Measurement Error in Surveyed Data: Revisiting the Study of Income and Consumption Dynamics

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Abstract

A sizable volume of literature on the study of income and consumption dynamics has developed through the application of panel data surveys. Very few researchers, however, have provided solutions to the measurement error bias generated by surveyed income and consumption, although the presence of such bias has been widely acknowledged. This paper uses data from the Korean Labor and Income Panel Study (KLIPS) to examine whether the measurement error in surveyed income and consumption has the potential to generate biases for studies on income and consumption dynamics. A first-differenced dynamic panel model is estimated with lagged incomes and consumptions as internal instruments, and an external instrument – individuals' satisfaction regarding their household income – is used. This study suggests that there is substantial time-varying measurement error in surveyed income and consumption, and this error plays an important role for both studies of income and consumption dynamics. The combined effect of unobserved heterogeneity and time-invariant measurement error leads to an upward bias, but the effect of time-varying measurement error offsets the combined effect of unobserved heterogeneity and time-invariant measurement error.

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1. Introduction

The study of income or consumption dynamics, which investigates the degree of income or consumption persistence over time, has always been of great concern for economists and policy makers. Both research areas discuss whether policies for the redistribution of income are necessary and provide suggestions creating and implementing poverty-reducing policies. Results from the studies of income and consumption dynamics, however, can show varying degrees of persistence, despite relatively similar amounts of income and consumption behavior across the population. This situation arises in which, for example, income fluctuates over time while consumption is smooth. This distinction emphasizes the role of financial institutions: well-established institutions facilitate consumption smoothing and help people deal with individual income shocks.

This explanation closely relates to the Permanent Income Hypothesis (PIH) [Friedman (1957)]. According to the PIH, people consume income based on the expectation of lifetime income rather than current income. In fact, research on consumption dynamics has investigated this hypothesis extensively, with many studies providing evidence in support of it [Hall and Mishkin (1982)]. If one were to accept the PIH, observed consumption fluctuations resulting from income shocks would have to be attributed to a lack of adequate financial institutions. More recently, therefore, the direction of consumption dynamics research has shifted, with the acceptance of the PIH [Deaton (1992)], towards the investigation of how people deal with fluctuations of income and whether financial institutions are available to help people. A society requires financial institutions if studies indicate that individuals cannot smooth their consumption. When dealing with developing countries, this issue becomes even more relevant, as they typically lack these sorts of financial institutions.

A sizable volume of literature on these studies of income and consumption dynamics has developed [Deaton (1992, 1997), Bhargava and Ravallion (1993), Jacoby and Skoufias (1998), Browning and Collado (2001), Mckenzie (2001), and Kazianga and Udry (2004)]. Panel data surveys in particular have accelerated the development of this literature in the last two decades; however, few researchers have adjusted for deficiencies arising from measurement error in surveyed income or consumption, which is the main variable in each study. This is true despite the fact that the surveyed data is presumed to have substantial measurement error, the bulk of which are discussed in the following section. In an attempt to bring greater empirical rigor to this area of research, this paper examines income and consumption trends in South Korea to determine whether measurement error in surveyed income or consumption plays an important role in the study of income or consumption dynamics.

There are two groups of measurement error analyses in this literature. One type of analyses is a validation check to estimate the presence of measurement error itself in surveyed data; the other is through the use of advanced econometric techniques to correct bias. This latter group, however, typically confines measurement error to classical measurement error alone, ignoring the potential source of non-classical measurement error. This conflicts with the findings of the aforementioned research results on income or consumption dynamics. This paper, therefore, does not ignore the potential existence of non-classical measurement error, while it is assumed that non-classical measurement error is time-invariant. This study, moreover, bridges both groups of literature through an approach which identifies and corrects measurement error bias when validation checks are not possible.

The recent literature on linear dynamic panel data models, including unobserved heterogeneity, uses the values of lagged two periods (or more) as additional instruments for the first-differenced model [Arellano and Bond (1991)]. With the restriction of time-varying measurement error, however, the income or consumption of lagged two periods is not a suitable instrument. Accordingly, the values of lagged three or more periods are used as instruments in this case [Blundell and Bond (2000)]. By using this difference of lagged levels, this paper proposes a method to examine the existence and contributions of measurement error in survey data. This method is useful especially when the direct comparison of real versus surveyed values is impossible but when external instruments are available for income and consumption dynamics. In order to use the Arellano and Bond estimators, an additional assumption is required about the errors in the model: they must be serially uncorrelated over time. Therefore, an external instrument must be used to check for the assumption that serial uncorrelatedness is reasonable. In particular, this study uses individuals' satisfaction regarding their household income as external instruments for differenced lagged income and consumption to test the assumption of serial uncorrelatedness among error terms. An additional assumption, however, is required for these external instruments to be valid.

Using these different instruments for each estimation can reflect the differences among assumptions. In particular, estimations using the income or consumption values of lagged two periods or more as additional instruments can apply to situations where there is only time-invariant measurement error. Other instruments, however, can apply to situations where there may be time-varying measurement error. The Hausman test is used here to compare the estimates with and without the restriction of time-varying measurement error. Nevertheless, these Arellano-Bond estimates would be biased if the assumption of serial uncorrelatedness were violated, regardless of which levels of lagged dependent variables are used as instruments. Since this study employs external instruments as well, this assumption is also testable by the Hausman test which compares estimates using internal instruments to those using external instruments. Estimations employing internal instruments are based on the assumption that the errors are not serially correlated, but the use of external instruments do not require this assumption. If this assumption is violated, bias is generated, and the estimate with internal instruments will be significantly different from those with external instruments.

My results show that time-invariant measurement error and unobserved heterogeneity are significant sources of bias in Korean income and consumption dynamics, though this study cannot distinguish one from the other. For both studies, the first-differenced model with instruments corrects the bias caused by time-invariant measurement error and unobserved heterogeneity and gives a significantly different coefficient from that of the Ordinary Least Square (OLS) method. More importantly, this study suggests that time-varying measurement error plays an important role for both studies of income and consumption dynamics. The combined effect of unobserved heterogeneity and time-invariant measurement error leads to an upward bias, but the effect of time-varying measurement error offsets the combined effect of unobserved heterogeneity and time-invariant measurement error.

In terms of policy implications, this study finds that around half of income and consumption can be explained by past income and consumption. Therefore, Korean households smooth consumption from income shocks in some extent, though their income is also somewhat persistent.

The remainder of the paper is organized as follows: Section 2 discusses the potential presence of measurement error; Section 3 presents the empirical model and describes the data; Sections 4 and 5 focuses on empirical strategies and findings, respectively; and Section 6 concludes.

2. Potential Sources of Measurement Error

There are several reasons why the quality standards of income surveys should be suspected, primary of which is the observed presence of measurement error in income in earlier studies. These studies classify the source of measurement error into two categories: the respondents' inadequate ability to accurately recall their income and intentional under-reporting (or over-reporting). It is presumed that there are substantial recall errors in surveyed income, which is confirmed through several studies of U.S. data [Mellow and Sider (1983), Duncan and Hill (1985), Bound and Kruger (1991), Bound, Brown, Duncan, and Rodgers (1994), Pischke (1995), and Bound, Brown, and Mathiowetz (2001)]. These recall errors are typically related to those responses associated with a respondent's age, sex, level of education and job type. A large number of self-employed households, for example, often confuse personal and business income and expenses and generate recall errors in surveyed income [Coder (1992)]. It is also worth noting that the recall errors in income for men are higher than those for women [Bound and Krueger (1991)].

Income tax also has long been suspected as a main source of measurement error in surveyed income because respondents may have a motive to under-report their income with the aim of lowering their taxable income [Morgenstern (1963)]. If the government adopts a cumulative income tax system, households can reduce their tax by hiding their income within a certain range.[1] One piece of evidence supporting this suspicion is the phenomenon that surveyed income is often substantially less than surveyed consumption in country-level data. Other sources – such as recall error – may create a low reported income, but a more pervasive explanation of the phenomenon is respondents' intentional under-reporting, since consumption is the element more likely to be underestimated with recall errors. This phenomenon is often observed in poor-quality data [Deaton (1997)].

To approach these measurement error problems, there are two streams of studies: a validation check to estimate measurement error itself and the use of advanced econometrics to correct bias. Several studies have attempted to estimate measurement errors in household survey income data directly by using administrative data such as tax records, social security administration records and employer records [Mellow and Sider (1983), Duncan and Hill (1985), Bound and Kruger(1991), Coder (1992), Bound, Brown, Duncan, and Rodgers (1994), Pischke(1995), Bound, Brown, and Mathiowetz (2001) and Gottschalk and Huynh (2005)]. However, these studies have been limited mainly to U.S. data. Surveyed income data of most other countries are used without any validation check for income dynamics. Some of the difficulties of a validation check are mainly due to the lack of comparison data, the lack of budget, or privacy issues. On the other hand, some, though surprisingly few studies of income dynamics have identified and corrected measurement error bias by employing other approaches rather than the direct validation check [Solon (1989), Antnam and McKenzie (2005), Gottschalk and Huynh (2006)].

[1] There is another view of intentional over-reporting. Even respondents who have low income can over-report their income to hide their miserable situations.

While evidence of measurement error in surveyed income in the United States or developing countries is not perfectly applicable to surveyed income for all countries, it does establish a benchmark. According to the evidence, measurement error is likely to be correlated with both the true income, due to tax reasons, and with other covariates. It shows that the popular assumption, which confines classical measurement error only in variables, is not suitable for surveyed income. Consequently, this paper does not make any particular assumptions for measurement error in surveyed income but accepts any source of measurement error. Instead of restricting the type of measurement error (i.e. whether or not it is classical measurement error), this paper assumes that measurement error can be decomposed into time-varying and time-invariant components. The decomposition makes it possible to take away the time-invariant measurement error and allows the more plausible assumption that the first differencing captures non-classical measurement error component. The details are described in next section.

Unlike surveyed income, surveyed consumption has been used without a validation check in most studies of consumption dynamics, although measurement error in surveyed consumption has received attention in the literature [Altonji and Siow (1987)]. Indeed, a validation check is extremely difficult due to the lack of comparative data. Some studies, however, try to compare data from two different surveys to explore the characteristics of measurement error in surveyed consumption [Browing, Crossley, and Weber (2003)]. Other studies have attempted to estimate the degree of measurement error in surveyed consumption with experimental settings. Gibson (2002), for example, compares food consumption retrospectively asked of a random half of the respondents to diaries food consumption asked of the other half. Some, though very few, studies of consumption dynamics have corrected measurement error bias by employing advanced econometrics like the study of income dynamics [Attanasio, Battistin, and Ichimura (2004)].

The consensus on measurement error in surveyed consumption is that the source of measurement error is mainly due to respondents' poor ability to recall correctly. Unlike surveyed income, there are only a few motives for respondents to under-report their consumption. However, surveyed consumption is more likely to have recall error than the surveyed incomes, especially for retrospective data due to the lack of documented records of consumption. In fact, households are more likely to have records of income like individual income tax forms though it may not be true for households in poor countries or rural area. Recall error may be generated more often if the survey suffers from the lack of subdivision of consumption categories. Based on the characteristics of recall errors, measurement error in surveyed consumption can be time-varying, which may consist mostly of random or classical measurement error. Consequently, the primary concern here is related to whether the potential existence of recall error in surveyed consumption can be ignored.

