

# Short-run versus Long-run Income Inequality

by Yong-seong Kim\*

Using panel data sets, this paper examines income inequality in Korea during 1988-1997. It shows that income inequality arises from persistent factors such as unmeasured individual characteristics rather than transitory components. In addition, the sources of income variations have systematic patterns among educational groups. When income inequality is compared between 1988-92 and 1993-97, various indices indicate that income inequality has reduced. However little improvement was made in terms of persistency of income inequality. This result may suggest that the attainment of low inequality during the period is not as desirable as it appears once long-run income inequality is taken into account.

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## I. Introduction

What makes one's income different from others? How freely can one move up and down across socio-economic status? These are the topics of many debates and of interest to both policy-makers and economists in almost all countries. Numerous studies on this topic have been done for U.S. and other developed countries.<sup>1</sup> Surprisingly, studies for developing countries are limited. Despite a growing concern about imbalance between income growth and its distribution, little attempt has been made. The reason is that this type of studies heavily relies on a panel data set, which is not readily available in most developing countries. In this perspective, it is exceptional to have a Korean micro-panel data set which gives us an unique opportunity to understand income inequality and mobility for developing countries such as Korea.

A study on Korean case is particularly interesting. As well-known, Korea has experienced dramatic economic development. From one of the poorest countries in 1960s, it became a member of the Organization for Economic Cooperation and Development (OECD) in 1996. During the period (1988-1997) under the consideration in this paper, Korean economy has grown remarkably: Per capita income (in 1985 constant price) was nearly doubled from \$ 5,607 in 1988 to \$ 10,131 in 1997. This rapid change gives an extraordinary chance to examine the impact of economic growth might have on income distribution and mobility.

This paper is organized as follows. In the next section, previous studies are briefly reviewed and compared with this paper. Section III introduces a simple econometric model for decomposing income inequality by its sources. In section IV, the data issues are addressed and then the results are presented. Section V summarizes and concludes this paper.

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<sup>1</sup> For comparative studies on this subject, see Gottschalk (1993) on income inequality in seven industrialized countries, and Baker and Solon (1997) for Canada.

## II. Previous studies

There has been large volume of studies on income distribution in Korea since late 1970s. Although estimates of income inequality slightly different depending upon the data used (Lee & Hwang, 1998), most studies agree that 1) income inequality increases in 1990s, especially after the financial crisis<sup>2</sup>; 2) wealth is far less equally distributed than income (Lee & Hwang, 1998; Lee, 2000);

There are no consensus on the direction of income inequality over the path of economic growth: rising inequality (Kim & Ahn,1987); inverse-U type (Choo,1993); falling inequality (Kim & Topel, 1995; Fields & Yoo, 2000). Despite the controversy over the direction of income inequality, it is believed that factors such as education, industry, occupation, and experience, are important factors in determining the level of inequality over time.

Most of previous research, however, mainly focuses on income inequality at a point of time measured by inequality indices. Although this snapshot view of income inequality receives attention from the public, it tells us little about the nature and the direction of income inequality. If an increase in income inequality is primarily due to transitory income volatility, current deterioration of income distribution is less serious as the transitory shocks fade away over time. On the other hand, if income distribution becomes less equal due to persistent factors, one should concern about long-lasting income inequality.

Different from the previous studies, this paper attempts to analyze income inequality by its sources. Specifically, an individual's income is decomposed by permanent and transitory parts. Income volatility due to transitory component causes welfare loss to liquidity-constrained workers, but its impact on income inequality is less fundamental. Widening income gap due to persistent factor, however, has a profound impact on income distribution.

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<sup>2</sup> Lee (2000), using the "Family Income and Expenditure Survey" reports the Gini coefficient for 1997 (0.261) and for 1999 (0.286).

### III. Econometric model for income inequality

We start our discussion by positing the following simple earnings equation (Solon, 2001):

$$(1) \quad Y_{ibt} = \exp[\delta_i + \beta(t - b) + v_{it}],$$

where  $Y_{ibt}$  is the measured real monthly earnings at time  $t$  of  $i^{\text{th}}$  worker born in year  $b$ ,  $\delta_i$  represents the earnings component of individuals due to permanent attributes such as gender, the level of education, motivation and intelligence. The term  $\beta(t - b)$  captures the individual's earnings' profile rising with his potential experiences ( $x = t - b$ ). The last term  $v_{it}$  is a transitory deviation from the individual's life-cycle earnings trajectory.

