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Allocation of Time and Consumption-Equivalent Welfare: A Case of South Korea

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Preliminary. Comments Welcome.

Abstract

Using "2014 Time Usage and Quality of Life" of 17th KLIPS (Korean Labor and Income Panel Study), the first and most detailed time use survey of its kind in South Korea, we first document the patterns of time use in market work, nonmarket work (household work), child care, and a variety of definitions in leisure. We find that, while men work longer hours, men's additional market work is well compensated by more leisure and less hours in nonmarket work and child care. We also find within-household unequal distribution of time use in nonmarket work, child care, and leisure in favor of men. Consistent with the cases of US and other advanced economies, high-income earners tend to enjoy less hours of leisure while they spend more money in leisure activities. As an illustrative purpose to see the determinants of household-level welfare, we calculate the consumption-equivalent measure that considers both consumption, leisure, life expectancy, and uncertainty. Our result suggests that household-level welfare measures based solely on income or consumption are both incomplete and misleading.

Keywords: inequality, consumption-equivalent welfare *JEL classification*: D13, I31, J22

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1 Introduction

Understanding on how individuals and households allocate their time on market work, nonmarket work, and leisure helps explain the various aspects of economic activities. For example, Becker (1965) presents an economic theory on how a rational individual/household should allocate time across various activities. Ghez and Becker (1975) emphasize the substitutability of time between market and nonmarket work for decision of consumption and labor supply over life cycle. Benhabib et al. (1991) successfully show that introducing home production significantly improves the quantitative performance of the standard model along several dimensions. Greenwood et al. (2005) show that innovations in consumer durables, which affects the relative price of work and leisure in the context of home production, leads to an increase in women's labor market participation. Aguiar and Hurst (2005) explain away the retirement puzzle by documenting that the dramatic decline in expenditures at the time of retirement is matched by an equally dramatic rise in time spent on home production. Aguiar et al. (2016) attempt to explain a recent decline in hours worked by less-educated young men in US through changes in leisure technology for computer goods broadly (and video games in particular).

While the lack of high-quality data on the time use hinders researchers from assessing rigorously many of the key empirical predictions from economic theories and models, the recent advances in terms of collecting new data and merging them with older data made researchers possible to explore the macroeconomic implications of time use.[1] While such data has not been available in South Korea, 17th KLIPS (Korean Labor and Income Panel Study) made the first step to collecting large and detailed individual-level time use data and making them public. We use the 2014 Additional Survey of "Time Usage and Quality of Life" of 17th KLIPS, which is the most detailed data on time use in South Korea.[2] Considering the fact that it is one of the world's hardest-working countries, it is imperative to understand the pattens in time allocation in South

[1] See Aguiar et al. (2012) and Aguiar and Hurst (2016) for a survey on the economics of time use.

[2] Strictly speaking, 2014 Additional Survey is not the first survey on time use in South Korea. The main theme of 2004 Additional Survey is on leisure and work hours. However, it provides too limited information and we regard 2014 survey as the first dataset on time use comparable to ones in other advanced countries. We discuss the differences between 2004 and 2014 surveys and document trends in comparable time use categories in section 3.3.

Korea and delve into their macroeconomic implications.

We have two goals. Firstly, we provide an overall description on time use for the case of South Korea. While doing so, we compare the patterns of South Korea with patterns in the US and other countries. While 2004 Additional Survey is less detailed, we also document the trends in market hours and leisure over the decade, 2004-2014. Briefly summarizing the time use survey, while South Korea has the fastest shortening working time in the OECD, people in South Korea still work longer hours, enjoy less amount of leisure compared to US and other countries. Gender inequality in terms of household work and child care seems severe against women. Most notably, we find that hour of leisure is a inferior good in South Korea, implying that high-income earners enjoy less hours of leisure.

Secondly, we measure consumption-equivalent welfare for the case of South Korea. By doing so, rather than providing a household-level welfare measure immune to criticism, we attempt to provide illustrative examples to highlight the factors we need to consider in calculating such measures. Our observation of leisure as a inferior good and two papers motivate our study. Aguiar and Hurst (2007b) document a cross-sectional pattern that higher income is associated with lower level of leisure, while rising income induces more leisure over time. Presenting this pattern, they argue that the conventional welfare measure based solely on income or consumption may provide an incomplete picture of economic well-being. Extending this logic more formally and broadly, Jones and Klenow (2016) proposes a summary statistics for the economic well-being and use it to compare welfare levels across countries. They consider consumption, leisure, mortality, and inequality and ask what would be the relative welfare level in terms of consumption-equivalents. They find that, while GDP per person is an informative indicator of welfare across countries, there are economically important differences between GDP per capita and their consumption-equivalent measure.[3] For example, GDP of France in 2005 is just 67 percent of the US value. Consumption per person in France was even lower at only 60 percent of the US. However, since lower mortality, lower inequality, and more leisure in France contribute to overall welfare, the consumption-equivalent welfare of France is equal to 92 percent of that in the US. Their study shows the importance of accounting for leisure and other factors when measur-

[3] Lucas (1987) uses the consumption-equivalent welfare to calculate the welfare cost of business cycles.

ing economic welfare. In our dataset, we also find that income is negatively associated with hours in leisure, suggesting that welfare calculation based solely on income or consumption can be misleading. In this regard, we measure consumption-equivalent welfare that considers both consumption and hours of leisure and find that welfare level of low-income group is higher compared to welfare level based solely on income or consumption. In addition, we measure consumption-equivalent welfare that consider both the hours in leisure and expenditure spent on leisure activities. We find that expenditures on leisure as well as hours of leisure are important and substitutability between consumption and leisure are critical. While we do not present a framework that fully incorporates the features of household production, our illustrative examples and patterns in summary statistics suggest that considering the aspects of household production and within-household gender inequality is important in measuring household-level welfare.

The rest of the paper is structured as follows: Section 2 briefly reviews the literature on the time use, focusing on the stylized facts that are closely related to the case of South Korea. Section 3 explains our data and documents the summary statistics and patterns at individual- and household-level. Section 4 explains our methodology and estimates the consumption-equivalent welfares. Section 5 discuss our findings along with future research agenda. Section 6 concludes with summary.

2 Literature Review

In this section, rather than attempting an extensive survey on the literature on the allocation of time, household production and related empirical studies. We limit our discussion on the stylized facts on time use in the US and other countries that are comparable to ones in South Korea.

As to hours worked in markets and hours in leisure, McGrattan and Rogerson (2004) shows that, since the late 1960s, time spent on market work for men has been falling, while it has been increasing steadily for women. Aguiar and Hurst (2007b) document that, between 1965 and 2003, average leisure time in the United States increased by roughly 5 hours per week for employed individuals between the ages of 18 and 65. Men's leisure time increased a little higher than women's (6.2 hours versus 4.9 hours). Aguiar

and Hurst (2007b) explore the patterns in leisure time in terms of leisure inequality. They show that, between 1965 and 1985, the average leisure time of low-educated households grew substantially while that for high-educated household actually contracted.

In the US, the time-series evidence suggests that rising incomes induce more hours in leisure, while the recent cross-sections suggest that higher incomes are associated with lower levels of leisure hours. Based on time-use data for seven industrial countries from the 1970s, Gimenez-Nadal and Sevilla (2012) find general decreases in men's market work coupled with increases in men's unpaid work and child care, while increases in women's paid work and child care coupled with decreases in unpaid work. They also find leisure inequality in favor of lower educated adults. In their study, trends in leisure inequality mirror the general increase in inequality of income and earnings, experienced in most countries over this period especially after the mid-1980s. All these findings are consistent with previous results for the US. Aguiar and Hurst (2007b) document that a growing inequality in leisure is mirrored by the growing inequality of wages and expenditures and emphasize that welfare calculation based solely on the latter might be incomplete.

As to hours spent in child care, Sayer et al. (2004), Aguiar and Hurst (2007b), and Ramey and Ramey (2010) document that time spent with children has been increasing from the mid-1990s. According to Ramey and Ramey (2010), this increase was particularly pronounced among college-educated parents. Less educated mothers increased their childcare time by over 4 hours per week whereas college-educated mothers increased theirs by over 9 hours per week. Fathers showed the same patterns, but with smaller magnitudes. Kimmel and Connelly (2007) find that mothers' time spent on child care increases with wage, while both leisure and home production time declines with increased wages. Similarly, Guryan et al. (2008) document that the income elasticity of child care time is strongly positive while those elasticities of both home production and leisure time are strongly negative. These results suggest that richer and high-educated parents spend more time with their children than poorer and low-educated parents.

3 Time Use in South Korea

3.1 Data and Variable Description

3.1.1 Data

Our research is made possible by the Additional Survey called "Time Usage and Quality of Life" of 17th KLIPS (Korean Labor and Income Panel Study). KLIPS, managed by Korean Labor Institute, is the annual panel data based on 5,000 households living in urban area, starting from 1998. KLIPS have two main datasets: personal and household. Personal data contains information on employment, consumption, work hours, wages, income, and life satisfaction of household members who reach at least 15 years old. Household data report information on household income, consumption, assets and liabilities, etc. KLIPS also has an additional survey with a specific theme every year. In the 17th survey of 2014, an additional survey was conducted on the time allocation for all respondents of the main survey, whose ages are between 14 and 75. The respondents report their activities based on 17 categories such as eating, childcare, sleeping, market work and others for every 30 minutes. It is a remarkably detailed dataset on individual-level time usage. Combining these with individual- and household-level information, we can construct a well-being measure based on various metrics such as consumption, leisure, and so on.

Following Aguiar and Hurst (2007b), we restrict our primary sample to include respondents aged 25 through 65 who are neither students nor retirees in order to minimize the role of time allocation decisions that have a strong intertemporal component, such as education and retirement. We also drop the respondents that report negative income and report the time use on "unusual days".

Table 1 reports 17 categories of time use. Each respondent answers one of the 17 categories for every 30 minutes. Table 2 shows our definition of time use categories: core market work, total market work, nonmarket work, child care, four measures of leisure. For ease of comparison, we try to follow the classification in Aguiar and Hurst (2007b) as closely as possible. As emphasized in previous studies, as child care can be regarded as laborious work or as leisure, we examine the category of child care separately from categories of nonmarket activities and leisure.

