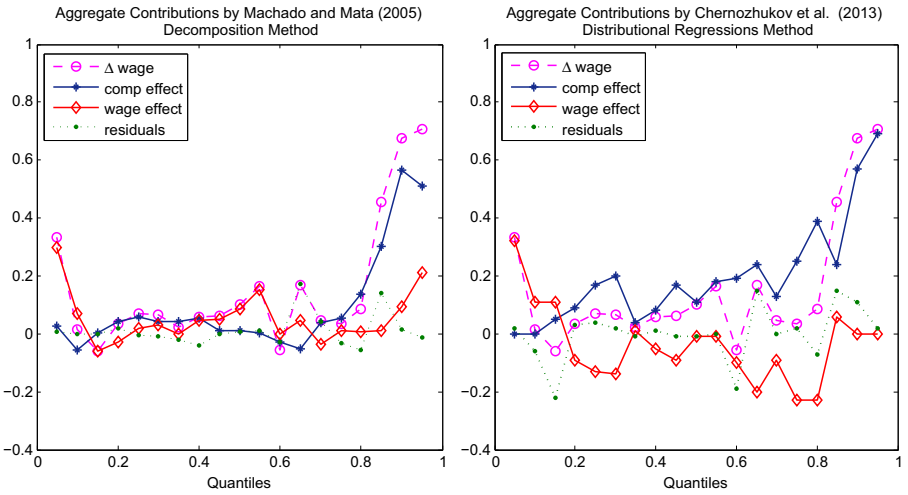

Fig. 5 Aggregate decomposition of changes in wage distribution function from Machado and Mata (2005) and Chernozhukov et al. (2013) decomposition methods

of schooling and union status are correlated with workers unobserved characteristics. The Oaxaca decomposition method deals with unobserved heterogeneity under the assumption that the distribution of workers unobserved skills remains the same over the two time periods. Taking the difference of wages at the same percentile of the distribution in two time periods gives consistent estimates of the impact of covariates as long as the underlying assumptions hold.[23]

Both Machado and Mata (2005) and Chernozhukov et al. (2013) decomposition methods show that the effects of education on the changes in 90/50 percentile wage gap are 0.057 and 0.052. These results imply that had the distribution of education remained the same as in 1998, the 90/50 wage gap would have increased by 5.7 % according to Machado and Mata (2005) method and by 5.2 % from the Chernozhukov et al. (2013) method. As shown in the top panel of Table 5, the 90/50 wage gap has actually increased about 58 % during the period 1998–2007. Both methods confirm that changes in the distribution of schooling can explain about 10 % of the increase in upper-tail wage inequality. Similarly, the results from both the decomposition methods show that changes in education level can not explain why the 50/10 wage gap has increased about 5 % during the same time period.

Lee et al. (2013) show that post financial crisis job growth was more concentrated in small business firms with mostly low paid jobs. In addition to the results of Lee et al. (2013), Fig. 7 and the left panel of Table 6 shows that the combined employment share of high school dropouts and graduates increases by 13.5 % while the combined shares of some college and college graduates decreases by the exact

[23] See Fortin et al. (2011) for detailed discussion on decomposition methods and causality.