By taking logarithm of (1), the earnings model can be written in a simple linear form:

$$(2) \quad \log(Y_{ibt}) = \delta_i + \beta(t - b) + v_{it}.$$

For the model being tractable, let us assume that the variables  $\delta_i$ ,  $t - b$ , and  $\varepsilon_{it}$  are mutually independent such that  $\sigma_\delta^2$ ,  $\sigma_b^2$ ,  $\sigma_v^2$  and  $\text{cov}(v_{it}, v_{is}) = 0$  for  $t \neq s$ . Then, the income inequality at time  $t$  can be measured by the variance of log earnings across all individuals:

$$(3) \quad \text{var}(\log Y_{ibt}) = \sigma_\delta^2 + \beta^2 \sigma_b^2 + \sigma_v^2$$

Equation (3) decomposes income inequality by its sources and it merits to note. First, as appeared in the second term of the right hand side of (3), the cross-sectional demographic structure affects income inequality profoundly. To make this point clear, consider an economy consisting of only two generations, 1 and 2. Total population is normalized to 1 and the shares of each generation are  $s_1$  and  $s_2 = 1 - s_1$ . Denote the mean and the variance of log earnings of each generation by  $\mu_g$  and  $\sigma_g^2$ , where  $g \in \{1, 2\}$  respectively. Under these settings, income inequality of total population at time  $t$  can be shown as:

$$(4) \quad \text{var}(\log Y_{ibt}) = s_1 \sigma_1^2 + (1 - s_1) \sigma_2^2 + s_1 s_2 (\mu_1 - \mu_2)^2$$

Total income inequality depends not only on the within-generation income variance,  $\sigma_g^2$ , and the average level of income,  $\mu_g$ , but also on the shares of generations in the population. A younger cohort being at the different stage of life cycle tends to earn less than the older cohort. As the younger cohort eventually becomes the older cohort, this type of inequality is less serious from each individual's lifetime perspective.

Second, in equation (3),  $\sigma_s^2$  and  $\sigma_v^2$  represent permanent and transitory income variations. While temporal volatility of income captured by  $\sigma_v^2$  significantly changes the consumption of liquidity-constrained individuals, it has less impact on the income inequality in the long run. Permanent income variation, on the other hand, is persistent and it determines long-run income inequality over time – that is, income mobility.

## IV. Data and Results

The empirical analysis is based on the Korean National Statistical Office's "Family Income and Expenditure Survey" (FIES), a national longitudinal survey that began to interview approximately 5,500 households from seventy-two cities since 1963. The FIES contains information on income and expenditure of the same families for five years – i.e., quinquennial panel data<sup>3</sup>. Unfortunately, the FIES excludes households of which the head: i) has no other family members; ii) is self-employed; or iii) works in agriculture or fishery industries. The excluded groups presumably have higher income variations on average than those are included.

The samples are drawn from 1988-1992 FIES (N=425) and 1993-1997 FIES (N=535) of household male heads with the age of 29-58 who reported a positive labor income for all 5 years. By restricting a minimum age at 29, most of individuals in the sample completed their schooling and have positive work experiences. Maximum age is set at 58 in order not to pick up abnormal income variations and mobility typically observed at the time imminent prior to retirement (mostly 60 years old in Korea).

Table 1 describes the summary statistics. Two samples are compatible in many aspects: The average age and experiences are approximately 42 years and 19 years, respectively; the average years of schooling is about 11 years for both samples. The average household head's labor incomes (adjusted by 1995 CPI =100) are 1,161,238 Won in 1988-92 and 1,554,908 Won in 1993-97, respectively. The table also shows that labor income increased substantially during the sample periods (at an average annual rate of 7.7% for 1988-92 and at 6.0% for 1993-97).