3.1.2 Converting Daily to Weekly Hours

One limitation of Additional Survey on time use is that some respondents answered the survey questionnaire on their working days, while others did on non-working days (mostly, weekends). We do not have data on their time use on non-working days for the former, while there is no data on working days for the latter. In order to construct the weekly hours spent on time use, which makes comparable to other research such as Aguiar and Hurst (2007b), we need imputation. We do it in three ways:

(1) Method 1: assuming that two samples of workday and non-workday are similar, weekly hours spent on each time use are calculated as (average time use of working day $\times$ 5 + average time use of non-working day $\times$ 2)

(2) Method 2: we first regress each time use category on the various combinations of demographic variables and identify the variables that have explanatory powers. We find that dummy variables for sex, employment, marital status, and whether it is a workday or a holiday are important among them. We divide the sample of non-working day group into demographic cells defined by two sex categories, two marital status, and whether a respondent is employed or not. After calculating the average hours on each time use of eight demographic cells based on non-working day group, we impute those average values into the corresponding cells of working day group. Then we obtain weekly hours spent on each time use as (time use of working day $\times$ 5 + imputed value $\times$ 2)

(3) Method 3: Based on non-working day sample (1,202 individuals), we regress each time use category on demographic variables (gender, age, education level, marital status, dummy of household head, 19 areas, employment, temporary job). Using the estimates from these regressions, we use the demographic variables of working day sample and construct the fitted values of time use.[4] Then we obtain weekly hours spent on each time use as (time use of working day $\times$ 5 + fitted time use of non-working day $\times$ 2)

Table 3 shows average hours per week spent on each time use category based on method 2. Table A1 and A2 in appendix show average hours per week based on method

[4]We make the fitted values bounded within the minimum and maximum values of each category.

1 and method 3. They are very similar in terms of average hours and exhibit high correlation among the three methods. We use the weekly hours based on method 2 as our benchmark.[5]

3.2 Allocation of Time: Individual-Level

Panel (a) in table 3 displays the weekly hours spent on each time use category by five samples: full sample, women, men, employed men and employed women. In average, men tend to spend more time in market work while women spend more time in nonmarket work (including house chore) and child care. In terms of total hours of work both in market and non-market, employed women tend to work more. For example, employed women spend more time by working in market and home by 6.3 hours (64.5−58.2). Including time of child care makes the gap wider by 7.7 hours (68.4−60.7).

According to OECD statistics, an average South Korean tends to work 2,124 hours in 2014, second to Mexico among OECD countries.[6] The Economically Active Population Survey conducted by Statistics Korea reports that an average South Korean works 2,285 hours in 2014. [7] According to the Survey, the share of workers who work longer than 52 hours per week is 19.0%. Our dataset shows a similar picture. In terms of core market work for the employed, the annual working hours amount to 2,320 hours. The share of employees who work longer than 52 hours per week is 23.6%.

Panel (b) reports correlation coefficients among time use categories. Correlation coefficient between core market work and total market work is close to one. Four measures of leisure are closely related to each other. Hours of leisure is negatively correlated with market work and the correlation coefficient is very high, which ranges from −0.63 to −0.88. Since child care is added to leisure measure 3 and 4, the correlation coefficients between child care and leisure measure 3 and 4 are positive, while those between

[5] An unintended by-product of imputation based on method 1-3 is that we have many non-zero hours of child care even for families without infants. We also proceed our analysis by imputing zeros for child care time of those families and confirm that those non-zero hours of child care do not affect our results much.

[6] The OECD statistics of 'average annual hours actually worked per work' is obtained by dividing the total number of hours worked over the year by the average number of people in employment. Note that the data are intended for comparisons of trends over time, rather than for cross-country comparisons because the sources of data are different. The related link is https://stats.oecd.org/Index.aspx?DataSetCode=ANHRS.

[7] The Survey can be found at the following link: http://kosis.kr/eng/statisticsList/statisticsList_01List.jsp?vwcd=MT_ETITLE&parentId=B.

child care and leisure measure 1 and 2 are negative. When we calculate the correlation coefficients in sub-samples (not reported here), the pattens are similar in sub-samples. However, correlation between market work and nonmarket work, and market work and child care become very weak for employed men.

Since we have eight categories of time use and lots of demographic and job-related variables. It is more convenient to run simple regressions to see which variables are more closely related to each time use category. Table 4 shows the result. For dependent variables, we use core market work, nonmarket work, child care, leisure measure 1 and leisure measure 4 in turn. We drop total market work, leisure measure 2, and leisure measure 4 because they are highly correlated with core market work, leisure measure 1, and leisure measure 3, respectively. For regressors, we include dummy variables for male, high-skilled person (one with a college education or more), part-time job, regular job, private company, medium and small firms, living in Seoul, living in metropolitan areas, ages. And we also include log of labor income.

Other things being equal, men work longer by 3.58 hours in average. However, their longer work is compensated by less nonmarket work (-12.15 hours less), less child care hours (0.36 hours less) and longer leisure (8.59 hours more in case of leisure measure 1). It suggests that gender inequality in terms of time use may be severe. High income earners tend to work longer and rest more, while spending less time on nonmarket work. This pattern is consistent with ones in the US and other countries, as reported in Aguiar and Hurst (2007b) and Gimenez-Nadal and Sevilla (2012). If one works for private companies, she/he tends to work longer and enjoy less leisure. People residing in Seoul or metropolitan area work longer and enjoy less leisure. People work longer hours when they are relatively young and enjoy more leisure when they get older.

One thing that deserves more scrutinization is the effect of skill level on time use. Our dummy variable of high-skilled worker takes a value of one if an individual receives education of 16 years or more. The result in table 4 shows that more educated people work less and enjoy more leisure. Considering a positive correlation between education level and labor income, this result seems odd. If we calculate the average hours by education level or skill level, we find that more educated (or high-skilled) workers tend to work more and enjoy less leisure. We find that, in average, high-skilled workers spend 34.4, 10.2, 0.9, 37.1, and 112.4 hours in core market work, nonmarket work,

child care, leisure measure 1, and leisure measure 4, respectively. For low-skilled works, those average hours are 32.0, 13.3, 0.5, 39.5, and 114.8 hours. We find that this discrepancy results from the significant explanatory power of male and labor income on skill level.

3.3 Trend in Time Use over a Decade: 2004-2014

While it is very informative to look at the cross-sectional differences in allocation of time, it is also important to examine the trends. Our dataset, KLIPS, has the additional survey on leisure and work hours in 2004. However, there are several differences between 2004 and 2014 additional survey. Firstly, 2004 survey has far fewer questions and thus provides far less detailed information. Secondly, some questions are different. For example, 2014 survey asks how many hours a respondent spent in each time use category *yesterday*. Thus, an employed person may report hours of his/her workday or holiday. Meanwhile, 2004 survey requires a respondent to fill in hours spent in each time use category for weekday, Saturday, and Sunday, respectively.[8] Third, the objectives are different. 2004 survey aims to see the effect of law of shortening legal working hours implemented in July 2004 on hours of work and leisure. The objective of 2014 survey is more extensive. In addition to reporting hours in time use, it also aims to enhance our understanding on the extent of workers' self-decision on work hours, quality of life including balance between work and leisure, maternity protection and others. It is why we use 2014 survey as our main dataset.

While the questionnaire is different, we find three categories of time use whose definitions are directly comparable: total market hour, leisure mesure 1, and leisure measure 2. Table 5 shows the trends in three time use categories between 2004 and 2014. Over the decade, hours in total market work decline from 40.12 hours to 37.36 hours. And this decline is more noticeable for employed women: 57.40 hours to 48.64 hours. Interestingly, average hours per week spent in leisure measure 1 does not change much over the decade while hours in leisure measure 2 increases approximately by 10 hours. Following our time use classification in table 2, an increase in leisure hours results from an increase in hours of sleeping and personal care.

[8] In terms of converting daily hours into weekly hours, as discussed in section 3.1.2, 2004 survey is more convenient.

We also check the average hours of those who answered the surveys both for 2004 and 2014. The sample sizes for each group are 4,751 (full), 2,469 (women), 2,162 (men), 1,302 (employed women), and 1,833 (employed men). We find that those who are present both in 2004 and 2014 spend more hours in work and less hours in leisure while the differences in average hours are not significantly large. The patterns are not much different from the ones reported in table 5.

3.4 Allocation of Time: Household-Level

Now we report a summary statistics and patterns of time use at household-level. In this section and the following section where we estimate the consumption-equivalent measures of economic welfare, our unit of analysis is household-level. There are several reasons for focusing on household-level unit. Firstly, many measures of inequality or economic welfare such as quintiles of income are based on household-level. In this regard, household-level hours spent on each time use is more suitable to incorporate household-level economic variables such as income, consumption, and net worth into analysis of time use. Secondly, consistent with home production theory, the unit of analysis should be the entity of joint-decision making and it is a household, not an individual. Thus, we focus on household-level analysis henceforth.[9]

We restrict the sample to only include couples who have both household head and spouse and at least one person is employed. We find that, in case of a young couple who reside with their parent couple, there seems to be many mis-reported labor income. For example, some young couples report their parent's income as their labor income. We also exclude a single family. We find many cases in which a single person who lives alone report his or her parent's wealth as his or hers.

Table 6 shows the average hours spent on each time use for all families (couples), double-income family, single-income family, families with infants whose age is 6 or below, and families with children whose age is between 7 and 18 below. Note that the average hour is the average of household head and spouse. For example, 34.88 hours of core market work for all families means that each person spends 34.88 hours in core market

[9]However, our household-level approach has some limitations. For example, if adult kids that work and make money may affect the time use of their parents. In addition, since we exclude the group of single family that earns relatively less income, our sample based on couples would represent relatively richer people.

work in a week. Table 6 clearly shows that double-income family works longer, enjoys less leisure, and spend less hours in child care. Double-income family also spends less hours in nonmarket work, suggesting that they may substitute market goods for their hours in nonmarket work. A single-income family in which one person is not working spends more time in nonmarket work and child care, suggesting the division of labor. Having an infant (or infants) requires roughly 7 hours more even compared to the case of having a kid (or kids) whose age is between 7 and 18. Having an infant reduces leisure while having a kid does not affect that much.

Table 7 shows men's and women's average hours spent on each time use category based on the sample of double-income and single-income families. Note that the hours on child care is based on families who have an infant (or infants) whose age is under 6. In case of double-income family, men work for longer hours by 7.3 hours (=49.07-41.81) but women spend more time in nonmarket work (16.3 hours longer) and child care (7.9 hours longer). In our sample, the average labor income of men's of double-income family is 38.0 million won and that of women's is 21.4 million won. While we need a more explicit model of household production to tell if this pattern results in rational division of labor within a household or gender inequality in terms of time use favoring men, table 7 shows the within-household unequal distribution of time use. For the case of single-income family, table 7 shows more unequal distribution of time use. However, to some extent, this pattern can be partly explained by within-household division of labor due to the characteristics of single-income family.

