Excess Sensitivity in Consumption: Evidence from Korean Household Data

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Abstract

The monthly salaries and allowances of Korean government employees are known in advance but vary greatly throughout the year. Using a large Korean monthly panel data set from 1994 to 2003, we examine how nondurable consumption expenditure in households headed by government employees responds to predictable income changes. We ¯nd excess sensitivity in consumption during the pre-Asian ¯nancial crisis era in households headed by young government employees with low liquid assets or low income. These household features are commonly associated with liquidity constraints. Further analysis shows that despite the apparent association, liquidity constraint is not the most convincing explanation for the excess sensitivity. Instead, the empirical ¯nding is consistent with the theory that certain households deviate from consumption smoothing when the e®ort involved exceeds the welfare gained.

Keywords: household consumption, excess sensitivity

JEL Codes: D12, E21

1 Introduction

The power of an empirical test on whether household consumption responds to anticipated changes in income (i.e., excess sensitivity) critically depends on the researcher's knowledge in the households' information on future income. In this study, we examine a large panel data set on monthly consumption and income of Korean households headed by government employees. The most crucial feature of the data set is that the government employees' salary and the monthly allowance payment schedules are known in the beginning of the year. The monthly salary and allowance vary greatly across time and across households but is perfectly certain. The large and regular variations in predictable income of the Korean government employees and the long panels allow us to circumvent the problem of estimating expected incomes and a®ord us a powerful test of excess sensitivity. [1]

For all households headed by government o±cials between 1994 ¡ 2003 we ¯nd statistically signi¯cant but economically minor excess sensitivity of household expenditure on nondurables to anticipated head of household salary growth. Furthermore, we ¯nd that the minor excess sensitivity for the sample as whole is due to economically signi¯cant excess sensitivity of expenditure by households headed by young government o±cials (we call them young households) with low liquid wealth or low income before the 1997 Asian ¯nancial crisis. In the household consumption literature, young age, low liquid wealth, and low income are characteristics often associated with liquidity constraints. It is natural to treat liquidity constraint as the leading hypothesis for the excess sensitivity found in the study, for which we conduct a number of tests. The tests do not support the liquidity constraint theory but they do yield insights on household consumption

[1] The Korean household data are more desirable than the most heavily studied household income and consumption data, the Panel Study of Income Dynamics (PSID) and the Consumption Expenditure Survey (CEX) for the U.S. and the Family Expenditure Survey (FES) for the U.K. The PSID only includes annual or semi-annual household expenditure on food and is known to contain large measurement errors (see Runkle 1991). The quarterly CEX data have limited panel features and large measurement errors in income (see Lusardi 1996). The FES data have no panel feature at all. Household data studied (by Hayashi 1985, Mork and Smith 1989, Browning and Collado 2001) for other developed countries (Japan, Norway, and Spain) are quarterly series with limited observations on each household.

behavior that are not fully appreciated.

First, we ¯nd that consumption is more responsive to negative predictable salary growth than to positive growth. Second, for the sample that includes all households, consumption growth of those with lower levels of liquid wealth (measured by the liquid asset-disposable income ratio) is no more responsive to predictable income growth. The third, and we believe the most convincing test of the liquidity constraint theory, is an examination of the consequence of the change in the long-run prospects of the income on short-run excess sensitivity. We ¯nd that for the period in which the liquidity constraint is most likely to be widely prevalent for the households headed by young government o±cials, the excess sensitivity is absent. The predicted lifetime income for government o±cials was signi¯cantly reduced by the Asian ¯nancial crisis (that hit Korea at the end of 1997). The salary scale of all government o±cials was frozen between 1997 to 1999, then jumped sharply in 2000. As the economic prospects improved substantially throughout 1999, so did the permanent income of the young government o±cials. With the salary frozen below the permanent income, liquidity is likely to be tighter for households headed by young o±cials compared to the pre-crisis era. Other measures of liquidity con¯rm the tightening of households' liquidity in 1999. However, there is no evidence of excess sensitivity after the Asian ¯nancial crisis (and in the year 1999) for all households in the sample and for young households with low liquid wealth or low income.