3. Empirical Model and Data

3.1. Empirical Model

The most basic model of income or consumption dynamics estimates income or consumption trends by regressing either current per capita household income or consumption on its lagged value, controlling other household demographic variables and unobserved heterogeneity. These two basic models appear here as

$$Y_{it}^{*} = \gamma_y Y_{it-1}^{*} + \beta_y' X_{it} + \alpha_i^y + \varepsilon_{it}^y \tag{1}$$

and

$$C_{it}^{*} = \gamma_c C_{it-1}^{*} + \beta_c' X_{it} + \alpha_i^c + \varepsilon_{it}^c, \tag{2}$$

where Y_{it}^{*} is the true per capita income and C_{it}^{*} is the true per capita consumption of household i in time period t, X_{it} is a vector of household i's demographic variables in time period t, and α_i^k (k indicates income or consumption respectively) is unobserved heterogeneity of household i.[2] Here, $E(\varepsilon) = 0$, $cov(X_{it,}\, \varepsilon_{it}^{k}) = 0$, $cov(Y_{it-1}^{*}, \varepsilon_{it}^{y}) = 0$, $cov(C_{it-1}^{*}, \varepsilon_{it}^{c}) = 0$ and $cov(\alpha_i^k, \varepsilon_{it.}^{k}) = 0$ for k=y or c.

However, one does not observe the true measure Y_{it}^{*} or C_{it}^{*} but rather observes Y_{it} or C_{it}. The observed data, Y_{it} and C_{it}, with measurement error for true income or consumption are, thus,

$$Y_{it} = Y_{it}^{*} + \eta_{it}^{y} \tag{3}$$

and

$$C_{it} = C_{it}^{*} + \eta_{it}^{c}. \tag{4}$$

The models with measurement error, after substituting equation (3) into equation (1) and equation (4) into equation (2), are

$$Y_{it} = \gamma_y Y_{it-1} + \beta_y' X_{it} + \alpha_i^y + \varepsilon_{it}^{y} - \gamma_y \eta_{it-1}^{y} + \eta_{it}^{y} \tag{5}$$

and

$$C_{it} = \gamma_c C_{it-1} + \beta_c' X_{it} + \alpha_i^c + \varepsilon_{it}^{c} - \gamma_c \eta_{it-1}^{c} + \eta_{it}^{c}. \tag{6}$$

Here, $cov(\eta_{it}^{k}, \varepsilon_{it.}^{k}) = 0$ for k=y or c.

The model with measurement error produces biased estimates, though the degree of biasedness depends on the assumptions of the measurement error. In this study, no assumption is applied to measurement error: the model allows all types of measurement error, including non-classical measurement error. (i.e. $cov(\eta_{it}^{y}, Y_{it}^{*}) \neq 0$, $cov(\eta_{it}^{c}, C_{it}^{*}) \neq 0$, $cov(\eta_{it}^{k}, \alpha_i^k) \neq 0$ and $cov(X_{it,}\, \eta_{it}^{k}) \neq 0$ for k=y or c are all possible). As it is well known, the direction of bias depends on whether the measurement error is non-classical or classical in nature. The OLS estimate of γ (either γ_y or γ_c) will be biased towards zero if only classical measurement error is assumed. However, as mentioned in Section 2, measurement error in reported incomes is likely to be correlated with household characteristics and with true income. It is not likely,

[2] Note that time-varying unobserved heterogeneity is ignored in this study.

thus, that classical measurement error is present solely in the estimations involving reported income. Hence, this paper does not restrict the type of measurement error, allowing all types.

In this case, the direction of the bias and the contribution of errors in the model were not theoretically determined yet. The estimation with instruments of the above model cannot identify unobserved heterogeneity and measurement error separately because even valid instruments correct for bias from unobserved heterogeneity and measurement error at once. However, the general conclusion of previous empirical studies on income or consumption dynamics is that unobserved heterogeneity supports the likelihood of an upwards bias but measurement error supports the likelihood of a downwards bias. In any case, unobserved heterogeneity and measurement error in the error term are likely to generate bias with separate mechanisms.

Such linear dynamic panel data models usually take first differences:

$$\Delta Y_{it} = \gamma_y \Delta Y_{it-1} + \beta_y' \Delta X_{it} + \Delta\varepsilon_{it}^y - \gamma_y \Delta\eta_{it-1}^y + \Delta\eta_{it}^y \tag{7}$$

and

$$\Delta C_{it} = \gamma_c \Delta C_{it-1} + \beta_c' \Delta C_{it} + \Delta\varepsilon_{it}^c - \gamma_c \Delta\eta_{it-1}^c + \Delta\eta_{it}^c. \tag{8}$$

Taking first differences removed unobserved heterogeneity; however, even in the case of no measurement error, the OLS estimates for the first-differenced model is biased because Y_{it-1} and C_{it-1} are still correlated with the error terms because of their dynamic setting. Even more serious is the fact that Y_{it-1} or C_{it-1} can be correlated with measurement error in the case of the presence of measurement error.

Measurement error η_{it} (either η_{it}^y or η_{it}^c) is often decomposed into time-invariant and time-varying components because the first difference leaves only time-varying components of measurement error:

$$\eta_{it}^k = e_i^k + v_{it}^k \quad \text{for } k = y \text{ or } c, \tag{9}$$

then,

$$\Delta Y_{it} = \gamma_y \Delta Y_{it-1} + \beta_y' \Delta X_{it} + \Delta \varepsilon_{it}^y - \gamma_y \Delta v_{it-1}^y + \Delta v_{it}^y \tag{10}$$

and

$$\Delta C_{it} = \gamma_c \Delta C_{it-1} + \beta_c' \Delta X_{it} + \Delta \varepsilon_{it}^c - \gamma_c \Delta v_{it-1}^c + \Delta v_{it}^c, \tag{11}$$

where e_i^k is time-invariant measurement error, and v_{it}^k is time-varying measurement error for k=y or c. It is assumed here that time-invariant measurement error primarily captures non-classical measurement error, and that the first differencing takes away potential bias generated by non-classical measurement error. This assumption is more plausible than assumptions which completely ignore any possibility of the existence of non-classical measurement error.

In this paper, models (10) and (11) are estimated with possible sets of instruments including lagged incomes or consumption, in accordance with Arellano and Bond (1991). Details about the included instruments are introduced in the next section, but it is important to note here that models (10) and (11) are distinct from the typical unobserved heterogeneity model ignoring the potential existence of time-varying measurement error[3], because of the lagged difference of the total error term. (i.e.$\Delta v_{it-1}^k = v_{it-1}^k - v_{it-2}^k$ for k=y or c). Hence, a different approach is needed, the basis of which is detailed in Section 4.

3.2. Data

The data used for this study comes from the Korean Labor and Income Panel Study (KLIPS), which is conducted by the Korea Labor Institute. The KLIPS is the only income and labor-related panel survey in Korea and has been conducted annually since 1998. There are currently nine different years of data available, 1998-2006, the bulk of which focuses on the income, consumption, wealth and expenditures of households. It also included data on labor

[3]The typical unobserved heterogeneity model refers to $\Delta Y_{it} = \gamma \Delta Y_{it-1} + \beta' \Delta X_{it} + \Delta \varepsilon_{it}$ or $\Delta C_{it} = \gamma \Delta C_{it-1} + \beta' \Delta X_{it} + \Delta \varepsilon_{it}$.

status as well as demographic information such as self-reported health and satisfaction for individuals.

The KLIPS sample is an equally-distributed sample of households from Korea's seven metropolitan cities and urban areas in eight provinces. With a target of 5,000 households. 13,738 of respondents aged 15 and over were interviewed in 1998. 3,821 of the original 5,000 households were interviewed in 2006, which denotes a retention rate of about 76%, comparable to the nine waves of the Panel Study of Income Dynamics (PSID) in the U.S. The survey replaces the 24% attrition with new households each year to keep the number of households at 5,000. However, only the original households surveyed in 1998 are used for my analysis because this study requires follow-up information over all the years (1998-2006).

Household Income Variables

I examine per capita income dynamics at the household level, and per capita household income variables are used for the independent and dependent variables in this study. Substantial measurement errors are assumed, as it has been stated in Section 2 of this discussion.

KLIPS reports the following six types of household income: labor income, financial income, real estate income, social insurance income, transferred income and other income. Taking them in order, labor income is earned income in compensation for work, including wages or salary received from an employer or self-employment. Financial income is accrued from financial assets, such as interest on savings, stock dividends, interest on private loans and gains on securities transactions. Real estate income is earned from the receipt of housing rental fees, land lease fees, and gains on real estate transactions. Social insurance income arises from benefits such as national pensions, special professional pensions, industrial accident compensation insurance, military pensions, and unemployment benefits. Transferred income is based on that received from relatives for living expenses or from the government for education costs and unconditional aid. The survey also includes a measure for all other sources of income which are not included in the previous five types. All income is after-tax income in units of 10,000 won, and it basically identifies the income of the past calendar year.[4]

The survey also includes individual levels of labor income for each member of the household. Individual labor income information is utilized in this discussion rather than the household labor income for two reasons. First, the measured period in household labor income is inconsistent across waves because it reports average monthly labor income from the first to third years and shifts to annual earnings from the fourth to ninth waves.[5] Individual level of income, however, is surveyed as average monthly labor income consistently across all waves. Second, it is uncertain that an individual in the household has correct knowledge of the other household members' income. As such, I construct individual labor incomes of all members in a household, and the total household income variables are generated using constructed labor income from individual and household levels of financial income, real estate income, and other income. Social insurance and transferred income are excluded, as they are basically earned through the help of others. The main object of studying income dynamics is to show the degree to which current household incomes are affected by previous household incomes in the absence of such assistance. Examining this dynamics as the per capita level, total household income is divided by household size.

As it has been mentioned already, the main aim of the study of income dynamics is to investigate the distribution of income and poverty trap. Thus, low-income households are important samples for this study. KLIPS reports that 10 percent of respondents are zero-income households for each year. To retain this important sample within my constructed dataset, per capita household income variables are altered in logarithmic forms after adding one (i.e. $ln\ (Income + 1)$).[6]

Measurement error in this income variable cannot be ignored. As it was described earlier, intentional under-reportings are suspected. Since the adopt of a cumulative income tax

[4] 10,000 won $\approx$ 9 dollars

[5] KLIPS asks "monthly average income in the past calendar year" for the first to the third wave, but alters the question to "total earned income in the past calendar year" for the fourth to ninth wave.

[6] Adding one could be criticized as an arbitrary choice. Additional robustness checks are conducted.

system by the Korean government, households can reduce their taxable income by reporting within a certain range. This type of measurement error is more likely to be non-classical, which is assumed to be time-invariant measurement error in this study. Recall error in income can also not be ignored. According to Coder [1992], self-employed individuals often generate recall error, and 37% of individuals are self-employed in KLIPS. Consequently, a large share of my dataset may be suspected of producing recall error, which is assumed to be random measurement error for this study.

Household Consumption Variables

Like the study of income dynamics, per capita consumption variables are constructed at the household level and are utilized as both independent and dependent variables in the subsequent analysis. Though there are fewer motives to under-report in surveyed consumption, substantial recall errors are assumed because of the lack of documented records for retrospective and aggregated questionnaire.

KLIPS reports household expenditure through two methods: through the direct reporting of total household expenditure and through a disaggregated method, which is based on details of household expenditure. The measured period in the survey is inconsistent. Specifically, household living expenses are investigated through both methods only in the second, fourth and following waves. The survey directly asks for total household consumption excluding the disaggregated details for the first and third waves. To have a sufficient sample size, I have chosen to include only household expenditure based on the direct reporting method, while a separate per capita household consumption variable is also constructed, by aggregating subdivided consumption. This method is also preferred due to the lack of subdivision of consumption categories in KLIPS, which shows no difference between the aggregate and disaggregate levels of expenditure.[7] Unlike income variables, only two households report zero consumption. Per capita household consumption variables are altered in

[7] KLIPS suffers from the lack of subdivision of consumption categories. Other panel surveys usually have more categories for expenditure data. Some have more than a hundred categories, but KLIPS only has 11 (for the second wave) to 20 (for the ninth wave) categories.

logarithmic forms without adding one. Two zero consumption households are excluded for my study.