Table 8 shows the average hours spent on each time use category by income quintile. Income quintile 5 denotes top 20% income group. Panel (a) shows that high-income group tends to spend more time on market work, less on nonmarket work and leisure. Figure 1 well summarizes the patterns. High income group work longer hours while spend less hours in leisure. A negative association between income and leisure can be partly explained by substitutional effect. Higher hourly wage of high-income group makes this group's leisure hour more expensive, making this group work more. However, one still can ask why low-income group doesn't try to work more to raise income. Figure 2 shows the disposable income, hourly wage, consumption, expenditure on leisure activities by income quintile. Income and consumption variables are divided by the square root of family size. Note that high income group spends more money on

leisure activities. It suggests the substitutability between leisure hours and expenditure. In section 4, we calculate the welfare measure that considers both consumption and leisure.

3.5 A Comparison with American Time Use Survey

We provide summary statistics of time use in individual- and household-level and explain some distinctive patterns. In order to put the time use patterns of South Korea in perspectives, we compare them with ones of the US. We use the news release from Bureau of Labor Statistics on 2015 American Time Use Survey.[10] Below is the comparable parts on time use in South Korea and the US. Numbers in parenthesis are the statistics from KLIPS in 2014.

- Employed persons work an average of 7.6 (9.0) hours on a day they worked.
- On the day they worked, employed men worked 42 (60) minutes more than employed women. This difference might be affected by the relative likelihood of working part time. However, even among full-time workers, men works longer than women; 8.2 (9.3) hours compared with 7.8 (8.7) hours.
- From 2003 to 2015, the share of men doing food preparation and cleanup on an average day increases from 35 percent to 43 (22) percent. The average time per day men spend doing food preparation and cleanup increases from 16 minutes in 2003 to 21 (19) minutes in 2015.
- From 2003 to 2015, the share of women doing housework on an average day decreased from 54 percent to 50 (87) percent. The average time per day women spend doing housework declined from 58 minutes in 2003 to 52 minutes (2.85 hours) in 2015.
- Of those who engaged in leisure activities, men spend 5.8 (5.0) hours in some sort of leisure activities while women do 5.1 (4.6) hours.
- Adults living in households with children under age 6 spend an average of 2.0 (2.6) hours per day providing childcare. Adults living in households where the youngest child was between the ages of 6 and 17 spend 49 (31) minutes per day.

[10] See the link at https://www.bls.gov/news.release/atus.nr0.htm for more detail.

- On an average day, among adults living in households with children under age 6, women spend 1.0 (4.0) hours providing child care. By contrast, men spend 25 (60) minutes.

Again, we can see that people in South Korea work longer hours, enjoy less leisure. And severe gender inequality seems to exist in terms of nonmarket work (that is, household activities), child care, and leisure.

4 Measuring Consumption-Equivalent Welfare

In this section, we propose comprehensive welfare measures discernible from single-dimensional indicator such as income level. The approach starts from what Jones and Klenow (2016) develop to compare the welfare level across countries. Their goal is to set an index, called consumption-equivalent measure or scale of welfare, with various sources of lifetime expected utility in each country. Despite various chrateristics, which may affect welfare possibly in different ways depending on the group, consumption equivalent measure is an appreciable indicator making welfare level comparable among them. This is done by keeping other things equal for the target group, virtualy adjusting copnsummtion expenditue until the utility level equal to that of comparison group. For example, while per capital GDP and consumption in France are just 67% and 60% of the US values, its consumption-equivalent measure that considers leisure, mortality, and inequality is equal to 92% of that in the US. It is natural to ask to an American "how much would you have been happy if you were born in France, not in the US?" Then one would answer "I would have enjoyed 92% of happiness as much as I do in the US, because I could have benefitted from lower inequality, lower mortality, and more leisure despite lower consumption and income." We adopt what Jones and Klenow (2016) develop as the basic tool, and will improve it further with detailed information and argements such as quality of leisure or home product.

4.1 Conceptual Difference

Before proceeding, it is worth discussing conceptual difficulties in applying the methodology of Jones and Klenow (2016) to our household-level analysis. Firstly, consumption-equivalent measure has innate relativity so that we need at least one reference group.

However, our unit of analysis is household-level in a country and it is not easy to find a reference group at the household-level comparison, such as the US. Instead, rather than arbitrarily picking up a household as baseline, we take the top 20% group in terms of income as a reference group.

Secondly, there is subtle difficulty in interpreting variables such as inequality. For example, it is straightforward to interpret the negative effect of inequality. In the context of Rawl's *veil of ignorance*, being born in the US means that one would enjoy more consumption in average compared to be born in France, however in the meanwhile, one would face higher chances of living richer or poorer. If we denote an inequality measure of country i as σ_i^2, it is easy to calculate σ_i^2, for every country in the sample and compare it with each other. However, if i refers to a household or an income quintile in the same country, σ_i^2 is conceptually vague.[11] Therefire, for the time being, it is better to define σ_i^2 as uncertainty of a household income within an income group.

4.2 How to Calculate the Equivalent Measures for Income Groups

With a simple case of log utility or consumption-leisure separable utility function, we briefly illustrate on how to calculate consumption-equivalent measure λ_q where q denote the quintile based on income.

Let C_q and ℓ_q denote a household's annual consumption and a measure of leisure, respectively. Our utility function that considers both consumption and leisure is:

$$\begin{aligned} u(C_q, \ell_q) &= \bar{u} + \log C_q + \nu(\ell_q) \\ &= \bar{u} + \log C_q - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}}. \end{aligned}$$

where consumption (C_q) is defined as measured real consumption less housing and education expenditure as well as non-consumption payment such as social insurance fee, which is defined following Meyer and Sullivan (2013). The definition of leisure (ℓ_q) can vary according to the leisure measures by Aguiar and Hurst (2007b), or whether it comprises housework hours or not.[12] Most broad measure of leisure is what Jones and

[11] We find that inequality is severe only in top 20% and bottom 20% income group. The Gini coefficients of disposable income for income quintiles are 0.17 (top 20%), 0.05, 0.04, 0.05, and 0.15 (bottom 20%), respectively.

[12] If there is home production augument in an utility function, housework hours will not be comprised

Klenow (2016) define, which is total time endowment less total market work hours.

In calculating equivalent scales, we will treat an household as if it consists of an individual representing overall household charateristics. Let a be the individual's age, then a household's lifetime expected utility:

$$U_q = E\left[\sum_{a=1}^{\infty} \beta^a S_q(a)\left(\bar{u} + \log C_q - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}}\right)\right]$$

where $S_q(a)$ is the survival rate for a household in each income quintile, assuming that survival rates or life expectancies are different by quntile.[13] We will explain our choice of the parameters later on: the Frisch elasticity ϵ, the utility weight on leisure θ. Suppose consumption in each income group is lognormally distributed across household at a point in time independently of household charateristics, with arithmetic mean c_q and a variance of log consumption of σ_q^2 then $E(\log C_q) = \log c_q - \frac{1}{2}\sigma_q^2$.

Let $\beta = 1$ and ℓ be deterministic, then lifetime expected utility is represented in a simplified form with life expectancy $\text{LE}_q = \sum_{a=1}^{\infty} S(a)_q$.

$$U(c_q, \ell_q) = \text{LE}_q\left(\bar{u} + \log c_q - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}} - \frac{1}{2}\sigma_q^2\right)$$

$q = 5$ refers to top 20% income group and $q = 1$ refers to bottom 20% income group. Life expectancy by income quintile is on table 12. The welfare levels of top 20% income group and bottom 20% group are:

$$U(c_5, \ell_5) = \text{LE}_q\left(\bar{u} + \log c_5 - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_5)^{\frac{1+\epsilon}{\epsilon}} - \frac{1}{2}\sigma_5^2\right),$$

and

$$U(c_1, \ell_1) = \text{LE}_q\left(\bar{u} + \log c_1 - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_1)^{\frac{1+\epsilon}{\epsilon}} - \frac{1}{2}\sigma_1^2\right).$$

Consumption-equivalent welfare for quintile $q = 1$ can be calculated by finding λ_1 from following equation:

$$U(c_1, \ell_1) = U(\lambda_1 c_5, \ell_5)$$

within leisure.

[13] Life expectancy by income quintile is well described in Khang et al. (2015). They show that life expectancy increases according to income level.

and we can calculate λ_q for $q = 2, 3, 4$ from

$$U(c_q, \ell_q) = U(\lambda_q c_5, \ell_5)$$

For parameter values, Moon and Song (2016) estimate the Frisch elasticity of labor supply in Korean labor market being 0.23 only with intensive margin. Considering intensive and extensive margin altogether, it turns out to be 0.99 without normalizing the sample size and 0.93 with normalization. In our sample, a household consists of employed as well as non-employed members, so labor supply is concerned with both intensive and extensive margin. In this regard, we take 1.0 which is approximately what Moon and Song (2016) suggest. To calibrate the weight on the disutility from working, θ, we exploit KLIPS data as much as we can. Let w be aftertax real income, $(1-\ell)$ be labor supply and c be real consumption at the period, then we obtain the weight as $\theta = w(1-\ell)^{-1/\epsilon}$ which is out of the first order condition of a household's labor supply decision. θ is calibrated as being 12.8 that is smaller than what Jones and Klenow (2016) has arrived with the US data, 14.2. [14] $\bar{u}$ is the intercept of the utility function and it is important as long as we compare utility in lifetime so as to measure value of life for each household. Details on calculating the intercept in flow utility $\bar{u}$ is on appendix.

4.3 Case 1: Log Utility Function

Table 9 shows each quintile's income and consumption ratio to that of top 20% income group along with the consumption-equivalent measures of welfare with log utility, λ_q^{log}. While the income ratios are 0.22, 0.35, 0.45, and 0.59 for $q = 1, 2, 3, 4$, respectively, the consumption-equivalent measures of welfare are 0.52, 0.61, 0.68, and 0.77, where leisure is defined as leisure measure 2 plus housework (non-market work) hours. While income ratio of bottom 20% income group to that of top 20% is only 22%, welfare comprising both consumptuon and leisure measured in consumption unit is 52%. Table 9 clearly shows that conventional welfare measures that rely solely on income may underestimate the welfare levels, in case of South Korea where low-income groups typically enjoy more leisure.