Table 1. Summary of statistics

Variable	Mean	Std. Dev.	Min	Max
<u>1988-92 :</u>				
age	41.98	7.26	29	58
education	11.66	3.22	0	18
experience	19.32	8.49	3	43
earnings:	1161238	552899	127132	5476070

Table 1. Summary of statistics (continued)

Variable	Mean	Std. Dev.	Min	Max
<u>1993-97 :</u>				
age	42.67	7.40	29	58
education	11.91	3.11	0	18
experience	19.77	8.68	1	41
earnings:	1554908	674003	162018	6267759

Source: Two samples of FIES for 1988-92 and 1993-97.  
Sample is from household male head with age between 29-58.  
Experience is calculated as age-schooling-6-3.  
Earnings (household head labor income) are in 1995 Won.

Table 2 reports the results from widely used indices such as Gini coefficient, coefficient of variations, and coefficient of deviations<sup>3</sup>. The higher the values of these indices indicate the less equal in the income distribution. All indices shows that income inequality decreased during 1993-97 compared to the previous 5 years.

<sup>3</sup> For extensive discussion for measurement, see Bartholomew (1996)

Table 2. Summary measures for income inequality.

Year	CV	CD	Gini
88-92	0.48	0.39	0.25
93-97	0.43	0.36	0.24

Source: Two samples of FIES for 1988-92 and 1993-97.

CV=coefficient of variations. CD=coefficient of deviation GINI=Gini coefficient

It is important to examine income inequality by the components in the study of income distribution. To remove the income inequality caused by the different stages of individual's earnings profiles, we obtain the residual earnings,  $y_{it}$ , by regressing log of earnings on age, age age<sup>2</sup>, and other relevant variable that might affect one's earnings. In this case, the residual earnings can be seen as the sum of two components<sup>6</sup>: The permanent component ( $\delta_i$ ) may be thought of unmeasured individual characteristics with its mean zero and the variance equal to  $\sigma_\delta^2$ . The transitory component ( $v_{it}$ ) is purely random, having its mean zero and the variance equal to  $\sigma_v^2$ . Thus the variance of the residual earnings,  $\text{var}(y_{it})$ , can be written as

$$(5) \quad \text{var}(y_{it}) = \sigma_\delta^2 + \sigma_v^2$$

Following Gottschalk and Moffitt (1994), the permanent component of income can be measured by an average of an individual's income over time ( $y_i^P$ ) and then the transitory components can be computed as the deviation of current earnings from the permanent components ( $y_{it}^T$ ). Using this definition, each component of income and the variances can be written compactly as<sup>7</sup>

$$(6) \quad y_i^P = \sum_t y_{it} / T, \quad y_{it}^T = y_{it} - y_i^P,$$

$$\sigma_\delta^2 = \sum_i (y_i^P - \bar{y})^2 / (N-1) - \sigma_v^2 / T, \quad \sigma_v^2 = \sum_t \sum_i (y_{it}^T)^2 / N(T-1)$$

where  $\bar{y} = \sum_i \sum_t y_{it} / NT$

The results are presented in Table 3. Several points are worth mentioning.

Table 3. Permanent vs. transitory variance of earnings

	1988-92			1993-97		
	$\sigma_{\delta}^2$	$\sigma_v^2$	$\rho$	$\sigma_{\delta}^2$	$\sigma_v^2$	$\rho$
Overall	0.160	0.032	0.832	0.116	0.024	0.827
ed<high	0.104	0.046	0.696	0.093	0.038	0.711
ed=high	0.108	0.029	0.786	0.088	0.021	0.810
ed>high	0.084	0.016	0.840	0.068	0.014	0.826

Source: Two samples of FIES for 1988-92 and 1993-97.  
 Numbers are based on author's calculation

First, the variances of both permanent ( $\sigma_{\delta}^2$ ) and transitory component ( $\sigma_v^2$ ) are lower in 1993-97 compared to those of 1988-92. However, the fraction of permanent income variance to total variance ( $\rho = \sigma_{\delta}^2 / (\sigma_{\delta}^2 + \sigma_v^2)$ ) between two sample periods is very close. Second, a clear pattern is observed along the different education groups: the lower the level of education, the higher overall income variations ( $\sigma_{\delta}^2 + \sigma_v^2$ ); the lower the level of education, the lower the fraction of permanent income variance to total variance ( $\rho$ ). This implies that income is more volatile to less educated group due to transitory components.