In the recent literature, a pattern has emerged in the estimates of excess sensitivity based on natural experiments where certain income changes are anticipated by households. Using the CEX data, Souleles (1999), Parker (1999), and Johnson et al. (2006) found excess sensitivity of household consumption to non-regular anticipated windfall of income (such as tax rebates). Browning and Collado (2001) (using Spanish household data) and Hsieh (2003) (using the CEX data) found no evidence of excess sensitivity to large and regular anticipated income changes. This pattern is consistent with the notion that the discipline of consumption smoothing is highly valuable when predictable income changes are large and regular, and not as valuable when they are small or non-regular.

Unlike the existing studies based on quarterly data and without taking into account of intertemporal dependency in consumption, the present study uses monthly data and estimates excess sensitivity jointly with intertemporal dependency in consumption. The estimate indicates a high intertemporal dependency in monthly consumption, which implies a low cost of small deviation from monthly optimal consumption smoothing. The estimation also finds excess sensitivity to large and regular anticipated income variations in consumption of a subgroup of households during a given period. These results suggest an alternative theory to the conventional arguments on excess sensitivity in household consumption. We argue that consumption smoothing takes effort to plan and discipline to execute. Even in the absence of liquidity constraint, households may fail to smooth consumption because the effort involved exceeds the welfare gained. The cost and benefit of consumption smoothing are household dependent and time varying. The characteristics of poor household planners are closely related to those often associated with liquidity constraints. The contrast in estimated excess sensitivity before and after the financial crisis suggests that some households are less willing to make the effort to achieve optimal smoothing in a time of prosperity, but are willing to do so after a period of hardship.

The rest of the paper is organized as follows. Section 2 gives a detailed description of the data set. Section 3 provides the empirical estimates of excess sensitivity. Section 4 examines in more detail excess sensitivity before and after the Asian financial crisis and conducts robustness checks on the empirical findings. Section 5 reconciles our results with a number of recent studies on household consumption expenditure. Section 6 offers concluding remarks.

2 Description of the Korean Household Survey Data

Our study is based on the Family Income and Expenditure Survey in urban areas of Korea from January 1994 to December 2003. The survey contains panel data on household income, demographics, and expenditures. The household income variables include monthly salary and allowances of the head of household, wage incomes of the spouse and other household members, and income from other categories such as property earnings. The expenditure variables include food, housing, apparel, services, education, medical and health care, transportation, and other outlays. In Appendix 1 we provide detailed information for the sub-categories of nondurable consumption expenditure.

Each household is surveyed monthly for up to five years. For the sample period 1994 to 2003, the data set contains three waves of household samples. The first wave is from 1994 to 1997, the second is from 1998 to 2002, and the last one is for 2003. The survey covers around 5,500 households for each year, among them around $3,000$ are headed by salary and wage earning workers. These salaried workers can be grouped into four categories: (1) government employees; (2) white collar office workers in the private sector; (3) regular labor (with permanent blue collar jobs); (4) non-regular labor (typically non-skilled labor with temporary jobs). Because our institutional knowledge on the predicability of salary and allowances is limited to the the government employees, income and consumption. Growth rates in January (over December of the previous year) are not used in pooled regressions but are used in ¯xed e®ects models. We exclude observations for which the nominal consumption expenditure, or real monthly income growth, or real consumption growth is outside the range of three times the sample standard deviation (and keep the rest of observations on the households). The remaining samples of growth rate vary by the components of consumption expenditure. For total expenditure on consumer nondurables, our ¯nal sample includes 18;616 monthly observations of growth rates for pooled regressions. For ¯xed e®ects models, we create panels with monthly observations of one to ¯ve years. This cuts the number of observations on month growth rates by over 2;500 and keeps 873 household panels in the sample.

The present study on monthly household consumption panel data is the only one we know of. For the purpose of comparing with existing studies on quarterly household data of di®erent countries, we construct quarterly data by time-aggregating the Korean monthly data. For pooled regressions, the growth rates from the ¯rst quarter over the fourth quarter of the previous year are omitted, as are the outliers (observations outside three times the sample standard deviation).

The salary and allowance schedules of Korea government employees are published in the beginning of the year following the approval of the congress. The complicated system of salaries and allowances is under the supervision of the Ministry of Government Legislation and Korea Civil Service Commission. Besides base salary, there are several dozens types of allowances. The allowances depend on rank, seniority, family composition, and job classi¯cation and make up a substantial portion of the government employees' income.