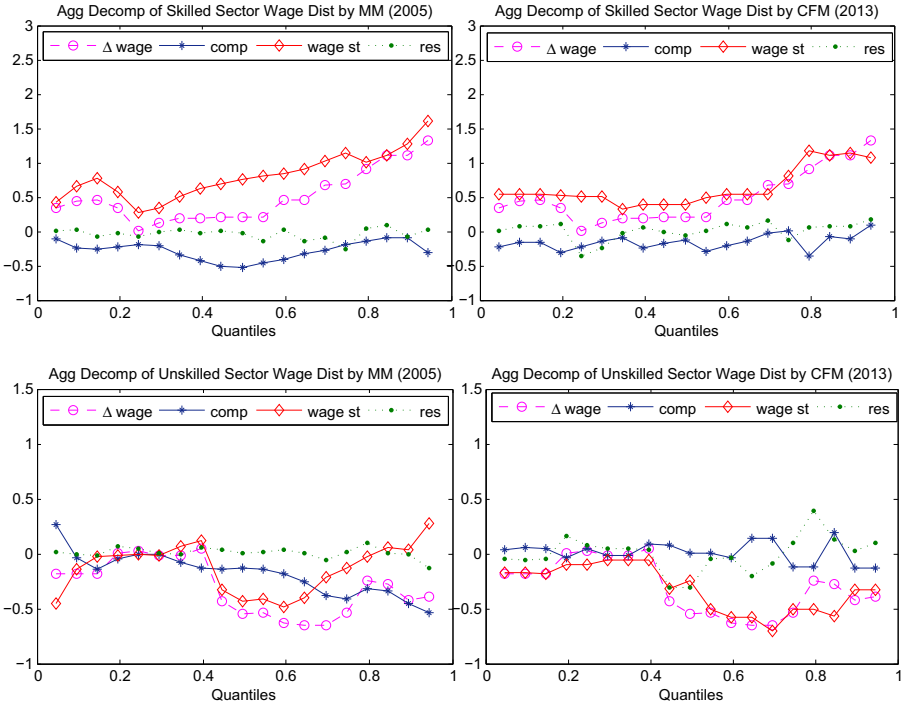

Fig. 6 Aggregate decomposition of changes in wage distribution function from Machado and Mata (2005) and Chernozhukov et al. (2013) decomposition methods for skilled and unskilled sectors

same percentage. Decomposing these changes of employment shares by gender we note that female HS graduate workers contribute about 70 % of the total increase in the high school graduate employment share, while in contrast male college graduate workers dominate the fall in college graduate employment share.

The middle and bottom panels of Table 6 show that from 1998 to 2007 about 25 % of total workers move from skilled to unskilled occupations where the average wage is 40 % lower. Moreover, out of these workers about 87 % are some college and graduate male workers.[24] In contrast, the employment share of post college graduate workers in skilled sector occupations has increased about 19 %. The middle right panel of Table 6 shows that the average wage of these workers has increased about 30 %.[25] These shifts in relative demand for different education groups across skilled and unskilled occupations play a major role in changing the distribution of education.

[24]From the second panel of Table 6 we note that some college (14.5) and college workers (7.3) contribute 87 % to the total change of 24.8 % workers who moved from skilled to unskilled sector.

[25]From the third column of the middle panel of Table 6 we see that the employment share of post college graduate workers has increased about $0.06/0.31 = 19$ % during the period 1998 to 2007.

Table 5 Impacts of education and unionization on wage inequality from Machado and Mata (2005) and Chernozhukov et al. (2013) Decomposition methods

	90/10 gap	90/50 gap	50/10 gap	75/25 gap	Gini Coeff
Overall change in wage ineq					
2007	1.833	1.273	0.629	0.644	0.450
	(0.029)	(0.032)	(0.015)	(0.070)	(0.010)
1998	1.204	0.693	0.580	0.680	0.370
	(0.095)	(0.015)	(0.093)	(0.058)	(0.010)
Δ	0.629*	0.580*	0.049*	−0.036*	0.080*
	(0.003)	(0.002)	(0.002)	(0.005)	(0.010)
Impact of change in dist of edu					
MM	0.063*	0.057*	0.005*	0.041*	0.001
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
	0.099	0.098	0.104	−1.167	0.014
CFM	0.002	0.052*	−0.050*	−0.007*	0.018*
	(0.002)	(0.001)	(0.003)	(0.001)	(0.002)
	0.003	0.090	−1.031	0.185	0.217
Impact of change in dist of union					
MM	−0.015*	−0.023*	0.008*	−0.021*	−0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	−0.024	−0.040	0.163	0.591	−0.006
CFM	0.015*	0.038*	−0.024*	0.002*	0.017*
	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)
	0.023	0.066	−0.487	−0.059	0.201

MM and CFM denote Machado and Mata (2005) and Chernozhukov et al. (2013) Decomposition Methods. Note that the third row of each block in the middle and bottom panel shows the percentage change of wage inequality explained by that block variable on the wage gap specified in the column variable. The numbers in the parenthesis represent the bootstrap standard errors which have been generated through 200 replications. The asterisks denote statistical significance at the 5 % significance level

To protect marginalized workers from market exploitation and increase competition in the labor market, the Korean government adopted employment stabilization program and pro-FDI policies. The objective of the employment stabilization program was to provide employment insurance mainly for unskilled workers whose relative income did not change much compared to highly skilled workers.[26] However, this program did not cover most of the low skilled workers and failed to achieve its goal. Yun (2009) argues that this mis-execution of the employment stabilization program is one of the main reasons the government failed to control the diverging trend of Korean wage inequality.