It is reasonable to think that the impact of the transitory component may last more than a year. If the impact of transitory on income inequality lasts for only a single year, the serial correlation of residual earnings is  $\rho = \sigma_{\delta}^2 / (\sigma_{\delta}^2 + \sigma_v^2)$ , which does not vary over time. On the contrary, if temporary impact persists more than single year, the serial correlation of residual earnings gradually phases out over time. To check this possibility, serial correlation of residual earnings are presented in Table 4.

Table 4. Serial correlation of earnings (residuals)\*

year	88	89	90	91	92	year	93	94	95	96	97
88	1					93	1				
89	0.88	1				94	0.86	1			
90	0.83	0.92	1			95	0.80	0.89	1		
91	0.77	0.85	0.93	1		96	0.77	0.85	0.90	1	
92	0.70	0.78	0.82	0.87	1	97	0.73	0.78	0.82	0.88	1

Source: Two samples of FIES for 1988-92 and 1993-97.  
 Regressing log of earning on age, age<sup>2</sup>, year and industry dummies.

Table 4 supports the notion that the impact of temporary income shock carries over more than a single year. To incorporate this feature into the model, we assume that the transitory component follows an AR(1) process (Lillard and Willis,1978):

$$(7) \quad v_{it} = \gamma v_{it-1} + \eta_{it}, \text{ where } \eta_{it} \sim (0, \sigma_{\eta}^2).$$

With the presence of serial correlation in the residual earnings, the variances of income components  $\sigma_{\delta}^2$  and  $\sigma_v^2$  cannot be obtained directly. In stead,  $\sigma_{\delta}^2$  and  $\sigma_v^2$  can be estimated by fitting a random-effect model with a serial correlation of error component. A standard three-step procedure is used (Hsiao, 1986; Baltagi, 1995; Greene, 1999). In the first step,  $\log Y_{it} - \log Y_i^P$  is OLS-regressed on  $\log Y_{it-1} - \log Y_i^*$  and  $(X_{it} - X_i^*)$  where  $X_{it}$  is a vector of individual characteristics in the earnings equation and  $X_i^* = \sum_t X_{it-1} / T$ . The coefficient of  $(\log Y_{it-1} - \log Y_i^*)$  is treated as the estimated value of  $\gamma$  (Durbin, 1960)<sup>9</sup>. In the second step,  $\gamma$  from the first step is used in the Cochrane-Orcutt transformation of the original earnings equation.<sup>4</sup> Finally, the equation from the second step is estimated by the random effect method.<sup>5</sup>

<sup>4</sup> Compared to the Cochrane-Orcutt method, Paris-Winston method causes additional complication in the heterogeneity of error terms

<sup>5</sup> The estimated parameters (standard errors) on age and age<sup>2</sup> are as follows:  
 For 1988-92: 0.0434503( 0.020567) for age and -0.00048(0.000238) for age<sup>2</sup>. overall R<sup>2</sup>=0.1150.  
 For 1993-97: 0.0624691(0.012720) for age and -0.0006836(0.000145 ) for age<sup>2</sup>. overall R<sup>2</sup>= 0.2386. The regression results show that the maximum labor earnings is achieved at approximately 45-46 years old.

The results are presented in Table 5. It shows that: i) overall within year income variance is lower in 1993-97 compared to 1988-92; ii) the same pattern of variances components in each education group appears as observed in Table 3: the lower the level of education, the higher overall income variations ( $\sigma_{\delta}^2 + \sigma_v^2$ ); the lower the level of education, the lower the fraction of permanent income variance to total variance ( $\rho$ ).

A few more points are worth mentioning. First, most of the income difference arises from permanent component difference, which represents approximately 87 percent of total income variance. Purely random stochastic difference explains 12.5 percent (in 1988-92) and 12.2 percent (in 1993-97).

