**Inequality of Opportunity in South Korea**

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**Abstract**

We decompose inequality of individual achievement, measured by income, education, and health, into the part due to unequal circumstance and due to differential exercise of individual effort. We use individual data in the Korea Labor and Income Panel Studies of those who were born between 1960 and 1980. Unlike Ko and Lee (2013), who used only one circumstance variable (father's level of education), we use five circumstance variables: father's education, gender, birth year, grown-up region until 14 years old, and the number of siblings. We chose individual education and individual income as the variables for individual achievement. Regarding inequality of individual education, the circumstance is found to account for 47% of the inequality, and the effort is found to account for 53%. Among the circumstance variables, father's education contributes the most (about 31% of inequality) and the gender the second largest (7%). Birth year accounts for 4%, the number of siblings accounts for 3%, and grown-up region accounts for 2%. Regarding inequality of individual income, circumstances account for 52% of the inequality, individual effort accounts for 48% of the total inequality. Gender is the most important circumstance variable (39%), and father's education (12%) is the next. Birth year and grown-up region exhibit little effect (less than 1%). The number of siblings shows almost no effect. Regarding inequality of individual health, the circumstance is found to account for 38% of the inequality. Gender contributes the most (24%) of the inequality, age(11%), and father’s education(2%) is the next.

**Key Words: Inequality of opportunity, circumstances, individual effort, Shapley value decomposition**

**JEL Code: D6, H3, J3**

**1. Introduction**

There is a consistent discussion about inequality, as inequality is getting worse. Traditionally, a discussion about inequality was mainly about inequality of outcome, but recently, an active discussion about inequality of opportunity is in progress.

The research about inequality of opportunity gives a great significance in a way that it gives policy alternatives by understanding the cause of inequality such as an effort and circumstances, not just analyzing the degree of inequality. An empirical study of inequality has great significance about Korea’s latest ‘dirt spoon, and gold spoon’ issue.

Despite the fact that inequality of opportunity is quite a familiar term to us, strict definition about the term needs to be preceded in order to do an empirical research on the inequality of opportunity. In this paper, we used the concept of the inequality of opportunity defined by Roemer (1993, 1998). Roemer first separates the inequality in a society into the inequality that is attributed to circumstances and to effort, and then call the inequality that is attributed to circumstance inequality of opportunity. In this context, circumstances are the vector of factors that is beyond individuals’ control, but that have great effect on their achievements. To be specific, parent’s education, parent’s income/ fortune, parent’s job, race, gender, birth place or growing region, number of siblings, birth year and genetically determined physical/cognitive ability are the factors that individuals can’t choose, but these have influence on their achievements greatly. We decompose the inequality by the part that is attributed to difference in circumstances and that in effort and then compute the contribution of each circumstance factors using the Shapley-value decomposition.

Among various data that tracked individuals’ information, we chose KLIPS which is proper for the inequality of opportunity research. We used 5 years (2010 to 2014) of KLIPS data. Our analysis sample is individuals who are born 1960 (54 years old at 2014) and 1980 (34 years old at 2014). These individuals are the ones who are economically most active among all age groups in the same year. Then, we used five circumstance variables: father’s education, gender, number of siblings, grown-up region, and birth year. We used inequality in labor income, education and BMI as an inequality of individual achievement: dependent variables.

In Korea, Ko and Lee (2013) is the first research that decomposed the inequality with the part with circumstances and that with effort. However, Ko and Lee (2013) used only one circumstance variable: father's level of education. However we use five circumstance variables: father’s education, gender, number of siblings, grown-up region, and birth year. Thus, a key difference between the current paper and Ko and Lee (2013) is that this research not only shows how much circumstances contribute to inequality, but also shows how much each five circumstance variable contributes to inequality of opportunity.

Our paper extends to the work of Erikson et al. (2015), who estimated inequality of opportunity in long-run income in Sweden. As circumstance variables, they used parental income, family structure, number of siblings, IQ, and non-cognitive ability. Unlike our paper, Erikson et al. (2015) controlled gender and compared the inequality of opportunity by gender.

We used age when analyzing the effect of birth year. There seems to be no problem with using age instead of birth year, as age follows birth year. However, there must be some attention when treating age entirely a circumstance variable. First, we can definitely treat individual’s age as a circumstance variable in the sense that it reflects the one’s birth year. However, at the same time, people accumulate experience and improve skills as they grow old. To be specific, proper interpretation about the fact that income increases as one grows older would be the result of accumulation of one’s skills and experience, not the result of factors that is beyond individuals’ control. On the contrary, in South Korea, education level of individuals decrease as one grows older, which can be explained by the lack of opportunity in education for those who were born in a long time ago. Therefore, as age contains the factor as a circumstance and the factor as one’s effort at the same time, the interpretation should be done with precaution. In Section 3, we present the method to decompose a circumstance factor among age.