Other Control Variables

A set of household characteristics is controlled. The set includes household size, fraction of elderly people, educational level of head of household, age of head of household, and the square value of the age of head of household, a locality indicator to show whether the respondent resides in Seoul, and a non-spouse indicator to show whether the household contains a wife or husband. All control variables are treated as exogenous. The main statistics are reported in Table 1.

Sample Size

The first-differenced model in most dynamics studies requires at least three years' data, whether or not measurement error is present. If only exogenous instruments are used in this analysis, these three years' of panel data are enough to correct the bias of both the measurement error and the unobserved heterogeneity. However, the Arellano-Bond method requires at least four years' data if there is potential time-varying measurement error. The next section explains the necessity of this additional data.

Table 3 summarizes the availability of instruments used in this paper. The constructed measure of household income is available only from 1998 to 2005, because household income is surveyed retrospectively though the individual labor income of the current year. Note that the household income is constructed using labor income at the individual level while the other categorized income is based at the household level. The household consumption, which is surveyed by the direct method, is available from 1997 to 2005. However, each individual's household income satisfaction data is available from 1999 to 2006. The overlapping periods for this analysis are only t = 2002, 2003, 2004 and 2005 because these variables are used at $t-3$ for the Arellano and Bond method and at $t-2$ as well as $t-3$ for the external instruments.

Sample size is even more restricted because the model requires several variables including income, consumption, other explanatory variables and external instruments. A number of households did not respond to all these questions, and the loss of data is reported in Table 4. I also exclude two households as outliers for the study of income dynamics and one household for the study of consumption dynamics using a Box-plot. After this elimination process, a total of $11,438$ households are analyzed for the study of income dynamics, and a total of $11,832$ households are analyzed for the study of consumption dynamics.

4. Model Identification

The main aim of this paper is to achieve a more precise estimate in the investigation of income and consumption trends by identifying biases that arise from measurement error. As already noted, my study estimates a first-differenced model to eliminate the effect of unobserved heterogeneity and time-invariant measurement error. Nonetheless, the endogeneity of a dynamic setting and time-varying measurement error remains. The use of instruments can deal with the problem for both investigations of income and consumption trends. One instrument can be two-period (or more) lagged dependent variable(s) [Arellano and Bond (1991)], but the Arellano-Bond estimator may not fit the assumption of serially uncorrelated errors. Accordingly, additional external instruments are included for this study. This serves to check for the assumption that serial uncorrelatedness is reasonable, though these external instruments are based on additional assumptions.

4.1. Choice of Instrumental Variables

A valid instrument is a variable that is (a) correlated with income or consumption for the study of income or consumption dynamics, respectively, once the other control variables have been netted out and (b) uncorrelated with the error term in the model. The valid instrument is (c) independent of measurement error. In this paper, these sets of instruments are used for both studies of income and consumption dynamics.

First, lagged dependent variables are used as instruments. The variables of the two or more lagged periods are well-known instruments in the first-differenced dynamic panel model. However, the condition (b) for a valid instrument necessarily leads to an assumption that the error term must not be serially correlated over time [Arellano and Bond (1991)]. In a typical model without time-varying measurement error, valid instruments for $\Delta Y_{it-1} = (Y_{it-1} - Y_{it-2})$ or $\Delta C_{it-1} = (C_{it-1} - C_{it-2})$ are the lagged levels $Y_{it-2}, Y_{it-3}, \ldots, Y_{i1}$ or $C_{it-2}, C_{it-3}, \ldots, C_{i1}$ as $E(Y_{it-s} \cdot \Delta\varepsilon_{it}^{y}) = 0$ or $E(C_{it-s} \cdot \Delta\varepsilon_{it}^{c}) = 0$ for $s = 2, 3, \ldots t-1$. However, model (10) or (11) with time-varying measurement error is distinguished from the typical first-differenced dynamic panel model. That is, model (10) or (11) includes the lagged time-varying measurement differenced term in the total error term (i.e. $\Delta v_{it-1}^{k} = v_{it-1}^{k} - v_{it-2}^{k}$ for k=y or c). Since $E(Y_{it-2} \cdot \Delta v_{it-1}^{y}) \neq 0$ or $E(C_{it-2} \cdot \Delta v_{it-1}^{c}) \neq 0$, the lagged level Y_{it-2} or C_{it-2} is not a valid instrument.[8] The set of lagged levels $Y_{it-3}, \ldots, Y_{i1}$ or $C_{it-3}, \ldots, C_{i1}$, which is my second set of instruments for the study of income or consumption dynamics respectively, must be used to indicate and correct for time-varying measurement error. Therefore, the difference of coefficients between models using the first and the second set of instruments indicate the direction and contribution of any bias by the time-varying measurement error.

As mentioned, this paper additionally uses an external instrumental variable for the differenced lagged income and consumption to check for the assumption that serial uncorrelatedness is reasonable, although an additional assumption is needed for this instrument to be valid. In particular, individuals' satisfaction regarding their household income, which refers to the response of each household head to the question 'how much are you satisfied with your household net income,' is used.[9] There are undeniable relationships of income satisfaction with income and consumption [Easterlin (2001)], but the validity of this external instrument

[8] Models are described in Section 3.

[9] Eating-out consumption and asset variables are also experimented as external instruments respectively for differenced income and consumption. The estimates using asset as instruments are robust with those using income satisfaction, while the estimates using eating-out consumption shows sensitivity with low F statistics in the first stage regression.

is suspected in a level model (i.e. the model (1) or (2), which is not first-differenced) because this variable may be correlated with unobserved heterogeneities. It can be argued that a positive mindset as one of the unobserved heterogeneities can be correlated with income satisfaction. A first differencing, however, eliminates unobserved heterogeneity and reduces the problem. Once the first differencing is taken, a key assumption for this external instruments is that time-varying measurement error is generated in an entirely random manner. This is reasonable because time-varying measurement error is mostly regarded as random measurement error. However, the lagged levels of this instrument must also be chosen carefully. Contrary to the instrument sets of lagged dependent variables, this external variable at any t is not correlated with the lagged time-varying measurement differenced term (i.e. Δv_{it-1}^{k} for k=y or c). Nevertheless, this variable at t or $t-1$ may be correlated with the differenced residual (i.e. $\Delta\varepsilon_{it}^{y}$), which represents individual income shock. For example, some can argue that people with negative (or positive) income shock at a particular year are more likely to report income dissatisfaction (or satisfaction). Therefore, individuals' satisfaction regarding their household income at $t-2$ and $t-3$ are used as external instruments for the model which addresses time-varying measurement error.

Satisfaction-related questions are included in KLIPS, including household income satisfaction at the individual level for each year except for the first wave. Household income satisfaction is surveyed as current satisfaction at the time of responding to the questionnaire, and each individual responds according to degree of satisfaction on a 1 to 5 scale, with "1" being very satisfied and "5" being very dissatisfied. Lower scores, therefore, measure higher satisfaction. Table 5 and 6 respectively report average income satisfaction by income group and by consumption group. It is evident that lagged income satisfaction is strongly correlated with lagged income and consumption except for those who are ranked in the highest one percent of income. However, the correlation between income satisfaction and changes in income (or changes in consumption) is not strongly evidenced because each relationship looks like a U-shape in Table 6.

Condition (c) is satisfied, however, only according to the assumption that there is no correlation between household income satisfaction and time-varying measurement error in income or consumption. This assumption is also likely to be satisfied, but some might doubt its validity. For example, individuals may generate sporadic measurement error in income and may equate satisfaction or dissatisfaction from irregular income with good or bad luck. Thus, incorrect responses may be provided for a retrospective question on previous years' income because of income deviations from previous income profiles.[10] Moreover, some individuals cannot remember their income accurately because they are simply satisfied and, therefore, unconcerned about their income. Similar arguments can be applied to the study of consumption dynamics. In such cases, household income satisfaction and time-varying measurement error in income (or consumption) are correlated with one other, violating condition (c). This study only assumes that time-varying measurement error is generated in an entirely random manner and thus is not correlated with household income satisfaction. Once condition (c) is accepted, condition (b) is valid because unobserved heterogeneity is removed from the first differencing.

4.2 Tests

Each set of instruments is valid under the particular assumptions addressed above. To review, first, my external instrument is valid only if it is exogenous. Second, the validity of both sets of internal instruments depends upon the assumption that the error term must not be serially correlated over time. Finally, the use of internal instruments with Y_{it-2} or C_{it-2} requires the assumption that there is no time-varying measurement error. The last two assumptions can be tested by comparing the estimates with and without the restriction of these assumptions, while those tests are built upon the first assumption. The assumption, the exogeneity of external instruments, is valid if time-varying measurement error is generated in an entirely random manner.

[10] Note that KLIPS asks "current household income satisfaction" but "past year income".

This study examines whether or not the difference between the estimates with and without the restriction of these assumptions are statistically significant. In other words, is the difference between the estimates using external versus internal instruments statistically significant? If the answer is yes, the assumption that the error term is not serially correlated over time is invalid conditional on the validity of the external instruments. In addition, another question is whether the difference between the estimates using two different sets of internal instruments is statistically significant. The answer also points out the validity of the assumption that there is no time-varying measurement error. This study compares the estimates γ (γ_y or γ_c) with and without the restriction of my assumptions in model (10) or (11).[11] For these analyses, the standard error of the difference of these estimates must be calculated, as well as the difference itself. The calculation of the standard error is difficult in most cases, but in this study an easy way proposed by Hausman (1978) is used to calculate it.

Hausman proved that for some conditions the square root of the difference of the variance of these estimates is asymptotically the same as the one we need.[12] My analysis satisfies its requirements. The method of Hausman test is as follows. One estimator must be consistent under the null hypothesis, while the other estimator must be consistent under the null and alternative hypothesis. The latter must also be less efficient under the null hypothesis (for example, one can set the latter estimator as $\widehat{\gamma_A}$ and the former as $\widehat{\gamma_B}$). Consequently, the *plim* $(\widehat{\gamma_A} - \widehat{\gamma_B})$ is non-zero under the alternative hypothesis because $\widehat{\gamma_B}$ is inconsistent under the alternative hypothesis while $\widehat{\gamma_A}$ is consistent. By contrast, *plim* $(\widehat{\gamma_A} - \widehat{\gamma_B})$ is zero under the null hypothesis. Therefore, the test only needs to examine whether or not the *plim* $(\widehat{\gamma_A} - \widehat{\gamma_B})$ is zero. If it is zero, the null hypothesis cannot be rejected. To fit the method, my null hypothesis must be that an assumption is correct. The $\widehat{\gamma_A}$ and $\widehat{\gamma_B}$

[11] A more accurate test is to compare all respective coefficients with and without the restriction of the assumptions in model (10) or (11). Therefore, strictly speaking, these comparisons only show whether there is bias of the coefficient γ from time-varying measurement error or serial correlation among error terms. However, my main interest in this study is only the coefficient γ.

[12] The Hausman test requires that 1) one of the two estimations be nested in the other estimation, 2) one of the two estimates achieve the Cramer-Rao lower bound, and 3) there not be a finite sample problem.

respectively must be set as one estimate which does not require an assumption and as the other estimate which requires it. By doing so, both estimates are consistent under the null hypothesis that the assumption is correct, but the estimate which requires the assumption, needless to say, is inconsistent under the alternative hypothesis. Accordingly, if the difference of these two estimates is not significantly different from zero, then the null hypothesis cannot be rejected, and neither can the assumption.