[26]Highly skilled workers refer to only post college graduate workers.

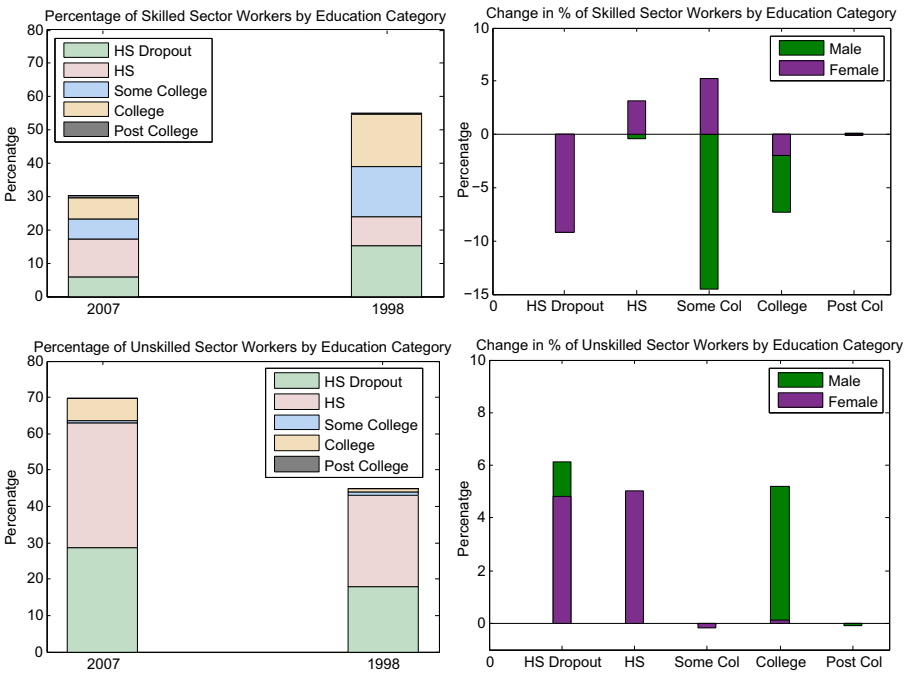

Fig. 7 Employment shares and the percentage changes from 1998 to 2007 in skilled and unskilled sectors by education groups

The left panel of Fig. 2 shows that FDI in agriculture, manufacturing and service sectors doubles from 1997 to 2000 and then goes back to the original level by 2003. Decomposing the total changes of employment shares across five different education groups in both skilled and unskilled occupations, male college dropout and female high school dropout workers are affected by FDI policy most adversely. As shown in Table 6 employment shares of these two groups decreased by 14.6 and 4.4 % respectively, and the average real wages fell by 40 and 20 %. These gender specific changes in relative demand due to the FDI policy is also one of the main reasons why 90/10 and 90/50 percentile wage gap increased by 62 and 58 % from 1998 to 2007.[27]

Our results for the changes in the distribution of education support the SBTC hypothesis, a controversial issue in the Korean wage inequality literature. Following the Katz and Murphy (1992) method, Choi and Jeong (2003) show that the wage gap between college graduates and high school graduates decreased during the 1980s and then increased from 1993 to 2000. Choi and Jeong (2003) also claim that during the 1980s the college premium declined due to the excess supply of high skilled

[27] The trends of both 90/10 wage ratio is shown in left panel of Fig. 3.