We mainly used income data which has a value greater than zero. It was to prevent overestimating the effect of those who has no income at all such as housewives to the results. However, the results of using the whole sample and the results of using male sample were generally similar.

We find that regarding inequality of individual education, the circumstance is found to account for 47% of the inequality, and the effort is found to account for 53%. Among the circumstance variables, father's education contributes about 31% of inequality and the gender about 7%. Regarding inequality of individual income, circumstances account for 52% of the inequality, individual effort accounts for 48% of the total inequality. Gender is the most important circumstance variable, which accounts for 39% of the inequality, and father's education about 12%. When it comes to the health inequality, circumstance attributes 38% of the inequality and individual effort accounts for 62% of the inequality. Gender contributes the most in inequality as 24%, age about 11%, and father’s education about 2%.

The rest of the paper is structured as follows. In Section 2, we provide short literature review of papers inside and outside of Korea. In Section 3, we present the model and method and we describe the data in Section 4. In Section 5, we report the results. Lastly, we summarize the results and provide a further discussion.

**2. Literature Review**

The first research about inequality of opportunity in Korea is Kim and Lee (2008). This paper computes optimal tax and redistribution policy to reduce the level of inequality. Also, they find out that Korean tax-benefit policies have played almost no role in correcting unequal opportunities for income acquisition among people.

Another way of inequality research is decomposing inequality into the part due to unequal circumstance and due to differential exercise of individual effort. Ko and Lee (2011) use father’s education as a circumstance variable and analyzed how much this circumstance explains inequality of son’s achievement. They find that father’s education accounts for 16~25% of son’s education inequality and 2~12% of son’s income inequality.

Kim et al. (2016) analyze the inequality of opportunity using three circumstance variables: education, father’s education, and gender. They find that, the circumstance variables account for 88.3% increase in inequality of opportunity of male who is in their thirties for 10 years. As following policy implications, this paper suggests the policy that can improve the inequality, improve the quality of employment, and to expand budget on public education.

Erikson et al. (2015) uses 5 circumstance variables: parental income, parental education, number of siblings, family structure, IQ, and non-cognitive ability. Controlling gender, they compared inequality of opportunity by gender using other circumstance variables. Their result is that, the circumstance variable accounts for 31% of male’s inequality and 25% of female’s inequality. The result shows that inequality of opportunity is greater for male than for female.

Peichl et al. (2015) uses various circumstance variables including height of individuals to analyze the part of inequality of opportunity that is explained by the spouse in Germany. According to this paper, the effect of income of the spouse is decreasing due to assortative mating, and less responsibility of the individual on the spouse variable, higher the level of inequality of opportunity.

Ferreira et al. (2008) analyzes inequality of opportunity in Latin America using various circumstance variables including race. In this paper, they explore inequality of opportunity of expenditure and income. The result shows that inequality opportunity is higher in income than expenditure in any cases.

Checci, Peragine (2010) compare inequality of opportunity of South Italy and North Italy using several circumstance variables. As a result, the paper shows that inequality of opportunity in labor market is greater in South Italy, which is less developed region. Checci, Peragine (2010) analyzed the reason of this result is can be linked to internal migration flows such as brain drain.

Nilsson (2005) analyzes inequality of opportunity in Sweden, using many circumstance variables about family background. The result shows that inequality of opportunity in labor income, stable family relationship (nurturing parent matches with biological parent) accounts the most.

Bourguignon et al. (2003) explore inequality of opportunity of income in Brazil. This paper limited their sample on city dwellers. As a result, among circumstance variables, parental education accounts 55% of inequality of income, and adding father’s occupation, two circumstance variables accounts 80% of inequality.

**3. Methods**

We now explain the methods we use in this paper in three ways. First, we show the conceptual structure of the model and the regression specifications. Second, we present the method of decomposing inequality into inequality due to circumstance and inequality due to effort. Out method is known as Shapley-value decomposition. Lastly, we outline the method of decomposing the estimated value of effort to type-specific effort and individual effort.

1. The conceptual framework of the model and regression specification

The approach we use is originally based on Erikson et al. (2015). We measure the inequality by two measures: Gini coefficient (Gini) and coefficient of variation (CV). Gini is sensitive to a variation in inequality of middle class, but not sensitive to variation in inequality of upper class. On the other hand, CV is sensitive to variation in upper class than in middle class.

We intend to explore which part of inequality is attributable to circumstance and which part is attributable to effort. Circumstances are the factors that are beyond individual’s control, but affect individual achievements. There are various circumstance variables beside our circumstance variables: father’s education, gender, age, grown-up region, number of siblings, height, appearance, family background, IQ, etc. In this paper, we used only 5 circumstance variables due to a matter of measurement. Individual effort is the part that affected by individual’s diligence when everyone is under same circumstances. The problem is that it is hard to measure the effort. Therefore, we substituted the parts that measurable circumstances account for from the variation of a dependent variable, and set the rest residual as an effort. Thus, the part of our result which is regarded as the part due to an effort could actually be due to other circumstances.