Again, this study examines two assumptions: (1) there is no serial correlation among error terms, and (2) there is no time-varying measurement error in surveyed variables for both studies. The main interest of this study is to find whether (2) there is no time-varying measurement error, but test (1) should precede test (2) because the examination about time-varying measurement error is based on the assumption of serial uncorrelatedness. In particular, estimates using the Arellano-Bond estimator would be biased if the assumption of serial uncorrelatedness were violated, regardless of which levels of lagged dependent variables are used as instruments. Therefore, I begin with the test whether there is no serial correlation among error terms. The basic idea is as follows: the estimation employing the lagged incomes as instruments is based on the assumption that there is no serial correlation. If this assumption is violated, the estimation generates bias, and the estimate using those (lagged three periods and more income or consumption as instruments, which also address time-varying measurement error) is significantly different from the estimates using external instruments. Therefore, the null and alternative hypotheses are

H_0 : *The error term in the first-differenced model is not serially correlated, and*

H_1 : *The error term in the first-differenced model is serially correlated.*

The estimate in my first-differenced model using external instruments could be $\widehat{\gamma_A}$, and the estimate in the same model but using internal instruments could be $\widehat{\gamma_B}$. However, in this case, the first-differenced estimation using only internal instruments is not nested in the estimation using external instruments. A nested test can be constructed by getting a coefficient using both internal and external instruments at the same time and by comparing these coefficients with coefficients using only external instruments. In other words, $\widehat{\gamma_A}$ must be the estimate in the first-differenced estimation using only external instruments and $\widehat{\gamma_B}$ must be the estimate in the same estimation using both external and internal instruments. Consequently, both $\widehat{\gamma_A}$ and $\widehat{\gamma_B}$ are consistent, but $\widehat{\gamma_A}$ is less efficient under the null hypothesis. On the other hand, $\widehat{\gamma_B}$ is inconsistent, while $\widehat{\gamma_A}$ is still consistent under the alternative hypothesis. Then, the *plim* $(\widehat{\gamma_A} - \widehat{\gamma_B})$ must be non-zero under the alternative hypothesis. By contrast, *plim* $(\widehat{\gamma_A} - \widehat{\gamma_B})$ must be zero under the null hypothesis. Therefore, the study only needs to examine whether or not the *plim* $(\widehat{\gamma_A} - \widehat{\gamma_B})$ is zero. If it is zero, my assumption cannot be rejected.

Once the assumption that there is no serial correlation among error terms is accepted, the test for whether there is no time-varying measurement error in surveyed income or consumption is based on the following null and alternative hypotheses:

H_0 : *There is no time-varying measurement error in surveyed variables, and*

H_1 : *There is time-varying measurement error in surveyed variables.*

In this case, $\widehat{\gamma_A}$ is the estimate in the first-differenced estimation with the restriction of time-varying measurement error, and $\widehat{\gamma_B}$ is the estimate in the estimation without it. In particualr, there are three ways to examine these hypotheses. The first option is to compare one estimate $(\widehat{\gamma_A})$ using only external IVs to the other $(\widehat{\gamma_B})$ using both external and internal IVs including Y_{it-2} (or C_{it-2}). This is a combined test of serial uncorrelatedness and time-varying measurement error. The alternative options are to compare the latter estimates $(\widehat{\gamma_B})$ to another estimate $(\widehat{\gamma_A})$ using the same IVs but excluding Y_{it-2} (or C_{it-2}) or to compare one $(\widehat{\gamma_A})$ using only internal IVs excluding Y_{it-2} (or C_{it-2}) to the other $(\widehat{\gamma_B})$ using only internal IVs including Y_{it-2} (or C_{it-2}). Again, both $\widehat{\gamma_A}$ and $\widehat{\gamma_B}$ are consistent, but $\widehat{\gamma_A}$ is less efficient under null hypothesis. On the other hand, under the alternative hypothesis, $\widehat{\gamma_B}$ is inconsistent, but $\widehat{\gamma_A}$ is still consistent. Like test (1), this study examines the difference of $(\widehat{\gamma_A} - \widehat{\gamma_B})$.

5. Results

The ordinary least square (OLS) method without first differencing deals with neither unobserved heterogeneity nor measurement error bias, yet it is a good starting point for this study in order to provide a general idea about bias. Table 7 presents the estimates for the model without first differencing using the OLS method and the instrumental variable (IV) method. Using the OLS method, the coefficients γ_y and γ_c are .52 and .62 respectively, which indicate the effect of past income on current income or the effect of past consumption on current consumption. All other covariates have expected signs. However, the IV method is essential if unobserved heterogeneity and measurement error in surveyed income or consumption are assumed, and it can provide consistent estimates once the exogeneity of the IV is justified. My IV estimations in the level model for both studies of income and consumption give higher estimates γ (.78 and .95 respectively) than those of the OLS results, but none are consistent because my IVs, individuals' satisfaction regarding their household income, are more likely to be correlated with unobserved heterogeneity in the level model. Suspected unobserved heterogeneity, for example, may include a positive or negative mindset. Some may argue that people with a positive mindset are more likely to be satisfied with their income, work harder and have a greater future income. A similar argument can be applied to the study of consumption dynamics. Some may argue that people with a positive mindset are more likely to be satisfied with their income, worry less and consume more. Therefore, those IVs do not qualify as exogenous variables in the level model .

Tables 8 and 9 report the main results dealing with not only measurement error but also unobserved heterogeneity by taking a first differencing. Table 8.1 reports the estimates in the second stage regressions for the study of income dynamics, and Table 9.1 reports those for the study of consumption dynamics. Note that the first differencing takes away only unobserved heterogeneity and time-invariant measurement error. The first-differenced model using the OLS method gives a negative coefficient, but it is biased by not only time-varying measurement error but also a dynamic setting. Therefore, the IVs explained in the previous section and different combinations of these are used to correct such bias. However, for each study, only one result using external IVs is reported, in addition to two sets of internal IVs (one set includes Y_{it-2} or C_{it-2}, but the other does not). In particular, the estimations using income satisfaction at $t-2$ and $t-3$ together as external IVs are reported for both studies of income and consumption dynamics. Table 10, moreover, reports the estimations using both internal and external IVs as well.

The corresponding first-stage estimations are reported in Tables 8.2, 9.2 and 10.2. These estimations for each set of IVs confirm condition (a) in Section 4. All F statistics indicate that identifying IVs are jointly significant at the 1% level and confirms that the instruments used in my study are strongly correlated with differenced lagged income or consumption, once the other covariates have been netted out. The first-stage estimations using external IVs show F statistics as 12.24 and 10.26 respectively for the income and consumption dynamics. Only F statistic of an estimation using lagged incomes excluding Y_{it-2} as IVs is a value of much less than 10.[13] All the coefficients of these identifying IVs also have the expected signs. As seen in Table 10.2, however, all F statistics are higher than 10 once external IVs are additionally used with these internal IVs.

My main interest is the coefficient γ (γ_y or γ_c), which indicates the effect of past income on current income or the effect of past consumption on current consumption, rather than other covariates. For the study of income dynamics, the coefficients γ_y are .59 (at the 5% significance level), .13 (at the 1% significance level) and .49 (at the 10% significance level) respectively for the estimations using external IVs, internal IVs including Y_{it-2} and internal

[13] It is a rule of thumb that F statistic takes a value greater than 10 for a weak-identification test [Staiger and Stock (1997)]. However, the number is arbitrary.

IVs excluding Y_{it-2} in the first-differenced model. This result suggests that unobserved heterogeneity and time-invariant measurement error together may be significant sources of bias based on the comparison between the estimates (.52 versus .13) using the OLS without a first differencing and the IV method using internal IVs including Y_{it-2} in the first-differenced model, although this study does not statistically examine the difference.[14] However, internal IVs including Y_{it-2} cannot address time-varying measurement error, and therefore a more accurate coefficient that corrects bias from time-varying measurement error is either .59 or .49. These results may suggest that time-varying measurement error offsets the combined effect of unobserved heterogeneity and time-invariant measurement error.

The Hausman test, furthermore, enables me to statistically examine two assumptions of serial uncorrelatedness among error terms and time-varying measurement error in surveyed income. First, for the test as to whether or not there is serial correlation among error terms, the coefficient using only external IVs must be compared to a coefficient using both external and internal IVs but excluding Y_{it-2}. Table 11 shows the results of the Hausman tests. The difference between these coefficients using only external IVs versus both internal and external IVs is .0487, but the high standard error of the difference (.2394) suggests that the error term in the first-differenced model is not serially correlated. However, the test results for time-varying measurement error in surveyed income are inconsistent, even though the comparison of one model using external IVs to the other using external and internal IVs is left out. Again, this comparison may not accurately examine the existence of time-varying measurement error because it tests serial uncorrelatedness at the same time. The alternative options, as explained in the previous section, indicate more exactly the existence of time-varying measurement error rather than serial uncorrelatedness. However, the results of two alternative options are inconsistent. That is, the result from the comparison of estimates using only internal IVs (i.e. estimates in (3) versus in (4) in Table 8) is not the same as that using both internal and external IVs (i.e. estimates in (3) versus in (4) in Table 10).

[14] The OLS method for the level model cannot be statistically compared to the IV method for the first differenced model because these are not nested.

The differences between the coefficients γ_y are similar (.3650 for the former and .3967 for the latter) but the standard errors of the difference are .2727 and .1512 respectively. Therefore, the latter suggests that there is substantial time-varying measurement error, but the former does not. The former result, however, may be due to the high standard error of the coefficient using internal IVs excluding Y_{it-2}, which has a small F statistic in the first stage regression.

My study of consumption dynamics, on the other hand, presents the coefficients γ_c as .60 (at the 5% significance level), .20 (at the 1% significance level) and .41 (at the 1% significance level) respectively for the estimations using external IVs, internal IVs including C_{it-2} and internal IVs excluding C_{it-2} in the first-differenced model. This result also suggests that unobserved heterogeneity and time-invariant measurement error together may be significant sources of bias like the study of income dynamics. Compared to the estimate .62 from the OLS method without first differencing, the estimate from the IV method with internal IVs including C_{it-2} in the first-differenced model is much lower (.20). However, internal IVs including C_{it-2} cannot address time-varying measurement error, and therefore a more accurate coefficient that corrects bias from time-varying measurement error is either .60 or .41. All these coefficients suggest that around half of consumption can be explained by past consumption. Therefore, these supports the evidence of consumption smoothing though it is not perfect smoothing.

The Hausman test is also applied to the study of consumption dynamics and presents serial uncorrelatedness among error terms. Most importantly, this study consistently indicates that the effect of time-varying measurement error on consumption dynamics is statistically significant. As seen in Table 11, the difference between the coefficients γ_c in estimation (3) and (4) in Table 9 is .2092 and has a relatively small standard error (.0545). The comparison of the estimates using both internal and external IVs confirms this. The difference between the coefficients γ_c in estimation (3) and (4) in Table 10 is .2046 and also has a relatively small standard error (.0532). This study, in particular, shows the downward bias from the time-varying measurement error in the surveyed consumption. It suggests, therefore, that the effect of time-varying measurement error offsets the combined effect of unobserved heterogeneity and time-invariant measurement error.

6. Discussion and Conclusion

My study emphasizes the importance of data quality, especially for surveyed income and consumption. Indeed, this study finds that measurement error is an important factor that leads to bias in both studies of income and consumption dynamics, although the bias can, in some cases, offset the bias generated by unobserved heterogeneity. The first differenced model with instruments corrects for bias caused jointly by time-invariant measurement error and unobserved heterogeneity and gives a significantly different coefficient from the one attained through the OLS method. However, it is unfortunate that this study cannot distinguish between the effects of time-invariant measurement error and unobserved heterogeneity.