Table 6 Changes in employment shares and monthly average log wage in all, skilled and unskilled sectors by five education groups and gender

	Percentage of workers					Monthly average log wage				
	Y2007	Y1998	Δ	Δ_{Male}	Δ_{Female}	Y2007	Y1998	Δ	Δ_{Male}	Δ_{Female}
All Sectors										
HS dropout	34.658	32.976	1.681	6.051	−4.370	7.374	7.125	0.249	0.590	−0.179
High school	45.785	34.048	11.737	3.524	8.213	7.534	7.245	0.289	0.435	0.133
Some college	6.633	16.098	−9.465	−14.551	5.086	7.189	7.302	−0.113	0.392	0.159
College	12.493	16.415	−3.922	−2.090	−1.832	7.818	7.932	−0.114	0.620	−0.910
Post college	0.431	0.463	−0.031	0.043	−0.074	7.974	7.665	0.309	0.234	0.181
Row sum	100.000	100.000	0.000	−7.023	7.023					
Skilled sector										
HS dropout	5.932	15.173	−9.241	−0.064	−9.177	7.631	7.442	0.190	−0.280	0.203
High school	11.451	8.646	2.805	−0.367	3.172	7.126	7.085	0.041	0.002	0.077
Some college	5.950	15.173	−9.223	−14.502	5.279	7.154	7.311	−0.157	0.496	0.182
College	6.453	15.684	−9.231	−7.27	−1.961	6.977	7.950	−0.973	−0.125	−0.960
Post college	0.377	0.317	0.061	0.129	−0.068	7.999	7.717	0.282	0.218	−0.138
Row sum	30.164	54.993	−24.829	−22.075	−2.755					
Unskilled sector										
HS dropout	28.726	17.803	10.922	6.115	4.807	7.321	6.855	0.466	0.601	0.081
High school	34.334	25.402	8.932	3.891	5.041	7.670	7.299	0.370	0.447	0.266
Some college	0.683	0.925	−0.242	−0.049	−0.193	7.493	7.159	0.335	0.310	0.282
College	6.040	0.731	5.309	5.181	0.129	8.717	7.561	1.156	1.107	0.254
Post college	0.054	0.146	−0.092	−0.086	−0.006	7.797	7.552	0.245	−0.047	1.426
Row sum	69.836	45.007	24.829	15.051	9.778					

Δ denotes the difference between 2007 and 1998. Again, Δ_{Male} and Δ_{Female} represent the difference between 2007 and 1998 for male and female respectively. By definition, $\Delta = \Delta_{Male} + \Delta_{Female}$. Also, by definition row sum of all sector is equal to the sum of row sums of skilled and unskilled sectors

workers and the main reason for increasing college premium after 1993 is excess demand of high skilled workers. Choi and Jeong (2003) results also support the SBTC hypothesis.

By following the Melly (2005) decomposition method, Sung (2009) shows that the composition effect was higher than the price effect from 1993 to 1997, while the two effects were equally important over the period 1999 to 2006. Sung (2009) also claims that the residual effect can explain about 10 % of the upper-tail wage inequality (90/50 percentile gap) and almost one third of the lower-tail wage inequality (50/10 percentile gap) for the same time period. These results contradict the importance of the SBTC hypothesis to explain the change in Korean wage inequality. To reconcile these results Kang and Yun (2008) investigate the U-shaped pattern of Korean wage inequality from 1980 to 2005 using Korean occupational wage survey data and show

that human capital variables have played an important role in explaining the decreasing trend of wage inequality during the 1980s and a steep upward trend of wage inequality since the mid-1990s.[28]

The Role of Labor Unions

The effects of unions on wage inequality can be decomposed into two parts. First, unions raise the wages of unionized low skilled workers more than those of high skilled workers and thus reduce wage inequality across different income groups. This is known as the inequality decreasing within effect ((Freeman 1980) and (Freeman 1982)), (Blau and Kahn 1996; Card 1996). Second, while unions reduce wage inequality within the union sector, they increase wages of their union members relative to the wages of non-unionized workers.[29] This is the inequality increasing between effect (see (Card 1998)). The Machado and Mata (2005) decomposition method results show that from 1998 to 2007 the within effect is higher than the between effect for a small margin and thus unions marginally reduce the lower-tail wage inequality and do not have much impact on the upper-tail wage inequality.[30]