Throughout this study, we de¯ne the head of household salary income as the sum of base salary and allowances. In the data set, the salary income data collected as a single sum. For each government employee, the monthly payments vary greatly from month to month mainly (but not exclusively) because of variation in the allowances. By government regulation, the government employees know at the beginning of the year the exact amounts of the payments of the salary and most allowances in each month. The government o±cials also receive bonuses (customarily related to holidays) which are largely anticipated in quantity. The measure of anticipated salary income in this paper does not include bonuses. But inclusion of bonuses does not materially change the conclusion of the paper (the details are available upon request.)

Although there is no uncertainty in nominal salary and allowances, the monthly in°ation rate is uncertain. We do not consider the in°ation risk as an important issue, for two reasons. First, for the sample period studied, the monthly average of in°ation and the standard deviation of in°ation are negligible (0:3% and 0:5%, respectively) compared with the magnitude of the °uctuations in monthly pay, with a large portion of in°ation being predictable. Second, we found in all cases estimates based on nominal data are very similar to those reported in the tables of this paper based on real data.

Table 1 reports the summary statistics for government employee households. The unit is one thousand Korean won (which is about one U.S. dollar by the current exchange rate). The table shows that on average the main source of income is the labor income (salary, allowances, and bonuses) of the head of the household. This is not surprising, given the fact that in about three-quarters of the households in our sample the spouse is not employed. The table shows that food expenditure (including restaurant food) is the largest item of nondurable consumption, accounting for about one-third of the total non-durable consumption, while personal care & entertainment is a close second. Note that Table 1 shows that the wage income of other household members, which is most likely to be unpredictable, exhibits a larger standard deviation than the head of household salary income. The variation in household consumption is partially attributed to this portion of the household income.

We will close the data description section by summarizing and elaborating the nature of the variations in monthly salary income as anticipated, in general exogenous to monthly consumption variations, and large in magnitude. First, as suggested earlier, allowances are paid with regularity.

In cases when changes in some minor allowances are not known in the beginning of the year (say because the employee moves from a rural area to the capital city in the middle of the year), they are expected months ahead of the time and do not constitute surprises in the month of payment. Promotion in the rank occurs infrequently and the resultant new salary follows a schedule known in advance.

Second, the salary income variations are in general exogenous to monthly consumption variations. The timing and amount of the salary income are set by government regulations. Allowances dependent on household characteristics (e.g. the number of children) may not be viewed as strictly exogenous to the average level of consumption. But the amount of such allowances is known in the beginning of the year and should not affect the monthly consumption growth if the family exercises consumption smoothing. The monthly salary and allowance variation may correlate with seasonal factors, as is the consumption growth. These correlations do not drive our empirical results though. As we will show in the next section, we control seasonal dummies in the regressions (and the presence of the seasonal dummies does not change the nature of the estimated excess sensitivity). But more importantly, the data show that the monthly variations in salary income are large and so are the variations in salary income growth across households within each month. The bottom of Table 1 shows the average of cross-sectional and cross-monthly statistics for the head of household salary income growth rate and household nondurable consumption growth rate from 1994 to 2003, adjusted for inflation. All growth rates are defined as the first difference in the logarithm of levels. The monthly salary variations are quite large. The average standard deviation of monthly salary growth over time and across unbalanced panels of households is 0.182, (18.2%). The standard deviation of the `within' component (the variation of a given household over months) is $17.9\%$. The relatively small `between' component (the variation of average growth across households, about 5.2%) means that the average of salary income growth is fairly small across households (largely because the existence of long panels.) However, for each month in the sample period there is a substantial cross-household variations in salary income growth as well as in consumption growth. The averages of the monthly cross-household standard deviations in salary income growth and nondurable consumption growth are about 15.7% and 30.7% respectively. This suggests that neither salary income growth nor consumption growth are synchronized across households by seasonal factors. The large cross-household and cross-time variations in salary and consumption growth afford a good opportunity for the powerful test on excess sensitivity.