This non-separation makes it difficult to evaluate the potential effects of time-invariant measurement error. The general findings of previous studies of income and consumption dynamics indicate that unobserved heterogeneity leads to an upward bias. This study also finds that the combined effect of unobserved heterogeneity and time-invariant measurement error leads to an upward bias. One could, in an extreme case, argue that there is no effect of time-invariant measurement error and that bias is completely generated by unobserved heterogeneity. Nonetheless, as explained in section 2, there potentially exists time-invariant measurement error especially in surveyed income. Therefore, this study suggests either that time-invariant measurement error generates bias in the same direction as that from unobserved heterogeneity or that the magnitude of this bias is never large enough to offset the bias from unobserved heterogeneity.

Above all, this paper suggests a method to examine the existence of time-varying measurement error in survey data when the direct comparison of real versus surveyed values is impossible. With the restriction of time-varying measurement error, the income and consumption of lagged two periods is not a suitable internal instrument. Therefore, the values of lagged three or more periods can be used as alternative instruments to identify the potential existence of time-varying measurement error. This study empirically supports the view that there is substantial time-varying measurement error in surveyed income and consumption, which are the most popular and frequently applied variables in empirical studies. This result equivalently suggests that bias of time-varying measurement error should be addressed in the studies of income and consumption dynamics. The combined effect of unobserved heterogeneity and time-invariant measurement error leads to an upward bias, but the effect of time-varying measurement error offsets the combined effect of unobserved heterogeneity and time-invariant measurement error.

However, the validity of the external IVs is crucial for this study. The standard errors of coefficients using external IVs are higher than those using internal IVs, though the standard errors are low enough to conclude that each coefficient γ is statistically significant. Some may argue that serial uncorrelatedness among error terms from my test might be driven by the higher standard error of coefficients using invalid external IVs, but the exogeneity of my external IVs is logically justified.[15] Once this serial uncorrelatedness is accepted, the comparison of coefficients γ using internal IVs excluding lagged two time periods dependent variable versus using internal IVs including it is the more precise way to examine the effect of time-varying measurement error, in terms of the power of tests. This comparison confirms the bias from time-varying measurement error.

The policy implications in relation to income or consumption trends in Korea are consequential. This study finds that around half of the income and consumption can be explained by past income and consumption, though these results on income and consumption dynamics indicate that there is neither perfect consumption nor income smoothing. This paper, therefore, concludes that Korean households to some extent, smooth consumption from income shocks though their income is also somewhat persistent.

[15] There is also a way to examine this serial uncorrelatedness even when external IVs are suspected as weak instruments. See Hahn, Ham and Moon (2007).

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<Table 1> Summary Statistics - Mean and Standard Deviation

Variables	Year 2002	2003	2004	2005	Total
For the study of income dynamics					
Per capita income	651.20	671.73	706.08	715.45	686.31
	(787.90)	(903.16)	(997.68)	(914.95)	(904.80)
Lagged per capita income	608.16	649.00	664.97	718.06	660.33
	(953.73)	(785.67)	(871.20)	(1020.05)	(912.64)
ln(per capita income)	5.51	5.46	5.48	5.54	5.50
	(2.25)	(2.32)	(2.35)	(2.32)	(2.31)
ln(lagged per capita income)	5.38	5.52	5.48	5.51	5.47
	(2.26)	(2.24)	(2.30)	(2.33)	(2.28)
Household Size	3.41	3.38	3.34	3.27	3.35
	(1.31)	(1.32)	(1.32)	(1.31)	(1.32)
Male aged over 65	0.06	0.07	0.07	0.08	0.07
	(0.16)	(0.17)	(0.17)	(0.18)	(0.17)
Female aged over 55	0.17	0.18	0.19	0.20	0.19
	(0.28)	(0.28)	(0.29)	(0.29)	(0.29)
Sex of head	1.16	1.16	1.17	1.17	1.16
	(0.36)	(0.37)	(0.37)	(0.38)	(0.37)
Education of head	10.18	10.19	10.23	10.27	10.22
	(4.49)	(4.46)	(4.44)	(4.44)	(4.46)
Seoul dummy	0.23	0.22	0.22	0.21	0.22
	(0.42)	(0.41)	(0.41)	(0.41)	(0.41)
Nonspouse dummy	0.21	0.22	0.22	0.24	0.22
	(0.41)	(0.41)	(0.42)	(0.43)	(0.42)
Age of head	51.43	52.88	53.74	54.57	53.16
	(12.92)	(12.77)	(12.62)	(12.52)	(12.76)
Lagged income satisfaction of head	3.52	3.42	3.44	3.46	3.46
	(0.82)	(0.78)	(0.80)	(0.80)	(0.80)
Obs #	2,821	2,861	2,876	2,880	11,438
For the study of consumption dynamics					
Per capita consumption	498.10	526.96	527.04	550.79	525.85
	(316.94)	(319.74)	(293.05)	(334.58)	(316.94)
Lagged per capita consumption	453.01	497.79	526.15	529.26	501.78
	(288.84)	(309.32)	(314.69)	(294.51)	(303.53)
ln(per capita consumption)	6.06	6.12	6.13	6.17	6.12
	(0.56)	(0.56)	(0.53)	(0.54)	(0.55)
ln(lagged per capita consumption)	5.96	6.06	6.12	6.13	6.07
	(0.57)	(0.56)	(0.55)	(0.53)	(0.55)
Obs #	2,938	2,917	2,982	2,995	11,832

Note. Observations for households analyzed in this Study
Standard deviations in parentheses

<Table 2.1> Income Transition Matrix (all years)

	t						
t-1	Zero Income	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile	Total
Zero Income	1,026	236	115	61	49	44	1,531
	(67.02)	(15.41)	(7.51)	(3.98)	(3.20)	(2.87)	(100.00)
1st Quintile	225	918	371	171	86	65	1,836
	(12.25)	(50.00)	(20.21)	(9.31)	(4.68)	(3.54)	(100.00)
2nd Quintile	93	386	792	466	203	74	2,014
	(4.62)	(19.17)	(39.32)	(23.14)	(10.08)	(3.67)	(100.00)
3rd Quintile	72	190	402	769	525	153	2,111
	(3.41)	(9.00)	(19.04)	(36.43)	(24.87)	(7.25)	(100.00)
4th Quintile	69	93	198	421	833	407	2,021
	(3.41)	(4.60)	(9.80)	(20.83)	(41.22)	(20.14)	(100.00)
5th Quintile	69	62	83	146	378	1,187	1,925
	(3.58)	(3.22)	(4.31)	(7.58)	(19.64)	(61.66)	(100.00)
Total	1,554	1,885	1,961	2,034	2,074	1,930	11,438
	(13.59)	(16.48)	(17.14)	(17.78)	(18.13)	(16.87)	(100.00)

Relative frequency within its row of each cell in parentheses

<Table 2.2> Consumption Transition Matrix (all years)

	t					
t-1	1st Quintile	2nd Quintile	3rd Quintile	4th Quintile	5th Quintile	Total
1st Quintile	1313	630	191	111	38	2,283
	(57.51)	(27.60)	(8.37)	(4.86)	(1.66)	(100.00)
2nd Quintile	511	837	515	305	79	2,247
	(22.74)	(37.25)	(22.92)	(13.57)	(3.52)	(100.00)
3rd Quintile	222	576	747	549	168	2,262
	(9.81)	(25.46)	(33.02)	(24.27)	(7.43)	(100.00)
4th Quintile	114	334	598	1010	493	2,549
	(4.47)	(13.10)	(23.46)	(39.62)	(19.34)	(100.00)
5th Quintile	40	102	204	608	1,537	2,491
	(1.61)	(4.09)	(8.19)	(24.41)	(61.70)	(100.00)
Total	2,200	2,479	2,255	2,583	2,315	11,832
	(18.59)	(20.95)	(19.06)	(21.83)	(19.57)	(100.00)

Relative frequency within its row of each cell in parentheses

<Table 3> Data Availability

Year	Income	Consumption (1)	Consumption (2)	Income Satisfaction
1997		Yes		
1998	Yes	Yes	Yes	
1999	Yes	Yes		Yes
2000	Yes	Yes	Yes	Yes
2001	Yes	Yes	Yes	Yes
2002	Yes	Yes	Yes	Yes
2003	Yes	Yes	Yes	Yes
2004	Yes	Yes	Yes	Yes
2005	Yes	Yes	Yes	Yes
2006				Yes

Note. Consumption (1) refers to directly-asked consumption and consumption (2) refers to aggregated one from diaggregated questions

<Table 4.1> Sample Size Construction, *for the study of income dynamics*

Variables	2002	2003	2004	2005	Total
Income at t	3,488	3,592	3,578	3,592	14,250
- Income at t-1	3,300	3,287	3,360	3,394	13,341
	(188)	(305)	(218)	(198)	(909)
- Income at t-2	3,008	3,124	3,104	3,199	12,435
	(292)	(163)	(256)	(195)	(906)
- Other covariates at t	2,973	3,102	3,080	3,182	12,337
	(35)	(22)	(24)	(17)	(98)
- Other covariates at t-1	2,962	3,083	3,076	3,175	12,296
	(11)	(19)	(4)	(7)	(41)
- HH income satisfaction at t-1	2,939	3,060	3,047	3,112	12,158
	(23)	(23)	(29)	(63)	(138)
- HH income satisfaction at t-2	2,917	3,044	3,009	3,101	12,071
	(22)	(16)	(38)	(11)	(87)
- HH income satisfaction at t-3	2,822	2,863	2,878	2,882	11,445
	(95)	(181)	(131)	(219)	(626)
- Outliers	2,821	2,861	2,876	2,880	11,438
	(1)	(2)	(2)	(2)	(7)

Note. Marginal loss of observations in parenthesis

<Table 4.2> Sample Size Construction, *for the study of consumption dynamics*

Variables	2002	2003	2004	2005	Total
Consumption at t	3,516	3,638	3,637	3,639	14,430
- Consumption at t-1	3,333	3,354	3,459	3,495	13,641
	(183)	(284)	(178)	(144)	(789)
- Consumption at t-2	3,135	3,191	3,220	3,337	12,883
	(198)	(163)	(239)	(158)	(758)
- Other covariates at t	3,097	3,169	3,196	3,319	12,781
	(38)	(22)	(24)	(18)	(102)
- Other covariates at t-1	3,082	3,150	3,192	3,312	12,736
	(15)	(19)	(4)	(7)	(45)
- HH income satisfaction at t-1	3,056	3,125	3,161	3,242	12,584
	(26)	(25)	(31)	(70)	(152)
- HH income satisfaction at t-2	3,034	3,105	3,124	3,230	12,493
	(22)	(20)	(37)	(12)	(91)
- HH income satisfaction at t-3	2,939	2,918	2,983	2,996	11,836
	(95)	(187)	(141)	(234)	(657)
- Outliers	2,938	2,917	2,982	2,995	11,832
	(1)	(1)	(1)	(1)	(4)

Note. Marginal loss of observations in parenthesis

<Table 5.1> Averaged Household Income Satisfaction by Income Group

Income Group	Average Household Income Satisfaction									
	2002		2003		2004		2005		total	
	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S
0	387	4.036	388	3.938	403	3.918	427	3.981	1,605	3.968
0 ~ 250	358	3.927	299	3.826	300	3.850	315	3.813	1,272	3.857
250 ~ 500	798	3.677	713	3.607	676	3.676	631	3.702	2,818	3.665
500 ~ 750	672	3.310	731	3.347	672	3.369	663	3.413	2,738	3.359
750 ~ 1000	336	3.155	413	3.097	406	3.145	423	3.201	1,578	3.150
1000 ~ 1500	217	2.912	320	2.881	355	2.918	368	3.014	1,260	2.936
1500 ~ 2000	67	3.015	83	2.807	96	2.781	129	2.837	375	2.848
2000 ~ 2500	28	2.821	38	2.605	42	2.762	61	2.836	169	2.763
2500 ~ 3500	15	2.867	23	2.870	28	2.714	33	2.788	99	2.798
3500 ~ 4500	16	3.250	16	3.063	5	2.800	19	2.579	56	2.929
4500 ~ 6500	6	2.333	8	3.250	7	3.286	11	3.273	32	3.094
6500 ~ 10000	8	3.500	2	2.500	8	3.250	8	3.000	26	3.192
10000~	4	3.750	4	2.500	5	4.000	7	3.286	20	3.400
Total	2,912	3.520	3,038	3.417	3,003	3.443	3,095	3.466	12,048	3.461