[14] The difference may come out from difference in sample household charateristics between Korea and US. Our sample contains workers in age 21 to 65 whereas Jones and Klenow (2106) assume the first order condition holds for the average prime-age worker (25 to 55 years old)

4.3.1 Quality of Leisure in Log Utility Function

Becker (1965) argues that not only quantity but also quality of commodities consumed is important in economic analysis, especially on household's time allocation problem. We assume what determines the quality of consumption is time and related expenditure. If this is the case, leisure has to be considered not merely in terms of hours spent but also expenditure related to that. Let ℓ denote quality of leisure rather than leisure hour itself. Quality of leisure is defined as a composite good with leisure hours and related expenditures as input.[15] The technology or way of integration to produce quality of leisure has never been attempted in literatures, however we assume Cobb-Douglas function and take $\alpha = 0.5$ as baseline value. Let l_m and x_m denote a leisure measure (m = 1, 2, 3, 4) and related expenditure, repectively.[16] The quality of leisure replaces leisure hours as an argument in the utility function.

$$\ell_m = l_m^{\alpha}\, x_m^{1-\alpha}$$

Despite changing quality of leisure with leisure measure from 1 to 4, the equivalent measure is very consistent, especially for leisure measure 2 to 4, the gaps are mostly ignorable. With the quality of leisure measure 2 in log utility function, table 9 shows that equivalent scales are 0.208, 0.292, 0.399, 0.548 for $q = 1, 2, 3, 4$, which are smaller than income ratios, respectively. If this is the case, income is overestimating welfare levels for the low income groups. This happens because, in spite of more leisure hours, leisure quality can be different from quantity depending on amount of expenditure related to that as shown in figrue 3. For example, a household with low income can spend hours playing video games, however playing games for a long time may not be as much exciting as sailing yacht at near coast for an hour.

[15] When ℓ is quality of leisure, we cannot define ϵ as the conventional Frisch elasticity of labor supply no more, however measuring the equivalent scale with quality of leisure is an illustrative example of what we pursue to comprise the sources of welfare, such as home production, which are not counted in traditional way of welfare measures.

[16] Expenditures included in each leisure expenditure are categorized in table 8

4.4 Case 2: Non-Separable Utility Function

In log utility cases, we assume separability of the utility function, and marginal utility of consumption and leisure are independent. Separability is useful due to additivity so that we can decompose the equivalent measures into components. However, we need to lessen strong assumptions that we release independency between consumption and leisure. With a non-separable utility function, leisure and consumption are substitute:

$$U_q = \frac{C_q^{1-\gamma}}{1-\gamma}\left(1+(\gamma-1)\frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}}\right)^{\gamma}$$

The relative risk aversion parameter, γ, ranges 1 to 4 in macroeconmics literatures, and we take $\gamma = 1.5$ as baseline value. ϵ is the Frisch elasticity of labor supply which is constant, and calibrating the weight on disutility from working, θ, is not different from log utility function case at large. With $\gamma \neq 1$, θ is calibrated as, $\theta = w(1-\ell)^{-\frac{1}{\epsilon}}\left(\gamma C - w(\gamma-1)\frac{\epsilon}{1+\epsilon}(1-\ell)^{\frac{1+\epsilon}{\epsilon}}\right)^{-1}$ which shrinks to $\theta = w(1-\ell)^{-1/\epsilon}$ with $\gamma = 1$. We take θ as 12.8, the same value with log utility case. It can be verified that consumption and leisure are substitute by looking into second derivative of U_q by C_q and ℓ_q.

$$\frac{\partial^2 U_q}{\partial C_q \partial \ell_q} = \gamma(1-\gamma)\theta(1-\ell_q)^{\frac{1}{\epsilon}}C_q^{-\gamma}\left(1+(\gamma-1)\frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}}\right)^{\gamma-1} < 0$$

Due to the substitutibility between leisure and consumption, λ_q^{NS} is consistently lower than λ_q^{log}.[17] Table 9 reports the consumption-equivalent measures in case of non-separable utility function, λ_q^{NS}. With leisure measure 2, the values of λ_q^{NS} are 0.318, 0.483, 0.577, 0.686 for $q = 1, 2, 3, 4$, respectively. As shown in table 11 λ_q^{NS} is not sensitive to the value of γ neither to the leisure measures, which implies robustness of λ_q^{NS} in the case of non-separable utility function.

4.4.1 Quality of Leisure in Non-Separable Utility Function

The equivalent measures with quality of leisure in non-separable utility function are consistently lower than log utility case because of substitutibility between consumption and quality of leisure. Moreover, as in the case of log utility function with quality of

[17] Since leisure is a substitute good for consumption, cutting consumption down to the level of λ_q^{log} raise the marginal utility of leisure. Therefore λ_q^{NS} has to be lower than λ_q^{log} as much as increment in the utility from given leisure.

leisure, compensational effect by more leisure hour is also limited due to the quality of leisure is now concerned with related expenditures, as shown in table 8. λ^{NS} with the quality of leisure are 0.205, 0.309, 0.422, 0.561 with the quality of leisure measure 2 for $q = 1, 2, 3, 4$, respectively, which is smaller than any other equivalent measures formerly discussed.

4.5 Decomposing the Equivalent Measures

Due to additivity, it is possible only for the simple log utility case to decompose the equivalent measure of welfare to verify where the difference in welfare comes from, in terms of components of log equivalent scale.

$$\log \lambda_q = \log c_q - \log c_5 \tag{1}$$

$$+ \frac{\theta\epsilon}{1+\epsilon}(1-\ell_5)^{\frac{1+\epsilon}{\epsilon}} - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}} \tag{2}$$

$$+ \frac{\text{LE}_q - \text{LE}_5}{\text{LE}_5}\left(\bar{u} + \log c_q - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}} - \frac{1}{2}\sigma_q^2\right) \tag{3}$$

$$+ \frac{1}{2}\sigma_1^2 - \frac{1}{2}\sigma_q^2 \tag{4}$$

Above expression provides an additive decomposition of the forces that determine the consumption equivalent measure of welfare in each income group q relative to that of top 20% income group (q=5). $\log \lambda_q$ consists of four components; (1) differences in means of log consumption, (2) utility from leisure, (3) life expectancy, and (4) uncertainty in log consumption.

Table 10 shows which and how much a component contributes to log of equivalent measures of welfare. From 1st to 4th income quintile, log consumption has largest portion among the components in log of equivalent measures by -0.683, -0.523, -0.375, -0.245 for $q = 1, 2, 3, 4$, respectively. Meanwhile utility from more leisure compensates negative effects from life expectancy and log consumption by 0.140, 0.067, 0.005 for $q = 1, 2, 3$.[18] difference in life expectancy affects log equivalent measure of welfare by -0.109, -0.051, -0.031, -0.021, respectively. Since life expectancies are getting lower as a household place in lower income quintile, expected utility will be deteriorated as much

[18]It is interesting, however, that the compensation is not available yet for 4th quintile, so 4th quintile lose as much as 0.009 from leisure.

as life expectancy gap. Income distribution withing income group positively affects log of the equivalent measures around 0.02 for $q = 1, 2, 3, 4$.

5 Discussion

We discuss our findings along with an outline of empirical and theoretical extensions that we think interesting avenues for future research. Firstly, we find that low income is associated with more leisure in South Korea, suggesting that leisure is a inferior good. This observation is also consistent with ones in the US and other advanced economies. One explanation is substitution effect. Higher wages make leisure relatively more expensive since wage is the opportunity cost of leisure, so high-income group is not willing to have leisure. Then why doesn't low-income group work longer hours to increase income? Is it voluntary leisure or involuntary leisure? If it is the case for the former, In line with Aguiar et al. (2016), who argue that a decline in hours worked among young, low-skilled workers is partly associated with changes in leisure technology, it can simply be a reflection of the optimal response to the relative price of leisure. What if it is involuntary leisure? It can be due to broader social aspects, such as labor market regulations and labor unions. While we do not have a definite answer to this question, policy makers should be aware of the possibility of (in)voluntary leisure when considering employment policy reform. In addition, our examples show the importance of taking the quality of leisure into account. Different from the negative relation between income and hours of leisure, there is a positive relationship between income and expenditure on leisure activities in South Korea.

Secondly, we need a a more explicit treatment of household production. The previous discussion on leisure quality is one example. Another example can be the issue of gender inequality in time use, as clearly shown in table 7. While we observe unequal distribution of time use in nonmarket work, child care, and leisure in favor of men, we do not tell if such a pattern results from optimal division of labor or gender inequality. In this regard, we need to establish a more rigorous definition of gender inequality in terms of resource and time allocation within household first. Chiappori and Meghir (2014) emphasize that measures of inequality that ignore intra household allocations are both incomplete and misleading, discussing the determinants of intrahousehold al-

location of resources and welfare. To incorporate household production into the model or a welfare metric, we also need to know the values of key parameters. One example is the parameter on the substitutability of market goods and time for child care and leisure. We find that, while high-income group spend less hours in leisure, they spend more money in leisure category.[19] In this regard, empirical research on estimating key parameters in household production is also important.[20]

Thirdly, the availability of data on time use is important, too. According to Aguiar and Hurst (2016), there are four major limitations to existing time use surveys: (i) individual time use data are not linked to individual data on expenditures; (ii) the data are from repeated cross sections, and do not contain a panel component; (iii) the data do not include measures of time use from multiple members of the same household; and (iv) the data do not measure detailed activities while at market work. A benefit from richer datasets can be found in Borra et al. (2016). Using the longitudinal data from Australia, the UK, and the US, they find that selection into marriage by individuals with a higher taste for home-produced goods can explain about half of the observed differences in housework documented in the cross-sectional data. While our dataset in KLIPS well address the issue related to (iii), we hope that our dataset can continue and extend as panel data with well addressing the issues related to (i), (ii), and (iv).

6 Conclusion

While income is an informative indicator of welfare for an individual, a household, or a country, a measure based on income has well-known limitations as the Stiglitz Commission Report (2009) clearly illustrates in the case of GDP. In this regard, the purposes of our research are (1) to present summary statistics of time use using the "2014 Time Usage and Quality of Life" of 17th KLIPS (Korean Labor and Income Panel Study), the first and most detailed time use survey of its kind in South Korea, and (2) to calculate consumption-equivalent welfare measure that considers both consumption and leisure.

[19] As Aguiar and Hurst (2016) emphasize, the long-run effect of child care time on children's labor market outcome can be an important research topic.

[20] See Rupert et al. (1995), Aguiar and Hurst (2007a), González Chapela (2011), and Gelber and Mitchell (2012) for this line of research.

We find that, while men in South Korea work for longer hours, those extra work hours are well compensated by less hours in nonmarket work and child care, and more hours in leisure. Among double-income families, we observe severely unequal distribution of time use in terms of nonmarket work, child care, and leisure favoring men. In terms of leisure inequality, we find that low-income group enjoys more leisure, which is consistent with patterns observed in the US and other advanced economies.