3 Estimating Excess Sensitivity of Household Consumption

Our analysis is based on the following regression model

$$c_{it} = \phi y_{it} + h_1 c_{it-1} + h_2 c_{it-2} + \theta' x_{it} + \varepsilon_{it}. \tag{1}$$

c_{it} is nondurable consumption real expenditure growth of household i between period $t-1$ and period t. y_{it} is real salary income growth of the head of household i between $t-1$ and t, which is predictable before period t. Parameter ϕ represents excess sensitivity, the primary interest of this study. θ' is the transpose of an unknown parameter vector θ. The vector x_{it} consists of unity and two groups of control variables. The first group contains the demographic variables of households: age and age-squared of the head of the household, the logarithm of family size, and change in family size. The second group includes month- (for monthly data) or quarter- (for quarterly data) dummies, nine year dummies, and holiday dummies (Thanksgiving, which may be August or September). In the following, the term `seasonal dummies' means all time-related dummies. [2]

The estimates for the whole sample ($N = 14,740$) observations are (with standard errors in

[2] This model is consistent with a log-linearized first order condition of an optimal consumption model with time-nonseparable utility function. The utility-maximizing model imposes additional restrictions on the parameters, which may lead to rejection of the utility function even in the absence of excess sensitivity. For the purpose of testing for excess sensitivity, linear model (1) without additional restrictions on parameters is more useful.

parentheses)

$$c_{it} = 0.029(0.012)y_{it} - 0.591(0.009)c_{it-1} - 0.283(0.009)c_{it-2} + \theta' x_{it} + \epsilon_{it}. \tag{2}$$

The estimated excess sensitivity is significant at the five percent level and the lags of consumption growth are significant at one percent. In the household consumption expenditure literature, the lags of consumption are usually not included in regression models. The estimates of the lags of consumption growth are highly significant and robust to the presence of other regressors. The presence of the lags of consumption growth turns out to have a moderate impact on the estimates of ϕ, but has three econometric implications.

First, the inclusion of the lags of consumption growth results in a substantial gain in the R^2. The R^2 of regression (2) is 0.320 (32.0 percent). A version of regression (1) with only demographic variables results in $\hat{\phi} = 0.039(0.013)$ and R^2 of 0.004; adding seasonal dummies yields $\hat{\phi} = 0.061(0.013)$ and R^2 of 0.043; adding the first lag of consumption growth yields $\hat{\phi} = 0.057(0.012)$ and R^2 of 0.250. Lags of consumption growth substantially improve the fit of the model, but the third lag coefficient is not statistically significant and inconsequential for R^2. The second consequence of including the consumption lags is the elimination of the serial correlation in the errors. In the existing studies with data that do not have a strong panel feature, typically the intra-household lagged consumption growth is not included in the regression but standard errors are calculated with special attention paid to intra-household serial correlation in regression errors. Parker (1999, page 962 Footnote 9) noted that based on the quarterly U.S. CEX data, the first order intra-household serial correlation of regression errors is about -0.4. When the regressors do not include the lagged consumption growth, we find a similar serial correlation of the residuals for the quarterly data of Korean households, and a slightly larger one for the monthly data. To deal with the serially correlated errors, Parker (1999) utilized instrumental variables for unbiased estimates of the standard deviation of the estimates. With the inclusion of the two consumption growth lags, the least square residuals show little evidence of serial correlation. [3] The third implication of including lags of consumption growth as regressors is that OLS on the resultant dynamic panel data model is biased in finite sample and inconsistent for a large number of households. However, our analysis in Appendix 3 shows that these deficiencies do not materially alter the conclusions of the paper.

Using nominal data for (1) produced near identical estimates $\hat{Â} = 0.031(0.012)$ and R^2 of 0.322. For our empirical model, included in the regressor is the growth of salary plus allowances, excluding bonuses. We also run separate regressions with bonuses included in the head of household salary income and results are qualitatively the same.

The estimate of $\hat{Â} = 0.03$ is statistically significant but economically small. Note in Table 1 that the standard deviation of monthly growth of salary and allowances is 0.182, while that of nondurable consumption growth is 0.322. This means that a one standard deviation increase in salary growth causes consumption growth to increase by $\frac{0.03\times0.182}{0.322}$ (or 0.017) standard deviations.

The weak excess sensitivity in consumption for the sample may reflect a representative behavior for all households, or result from stronger excess sensitivity from a subgroup of households and/or in a sub-sample period. In the following, we seek to explain the excess sensitivity. In Table 2, we present estimates of excess sensitivity $Á$ in equation (1) using monthly consumption and salary income growth of various split samples. The estimated excess sensitivity is statistically significant for anticipated salary decrease, for low income households, and for households headed by young government officials.