We use the following regression for the analysis.

(1)

In this regression, is a variable that presents individual achievements such as individual education and income, and is a vector of circumstances with being the number of circumstances. is a residual that we treat the part as individual effort for convenience, despite the fact that part of it reflects the effect of circumstances. The aim of our analysis is to measure how much is due to variation of among variation of .

Now, we present the regression specification by dividing as individual education(), individual income() and individual health().

(1) A regression specification to estimate education equation

We estimate education equation by a regression of individual education on circumstance variables.

(2)

with as father’s education, as a dummy variable that presents male, as an individual’s age according to birth year, as a dummy variable that presents whether the grown-up region is above metropolitan city and as a number of siblings.

As we can see from a following result, an individual education has a strong negative relation with an individual birth year. This reflects that for those who were born in earlier times, the opportunity of education was very limited in Korea. As Korea went through a rapid economic growth, the opportunity of education varied considerably in the time of a birth. Therefore, the effect of birth year in education equation is completely considered as the part that is due to circumstance factors.

(2) A regression specification to estimate income equation

In the same context with (1), we gain a following regression of wage on circumstance variables.

(3)

Now, instead of , we use which represents experience of an individual by subtracting the schooling year from age of an individual. However, there is a critical error in this equation, as individual education is treated as a residual, omitted from the equation. Thus, a more accurate equation is

(4)

If we compare equations (3) and (4), we can see that . However, it is hard to distinguish the part due to circumstances from the part due to individual education, if we insert education directly to the equation like (4). Therefore, in order to decompose the part accountable to circumstances among education, we substitute (2) to education variable in (4), and gain the equation

(5)

However, we can’t instantly analyze the circumstances and effort with estimated coefficients and variables as is represented by individual’s effort, not individual’s circumstance.

Thus, for the sake of precision in our analysis, we omit the estimated experience part from individual income and use the following equation.

(6)

Now, every circumstance variables in (7) are the variables that have the characteristic only as circumstance variables. We use this regression to find out how much each circumstance variables contributes income, and how much estimated residual contributes an individual effort.

(3) A regression specification to estimate health equation

We estimate health equation by a regression of individual’s health indicator on circumstance variables.

(7)

with as a dummy variable that presents if individual workout regularly. In the same context with (2), we add education variable as individual education is treated as a residual, omitted from the equation. Thus, we use

(8)

Thus, by substituting equation (2), we have following regression equation.

(9)

As the workout variable represents individual’s effort for healthy life, we subtract the estimated workout part from individual’s health and use the following equation.

(10)

Now, every circumstance variables in (7) are the variables that have the characteristic only as circumstance variables. We use this regression to find out how much each circumstance variables contributes health, and how much estimated residual contributes an individual effort.

2. Decomposition of inequality using Shapley-value decomposition

Shapley-value decomposition is equilibrium allocation that in a coalition, players allocate a payoff by each player’s marginal contribution. In this paper we use the approach originally based on Lee and Lee (2016).

Shapley-value decomposition is useful when decomposing inequality measures by a marginal contribution of each source. In this paper, we decompose individual income to the sources such as the part by father’s income, the part by gender, etc. In this context, we can measure the marginal contribution of each source by using the sources of individual income are players of a game, and various combinations of income sources and the resulting inequality measures.

When decomposing inequality measures by Shapley-value decomposition, we should pay attention about how to deal with sources that are not included in which is a universal set comprised of various combinations of income sources. In this paper we used ‘equalized Shapley-value method’.

Originally designed by Cantreuil and Trannoy (1999), ‘equalized Shapley-value method’ is the the method that measure a inequality of by adding the mean of sources that are not included in , assuming that sources that are not included in gives its mean to all individuals. An individual is presented as , and an income source as , then is income source of an individual i. Now we can present a income distribution of income source as a dimension vector . When a subset of all income sources is , there is total the number of of subset that can be made by income sources with the number of . is a universal set of income sources .

An income made from income sources in set is a sum of each income sources in set , and it’s income distribution can be presented as a n dimension vector as follows. Then, with a principle of equalized Shapley-value decomposition, by adding a mean of income sources that are not included in to income sources in S, we get

, (11)

with as a mean of income source.

An equalized Shapley-value of income source is

. (12)

Therefore, we can compute marginal contributions of each circumstance variable with sums with various combinations of circumstances and resulting inequality measures.

3. Decomposing the residual to type-specific effort and individual effort

We divide each circumstance variables in to groups, and then call the combination of the groups as types. Then we categorize every individual to these types. We will introduce standards of categorizing in Section 4. As mentioned above, we measure an effort by the residual of a regression. Likewise, we are trying to explore what part of inequality of income, which has a distribution of , is due to circumstance or effort. Type is a combination of father’s education as 3groups, gender, birth year, grown-up region and number of sibling as 2groups. Therefore there exist 48 distinctive types. The key idea is that an individual should not be attributable for income difference determined by those types.