Given these patterns in time use, following the tradition of Lucas (1987) and a recent study by Jones and Klenow (2016), we calculate consumption-equivalent measure based on household-level data. We find that welfare measures that rely solely on income or consumption can be incomplete, underestimating the value of leisure.

Our household-level measure opens several venues for further research. Estimating key parameters in household production will provide more information on the substitutability of time and market goods in household activities, delivering rich implication for our understanding of labor supply, early childhood investment, within-household gender inequality, and so on.

A Appendices

A.1 Weekly Hours Spent on Time Use

This appendix shows the weekly hours spent on core market work, total market work, nonmarket work, child care, and four measures of leisure based on method 1 and 3.

Table A1: **Hours per Week Spent in Each Time Use Category, Individual-Level, Based on Method 1**

Assuming that two samples of workday and non-workday are similar, weekly hours spent on each time use are calculated as (average time use of working day × 5 + average time use of non-working day × 2)

(a) Average hours per week, by categories

time-use category				employed	
(hours per week)	full	women	men	women	men
(1) core market work	34.62	25.79	43.72	42.77	47.81
(2) total market work	39.64	29.62	49.97	48.62	54.43
(3) nonmarket work	12.33	18.43	6.03	14.01	5.78
(4) child care	4.60	6.20	2.94	3.56	2.96
(5) leisure measure 1	37.52	39.09	35.90	29.99	32.78
(6) leisure measure 2	107.64	109.31	105.91	99.00	102.33
(7) leisure measure 3	112.24	115.52	108.86	102.56	105.29
(8) leisure measure 4	116.04	119.95	112.00	105.37	107.79
(2) + (3)	51.96	48.05	56.00	62.63	60.21
(2) + (3) + (4)	56.56	54.25	58.95	66.19	63.17
sample size	6,727	3,416	3,311	2,021	3,021

(b) Correlation coefficients (sample size = 6,727)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) core market work	1.00							
(2) total market work	0.99	1.00						
(3) nonmarket work	-0.60	-0.61	1.00					
(4) child care	-0.31	-0.32	0.24	1.00				
(5) leisure measure 1	-0.69	-0.70	0.22	-0.11	1.00			
(6) leisure measure 2	-0.75	-0.76	0.16	-0.12	0.88	1.00		
(7) leisure measure 3	-0.85	-0.86	0.25	0.30	0.80	0.91	1.00	
(8) leisure measure 4	-0.91	-0.92	0.25	0.27	0.74	0.85	0.93	1.00

A.2 Value of Life in Korea

Jones and Klenow (2016) clarify that the intercept in flow utility, $\bar{u}$ is critical for valuing differences in life expectancy. To get appropriately parameterized $\bar{u}$, we have to know the value of life in Korea. Since there is no literature found concerning that problem, we impute the value as KRW 7.2 billion based on Murphy and Topel (2006) that choose a value around $6 million for the value of life in the US. The latter is in 2007 prices that we adjust the value into 2014 prices and multiply KRW/USD exchange rate in 2014 to turn it into KRW unit. As to normalize the value, we divide the value of life in Korea by average household income in 2014.

The next step is the intercept $\bar{u}$ calculaton by deducting average utility of sample households from the utility a household can obtain from the value of life. So $\bar{u}$ means welfare that average household can get from other sources of utility simply other than consumption and leisure.

$$\bar{u} = U(\text{value of life in KR}) - U(\bar{C}, \bar{\ell})$$

Value of the intercept $\bar{u}$ is different depending on parameter values and measures of leisure, also on utility function we assume.

A.3 Normalization of Variables

We normalize flow variables such as income to prevent the utility level from being affected by time period and money scales. However, since the data we use in analysis is not a time series, there is no standard such as reference year to normalize the variables with. Instead we devide the flow variables by average household income in 2014, therefore each household income and consumption expenditures are proporational to the unit value of average income. By doing so, income and expenditures are compatible with other arguments such as hours in the utility functions

A.4 consumption-equivalent Scale with CES Home Production

Home product, denoted by H, is sometimes ignored but an inevitable source of welfare level. Discussing welfare with home product is still on going subject despite of many

years of trials since its first attempt by Becker (1965). Schreyer and Diewert (2014) well develop theoretical structure in a household's optimization problem with home products. As Aguiar et al. (2012) clarify, including home product in welfare measure allows intratemporal substitutional effect between time and expenditure, in which the opportunity of time is a major concern for each household. A household would put more resources which is relatively cheaper to obatain the same level of welfare. If time is cheaper, which means real wage level is low, a household definitely increase housework to compensate low level of expenditure, as retirees mostly cook their meals at home.

Home product technology can be represented by two level CES function with real consumption E, nonmarket work N, and leisure or quality of leisure ℓ as inputs. Without loss of generality, we assume the elasticity of substitution between real consumption and nonmarket work as unit value. Then the first level of CES function is a Cobb-Douglas function just as quality of leisure. However, we are not assure such elastic relationship exists between home product and leisure, we leave the second level of CES function as it is with relatively low elasticity of substitution, henceforce. Now consumption argument, C in utility function is actually a composite good comprises expenditure and hours. If ℓ denotes quality of leisure then composite consumption measure C is

$$H = E^{\eta}\, N^{1-\eta}$$

$$\ell = l^{\alpha}\, x^{1-\alpha}$$

$$C = A[\kappa H^{\psi} + (1-\kappa)\ell^{\psi}]^{\frac{1}{\psi}}$$

and the utility function can be either separable or non-separable function with a little modification that the argument in disutility of labor is now defined as total market hours, L.

$$U(C_q, \ell_q) = \bar{u} + \log C_q - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}}$$

or

$$U(C_q, \ell_q) = \frac{C_q^{1-\gamma}}{1-\gamma}\left(1 + (\gamma-1)\frac{\theta\epsilon}{1+\epsilon}L_q^{\frac{1+\epsilon}{\epsilon}}\right)^{\gamma}$$

Home production in utility function is an illustrative example for now that parameters are set in a crude sense. A is factor productivity, which set to be $A = 3$ that make C and disutility from market work balanced. $\alpha = 0.8$ to make expenditure contribute

more to home product and $\beta = 0.7$ to give more weight to home product than leisure. $\psi = -5$ to represent limited substituional effect between home product and leisure. The welfare equivalent scales are on table 9.

Interestingly, as seen on figure 4, the equivalent measures with log utility function for 2nd, 3rd and 4th quintiles are quite close with each other, which implies that intratemporal substitution between hours and expenditure compensate lower level of income to some extent. Upon consumption equivalent measure with home product and log utility function, we can rearrange the income quintiles into three groups; 1st quintile as the first group, 2nd, 3rd and 4th quintile as the second, and 5th quntile as the third. Then there come two implications. Firstly, the second group enjoy welfare as much as 0.7 measured as λ, while income ratios within the group are 0.35, 0.45, 0.59. If this is the fact, it can be households' choice in which income quintiles they locate themselves, since they can compensate income with home product. For example, if a double-income family decides to be a single-income one, the household can move from 4th to 2nd income quintile, whilst keep their welfare level not deteriorated. Another example is the retirement consumption puzzle as in Hurst (2008). We may suggest our result as answer. After retirement, a household can move from 4th to 2nd quintile, still enjoy the same welfare level owing to dramatically increase in housework hours and drop in opportunity cost of time. Secondly, after all the consideration of housework and quality of leisure, inequality still exists in welfare level due to λs of the 1st quintile and 5th quintile, which are quite different from those of 2nd, 3rd, and 4th quintiles, making the 1st quintile absolute poverty group.

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Table A2: **Hours per Week Spent in Each Time Use Category, Individual-Level, Based on Method 3**

Based on non-working day sample (1,202 individuals), we regress each time use category on demographic variables (gender, age, education level, marital status, dummy of household head, 19 areas, employment, temporary job). Using the estimates from these regressions, we use the demographic variables of working day sample and construct the fitted values of time use.[21] Then we obtain weekly hours spent on each time use as (time use of working day $\times$ 5 + fitted time use of non-working day $\times$ 2)

(a) Average hours per week, by categories

time-use category				employed	
(hours per week)	full	women	men	women	men
(1) core market work	34.92	25.59	44.53	43.01	48.73
(2) total market work	39.93	29.25	50.96	48.76	55.53
(3) nonmarket work	11.93	20.76	2.81	16.25	2.53
(4) child care	4.53	6.61	2.39	3.83	2.42
(5) leisure measure 1	37.89	37.14	38.66	27.82	35.46
(6) leisure measure 2	108.08	107.16	109.03	96.72	105.40
(7) leisure measure 3	112.47	113.72	111.18	100.49	107.58
(8) leisure measure 4	116.17	118.05	114.23	103.00	109.94
(2) + (3)	51.86	50.02	53.77	65.01	58.06
(2) + (3) + (4)	56.40	56.62	56.16	68.84	60.48
sample size	6,727	3,416	3,311	2,021	3,021

(b) Correlation coefficients (sample size = 6,727)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) core market work	1.00							
(2) total market work	0.99	1.00						
(3) nonmarket work	-0.60	-0.62	1.00					
(4) child care	-0.32	-0.32	0.24	1.00				
(5) leisure measure 1	-0.63	-0.63	0.12	-0.18	1.00			
(6) leisure measure 2	-0.68	-0.69	0.06	-0.18	0.89	1.00		
(7) leisure measure 3	-0.81	-0.82	0.17	0.28	0.78	0.90	1.00	
(8) leisure measure 4	-0.88	-0.88	0.18	0.26	0.72	0.82	0.92	1.00

Table 1: **Time Use Categories**

This table shows the 17 time use categories reported in "Time Usage and Quality of Life" of 17th KLIPS (Korean Labor and Income Panel Study). 17th KLIPS corresponds to the year of 2014.

(1) Bedtime
(2) Personal care (e.g. meal, personal hygiene and preparing to go out)
(3) Commuting
(4) Main job-seeking activities (e.g. work of employees and all the other activities relating to work)
(5) Side job (e.g. extra income generating activities in addition to the main job)
(6) Job-seeking activities (e.g. writing resume, visiting a job-placement agency, searching the Internet in relation with the job-seeking activity and interview)
(7) Parenting (e.g. washing, putting children to sleep, playing, taking children to and picking them up from the daycare or school and education activities)
(8) Taking care of children and other family members (e.g. activities in relation with caring for the patient, meal preparation for the patient is not included in this activity.)
(9) Home-keeping activities (e.g. meal preparation, laundry, cleaning up, grocery shopping, running errands at bank or public office)
(10) Studying and self-development activities
(11) Leisure activities (e.g. reading newspaper or magazine, watching TV, video, movie, performance or exhibitions, searching the Internet or exercising)
(12) Religious activities (e.g. individual religious activities and participating in religious assembly or gathering)
(13) Volunteer activities
(14) Phone conversation or gatherings with family members or relatives
(15) Phone conversation or gatherings with colleagues
(16) Phone conversation or gatherings with friends, members of social group or with personal acquaintances)
(17) Other activities

Table 2: **Time Use Classification**

This table shows the definitions of core market work, market work, nonmarket work, childcare, and leisure. We try to follow the classification in Aguiar and Hurst (2007b) as closely as possible.