The Machado and Mata (2005) decomposition method results can be interpreted as though the distribution of education remained the same in 1998, namely the 90/50 wage gap would have decreased by 2.3 % and the 50/10 wage gap would have increased by 0.8 %. Changes in the distribution of unionization can explain about 16.3 % of a small increase in the 50/10 wage gap and has almost no impact to the changes in both the 90/50 and 90/10 wage gaps.[31] However for union effects the Chernozhukov et al. (2013) method results are not consistent with the results of the Machado and Mata (2005) decomposition method.[32] One possible explanation is that the distribution of unionization variable did not change much in the sample time period.[33] Chernozhukov et al. (2013) argue that for a discrete variable quantile and distribution regressions results may vary in finite sample even though the asymptotic results are similar in large sample.[34]

As shown in Table 5 the estimated impact of unionization on both upper-tail and lower-tail wage inequality is relatively small, consistent with previous studies. With fixed effect estimators Cho (2008) shows that during the period 1998 to 2006 the union wage premium was about 2.1 % in Korea. Cho argues that the union wage premium was relatively small compared to the other developed nations because only

[28] Kang and Yun (2008) used a modified Oaxaca-Blinder type decomposition method developed by Yun (2006).

[29] The wages of nonunion workers fall due to the increased supply of squeezed out workers from union jobs.

[30] For U.S. labor market data Freeman (1980), Kahn (2000), Card et al. (2004) and Koeniger et al. (2007) among others also find that unions reduce wage inequality.

[31] These results imply that unions have a stronger between effect (inequality increasing effect) on the 90/50 wage gap and larger within effect (inequality decreasing effect) on the 50/10 wage gap.

[32] The results are inconsistent because both the decomposition methods give exactly opposite sign.

[33] See Table 1 for details.

[34] This argument offers a possible explanation why the results in both the methods are not qualitatively same for unionization effect.

20 % of the small firms with less than 100 employees have union workers. Moreover, the unionization rate also changes less compared to the other developed countries. With the DiNardo et al. (1996) decomposition method Kim and Kim (2012) show that union effects are statistically insignificant from 2004 to 2009. This result supports our finding that unionization effects are unstable across decomposition methods. With a mean based decomposition method Yoo (1998) finds that during the late 1980s to mid-1990s declining unionization increases wage inequality approximately 3 %.

Sung (2009) argues that the inequality decreasing effect of labor unions is weaker in Korea than the US because the fraction of high skilled union workers in Korea is higher. In addition, we also find that the fraction of female union workers in Korea is much less than other developed nations. Furthermore Table 1 shows that the unionization rate falls by 2.5 % from 1998 to 2007 and 2.4 % of those union workers are from the middle and low skilled occupations. As a result, changes in the distribution of unionization mainly affect medium and low skilled workers leading to a small increase in the 50/10 wage gap with almost no effect in terms of the percentage change of 90/50 and 90/10 wage gaps.

Conclusion

Many studies have attempted to explain the rapid growth of Korean wage inequality since the mid-1990s and estimated the contributions of different factors using mean based decomposition methods. Figures 2 and 3 show that the pattern of changes in wage inequality vary across different income levels implying mean based decomposition methods are unable to explain wage gap changes in different parts of the distribution. The linear quantile regression based (Machado and Mata 2005) and distribution regression based Chernozhukov et al. (2013) methods decompose the change in the wage distribution into the composition effect, wage structure effect, and residual effect. The contributions of both aggregate and individual factors in different parts of the distribution are estimated by these counterfactual exercises.

The comparison between the wage density functions of 1998 and 2007 shows that the middle class has been shrinking since 1998. One of the main reasons of this polarization is the Korean economy has gradually transformed to highly skill intensive shifting a major fraction of the semi and low skilled middle class workers in the left tail of the wage distribution function. Also, changes in the distribution of schooling significantly affect the wage gap between high and middle income earners supporting the SBTC hypothesis. Furthermore, we find no impact of labor unions on upper-tail and lower-tail wage inequality suggesting labor unions have a weak role in the steep increase in overall wage inequality during the sample time period.