Denote each of the J circumstances as , which have the value of . Each type t consists of specific collection of . The set consists of elements . The type of specific individual’s income in the sample is . Then we measure the individual’s effort by the deviation of from the expected income of an individuals from type t, . We use the equation (1).

(13)

However, there also exists type-specific part in residual. Therefore, we will decompose the residual of the regression to type-specific effort and individual effort.

**4. Data**

1. Samples and Sources

KLIPS (Korean Labor and Income Panel Study) is a Korean census which conducts once a year on city-dwelling 5000 households and all members of the households. It’s first census started at 1998, and now it’s in progress in 2014, 17th census. KLIPS has both household data and household member data. We used household member data. Our sample is household members who are born between 1960 and 1980, registered in KLIPS.

(1) Dependent Variables (Variables for Individual Achievement)

We used three dependent variables, individual education, individual labor income and individual health in order to measure individual achievements. First, we used the responds about individual’s final school and whether an individual had completed the education to construct an individual education indicator. We combined an individual’s final school data and respond about whether an individual had completed the education to compute an individual’s total years of education and measure this as an individual education. A range of the individual education indicator is 0 year (no education) to 23 years (completed PhD). Second, in order to construct individual income indicator, we used 13th census (2010) to 17th census (2014) to get individual pre-tax labor income data from 2009 to 2013. Then, with CPI of each year, we converted the data to pre-tax real labor income data (with CPI of 2013).

Second, we used an average of 5 years of real labor income as an individual real labor income indicator.

Finally, we as an indicator of individual’s health, we used the body mass index (BMI).[[1]](#footnote-1) We used the respond about individual’s weight and height to construct a BMI indicator. The two variables are an average of 3 years of data.

(2) Explanatory Variable

We used five circumstance variables: father’s education, gender, birth year, grown-up region, and number of siblings.

We constructed a father’s education indicator in the same way as an individual education indicator from above. We combined the respond about father’s last school and whether he completed an education, and computed total years of father’s education. A range of the father’s education indicator is 0 year (no education) to 18 years (completed bachelor’s degree). In case of a gender indicator, 1 denotes male, 0 denotes female. As a measure of a birth year indicator, we count an individual’s age in full.

We constructed a grown-up region indicator by responds about a region an individual grew up until 14 years old, which 0 denotes cities up to metropolitan cities, and 1denotes otherwise. However, as city-dwellers are the census subjects of KLIPS, it is insufficient to interpret effect of a grown-up region as a difference of accessibility of infrastructures between rural and urban areas.

In case of a number of sibling indicator, 1 denotes an individual who has siblings more than a median, 0 denotes an individual who has siblings less than a median. However, we found out that birth rate is keep decreasing rapidly. Therefore, we used median of 1960s as a standard for individuals born in 1960s and the same for 1970s.

For the extended work to see the effect of the circumstances on individual’s health, we added the dummy variable that indicates whether the individual works out regularly or not as an explanatory variable. We used an average of 3 years of data.

(3) Type classification

We classified each circumstance variables to groups, and call combinations of groups as types. Then, classify every individual by the types. The table below provides a standard for a type classification.

**[Table 1 about here]**

Combinations of the groups make 48 types, and descriptive statistics for the 48 types are given in Table 2.

**[Table 2 about here]**

2. Descriptive Statistics

In Figure 1, we show the cumulative distribution of income with a groups of each circumstance variables. The result shows that a difference between groups is the most distinctive in father’s education and gender, as those are the circumstance variables that affect income inequality the most.

**[Figure 1 about here]**

In Table3, we show the correlation of each circumstance variables which is considered to affect the most on individual’s education with individual’s education years. The result shows that both father’s education and gender has fairly strong positive relationship with individual’s education. Among individuals who have more than 13 years of education, only 22% of them were those whose father has 0 to 6 years of education. On the other hand, those whose father has over 13 years of education were 78% of total. Also, among female, only 33% of them had more than 13 years of education, but male were 47%. On the other hand, 12% of female had 0 to 9 years of education, but in case of male, it was less than 9%.

**[Table 3 about here]**

Table 4 shows the regression result of each dependent variables that indicates individual’s achievement on circumstance variables.

**[Table 4 about here]**

According to the result, all circumstance variables, father’s education, gender, grown-up region, the number of siblings and the birth year have statistically significant effect on an individual’s education. The higher a father’s education is, the higher an individual’s education. Male have higher education than female. Individuals who grew up in metropolitan cities have higher level of education than those who are not. The more siblings an individual have, the lower an individual’s education. Finally, older people have lower level of education.

According to the regression result of income, father’s education and gender have statistically significant effect on an individual’s income. An individual has higher income if the individual’s father has higher level of education and if the individual is a male. As we explained in Section 3, education in the regression of income is used as an explanatory variable to omit the effort accountable part of birth year variable which has both effort and circumstance accountable parts.