Time use classification	Activities included
core market work	(4) + (5)
total market work	core market work + (3) + (6)
nonmarket work	(9)
child care	(7)
leisure measure 1	(11) + (13) + (14) + (15) + (16)
leisure measure 2	leisure measure 1 + (1) + (2)
leisure measure 3	leisure measure 2 + (7)
leisure measure 4	leisure measure 3 + (8) + (10) + (12) + (17)

Table 3: **Hours per Week Spent in Each Time Use Category, Individual-Level, Based on Method 2**

We divide the sample of non-working day group into demographic cells defined by two sex categories, two marital status, and whether a respondent is employed or not. After calculating the average hours on each time use of eight demographic cells based on non-working day group, we impute those average values into the corresponding cells of working day group. Then we obtain weekly hours spent on each time use as (time use of working day $\times$ 5 + imputed value $\times$ 2)

(a) Average hours per week, by categories

time-use category				employed	
(hours per week)	full	women	men	women	men
(1) core market work	34.84	25.43	44.55	42.81	48.80
(2) total market work	39.89	29.16	50.96	48.64	55.57
(3) nonmarket work	11.89	20.65	2.85	15.85	2.64
(4) child care	4.57	6.69	2.38	3.89	2.54
(5) leisure measure 1	37.73	37.06	38.42	27.83	35.06
(6) leisure measure 2	107.93	107.09	108.78	96.83	104.97
(7) leisure measure 3	112.49	113.78	111.16	100.72	107.51
(8) leisure measure 4	116.22	118.19	114.19	103.51	109.80
(2) + (3)	51.78	49.81	53.81	64.49	58.20
(2) + (3) + (4)	56.35	56.49	56.19	68.38	60.74
sample size	6,727	3,416	3,311	2,021	3,021

(b) Correlation coefficients (sample size = 6,727)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) core market work	1.00							
(2) total market work	0.99	1.00						
(3) nonmarket work	-0.60	-0.62	1.00					
(4) child care	-0.32	-0.33	0.33	1.00				
(5) leisure measure 1	-0.63	-0.63	0.08	-0.18	1.00			
(6) leisure measure 2	-0.68	-0.68	0.02	-0.18	0.89	1.00		
(7) leisure measure 3	-0.81	-0.81	0.16	0.25	0.80	0.90	1.00	
(8) leisure measure 4	-0.87	-0.88	0.17	0.22	0.74	0.84	0.92	1.00

Table 4: **Regression, Weekly Hours, Individual-level**

This table shows the results of regression analysis where the dependent variables are individual weekly hours spent on core market work, nonmarket work, child care, leisure measure 1 and leisure measure 4. Weekly hours are calculated based on method 2 (See table 3). The numbers in parentheses are robust standard errors. * and ** denote p-value < 0.10 and $p < 0.05$, respectively.

	Dependent Variables				
	core market work	nonmarket work	child care	leisure measure 1	leisure meisure 4
male	3.58**	-12.15**	-0.36**	8.59**	9.43**
	(9.11)	(-61.76)	(-5.32)	(27.57)	(23.12)
high-skilled worker	-2.73**	0.18	0.20**	0.89**	1.65**
	(-7.02)	(1.04)	(3.51)	(2.63)	(3.94)
ln(labor income)	2.85**	-1.55**	-0.04	-0.92**	-1.39**
	(8.92)	(-11.11)	(-0.92)	(-3.46)	(-4.08)
married	-0.88*	2.72**	0.57**	-5.69**	-5.65**
	(-1.81)	(12.23)	(5.57)	(-14.11)	(-11.27)
part-time job	-10.27**	2.25**	0.22*	3.83**	7.29**
	(-9.91)	(4.10)	(1.90)	(4.52)	(6.10)
regular job	-2.14**	-0.00	0.27**	0.44	0.73*
	(-5.06)	(-0.02)	(4.62)	(1.27)	(1.66)
private company	2.52**	-0.38*	-0.20**	-1.02**	-2.44**
	(5.86)	(-1.91)	(-3.01)	(-2.88)	(-5.42)
medium and small firms	-0.33	-0.09	-0.08	-0.49	0.06
	(-0.89)	(-0.48)	(-1.38)	(-1.57)	(0.16)
Seoul	2.02**	0.39*	0.14**	-1.20**	-3.52**
	(4.58)	(1.81)	(2.00)	(-3.20)	(-7.64)
metropolitan areas	0.80**	0.31*	0.14**	-0.71**	-1.53**
	(2.01)	(1.84)	(2.40)	(-2.22)	(-3.72)
age (31-40)	-0.68	3.31**	0.36*	-1.92**	-3.68**
	(-0.99)	(9.44)	(1.81)	(-3.20)	(-4.77)
age (41-50)	-0.58	4.48**	-0.55**	-0.33	-2.43**
	(-0.80)	(12.38)	(-2.90)	(-0.53)	(-3.00)
age (51-60)	0.18	3.60**	-0.77**	0.53	-1.30
	(0.23)	(9.54)	(-4.12)	(0.82)	(-1.55)
age (61-65)	-1.77*	2.82**	-0.59**	1.79**	1.90*
	(-1.71)	(6.51)	(-2.54)	(2.15)	(1.74)
R^2	0.14	0.65	0.17	0.20	0.18
sample size	4157.00	4157.00	2772.00	4157.00	4157.00

Table 5: **Trends in Hours per Week Spent in Each Time Use Category, Individual-Level, 2004-2014**

This table shows the trends in average weekly hours spent in total market work, leisure measure 1, and leisure measure 2 from 2004 to 2014. We report only the comparable categories that are available both in 2004 and 2014 Additional Survey of KLIPS. The sample sizes for each group are 9,216 (full), 4,667 (women), 4,539 (men), 2,350 (employed women), and 3,595 (employed men).

	total market work		leisure measure 1		leisure measure 2	
	2004	2014	2004	2014	2004	2014
(1) full	40.12	37.36	38.97	38.89	99.30	109.39
(2) women	29.56	26.30	38.86	38.47	99.50	108.94
(3) men	51.01	49.70	39.09	39.35	99.10	109.89
(4) women, employed	57.40	48.64	28.16	27.83	86.86	96.83
(5) men, employed	62.69	55.57	34.57	35.06	93.35	104.97

Table 6: **Hours per Week Spent on Each Time Use Category, Household-Level, Based on Method 2**

Panel (a) shows the average hours per week spent on each time use category. Weekly hours are calculated based on method 2. The numbers are the average hours of couples and does not include the hours spent by single family. Panel (b) shows the correlation coefficients among each time use category.

(a) Average hours per week, by categories

time-use category (hours per week)	all	double-income family	single-income family	with infant(s)	with children
(1) core market work	34.88	45.44	24.45	30.73	34.85
(2) total market work	39.75	51.45	28.19	35.54	39.85
(3) nonmarket work	13.27	10.73	15.78	13.52	13.53
(4) child care	5.98	4.09	7.85	14.05	7.28
(5) leisure measure 1	35.91	29.98	41.76	30.91	34.53
(6) leisure measure 2	105.94	99.45	112.35	101.08	104.21
(7) leisure measure 3	106.82	100.12	113.43	101.91	105.04
(8) leisure measure 4	109.87	102.40	117.25	105.72	108.16
(2)+(3)	53.02	62.18	43.97	49.05	53.38
(2)+(3)+(4)	59.01	66.28	51.83	63.10	60.67
sample size	2,097	1,042	1,055	463	1,512

(b) Correlation coefficients (sample size = 2,097)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) core market work	1.00							
(2) total market work	0.98	1.00						
(3) nonmarket work	-0.47	-0.47	1.00					
(4) child care	-0.26	-0.25	0.05	1.00				
(5) leisure measure 1	-0.63	-0.65	0.19	-0.26	1.00			
(6) leisure measure 2	-0.71	-0.73	0.08	-0.26	0.85	1.00		
(7) leisure measure 3	-0.72	-0.75	0.08	-0.27	0.84	0.99	1.00	
(8) leisure measure 4	-0.76	-0.78	0.08	-0.28	0.76	0.90	0.94	1.00

Table 7: **Hours per Week Spent on Each Time Use Category, , Based on Method 2**

This table shows men' and women's average hours spent on each time use category based on the sample that consists of double-income family and single-income family. For child care category, we calculate the average hours of families that have an infant or infants whose age is under 6. The number of double income families that have an infant or infants is 296 and the number for single-income families is 630.

time-use category	double-income family		single-income family	
(hours per week)	women	men	women	men
(1) core market work	41.81	49.07	3.77	45.12
(2) total market work	47.28	55.63	4.70	51.68
(3) nonmarket work	18.90	2.57	29.00	2.57
(4) child care	13.11	5.23	27.03	5.64
(5) leisure measure 1	25.50	34.46	45.97	37.54
(6) leisure measure 2	93.89	105.00	116.59	108.12
(7) leisure measure 3	94.70	105.55	118.17	108.68
(8) leisure measure 4	97.23	107.58	123.45	111.05
(2) + (3)	66.17	58.20	33.70	54.25
(2)+(3)+(4)	79.28	63.43	60.73	59.89
sample size	1,042	1,042	1,055	1,055

Table 8: **Hours per Week Spent by Income Groups, Household-Level**

Panel (a) shows the average weekly hours spent on each time use by income quintile. Disposable income divided by the square root of family size is used for income variable. Panel (b) shows the average disposable income, hourly wage, and consumption by income quintile. Those variables are real (basis year 2010 = 100). Hourly wage is labor income divided by core market work hours. Expenditures on leisure 1 and 2 are occured in enjoying leisure activities calculated according to expenditure categories matching definition of each leisure measure. Expenditure on leisure 2, 3 and 4 are the same due to data limitation.