3.1 Excess sensitivity to positive and negative anticipated salary growth

A leading candidate among possible explanations for the excess sensitivity found in monthly household consumption is liquidity constraint. One common approach to testing the presence of liquid-

[3] Standard errors presented are robust to heteroscedasticity of unknown form. The modified Durbin-Watson statistic for unbalanced panels (by Baltagi and Wu 1999) is 2.138, suggesting a negligible serial correlation in regression errors.

ity constraints is examining whether consumption responds more to positive anticipated income changes than to negative ones (e.g., Shea 1995, Souleles 1999, and Parker 1999). This asymmetry arises because a liquidity-constrained household cannot smooth consumption by consuming more in the current period when it anticipates a higher income in the next period, but it can save when it anticipates a lower income in the next period. Another common approach is to see whether excess sensitivity is associated with low liquid asset-income ratios (e.g., Hayashi 1985 and Zeldes 1989). We take both approaches and report the results for the whole sample period in Table 2.

To examine the symmetry of consumption response to positive and negative income growth, we denote $y_{it}^{+} = y_{it}$ if $y_{it} \geq 0$, and $y_{it}^{-} = y_{it}$ if $y_{it} < 0$. We estimate

$$c_{it} = \beta_1 y_{it}^{+} + \beta_2 y_{it}^{-} + h_1 c_{it-1} + h_2 c_{it-2} + \theta' x_{it} + \varepsilon_{it}. \tag{3}$$

In the first column of Table 2, consumption responses to both positive and negative anticipated salary growth but only the response to the latter is statistically significant. This asymmetry is the opposite of the pattern associated with liquidity constraint and is taken as evidence of absence of liquidity constraints in period $t - 1$. To further examine the role of liquidity constraints, we consider subgroups of the households by liquidity. The question we seek to answer is whether excess sensitivity is more prevalent among households with low liquid assets.

3.2 Subgroup tests on low and high liquidity households

To examine the liquidity constraint issue using the alternative approach, we select the high-liquidity and low-liquidity subgroups (defined as upper and lower 20% of the households based on the ratio of liquid assets to disposable income.) We measure liquid assets by the sum of cash-balances, interest bearing assets, and dividend earning stocks. The latter two assets are imputed from interest earnings by the short-term interest rate and dividend earnings by the dividend-price ratio of the Korean Stock Exchange Index.

In the column labelled split sample (i) in Table 2, the estimate of β for the high-liquidity group is 0.027 (with standard error (0.027)), not statically different from that for the low-liquidity group ($0.042(0.030)$). We take these estimates as weak evidence against the importance of liquidity constraints, for two reasons: First, our focus on the small subgroups with low and high liquidities limits the sample size and raises the errors in parameter estimates. Second, measured household liquidity does not reflect the household's ability to borrow. Although data on household borrowing are available, they are not reliable indicators of a household's ability to take additional loans for consumption.

3.3 Split sample tests on low and high income households

We split the sample into two sub-samples by household income. We define high and low salary income observations as those with head of household annual salary income above and below the average salary income of that year. Alternative grouping by total household income produces similar results, which is not surprising since the head of household salary is the main source of household income for the vast majority of the households in the sample. We focus on the grouping based on salary income because for government employees salary income is a good proxy for permanent income and probably the most important determinant of consumption decisions. Out of 14740 total observations, the number of observations in the low income group is 8516, the rest (6224 observations) are in the high income group. Low income is correlated with the age of the head of the household: 5872 out of 8516 low income observations are young households. In Table 2, split sample (ii) shows that the low income households exhibit statistically significant excess sensitivity ($\hat{\beta} = 0.046(0.018)$) while the high income households do not ($\hat{\beta} = 0.020(0.019)$). The magnitude of the estimate for the low income households, and the difference in estimates between the low and high income households are still small relative to monthly consumption variation.

It is a widely accepted practise in household consumption literature to examine young consumers for effects of liquidity constraints, which is supported by some aspects of the Korean household data. For government o±cials with rising lifetime income pro¯les and job security, the notion of liquidity constraint is plausible. According to the year 2003 salary table of the `general and privileged o±cers' published by the government, the salary of an entry level o±cer (9th rank) with 30 years of experience is about 2:4 times that of an o±cer of the same rank but without experience. If the o±cer is promoted through the years to the 5th rank, then with 30 years of experience, his/her salary is about 3:7 times that of an inexperienced entry level o±cer. However, low liquidity households are not disproportionately young: 1421 out of 2748 low liquidity observations are young households. It appears that the connection between age and liquidity constraints is tenuous. To compare the estimates of excess sensitivity for di®erent age groups, we split the sample by age of the head of household.