Finally, BMI is higher if the individual is male and old. Also, BMI is lower if father’s education is higher.

**5. Result**

In section 4, we identified basic information and relationship with an individual achievement by descriptive statistics of circumstance variables. Now, we turn to the decomposition of inequality of achievement into the part due to circumstances and the part due to an effort based on the model we outlined in Section 3. Especially, we explore how much each circumstance variable accounts the inequality. First, we focus on decomposition of education inequality, then that of income inequality and lastly that of health inequality.

1. Decomposition of education inequality

The estimated Gini for education inequality is 0.096, and the estimated CV is 0.188, which is fairly low level of inequality compared to income inequality. We decomposed this individual inequality into father’s education, gender, grown-up region, the number of siblings, birth year and residual as an effort.

**[Table 5 about here]**

According to table 5, 47% of education inequality is accounted for by circumstances and 53% is accounted for by an effort. To be specific, father’s education shows the biggest contribution, 31%, gender as 7%, birth year as 4% and the number of siblings as 3%. Grown-up region accounts 2% of education inequality. A birth year indicator which is treated as a circumstance variable in education inequality reflects the difference in level of accessibility in education as economic development is in progress in Korea.

Among estimated CV of education inequality, circumstance accounts 42% and effort accounts 58%, which indicates that inequality of circumstance is smaller in the inequality estimated by CV. Further, among circumstance variables, father’s education and gender and the number of siblings and birth year and grown-up region are important contributors to inequality, accounting for 29%, 7%, 3%, 3%, and 2 percent of education inequality.

2. Decomposition of Income Inequality

Prior to discussing the decomposition of income inequality, we found out that 95% of individuals who have 0 incomes in total sample is female. We can assume that considerable amounts of respondents are housewives from the fact that KLIPS is the census that is based on a massive amount of survey questions from each individual. However, in Korea, as most housewives became housewives by their own choices, it might be meaningless to analyze what factors affect the most to housewives’ 0 incomes. Of course, we can’t ignore some cases that they were trying to get a job but due to circumstance factors, when their opportunity costs exceed income, they give up their job and become housewives. However, most cases are not. On this account, if we include the samples which have 0 incomes, among circumstance variables, effect of gender might be overestimated. Therefore, we analyzed by omitting the individuals with 0 income in order to avoid overestimation.

Table 6 displays the result when we decompose income inequality of individuals who have income bigger than 0. The estimated Gini for income inequality is 0.348. Among that, circumstances shows 52% and effort shows 48% of contribution. Gender accounts the largest proportion of inequality with 39%, then, father’s education with 12%. Grown-up region and birth year barely have an effect, which was less than 1%. Finally, the number of sibling had almost no effect at all.

The income inequality measured by CV was 0.682, which was considerably high number. Circumstances attributed 47% and effort attributed 53%. Each circumstance variable’s attribution was, gender with 38%, father’s education with 9%, and rest were insignificant. The number of sibling also had no effect at all.

**[Table 6 about here]**

Although our main analysis is about sample of individuals who have income bigger than 0 in order to avoid overestimation, additionally, we analyzed the inequality of total sample, and a sample with male and income bigger than 0. The following result is on Table 7.

In case of total sample, the estimated Gini of income equality is 0.35, which is higher than that of our main analysis. Now circumstances account 59% of income inequality and an effort accounts 41%, which is fairly high number of contribution of circumstances, comparing that of our main analysis was 52%. Also, gender attributes 48% of total income inequality, which is 23% higher attribution than the result from our main analysis.

In case of the sample with male and income bigger than 0, the estimated Gini of income inequality is 0.27. Now, gender is excluded from circumstance variables, and father’s education shows the largest attribution, which is 14%. Other circumstance variable shows almost no effect, which is less than 1%.

**[Table 7 about here]**

3. Decomposition of health inequality

According to the decomposition of health inequality, the estimated Gini for health inequality is 0.063, and the estimated CV is 0.113.

**[Table 8 about here]**

According to table 8, circumstance accounts for 62% of health inequality. Gender shows the biggest contribution, 24%, age as 11%, father’s education as 2% and other variables accounts health inequality less than 1%.

**6. Conclusion**

In this paper, we analyzed the parts attributable of circumstances and parts attributable of effort from inequality of achievement. We used the sample of individuals who were born between 1960 and 1980 from KLIPS data, and measure an individual’s achievement by education years and 5 years (2009-2013) of labor income of individuals. Among measurable circumstance variables, we constructed father’s education, gender, birth year, grown-up region, number of siblings as circumstance variables, which enable us to observe not only the contribution of circumstance, but also the contribution of each circumstance variables for inequality.