(a) Average hours per week by each income quintile

category	income quintile				
(hours per week)	1	2	3	4	5
(1) core market work	30.31	31.71	36.23	38.07	37.83
(2) total market work	34.38	36.07	41.18	43.42	43.42
(3) nonmarket hour	13.95	14.26	13.30	12.42	12.55
(4) child care	6.83	7.70	5.91	4.98	4.56
(5) leisure measure 1	37.83	36.31	34.96	35.25	35.24
(6) leisure measure 2	109.24	106.67	104.47	104.70	104.68
(7) leisure measure 3	110.18	107.51	105.39	105.54	105.54
(8) leisure measure 4	113.76	110.82	108.52	108.02	108.34

(b) Average annual income, wage, and expenditrues for each income quintile

category	income quintile				
(KRW 10,000)	1	2	3	4	5
real disposable income	1,054.7	1,648.1	2,138.1	2,790.3	4,718.1
real wage (per hour)	1.03	1.28	1.47	1.71	2.53
real consumption	806.6	944.9	1,097.0	1,250.8	1,597.9
expenditure on leisure 1	165.2	199.7	231.3	277.6	364.0
expenditure on leisure 2	414.9	471.8	525.0	584.0	714.4

Table 9: **Income, Consumption Ratios and consumption-equivalent Measures λ_q**

The equivalent measures of welfare with non-separable utility function (λ_q^{NS}) is parameterized with $\gamma = 1.5$. For λ_q^{log} and λ_q^{NS} with quality of leisure, $\alpha = 0.5$ where $\ell = l^{\alpha}x^{1-\alpha}$. Details of CES home production function is on appendix.

	income quintile				
ratio	1	2	3	4	5
income ratio (y_q/y_5)	0.224	0.349	0.453	0.591	1.000
consumption ratio (c_q/c_5)	0.505	0.591	0.687	0.783	1.000
equivalent measure of welfare with leisure measure 1					
λ_q^{log}	0.541	0.650	0.679	0.762	1.000
λ_q^{log} with quality of leisure	0.278	0.368	0.466	0.613	1.000
λ_q^{log} with CES home production	0.616	0.760	0.747	0.763	1.000
λ_q^{NS}	0.308	0.475	0.574	0.683	1.000
λ_q^{NS} with quality of leisure	0.204	0.308	0.421	0.560	1.000
λ_q^{NS} with CES home production	0.230	0.462	0.548	0.618	1.000
equivalent measure of welfare with leisure measure 2					
λ_q^{log}	0.515	0.613	0.675	0.766	1.000
λ_q^{log} with quality of leisure	0.208	0.292	0.399	0.548	1.000
λ_q^{log} with CES home production	0.616	0.760	0.747	0.763	1.000
λ_q^{NS}	0.318	0.483	0.577	0.686	1.000
λ_q^{NS} with quality of leisure	0.205	0.309	0.422	0.561	1.000
λ_q^{NS} with CES home production	0.232	0.465	0.550	0.619	1.000
equivalent measure of welfare with leisure measure 4					
λ_q^{log}	0.519	0.615	0.680	0.761	1.000
λ_q^{log} with quality of leisure	0.209	0.292	0.400	0.544	1.000
λ_q^{log} with CES home production	0.616	0.760	0.747	0.763	1.000
λ_q^{NS}	0.323	0.487	0.583	0.681	1.000
λ_q^{NS} with quality of leisure	0.204	0.308	0.421	0.557	1.000
λ_q^{NS} with CES home production	0.232	0.465	0.550	0.619	1.000

Table 10: **Decomposing Log of Equivalent Measure** ($\log \lambda_q^{log}$)

Components are the sources that affect relative welfare level of households in q*th* quintile to that of households in 5*th*. (1) captures welfare inequality caused by consumption; $\log c_q - \log c_5$ (2) is the gain from intratemporal substitution between consumption and leisure hours $\frac{\theta\epsilon}{1+\epsilon}(1-\ell_5)^{\frac{1+\epsilon}{\epsilon}} - \frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}}$ (3) captures the effect of life expectancy differences; $\frac{e_q-e_5}{e_5}\left(\bar{u}+\log c_q+\frac{\theta\epsilon}{1+\epsilon}(1-\ell_q)^{\frac{1+\epsilon}{\epsilon}}\right)$(4) is relative gain or loss from uncertainty in log consumption $\frac{1}{2}(\sigma_5^2-\sigma_q^2)$. This decomposition is conducted with simple log utility function, and with leisure measure 2.

	income quintile				
components of $\log \lambda_q^{log}$	1	2	3	4	5
(1) mean of log consumption	-0.683	-0.523	-0.375	-0.245	0.000
(2) utility from leisure	0.129	0.084	0.013	-0.001	0.000
(3) life expectancy	-0.109	-0.051	-0.031	-0.021	0.000
(4) uncertainty	0.021	0.022	0.020	0.017	0.000

Table 11: **consumption-equivalent Scales (λ_q) with different value of γ and Leisure Measures in Non-separable Utility Function**

consumption-equivalent measures, λ_q, based on benchmark non-separable utility function with $\gamma = 1.5, 2, 3, 4$

	income quintile				
leisure definition	1	2	3	4	5
$\gamma = 1.5$					
Leisure Measure 1	0.308	0.475	0.574	0.683	1.000
Leisure Measure 2	0.318	0.483	0.577	0.686	1.000
Leisure Measure 3	0.319	0.482	0.578	0.685	1.000
Leisure Measure 4	0.323	0.487	0.583	0.681	1.000
$\gamma = 2$					
Leisure Measure 1	0.328	0.473	0.568	0.673	1.000
Leisure Measure 2	0.334	0.479	0.566	0.669	1.000
Leisure Measure 3	0.334	0.479	0.566	0.668	1.000
Leisure Measure 4	0.339	0.484	0.572	0.664	1.000
$\gamma = 3$					
Leisure Measure 1	0.363	0.478	0.562	0.654	1.000
Leisure Measure 2	0.352	0.468	0.542	0.631	1.000
Leisure Measure 3	0.352	0.468	0.542	0.630	1.000
Leisure Measure 4	0.356	0.472	0.547	0.628	1.000
$\gamma = 4$					
Leisure Measure 1	0.389	0.485	0.557	0.636	1.000
Leisure Measure 2	0.363	0.457	0.520	0.593	1.000
Leisure Measure 3	0.363	0.457	0.520	0.593	1.000
Leisure Measure 4	0.365	0.460	0.523	0.591	1.000

Table 12: **Life Expextancy by Income Groups**

This table shows life expectancies by income quintile and sex. male ratio is (number of male household member)/(number of total household member). Life exepctancy source : Kim et al. (2017)

	income quintile				
	1	2	3	4	5
male ratio	50.18	50.20	49.98	50.20	50.04
life expectancies					
men	70.91	75.20	76.96	77.43	78.84
women	80.30	82.71	83.06	83.65	84.12
mean	75.61	78.96	80.01	80.54	81.48

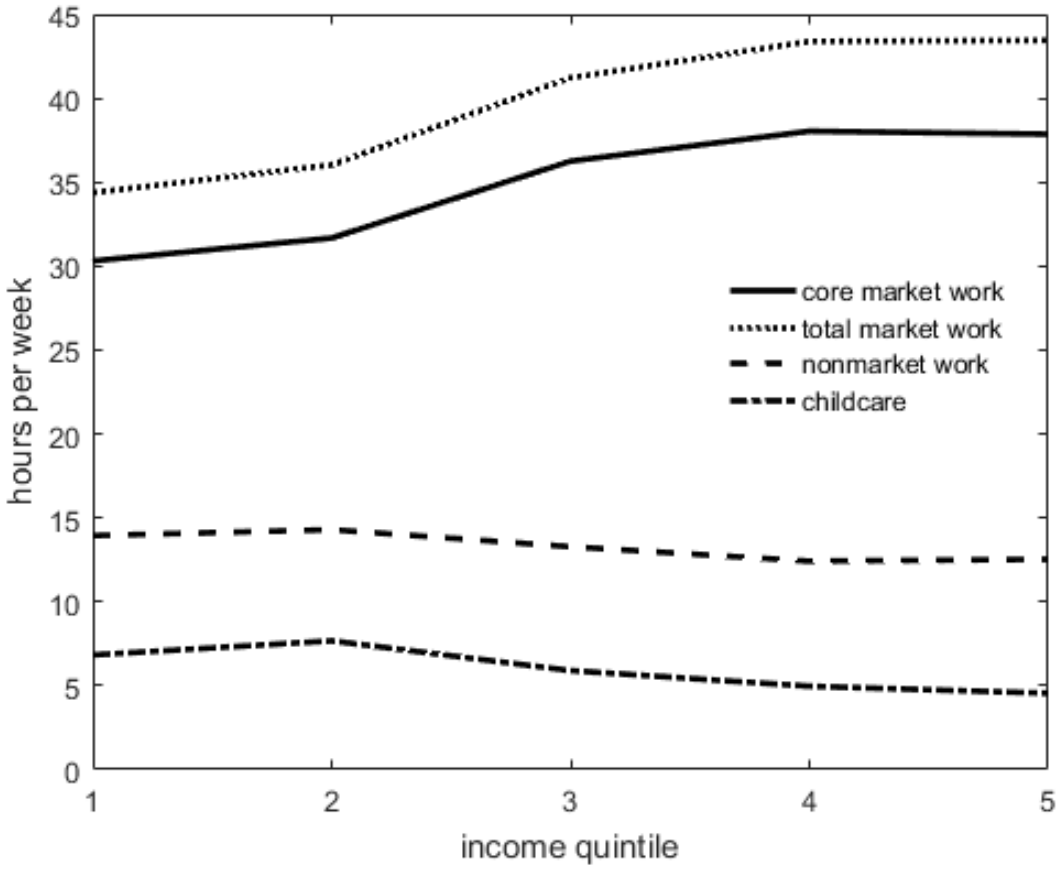

Figure 1: **Market and Non-market Work and Childcare Hours, by Income Quintile**

This figure shows each quintile's core market work, total market work, non-market work and childcare hours. Market hours increase with income while non-market work and childcare hours decrease. Market work hours for 4th income quintile is equal to or even less than that of 5th income quintile.