Since rising inequality is a concern for Korea, policy makers have adopted some redistribution policies such as easy credit for small and medium enterprises, employment stabilization, job skill development, and progressive income tax to achieve a wider range of income distribution, poverty reduction, and protection of marginalized workers from market exploitation. However, the effectiveness of these policies remains controversial. Yun (2009) provides an extensive analysis why these policies

failed to resolve the labor market polarization problem on the basis of three such as criteria miscalculation, under execution and under-regulation.

According to Yun (2009) the easy credit program for small and medium enterprises did not have much impact because the government provided credits and loans to small-and medium sized enterprises right after Korean economy went through 1997 financial crisis and industrial restructuring. Many small firms did not survive in the market because of the initial lack of demand right after the crisis. Moreover, the credit support did not continue for a long period of time. As a result, many enterprises were unable to survive. As a consequence of the Asian financial crisis, the Korean economy had a−5 % growth rate and a huge unemployment rate in 1997. To overcome this economic instability, the government introduced an employment stabilization program to support marginalized workers by expanding employment insurance. Implementation of this program failed to help targeted beneficiaries because 70 % of the non-regular workers were not covered by the program and 90 % of the budget was spent on less marginalized workers.

The job specific skill development program did not work because of the wrong execution. Yun (2009) argues that large enterprises with over 1,000 employees could reimburse about 38 % of their worker training cost but small enterprises with less than 50 workers could reimburse their training cost at only 13.6 %. This policy helped larger corporations compared to small and medium enterprises. According to a 2008 World Economic Forum report,[35] the Korean redistributive tax and transfer policies were evaluated the lowest among 114 countries in 2005. The report also points out that the main problems are corruption and economic rents that are mostly exploited by few economic giants. Moreover, these economic rents are protected by existing market regulations.

We find that since the Asian financial crisis, rapid growth in gender specific low paying jobs in the unskilled sector plays an important role for the diverging trend of Korean wage inequality. Along with widening wage inequality, sectorial wage gaps are also creating a gender wage gap in Korea. Raising skill level and productivity is critical for reducing earnings dispersion. The government may consider providing job specific training or vocational training especially for low skilled temporary workers to raise productivity. These policies can reduce sectorial wage gaps by increasing wages for the low skilled workers who are falling behind.

This study also shows that in Korean labor market high school dropout female workers and college dropout male workers are the most exploited groups due to skilled biased technological changes and a massive inflow of FDI. Policies that provide more equal access to high quality basic education should be the first step. The government should spend more money on public education to ensure lower high school dropout rate. This goal can be achieved by providing financial incentives to the economically vulnerable groups for better attendance at primary and high schools. These polices would be very effective by facilitating the accumulation of human capital, and making educational opportunities less dependent on socioeconomic circumstances.

[35] The report is available at http://www.weforum.org/reports

Yun (2009) argues that many unionized workers in Korea are concentrated in very large companies so that they have a tendency to represent relatively high income workers. Moreover, skilled union workers in large enterprises try to make firms more dependent on temporary workers which leads to a higher between group wage inequality. The insignificant wage inequality effect of labor unions supports this argument. Thus our results can also be used as a suggestive evidence to Korean policy makers considering labor market reform.

The results from two robust distribution parameter based decomposition methods show that a small fraction of skilled workers who belong at the upper tail of the wage distribution are extracting most of the benefits of technological change and international trade. This outcome has serious adverse effect on aggregate demand and growth rate since the mid-1990s. Policies that reduce labor market imperfections and institutional failures such wealth redistribution from the rich can help poor and middle-income workers. Korean policy makers also need to make sure that these welfare redistribution policies are well-designed and well-implemented so as not to reduce market efficiency.

This study provides a detailed discussion about why rising wage inequality is the defining challenge for Korea with its adverse effects on growth and other aspects of Korean economy. By investigating the role of aggregate and also individual demographic characteristics, this study also offers insight for Korean policy makers to explain the divergent trend of Korean wage inequality since the Asian financial crisis. Our findings provide a list of policy implications to address this wage inequality issue. To summarize, this study can serve as a base for the sustainable welfare or redistribution policies Korean policy-makers are currently seeking.

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