First, the level of inequality of education inequality is lower than that of income inequality. However, 47% of education inequality was accountable with circumstances. Especially, father’s education showed biggest contribution with 31%, and also gender with 7%. Second, in income inequality, despite the omission of sample with 0 income, circumstance accounted 52% of inequality. Especially, gender attributed the most with 39%, and then father’s education with 12%. Gender’s 39% attribution is considerably large number, considering that 95% of the omitted sample was female. Lastly, in health inequality, the degree of inequality is low comparing to education inequality and income inequality. Also, the effect of circumstance in inequality is relatively low. Gender showed the most contribution with 24%, age with 11%, and father’s education 2%. Therefore, we can conclude that father’s education is the most important contributor to education inequality, and gender is the most important contributor to income inequality and health inequality.

One of many limitations in our analysis is that there are numerous factors in circumstances besides our circumstance variables. Particularly, IQ, appearance, height, etc are significant factors that affect our achievement but beyond our control. Therefore, our result considerably underestimates the contribution of circumstances.

**References**

Ko, J. and W. Lee (2011), “Father’s education and son’s achievement”, Jaejunghak Yeongu (*Public Finance Study)* 4(2), pp.47~87. (written in Korean)

Kim, W and W. Lee, *A Study on the Extent to Which the Korean Tax Regime Equalizes Opportunities for Income Acquisition among Citizens*, *Korean Institute of Public Finance Research Report #08-03*, 2008. (written in Korean)

Kim, J, H. Seo, and W. Shin (2016), “An analysis on the contribution of the inequality of opportunity to income inequality : Evidence from Korean in 2000s”, *Ordo Economics Journal* 19(1) pp.41~67. (written in Korean)

Lee, S and W. Lee (2016), “Analysis of Contribution of Inequality of Income and Assest Inequality Using Shapley-value”, *Panel for Korean Economic Analysis, Scheduled*. (written in Korean)

Björklund, A., M. Jäntti, and J.E. Roemer (2012). “Equality of opportunity and the distribution of long-run income in Sweden,” *Social Choice and Welfare* 39 (2-3), pp. 675–696.

Bourguignon, F., F.H.G. Ferreira, and M. Menéndez (2003). “Inequality of outcomes and inequality of opportunities in Brazil”, World Bank Policy Research Working Paper No. 3174.

Checchi, D. and V. Peragine (2010). “Inequality of opportunity in Italy”, *Journal of Economic Inequality* 8 (4), pp. 429–450.

Eriksson, K.H, M. Jäntti, L. Lindahl (2015). “Gender and inequality of opportunity in Sweden”, mimeo

Ferreira, F. H., and J. Gignoux (2011). "The measurement of inequality of opportunity: Theory and an application to Latin America", *Review of Income and Wealth*, 57(4), pp. 622-657.

Gunatilaka, R., and D. Chotikapanich (2009). "Accounting for Sri Lanka’s expenditure inequality 1980-2002: Regression based decomposition approaches”, *Review of Income and Wealth*, 55(4), pp. 882-906.

Lee, W. (2015). “A Field Guide to Estimating Income Distributions”, unpublished lecture note.

Nilsson, W. (2005). “Equality of opportunity, heterogeneity and poverty”, PhD thesis. Umeå University.

Peichl, A. and M. Ungerer (2015). “Accounting for the spouse when measuring inequality of opportunity”, *ZEW Discussion Papers* No.15 (034). Centre for European Economic Research.

**Table 1: Summary of circumstance variables used**

|  |  |  |  |
| --- | --- | --- | --- |
| Circumstance  Variables | Group | Classification Criteria | Obs. |
| Father’s Education | Group 1 | 0-6 years | 1689 |
| Group 2 | 7-12 years | 1464 |
| Group 3 | Over 13 years | 281 |
| Gender | Group 1 | Female | 1824 |
| Group 2 | Male | 1610 |
| Birth Year | Group 1 | 1960-1970 | 1903 |
| Group 2 | 1971-1980 | 1531 |
| Grown-Up Region | Group 1 | Other cities | 2117 |
| Group 2 | Metropolitan cities | 1317 |
| Number of Siblings | Group 1 | Less than Median | 1352 |
| Group 2 | More than Median | 2081 |

Source: Korea Labor and Income Panel Study (Korea)