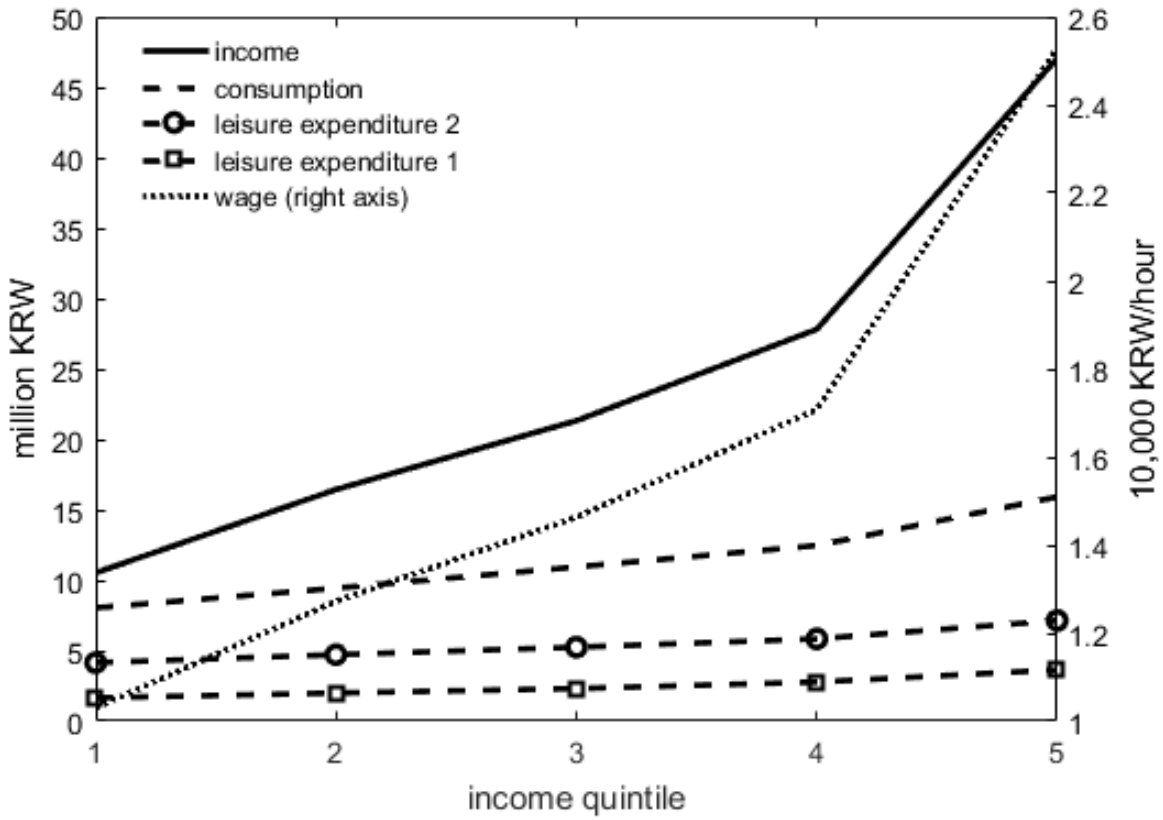

Figure 2: **Disposable income, Hourly Wage, Consumption, and Expenditure on Leisure Activities by Income Quintile**

This figure shows each quintile's real disposable income, real hourly aftertax wage, real net consumption less education and non-consumption expenditure, and expenditure on leisure activity 1 and 2.

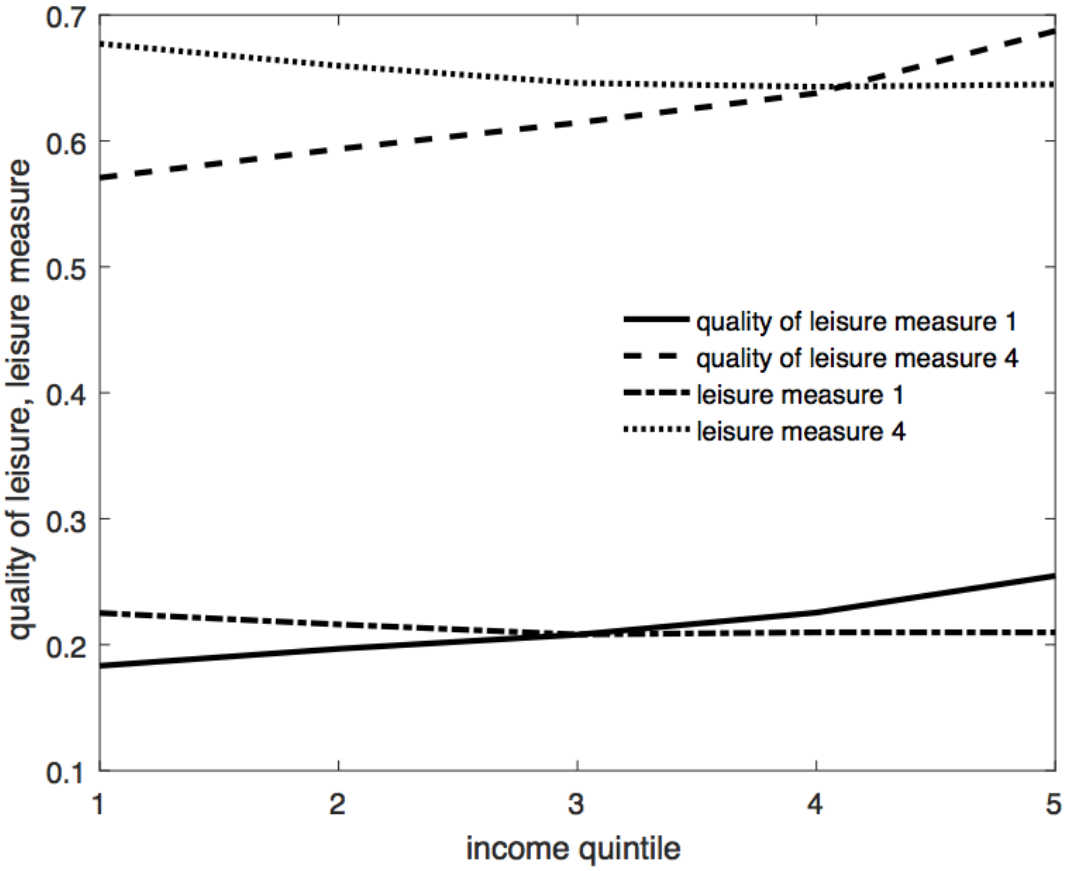

Figure 3: **Leisure Measures and Quality of Leisure Measures, by Income Quintile**

This figure shows each quintile's leisure measures and qualities of leisure measures in unit value. Unlike leisure measures that only count hours spent, the qualities of leisure measures comprise hours and expenditures. That explains why qualities of leisure measures have uprising figures contrast to leisure measures, since leisure related expenditure increases as income rises.

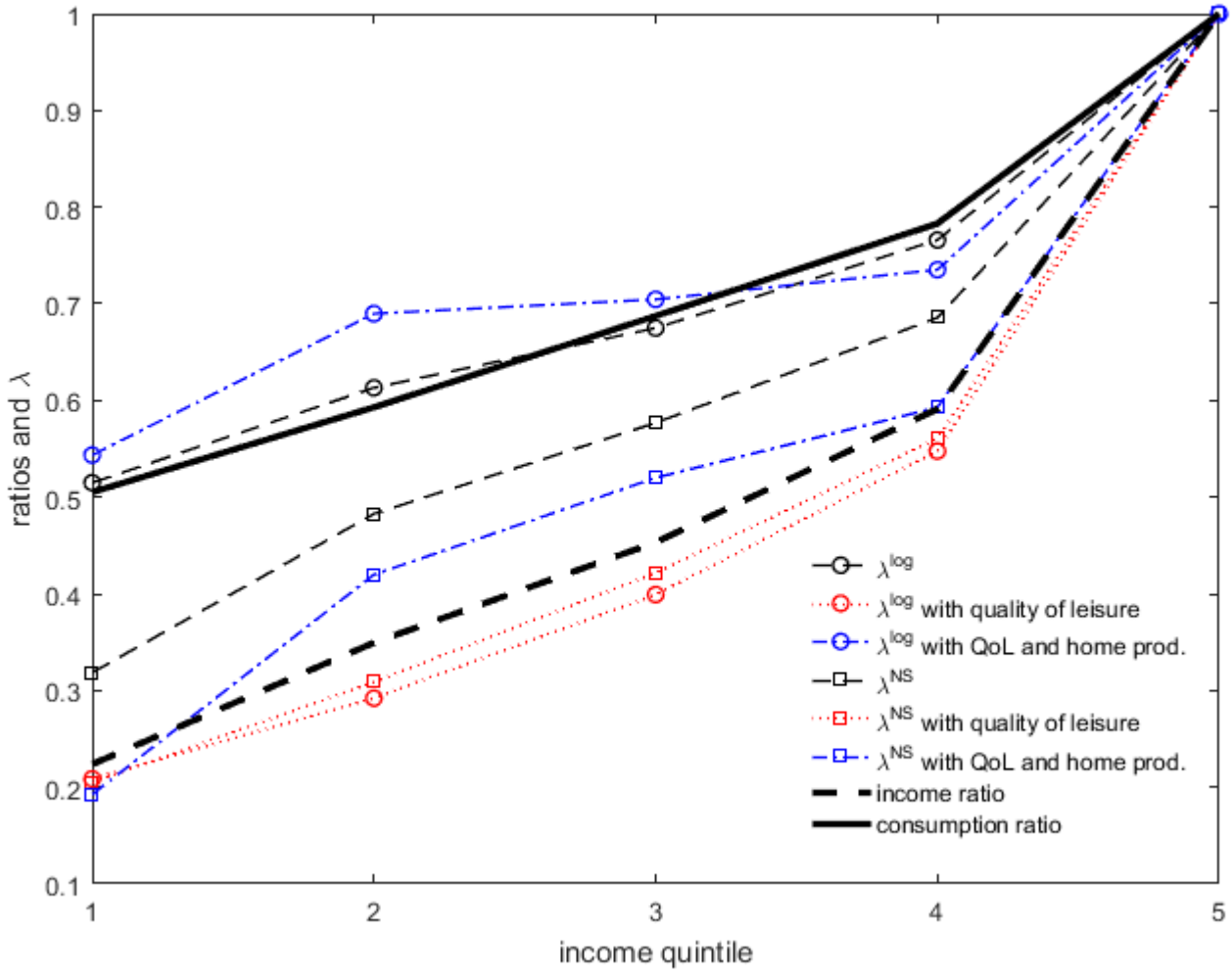

Figure 4: **Consumption-Equivalent Welfare Measures and Income, Consumption Ratios, by Income Quintile**

This figure shows each quintile's income and consumption ratios with consumption-equivalent welfare meausres. The benchmark λ^{log} and λ^{log} with quality of leisure are in line with consumption ratio. λ^{NS}s are between concumption ratio and income ratio. λ^{log} with home production is rather flat within 2nd to 4th income quintile. These λs are caculated with leisure measure 1, $\alpha = 0.5$ in quality of leisure, $\eta = 0.8$, $\kappa = 0.7$, $A = 3$ and $\psi = -5$ for CES home production function.