Note. Income and income satisfaction at t-1

<Table 5.2> Averaged Household Income Satisfaction by Consumption Group

Consumption Group	Average Household Income Satisfaction									
	2002		2003		2004		2005		total	
	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S
0	344	3.962	264	3.973	218	4.064	185	4.022	1,011	3.998
0 ~ 250	591	3.750	512	3.656	410	3.763	418	3.730	1,931	3.723
250 ~ 500	606	3.602	569	3.571	557	3.600	613	3.369	2,345	3.604
500 ~ 750	579	3.466	553	3.313	543	3.435	503	3.513	2,178	3.430
750 ~ 1000	369	3.341	442	3.346	501	3.345	483	3.412	1,795	3.363
1000 ~ 1500	153	3.222	219	3.201	277	3.231	366	3.303	1,015	3.249
1500 ~ 2000	130	3.100	193	3.145	175	3.240	210	3.119	708	3.153
2000 ~ 2500	90	3.156	104	3.000	148	3.014	131	3.198	473	3.089
2500 ~ 3500	40	3.000	61	2.902	88	2.909	93	3.097	282	2.982
3500 ~ 4500	70	3.000	91	3.088	115	3.026	115	2.887	391	2.995
4500 ~ 6500	17	2.765	37	2.811	29	2.897	50	2.960	133	2.880
6500 ~ 10000	28	3.000	46	2.804	49	2.898	49	2.837	172	2.872
10000~	16	3.188	13	2.615	13	2.615	13	2.615	55	2.782
Total	3,033	3.526	3,104	3.418	3,123	3.441	3,229	3.409	12,489	3.461

Note. Consumption and income satisfaction at t-1

<Table 6.1> Averaged Household Income Satisfaction by Change in Income Group

Change in Income	Average Household Income Satisfaction									
	2002		2003		2004		2005		total	
	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S
~-1000	32	2.875	80	3.213	81	3.000	63	3.159	256	3.090
-1000 ~ -750	27	3.000	22	3.364	40	3.125	40	3.100	129	3.132
-750 ~ -500	93	3.323	73	3.247	95	3.147	106	3.330	367	3.264
-500 ~ -400	68	3.294	51	3.373	81	3.222	59	3.407	259	3.313
-400 ~ -300	91	3.396	80	3.300	107	3.196	102	3.324	380	3.300
-300 ~ -200	154	3.416	142	3.479	165	3.364	150	3.420	611	3.417
-200 ~ -100	246	3.459	245	3.445	252	3.429	250	3.380	993	3.428
-100 ~ -50	179	3.570	151	3.318	161	3.174	178	3.421	669	3.378
-50 ~ 0	326	3.475	313	3.581	307	3.443	321	3.480	1,267	3.495
0	224	4.058	230	4.087	263	3.977	289	3.931	1,006	4.007
0 ~ 50	265	3.566	238	3.475	237	3.502	272	3.493	1,012	3.510
50 ~ 100	245	3.473	223	3.466	225	3.467	238	3.353	931	3.439
100 ~ 200	330	3.606	409	3.501	349	3.367	339	3.348	1,427	3.456
200 ~ 300	195	3.533	245	3.563	210	3.362	218	3.394	868	3.465
300 ~ 400	123	3.764	165	3.539	133	3.391	131	3.565	552	3.560
400 ~ 500	79	3.608	98	3.510	76	3.500	94	3.234	347	3.455
500 ~ 600	108	3.537	134	3.448	106	3.472	109	3.404	457	3.464
600 ~ 1000	45	3.578	62	3.419	34	3.412	45	3.378	186	3.446
1000~	82	3.585	77	3.234	81	3.383	91	3.132	331	3.329
Total	2,912	3.517	3,038	3.424	3,003	3.339	3,095	3.373	12,048	3.412

Note. Change in income between time t-2 and t-1, and avg. income satisfaction at t-2

<Table 6.2> Averaged Household Income Satisfaction by Change in Consumption Group

Change in Consumption	Average Household Income Satisfaction									
	2002		2003		2004		2005		total	
	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S	Obs	A.H.I.S
~-1000	7	3.286	10	3.400	8	2.500	8	2.875	33	3.030
-1000 ~ -750	9	3.444	9	3.111	7	3.000	18	3.056	43	3.140
-750 ~ -500	16	3.375	20	3.050	44	3.250	34	3.235	114	3.228
-500 ~ -400	18	3.333	25	3.200	31	3.484	41	3.390	115	3.365
-400 ~ -300	64	3.438	59	3.085	57	3.175	77	3.416	257	3.292
-300 ~ -200	96	3.458	111	3.378	157	3.369	176	3.290	540	3.361
-200 ~ -100	317	3.470	304	3.487	321	3.343	390	3.400	1,332	3.423
-100 ~ -50	244	3.602	284	3.627	301	3.528	345	3.484	1,174	3.555
-50 ~ 0	496	3.659	472	3.614	467	3.501	504	3.490	1,939	3.566
0 ~ 50	419	3.685	374	3.583	416	3.469	410	3.532	1,619	3.567
50 ~ 100	390	3.641	357	3.569	367	3.518	421	3.492	1,535	3.554
100 ~ 200	515	3.503	557	3.553	494	3.403	444	3.446	2,010	3.480
200 ~ 300	228	3.491	255	3.490	218	3.367	180	3.322	881	3.426
300 ~ 400	118	3.314	118	3.347	106	3.274	91	3.407	433	3.333
400 ~ 500	39	3.000	64	3.234	55	3.200	40	2.900	198	3.111
500 ~ 600	39	3.103	54	3.296	50	3.240	32	3.281	175	3.234
600 ~ 1000	4	3.250	21	2.952	13	3.000	9	2.889	47	2.979
1000~	14	3.357	10	2.800	11	2.909	9	3.222	44	3.091
Total	3,033	3.550	3,104	3.514	3,123	3.419	3,229	3.434	12,489	3.478

Note. Change in consumption between time t-2 and t-1, and avg. income satisfaction at t-2

<Table 7.1> The Second Stage Estimation without First Differencing
t=2002, 2003, 2004 and 2005

	Dependent Variable			
	Income at time t		Consumption at time t	
	OLS	IV	OLS	IV
Income at time t-1	0.5236***	0.7819***		
	(0.0079)	(0.0281)		
Consumption at time t-1			0.6193***	0.9544***
			(0.0069)	(0.0267)
Household size	0.0793***	0.0603***	-0.0588***	-0.0221***
	(0.0166)	(0.0172)	(0.0037)	(0.0051)
Male aged over 65	-0.4286***	-0.1636	-0.1636***	0.0026
	(0.1291)	(0.1669)	(0.0281)	(0.0386)
Female aged over 55	-0.9838***	-0.5538***	-0.1007***	0.0026
	(0.0928)	(0.1257)	(0.0200)	(0.0258)
Sex of head	-0.1104	0.0197	-0.0148	-0.0003
	(0.0732)	(0.0965)	(0.0159)	(0.0199)
Education of head	0.0243***	0.0110**	0.0206***	0.0035*
	(0.0045)	(0.0053)	(0.0010)	(0.0018)
Seoul dummy	0.0536	0.0045	0.0067	-0.0163*
	(0.0372)	(0.0410)	(0.0081)	(0.0088)
Nonspouse dummy	-0.1012	-0.0511	0.0121	0.0145
	(0.0629)	(0.0784)	(0.0137)	(0.0175)
Age of head	0.0875***	0.0394***	0.0147***	0.0040
	(0.0101)	(0.0127)	(0.0022)	(0.0030)
Square age of head	-0.0009***	-0.0004***	-0.0001***	-0.0001*
	(0.0001)	(0.0001)	(0.0000)	(0.0000)
Year dummy (2002)	-0.0202	0.0442	0.0003	0.0548***
	(0.0435)	(0.0461)	(0.0095)	(0.0114)
Year dummy (2003)	-0.1164***	-0.0978**	-0.0021	0.0201**
	(0.0431)	(0.0444)	(0.0094)	(0.0101)
Year dummy (2004)	-0.0645	-0.0448	-0.0286***	-0.0250***
	(0.0429)	(0.0441)	(0.0093)	(0.0095)
Constant	0.5303*	0.1429	2.0419***	0.2951*
	(0.2901)	(0.3254)	(0.0725)	(0.1600)
R-squared	0.5045		0.5714	
N	11,438	11,438	11,832	11,832

Note. IV: HH income satisfaction of head at year t-1
Huber-White standard errors in parenthesis
*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 7.2> The First Stage Estimation without First Differencing
t=2002, 2003, 2004 and 2005

	Dependent Variable			
	Income at time t-1		Consumption at time t-1	
	OLS	IV	OLS	IV
Household size		0.0776***		-0.1089***
		(0.0179)		(0.0051)
Male aged over 65		-0.9763***		-0.4867***
		(0.1908)		(0.0402)
Female aged over 55		-1.6855***		-0.3124***
		(0.1313)		(0.0287)
Sex of head		-0.4857***		-0.0381
		(0.1040)		(0.0242)
Education of head		0.0148**		0.0424***
		(0.0058)		(0.0014)
Seoul dummy		0.2734***		0.0876***
		(0.0416)		(0.0100)
Nonspouse dummy		-0.1028		0.0134
		(0.0867)		(0.0209)
Age of head		0.1962***		0.0340***
		(0.0127)		(0.0029)
Square age of head		-0.0020***		-0.0003***
		(0.0001)		(0.0000)
Year dummy (2002)		-0.2097***		-0.1517***
		(0.0492)		(0.0120)
Year dummy (2003)		-0.1084**		-0.0739***
		(0.0476)		(0.0117)
Year dummy (2004)		-0.0926*		-0.0135
		(0.0486)		(0.0114)
Constant		4.2428***		5.8624***
		(0.3628)		(0.0883)
Income Satisfaction at t-1		-0.7696***		-0.1799***
		(0.0238)		(0.0056)
R-squared		0.3641		0.3265
F statistics		1046.73		1017.05
N		11,438		11,832

Note. Huber-White standard errors in parenthesis
F statistics for the test of identifying instruments
*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 8.1> The Second Stage Estimation after First Differencing