**Table 2: Summary statistics, by type**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Edu (Average) | Income (Average) | Father’s edu  (Average) | Age | Obs. |
| Type 1 | 11.0 | 878.0 | 3.9 | 46.0 | 53 |
| Type 2 | 12.4 | 1274.2 | 5.1 | 35.3 | 73 |
| Type 3 | 12.1 | 1171.5 | 4.8 | 44.3 | 32 |
| Type 4 | 12.1 | 1168.1 | 5.0 | 35.4 | 46 |
| Type 5 | 11.0 | 1199.5 | 3.8 | 46.7 | 445 |
| Type 6 | 12.3 | 891.7 | 4.4 | 37.4 | 129 |
| Type 7 | 11.6 | 1098.3 | 4.0 | 46.2 | 101 |
| Type 8 | 12.5 | 935.8 | 5.0 | 36.8 | 28 |
| Type 9 | 12.9 | 4515.5 | 4.4 | 45.1 | 67 |
| Type 10 | 12.7 | 3189.1 | 4.8 | 35.9 | 80 |
| Type 11 | 12.4 | 2714.8 | 5.0 | 44.3 | 41 |
| Type 12 | 13.1 | 3232.3 | 5.1 | 36.3 | 52 |
| Type 13 | 12.0 | 3950.6 | 3.5 | 46.8 | 351 |
| Type 14 | 12.6 | 3377.9 | 4.1 | 37.5 | 84 |
| Type 15 | 12.2 | 3623.8 | 3.9 | 46.7 | 82 |
| Type 16 | 12.1 | 2937.5 | 4.3 | 37.5 | 25 |
| Type 17 | 13.1 | 1221.6 | 10.7 | 43.9 | 37 |
| Type 18 | 13.1 | 1279.6 | 10.6 | 35.1 | 130 |
| Type 19 | 13.4 | 1461.0 | 10.4 | 44.2 | 45 |
| Type 20 | 13.4 | 1326.9 | 10.7 | 35.0 | 166 |
| Type 21 | 12.3 | 1129.9 | 10.2 | 46.3 | 131 |
| Type 22 | 12.9 | 1460.8 | 10.2 | 36.3 | 96 |
| Type 23 | 12.9 | 1633.7 | 10.4 | 45.5 | 86 |
| Type 24 | 12.9 | 1484.7 | 10.5 | 36.0 | 81 |
| Type 25 | 13.3 | 3758.3 | 10.4 | 44.2 | 51 |
| Type 26 | 13.4 | 3382.0 | 10.5 | 34.9 | 134 |
| Type 27 | 14.5 | 4515.1 | 10.5 | 44.4 | 75 |
| Type 28 | 13.4 | 3695.9 | 10.8 | 35.3 | 177 |
| Type 29 | 13.3 | 3822.2 | 10.3 | 45.9 | 109 |
| Type 30 | 13.8 | 3890.9 | 10.1 | 36.4 | 43 |
| Type 31 | 13.8 | 4408.5 | 10.3 | 46.3 | 65 |
| Type 32 | 13.1 | 3310.4 | 10.2 | 36.3 | 38 |
| Type 33 | 13.5 | 1166.3 | 15.3 | 43.5 | 8 |
| Type 34 | 13.0 | 1186.8 | 15.4 | 34.3 | 13 |
| Type 35 | 14.9 | 1781.2 | 15.9 | 44.8 | 20 |
| Type 36 | 13.9 | 1591.5 | 15.7 | 34.5 | 48 |
| Type 37 | 13.7 | 1832.4 | 14.6 | 47.1 | 21 |
| Type 38 | 14.4 | 1317.2 | 14.0 | 38.4 | 5 |
| Type 39 | 14.9 | 1720.4 | 15.1 | 44.4 | 19 |
| Type 40 | 15.4 | 1077.7 | 16.2 | 37.7 | 11 |
| Type 41 | 14.7 | 4552.4 | 15.7 | 44.1 | 13 |
| Type 42 | 14.3 | 4540.2 | 15.3 | 34.3 | 16 |
| Type 43 | 15.6 | 4234.8 | 15.4 | 44.2 | 17 |
| Type 44 | 14.2 | 3958.3 | 15.8 | 35.2 | 41 |
| Type 45 | 15.2 | 5692.3 | 15.7 | 45.5 | 18 |
| Type 46 | 12.7 | 4159.5 | 15.4 | 36.8 | 10 |
| Type 47 | 14.8 | 5700.7 | 15.3 | 45.7 | 16 |
| Type 48 | 14.4 | 6063.5 | 15.2 | 38.4 | 5 |

Source: Author’s estimation, using Korea Labor and Income Panel Study (Korea)

**Table 3: Summary of individual’s education, by circumstance variables**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Individual’s Education | | | |
| Father’s Edu | 0-9 years | 10-12 years | Over 13 years | Total |
| 0-6 years | 0.166 | 0.610 | 0.224 | 1.000 |
| 7-12 years | 0.042 | 0.436 | 0.522 | 1.000 |
| Over 13 years | 0.011 | 0.213 | 0.776 | 1.000 |
| Total | 0.100 | 0.503 | 0.397 | 1.000 |
| Gender | 0-9 years | 10-12 years | Over 13 years | Total |
| Female | 0.120 | 0.551 | 0.329 | 1.000 |
| Male | 0.077 | 0.449 | 0.474 | 1.000 |
| Total | 0.100 | 0.503 | 0.397 | 1.000 |

Source: Korea Labor and Income Panel Study (Korea)