3.4 Split sample tests on young and old households

For our data sample, about a half of the households are young households (de¯ned those as headed by government o±cials 43 years old or younger), while the rest are labelled as old households. We split the sample into these two groups and report the estimated excess sensitivity in split sample (iii) of Table 2. The young households show excess sensitivity while the old households do not. The excess sensitivity found in young households will be shown later in the paper to be limited to a sub-sample period. The absence of excess sensitivity for old household is robust over time.

Before moving on to further economic analysis of the regression results, we explore the robustness of the estimates. First, to examine whether the estimate of excess sensitivity parameter *Á* is a®ected by a potential failure to fully control for seasonal factors, we run regression (1) separately using data of di®erent months. The point estimates of *Á* are in a narrow range centered by the estimate for the whole sample. We conclude that uncontrolled seasonal factors do not materially a®ect the estimates of *Á*. Inclusion of a time dummy of the Asian ¯nancial crisis (November 1997 or December 1997) does not alter the estimates of excess sensitivity either. Second, the presence of the first lag of salary income growth (which has a small coefficient and is not statistically significant in most cases) does not alter the estimate of the estimate of excess sensitivity to current salary income growth. Third, as discussed in Footnote 3, the standard errors reported are robust to heteroscedasticity of unknown form. We find that for all pooled regression estimates reported in the tables of this paper, standard errors are little changed by clustering within households, indicating a negligible intra-household correlation in the regression residuals. For example, the standard error of the excess sensitivity parameter in (2) after clustering within each household is 0.012, the same as that reported earlier to the third decimal point.

4 Further Analysis of the Excess Sensitivity

4.1 The Time-dependence of estimated excess sensitivity

During the sample period 1994-2003, the Korean economy went through the Asian financial crisis in 1997 and recovered by the end of 1998. The timing of the crisis and the dramatic recovery can be reasonably assessed by watershed events and by the changes in asset prices, foreign exchange rates, and GDP growth. The panic reflected in the exchange rate of the Korean won reached the climax at the end of 1997. The negative impact on economic activity was felt throughout 1998. Although for the government employees job security was not a grave concern, there were substantial shifts in the expected long-term income. We will explore the impact of the change in permanent income on excess sensitivity to anticipated monthly variation in salary growth. We first compare the excess sensitivity estimates in two sub-sample periods 1994-97 and 1998-2003, and later for different subgroups of households and in more segmented time periods. Splitting the sample into more sub-samples inevitably reduces the number of observations in each sub-sample. To mitigate the adverse effects of small sample, we consider the following model of dummy variables interacted with salary growth that borrows strength from the whole sample for estimation of dozens of nonessential parameters.

$$c_{it} = \sum_{j=1}^{J} \phi_j d_j y_{it} + h_1 c_{it-1} + h_2 c_{it-2} + \theta' x_{it} + \epsilon_{it}, \tag{4}$$

where the dummy $d_j = 1$ if the household belongs to a sub-sample j and 0 otherwise. The sub-samples are exclusively defined, so there is one and only one non-zero d_j. The first three columns of Table 3 show that regression (4) with dummy variables interacted salary growth produces similar results as model (1) on the samples split by income, or liquidity, or age. This suggests that restricting parameter vector (h_1, h_2, θ') to be identical across sub-samples does not significantly affect the estimates of parameter of interest.

We now examine whether the financial crisis induced a change in consumer behavior. The last column of Table 3 shows that the excess sensitivity is prevalent before the financial crisis and is absent after the crisis. Table 4 shows that excess sensitivity is most prevalent among the pre-crisis era young households who have low liquid assets or low income. Unlike the estimates for the whole sample, the excess sensitivity for the young with low liquidity is significant not only statistically but economically as well. The estimate of $\hat{\phi} = 0.18$ implies that a one standard deviation increase in salary growth causes consumption growth to increase by $\frac{0.18 \times 0.182}{0.322}$ (or approximately 0.1) standard deviations.