For the study of income dynamics , t=2002, 2003, 2004 and 2005

Dependent variable:	Estimation			
Income at t - Income at t-1	Without IV	External IV	Internal Instrument	
	(1)	(2)	(3)	(4)
Income at t-1 - Income at t-2	-0.3995***	0.5877**	0.1253***	0.4903*
	(0.0083)	(0.2844)	(0.0273)	(0.2740)
D. Household size	0.0810**	0.0585	0.0697	0.0631
	(0.0377)	(0.0666)	(0.0534)	(0.0631)
D. Male aged over 65	-0.0894	-0.1737	-0.1501	-0.1641
	(0.2533)	(0.5435)	(0.4427)	(0.5485)
D. Female aged over 55	-0.9748***	-0.5005	-0.7369**	-0.5614
	(0.1997)	(0.4311)	(0.3235)	(0.4079)
D. Sex of head	-0.1393	-0.3036	-0.2115	-0.3011
	(0.2251)	(0.4617)	(0.3560)	(0.4473)
D. Education of head	0.0867***	0.0732	0.0827**	0.0688
	(0.0308)	(0.0605)	(0.0414)	(0.0514)
D. Seoul dummy	0.0275	0.1741	0.1017	0.1599
	(0.1952)	(0.2704)	(0.2011)	(0.2619)
D. Nonspouse dummy	0.3914**	0.3713	0.3919	0.3701
	(0.1606)	(0.3058)	(0.2640)	(0.3165)
D. Age of head	0.2224***	0.1184	0.1613***	0.1257*
	(0.0408)	(0.0892)	(0.0528)	(0.0665)
D. Square age of head	-0.0019***	-0.0009	-0.0013**	-0.0010
	(0.0004)	(0.0008)	(0.0005)	(0.0006)
Year dummy (2002)	0.1469***	0.0904	0.1133***	0.1038**
	(0.0343)	(0.0570)	(0.0341)	(0.0422)
Year dummy (2003)	-0.0304	-0.1451**	0.0220	-0.0194
	(0.0354)	(0.0621)	(0.0323)	(0.0454)
Year dummy (2004)	-0.0200	0.0027	0.0159	-0.0134
	(0.0334)	(0.0508)	(0.0319)	(0.0407)
R-squared	0.1721			
Hansen J statistics		0.02	11.61	4.19
N	11,438	11,438	11,438	11,438

Note. all other covariates except for year dummies are first differenced (denoted by D.)
External IVs: Income satisfaction of head at t-2 and t-3,
Internal Ivs: (3) income at t-2, t-3 and t-4 (4) income at t-3 and t-4
Huber-White standard errors in parenthesis for the external iv model
Windmeijer's standard errors in parentheses for the internal iv models
*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 8.2> The First Stage Estimation after First Differencing

For the study of income dynamics , t=2002, 2003, 2004 and 2005

Dependent variable: Income at t-1 - Income at t-2	Estimation			
	Without IV	External IV	Internal Instrument	
	(1)	(2)	(3)	(4)
D. Household size		0.0268	-0.0310	0.0111
		(0.0423)	(0.0406)	(0.0458)
D. Male aged over 65		0.0889	-0.0984	-0.0384
		(0.2841)	(0.2637)	(0.2974)
D. Female aged over 55		-0.4878**	-0.0716	-0.2660
		(0.2240)	(0.2085)	(0.2352)
D. Sex of head		0.1022	-0.0103	0.0621
		(0.2535)	(0.2285)	(0.2577)
D. Education of head		0.0015	0.0864***	0.0259
		(0.0350)	(0.0322)	(0.0363)
D. Seoul dummy		-0.1482	-0.0492	-0.2681
		(0.2189)	(0.1976)	(0.2229)
D. Nonspouse dummy		0.0010	0.0352	0.0310
		(0.1804)	(0.1639)	(0.1849)
D. Age of head		0.1114**	0.2504***	0.1009**
		(0.0459)	(0.0422)	(0.0475)
D. Square age of head		-0.0012***	-0.0023***	-0.0010**
		(0.0005)	(0.0004)	(0.0005)
Year dummy (2002)		-0.0137	0.3658***	0.0894*
		(0.0499)	(0.0437)	(0.0489)
Year dummy (2003)		0.0565	0.4468***	0.1850***
		(0.0499)	(0.0426)	(0.0478)
Year dummy (2004)		-0.0806*	0.3094***	0.0047
		(0.0489)	(0.0423)	(0.0473)
Income Satisfaction at t-2		0.1073***		
		(0.0222)		
Income Satisfaction at t-3		-0.0853***		
		(0.0222)		
Income at t-2			-0.5019***	
			(0.0095)	
Income at t-3			0.2657***	-0.0283***
			(0.0101)	(0.0095)
Income at t-4			0.1799***	0.0189**
			(0.0090)	(0.0096)
R-squared		0.0043	0.2165	0.0032
F statistics		12.24	983.50	4.81
N		11,438	10,312	10,312

Note. all other covariates except for year dummies are first differenced (denoted by D.)

Huber-White standard errors in parenthesis

F statistics for the test of identifying instruments

*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 9.1> The Second Stage Estimation after First Differencing

For the study of consumption dynamics , t=2002, 2003, 2004 and 2005

Dependent variable:	Estimation			
Consumption at t - Consumption at t-1	Without IV	External IV	Internal Instrument	
	(1)	(2)	(3)	(4)
Consumption at t-1 - Consumption at t-2	-0.3151***	0.6030**	0.2002***	0.4094***
	(0.0080)	(0.2744)	(0.0199)	(0.0580)
D. Household size	-0.2221***	-0.3186***	-0.2806***	-0.2976***
	(0.0078)	(0.0323)	(0.0117)	(0.0135)
D. Male aged over 65	-0.0033	0.0460	0.0181	0.0353
	(0.0527)	(0.1067)	(0.0848)	(0.0970)
D. Female aged over 55	0.0251	0.1897**	0.1240**	0.1541**
	(0.0416)	(0.0918)	(0.0617)	(0.0697)
D. Sex of head	-0.0549	0.0350	0.0409	0.0135
	(0.0466)	(0.0873)	(0.0702)	(0.0768)
D. Education of head	0.0070	0.0134	0.0247**	0.0117
	(0.0064)	(0.0146)	(0.0109)	(0.0128)
D. Seoul dummy	-0.0042	-0.0292	-0.0197	-0.0235
	(0.0402)	(0.0637)	(0.0501)	(0.0561)
D. Nonspouse dummy	0.1201***	0.0907	0.1131**	0.0965*
	(0.0332)	(0.0563)	(0.0457)	(0.0505)
D. Age of head	0.0321***	-0.0041	0.0190	0.0038
	(0.0084)	(0.0207)	(0.0125)	(0.0145)
D. Square age of head	-0.0003***	0.0000	-0.0001	0.0000
	(0.0001)	(0.0002)	(0.0001)	(0.0001)
Year dummy (2002)	0.0949***	-0.0022	0.0198***	0.0188**
	(0.0072)	(0.0301)	(0.0073)	(0.0081)
Year dummy (2003)	0.0848***	-0.0222	0.0305***	0.0204***
	(0.0074)	(0.0330)	(0.0067)	(0.0074)
Year dummy (2004)	0.0216***	-0.0423**	0.0062	-0.0080
	(0.0070)	(0.0207)	(0.0064)	(0.0075)
R-squared	0.2209			
Hansen J statistics		0.09	23.24	3.74
N	11,832	11,832	11,832	11,832

Note. all other covariates except for year dummies are first differenced (denoted by D.)
External IV: HH income satisfaction of head at year t-2 and t-3
Internal IVs (1) consumption at t-2, t-3 and t-4 (2) consumption. at t-3 and t-4
Huber-White standard errors in parenthesis for the external iv model
Windmeijer's standard errors in parentheses for the internal iv models
*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 9.2> The First Stage Estimation after First Differencing

For the study of consumption dynamics , t=2002, 2003, 2004 and 2005

Dependent variable:	Estimation			
Cons. at t-1 - Cons. at t-2	Without IV	External IV	Internal Instrument	
	(1)	(2)	(3)	(4)
D. Household size		0.1068***	0.1019***	0.1026***
		(0.0089)	(0.0091)	(0.0091)
D. Male aged over 65		-0.0506	-0.0495	-0.0475
		(0.0606)	(0.0613)	(0.0613)
D. Female aged over 55		-0.1860***	-0.1691***	-0.1725***
		(0.0477)	(0.0486)	(0.0486)
D. Sex of head		-0.1210**	-0.0833	-0.0942*
		(0.0538)	(0.0541)	(0.0540)
D. Education of head		-0.0123*	-0.0015	-0.0040
		(0.0074)	(0.0074)	(0.0074)
D. Seoul dummy		0.0270	0.0316	0.0309
		(0.0462)	(0.0470)	(0.0470)
D. Nonspouse dummy		0.0242	0.0381	0.0332
		(0.0382)	(0.0387)	(0.0387)
D. Age of head		0.0411***	0.0434***	0.0445***
		(0.0096)	(0.0097)	(0.0097)
D. Square age of head		-0.0005***	-0.0004***	-0.0004***
		(0.0001)	(0.0001)	(0.0001)
Year dummy (2002)		0.0753***	0.1328***	0.1160***
		(0.0106)	(0.0108)	(0.0089)
Year dummy (2003)		0.0875***	0.1425***	0.1270***
		(0.0106)	(0.0109)	(0.0094)
Year dummy (2004)		0.0394***	0.1005***	0.0849***
		(0.0104)	(0.0109)	(0.0093)
Income Satisfaction at t-2		0.0030		
		(0.0047)		
Income Satisfaction at t-3		0.0067		
		(0.0047)		
Consumption at t-2			-0.0054***	
			(0.0020)	
Consumption at t-3			-0.0001***	-0.0001***
			(0.0000)	(0.0000)
Consumption at t-4			0.0001***	0.0000**
			(0.0000)	(0.0000)
R-squared		0.0529	0.0528	0.0522
F statistics		10.26	9.87	11.07
N		11,832	11,437	11,437

Note. all other covariates except for year dummies are first differenced (denoted by D.)

Huber-White standard errors in parenthesis

F statistics for the test of identifying instruments

*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 10.1> The Second Stage Estimation after First Differencing
t=2002, 2003, 2004 and 2005

Dependent variable:	Estimation			
Income at t - at t-1 or	Income Dynamics		Consumption Dynamics	
Consumption at t - at t-1	(1)	(2)	(3)	(4)
Lagged dependent variable	0.1422***	0.5390***	0.2018***	0.4063***
	(0.0263)	(0.1534)	(0.0200)	(0.0569)
D. Household size	0.0691	0.0621	-0.2806***	-0.2974***
	(0.0538)	(0.0647)	(0.0117)	(0.0134)
D. Male aged over 65	-0.1878	-0.1668	0.0164	0.0349
	(0.4462)	(0.5647)	(0.0848)	(0.0968)
D. Female aged over 55	-0.7344**	-0.5385	0.1245**	0.1533**
	(0.3260)	(0.4080)	(0.0617)	(0.0694)
D. Sex of head	-0.1971	-0.3138	0.0410	0.0131
	(0.3590)	(0.4532)	(0.0702)	(0.0767)
D. Education of head	0.0868**	0.0670	0.0247**	0.0119
	(0.0417)	(0.0518)	(0.0109)	(0.0128)
D. Seoul dummy	0.0991	0.1668	-0.0204	-0.0237
	(0.2036)	(0.2699)	(0.0502)	(0.0560)
D. Nonspouse dummy	0.4054	0.3674	0.1138**	0.0969*
	(0.2662)	(0.3252)	(0.0457)	(0.0504)
D. Age of head	0.1558***	0.1215*	0.0185	0.0042
	(0.0528)	(0.0653)	(0.0125)	(0.0143)
D. Square age of head	-0.0012**	-0.0009	-0.0001	0.0000
	(0.0005)	(0.0006)	(0.0001)	(0.0001)
Year dummy (2002)	0.1032***	0.1024**	0.0198***	0.0188**
	(0.0344)	(0.0435)	(0.0073)	(0.0081)
Year dummy (2003)	0.0052	-0.0251	0.0303***	0.0206***
	(0.0329)	(0.0396)	(0.0067)	(0.0074)
Year dummy (2004)	-0.0061	-0.0172	0.0060	-0.0077
	(0.0329)	(0.0410)	(0.0064)	(0.0075)
Hansen J statistics	19.59	4.02	24.12	4.68
N	11,438	11,438	11,832	11,832