**Table 4: Regression results**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Education | Labor Income | BMI | Labor Income\_Adj | BMI Adj |
| Fathers Education | (19.65) | (1.80) | (-0.83) | (7.82) | (-1.72) |
| Male | (8.67) | (35.87) | (13.66) | (37.22) | (13.44) |
| Grown-up region | (8.67) | -40.770  (-0.57) | (1.27) | (0.32) | (1.16) |
| Number of Siblings | (-2.27) | 90.03  (1.29) | (-0.96) | (0.73) | (-0.87) |
| Age | (-3.27) |  | (2.11) | (-1.45) | (2.06) |
| Exp |  | (7.18) |  |  |  |
| Education |  | (16.64) | (-2.83) |  |  |
| Workout |  |  | (-2.37) |  |  |
| Constant | (39.29) | (-10.67) | (22.64) | (6.62) | (34.84) |
| Obs | 3427 | 3432 |  | 3432 |  |

Source: Author’s estimation, using Korea Labor and Income Panel Study (Korea)

**Table 5: Equalized Shapley-value decomposition result of education inequality**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | GINI | | CV | |
| AC | RC | AC | RC |
| Fedu | 0.030 | 0.309 | 0.052 | 0.279 |
| Male | 0.007 | 0.071 | 0.012 | 0.066 |
| Growreg | 0.002 | 0.024 | 0.004 | 0.021 |
| Nsib | 0.003 | 0.029 | 0.005 | 0.024 |
| Age | 0.004 | 0.039 | 0.006 | 0.032 |
| Resid | 0.051 | 0.529 | 0.108 | 0.578 |
| Total | 0.096 | 1.000 | 0.188 | 1.000 |

Source: Author’s estimation, using Korea Labor and Income Panel Study (Korea)

Note :

1. AC stands for absolute contribution, and RC stands for relative contribution.

**Table 6: Equalized Shapley-value decomposition result of income inequality**

**(when income>0)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | GINI | | CV | |
| AC | RC | AC | RC |
| Fedu | 0.036 | 0.118 | 0.051 | 0.085 |
| Male | 0.120 | 0.391 | 0.228 | 0.380 |
| Growreg | 0.002 | 0.008 | 0.004 | 0.006 |
| Nsib | 0.000 | 0.001 | 0.001 | 0.001 |
| Age | 0.001 | 0.004 | 0.002 | 0.003 |
| Resid | 0.147 | 0.478 | 0.316 | 0.526 |
| Total | 0.307 | 1.000 | 0.600 | 1.000 |

Source: Author’s estimation, using Korea Labor and Income Panel Study (Korea)

**Table 7: Equalized Shapley-value decomposition result of income inequality**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Overall Sample | | | | Male, Income is bigger than 0 | | | |
| GINI | | CV | | GINI | | CV | |
| AC | RC | AC | RC | AC | RC | AC | RC |
| Fedu | 0.034 | 0.093 | 0.047 | 0.066 | 0.036 | 0.143 | 0.063 | 0.128 |
| Male | 0.176 | 0.477 | 0.336 | 0.474 |  |  |  |  |
| Growreg | 0.001 | 0.002 | 0.001 | 0.001 | 0.001 | 0.004 | 0.002 | 0.004 |
| Nsib | 0.001 | 0.002 | 0.001 | 0.002 | 0.000 | 0.002 | 0.001 | 0.002 |
| Age | 0.005 | 0.013 | 0.006 | 0.009 | 0.006 | 0.026 | 0.010 | 0.021 |
| Resid | 0.152 | 0.413 | 0.318 | 0.449 | 0.205 | 0.826 | 0.420 | 0.846 |
| Total | 0.368 | 1.000 | 0.709 | 1.000 | 0.249 | 1.000 | 0.497 | 1.000 |

Source: Author’s estimation, using Korea Labor and Income Panel Study (Korea)

**Table 8: Equalized Shapley-value decomposition result of health inequality**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | GINI | | CV | |
| AC | RC | AC | RC |
| Fedu | 0.001 | 0.017 | 0.001 | 0.013 |
| Male | 0.014 | 0.242 | 0.027 | 0.253 |
| Growreg | 0.000 | 0.007 | 0.001 | 0.007 |
| Nsib | 0.000 | 0.007 | 0.001 | 0.006 |
| Age | 0.006 | 0.106 | 0.01 | 0.101 |
| Resid | 0.037 | 0.621 | 0.066 | 0.619 |
| Total | 0.059 | 1.000 | 0.107 | 1.000 |

Source: Author’s estimation, using Korea Labor and Income Panel Study (Korea)

**Figure 1: Income distribution (CDF) by circumstance variables**

|  |  |
| --- | --- |
| EMB00001f441724 | |
| EMB00001f441722 | EMB00001f441723 |
| EMB00001f441720 | EMB00001f441721 |

Source: Author’s estimation, using Korea Labor and Income Panel Study (Korea)

1. We define BMI as follows: [↑](#footnote-ref-1)