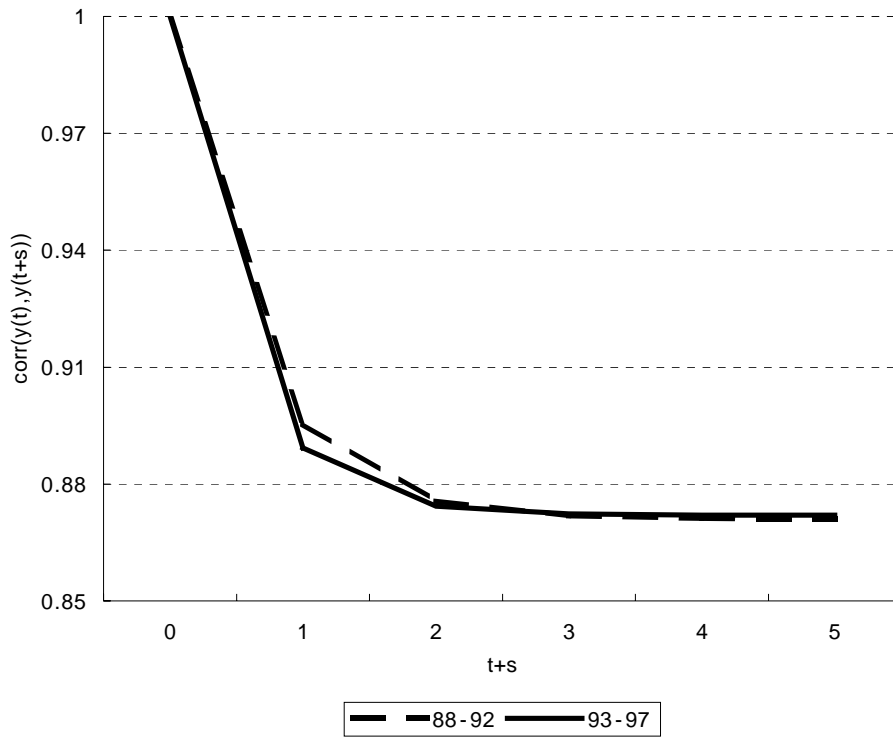
Table 5. Permanent vs. transitory variance of earnings: Serial correlation

	1988-92				1993-97			
	$\sigma_{\delta}^2$	$\sigma_v^2$	$\rho$	$\gamma$	$\sigma_{\delta}^2$	$\sigma_v^2$	$\rho$	$\gamma$
overall	0.161	0.024	0.871	0.190	0.126	0.018	0.872	0.135
ed<high	0.114	0.036	0.761	0.133	0.109	0.028	0.793	0.090
ed=high	0.116	0.021	0.848	0.268	0.097	0.016	0.861	0.194
ed>high	0.087	0.012	0.880	0.099	0.080	0.011	0.880	0.029

Source: Two samples of FIES for 1988-92 and 1993-97. Numbers are based on author's calculation

Second, the serial correlation of log of earnings between  $t$  and  $t+s$  can be shown as  $\text{corr}(y_{it}, y_{it+s}) = \rho + (1-\rho)\gamma^{|s|}$ . Using the value of parameters for  $\rho$  and  $\gamma$ , figure 1 shows that 89.6 percent of current income is correlated with the previous years income during 1988-92, and 88.9 percent, and the correlation gradually decreases until 87% as years apart.

Figure 1. Correlation of earnings



## **V. Discussion and Future Research**

Using data sets FIES 1988-92 and FIES 1993-97, this paper analyzes income inequality in Korea. By comparing statistical measures from two samples, it is shown that overall income inequality declines but the persistent component dominantly shapes income inequality. The result shows a systematic pattern between the level of education and the source of income inequality. The lower the education level, most of income inequality stems from transitory income volatility. As the level of education increases income variation increases due to the permanent component.

Several limitations should be taken into account when this result is interpreted. First, the size of each sample used in this paper is relatively small compared to studies done on this topic in other countries. Second, this study does not include the post-period of the recent financial crisis and recovery from it. Socio-economic restructuring during this period must have tremendous impact on income inequality. Further research is clearly warranted on this topic. Third, this research considers only labor income of household male heads. Although labor income is a significant portion of household total income, other sources of income such as capital income may play a very important role in shaping income inequality. Total income inequality rises if a bullish capital market gives the rich a better chance to join and share the capital market benefits while a depressed labor market squeezes the poor's labor earnings.

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