Note. all other covariates except for year dummies are first differenced (denoted by D.)
Ivs: (1) Income at t-2, t-3 and t-4, Incoms Satisfaction at t-2 amd t-3
(2) Income at t-3 and t-4, and Income Satisfaction at t-2 amd t-3
(3) Consumption at t-2, t-3 and t-4, and Incoms Satisfaction at t-2 and t-3
(4) Consumption at t-2, t-3 and t-4, and Incoms Satisfaction at t-2 and t-3
Windmeijer's standard errors in parentheses for the internal iv models
*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 10.2> The First Stage Estimation after First Differencing
t=2002, 2003, 2004 and 2005

Dependent variable:	Estimation			
Income at t-1 - at t-2 or	Income Dynamics		Consumption Dynamics	
Consumption at t-1 - at t-2	(1)	(2)	(3)	(4)
D. Household size	-0.0314	0.0109	0.1057***	0.1050***
	(0.0402)	(0.0457)	(0.0090)	(0.0091)
D. Male aged over 65	0.0554	0.0155	-0.0328	-0.0396
	(0.2613)	(0.2971)	(0.0603)	(0.0612)
D. Female aged over 55	-0.1260	-0.2786	-0.1798***	-0.1828***
	(0.2065)	(0.2348)	(0.0478)	(0.0485)
D. Sex of head	-0.2580	-0.0430	-0.1101**	-0.1246**
	(0.2269)	(0.2580)	(0.0533)	(0.0540)
D. Education of head	0.0478	0.0118	-0.0012	-0.0097
	(0.0320)	(0.0364)	(0.0073)	(0.0074)
D. Seoul dummy	-0.0468	-0.2699	0.0347	0.0298
	(0.1957)	(0.2224)	(0.0463)	(0.0469)
D. Nonspouse dummy	-0.1134	-0.0202	0.0202	0.0182
	(0.1626)	(0.1849)	(0.0381)	(0.0387)
D. Age of head	0.3825***	0.1479***	0.0648***	0.0513***
	(0.0428)	(0.0484)	(0.0096)	(0.0097)
D. Square age of head	-0.0039***	-0.0016***	-0.0006***	-0.0005***
	(0.0004)	(0.0005)	(0.0001)	(0.0001)
Year dummy (2002)	0.1076**	-0.0078	0.1100***	0.0722***
	(0.0469)	(0.0532)	(0.0107)	(0.0107)
Year dummy (2003)	0.2178***	0.1077**	0.1208***	0.0864***
	(0.0451)	(0.0512)	(0.0108)	(0.0108)
Year dummy (2004)	0.0838*	-0.0650	0.0858***	0.0452***
	(0.0447)	(0.0508)	(0.0108)	(0.0107)
Inc. or Cons. at t-2	-0.5270***		-0.0691***	
	(0.0096)		(0.0038)	
Inc. or Cons. at t-3	0.2475***	-0.0423***	0.0000***	-0.0001***
	(0.0101)	(0.0098)	(0.0000)	(0.0000)
Inc. or Cons. at t-4	0.1552***	0.0083	0.0001***	0.0000
	(0.0091)	(0.0099)	(0.0000)	(0.0000)
Income Satisfaction at t-2	0.0562***	0.1395***	0.0458***	0.0069
	(0.0210)	(0.0238)	(0.0053)	(0.0049)
Income Satisfaction at t-3	0.1240***	-0.0747***	0.0507***	0.0123**
	(0.0210)	(0.0235)	(0.0052)	0.0049
R-squared	0.2321	0.0073	0.0831	0.0568
F statistics	616.09	13.12	81.47	19.54
N	10,321	10,321	11,437	11,437

Note. all other covariates except for year dummies are first differenced (denoted by D.)
F statistics for the test of identifying instruments
*** significant at 1%, ** significant at 5%, * significant at 10%

<Table 11.1> Hausman Tests, *for the study of income dynamics*

	Models A	vs B	γ_A	γ_B	$\gamma_A - \gamma_B$
Test (1): Serial correlation	1	2	0.5877	0.5390	0.0487
			(0.2844)	(0.1534)	(0.2394)
Test (2): Time-varying measurement error	1	3	0.5877	0.1422	0.4454
			(0.2844)	(0.0263)	(0.2832)
	2	3	0.5390	0.1422	0.3967
			(0.1534)	(0.0263)	(0.1512)
	4	5	0.4903	0.1253	0.3650
			(0.2740)	(0.0273)	(0.2727)

Note. standard errors in parenthesis

Models using instruments

1. external IVs only: Income satisfaction of head at t-2 and t-3
2. both internal and external Ivs: income at t-3 and t-4, and Income satisfaction of head at t-2 and t-3
3. both internal and external Ivs: income at t-2, t-3 and t-4, and Income satisfaction of head at t-2 and t-3
4. internal IVs only: income at t-3 and t-4
5. internal IVs only: income at t-2, t-3 and t-4

<Table 11.2> Hausman Tests, *for the study of consumption dynamics*

	Models A	vs B	γ_A	γ_B	$\gamma_A - \gamma_B$
Test (1): Serial correlation	1	2	0.6030	0.4063	0.1967
			(0.2744)	(0.0569)	(0.2684)
Test (2): Time-varying measurement error	1	3	0.6030	0.2018	0.4013
			(0.2744)	(0.0200)	(0.2736)
	2	3	0.4063	0.2018	0.2046
			(0.0569)	(0.0200)	(0.0532)
	4	5	0.4094	0.2002	0.2092
			(0.0580)	(0.0199)	(0.0545)

Note. standard errors in parenthesis

Models using instruments

1. external IVs only: household income satisfaction of head at t-2 and t-3
2. both internal and external Ivs: consumption at t-3 and t-4, and income satisfaction of head at t-2 and t-3
3. both internal and external Ivs: consumption at t-2, t-3 and t-4, and income satisfaction of head at t-2 and t-3
4. internal IVs only: consumption at t-3 and t-4
5. internal IVs only: consumption at t-2, t-3 and t-4

<Table 12> Sensitivity of Estimations according to Adding 'a' for Dependent and Independent Variables, log (Income+a)

	External IV Only		External and Internal 2		Hausman Test (1)		External and Internal 3		Hausman Test (2)	
	Coef.	Std	Coef.	Std		Std	Coef.	Std		Std
a	A1		B1		*A1-B1*	*(A1-B1)*	B2		*B1-B2*	*(B1-B2)*
0.05	0.6409	0.3402	0.5482	0.1654	0.0927	0.2973	0.1427	0.0260	0.4055	0.1633
0.10	0.6314	0.3292	0.5485	0.1636	0.0830	0.2856	0.1427	0.0261	0.4058	0.1615
0.15	0.6252	0.3222	0.5482	0.1624	0.0771	0.2784	0.1427	0.0261	0.4055	0.1602
0.20	0.6205	0.3171	0.5477	0.1614	0.0728	0.2730	0.1427	0.0261	0.4050	0.1592
0.25	0.6166	0.3130	0.5471	0.1605	0.0695	0.2687	0.1427	0.0262	0.4045	0.1584
0.30	0.6133	0.3095	0.5466	0.1598	0.0668	0.2651	0.1426	0.0262	0.4039	0.1576
0.35	0.6104	0.3065	0.5460	0.1591	0.0644	0.2620	0.1426	0.0262	0.4034	0.1569
0.40	0.6078	0.3039	0.5454	0.1585	0.0624	0.2593	0.1426	0.0262	0.4028	0.1563
0.45	0.6054	0.3015	0.5448	0.1579	0.0607	0.2569	0.1425	0.0262	0.4022	0.1557
0.50	0.6033	0.2994	0.5442	0.1574	0.0591	0.2547	0.1425	0.0262	0.4017	0.1552
0.55	0.6013	0.2974	0.5436	0.1569	0.0576	0.2527	0.1425	0.0262	0.4012	0.1547
0.60	0.5994	0.2956	0.5431	0.1564	0.0563	0.2508	0.1425	0.0262	0.4006	0.1542
0.65	0.5977	0.2939	0.5425	0.1560	0.0551	0.2491	0.1424	0.0262	0.4001	0.1538
0.70	0.5960	0.2923	0.5420	0.1556	0.0540	0.2475	0.1424	0.0263	0.3996	0.1534
0.75	0.5944	0.2909	0.5415	0.1552	0.0530	0.2460	0.1424	0.0263	0.3991	0.1530
0.80	0.5930	0.2895	0.5410	0.1548	0.0520	0.2446	0.1424	0.0263	0.3986	0.1526
0.85	0.5916	0.2881	0.5404	0.1545	0.0511	0.2432	0.1423	0.0263	0.3981	0.1522
0.90	0.5902	0.2869	0.5400	0.1541	0.0503	0.2420	0.1423	0.0263	0.3977	0.1519
0.95	0.5889	0.2857	0.5395	0.1538	0.0495	0.2408	0.1423	0.0263	0.3972	0.1515
1.00	0.5877	0.2845	0.5390	0.1534	0.0487	0.2396	0.1422	0.0263	0.3967	0.1512
1.05	0.5865	0.2834	0.5385	0.1531	0.0480	0.2385	0.1422	0.0263	0.3963	0.1509
1.10	0.5853	0.2824	0.5381	0.1528	0.0473	0.2375	0.1422	0.0263	0.3959	0.1505
1.15	0.5842	0.2814	0.5376	0.1525	0.0466	0.2365	0.1422	0.0263	0.3954	0.1502
1.20	0.5832	0.2804	0.5372	0.1522	0.0460	0.2355	0.1421	0.0263	0.3950	0.1500
1.25	0.5821	0.2795	0.5367	0.1520	0.0454	0.2346	0.1421	0.0263	0.3946	0.1497
1.30	0.5811	0.2786	0.5363	0.1517	0.0448	0.2337	0.1421	0.0263	0.3942	0.1494
1.35	0.5801	0.2777	0.5359	0.1514	0.0443	0.2328	0.1421	0.0263	0.3938	0.1491
1.40	0.5792	0.2769	0.5354	0.1512	0.0437	0.2320	0.1420	0.0263	0.3934	0.1489
1.45	0.5783	0.2761	0.5350	0.1509	0.0432	0.2311	0.1420	0.0263	0.3930	0.1486
1.50	0.5774	0.2753	0.5346	0.1507	0.0427	0.2304	0.1420	0.0263	0.3926	0.1484
1.55	0.5765	0.2745	0.5342	0.1504	0.0423	0.2296	0.1420	0.0263	0.3923	0.1481
1.60	0.5756	0.2737	0.5338	0.1502	0.0418	0.2289	0.1419	0.0263	0.3919	0.1479
1.65	0.5748	0.2730	0.5334	0.1500	0.0414	0.2281	0.1419	0.0263	0.3915	0.1476
1.70	0.5740	0.2723	0.5331	0.1497	0.0409	0.2274	0.1419	0.0263	0.3912	0.1474
1.75	0.5732	0.2716	0.5327	0.1495	0.0405	0.2268	0.1419	0.0263	0.3908	0.1472
1.80	0.5724	0.2710	0.5323	0.1493	0.0401	0.2261	0.1418	0.0263	0.3905	0.1470
1.85	0.5717	0.2703	0.5319	0.1491	0.0397	0.2255	0.1418	0.0263	0.3901	0.1467
1.90	0.5709	0.2697	0.5316	0.1489	0.0393	0.2248	0.1418	0.0263	0.3898	0.1465
1.95	0.5702	0.2690	0.5312	0.1487	0.0390	0.2242	0.1418	0.0263	0.3894	0.1463
2.00	0.5695	0.2684	0.5309	0.1485	0.0386	0.2236	0.1418	0.0263	0.3891	0.1461

Note. Instrumental Variables: See Table 11.

Hausman test (1) is a test of serial correlation among error terms. Hausman test (2) is a test of time-varying measurement error.