There are already several indications against liquidity constraint as the leading theory for excess sensitivity found in the young Korean households: the response to positive salary growth is not stronger than that to negative salary growth (Table 2 first column); estimates of excess sensitivity with low liquidity and high liquidity are not significantly different (Table 2 column (i) and Table 3 column (i)); and the absence of excess sensitivity for the old households with low liquid assets.

The results based on different sample periods reveal another aspect of estimated excess sensitivity: that it may not be robust over time. In the following we argue that the pattern of the change in the estimates of excess sensitivity serves as an opportunity of testing the significance of liquidity constraint.

To examine how excess sensitivity changes over time we introduce a ¯ner division of the sample periods. The most indicative variable of the ¯nancial crisis, the Korean won, experienced sharp depreciation in October 1997 and quickly collapsed, from about 900 won per U.S. dollar to over 1600 in three months. But there were ample troubling signs abroad and at home before the collapse of the won. Abroad, the currency crisis in Thailand started in May 1997. Domestically, by the mid of 1997, several *chabeols* collapsed (including Hanbo Steel, the second largest steel maker in Korea, and Kia Motors, the third largest car maker). Given these events, we treat 1994 to the ¯rst half of 1997 as the period prior to the ¯nancial crisis.

The crisis resulted in year-over-year quarterly declines in 1998 GDP about 7%, declines in private consumption over 10% percent, declines in capital formation around 30%, and declines in import about 20% (source: Bank of Korea). In early 1999, there were clear indications that the crisis was over and the Korean economy staged a dramatic recovery through 1999. In the ¯rst quarter of 1999, GDP, employment (working hours), consumption, imports, and stock price indexes all started to show positive growth. The short-term interest rate (the 3-month call rate) dropped from about 25% in the beginning of 1998 to about 6% in the beginning of 1999 and stayed in the 5% range throughout 1999. [4] In every quarter of 1999, GDP growth was positive and larger than the decline that had occurred in the same quarter of 1998 and nearly 10% for the year. For these reasons, we consider the second half of 1997 to the end of 1998 as the crisis period.

Although the 1997 salary of government employees was not a®ected by the crisis and their jobs were quite secure, after the crisis there was a three year salary freeze, from 1997 to 1999. There is little doubt that government employees recognized the dramatic recovery starting at the beginning of 1999 meant a substantial increase in their permanent income. The fortune of workers

[4] The extraordinarily high short-term interest rate contained a large risk premium in a state of panic. We do not report estimates with short-term interest in the regression because the coe±cient on the time-varying risk-premium can not be precisely estimated. However, inclusion of short-term interest rates does not alter the estimated excess sensitivity.

in different industries may be tied to the economy in different ways, but because the annual salary of government employees is raised across rank, there should be little uncertainty regarding the positive prospects in permanent income for the government employees. Meanwhile, the government employees were receiving the same salary as they did in 1997. In the year 2000, the salary schedule of government employees was raised substantially. According to the salary tables, the nominal salary of an official of any given rank and experience jumped by about 40%. Although a change in compensation policy by converting some traditional bonuses and allowances to basic salary contributed to the large increase, the total compensation of government substantially increased as well (by about 20% in our sample).

Thus the year 1999 is of special interest for the purpose of testing the effect of liquidity constraint because the government employees anticipated a large increase in permanent income. The life-cycle theory implies an increase in current consumption and motive for borrowing. [5] If liquidity constraint is a key reason for excess sensitivity then one should expect to find strong excess sensitivity in 1999.

Table 5 reports the estimates of ϕ_j associated with salary income growth variable interacted with a variety of dummies, as indicated in (4). A striking feature of the table is that the only period that shows excess sensitivity is the pre-crisis period $1994 - 1997Q2$. For the pre-crisis period, young households with low liquid assets show the strongest excess sensitivity. Other periods, including the year 1999, show no evidence of excess sensitivity. The absence of excess sensitivity for the young with low liquidity (the subgroup that most likely face liquidity constraints) in 1999 (a period that liquidity constraints are most likely binding) is evidence against liquidity constraint as a major cause of the excess sensitivity found in the Korean household data. It should be noted that our conclusion only pertains to the Korean household data and does not shed new light to the tests on liquidity constraints based on other data sets.

[5] The diminished uncertainty throughout 1999 should have also reduced precautionary savings and further increased consumption. We will discuss the precautionary saving theory in the next section.

To guard against the possibility that the parameters in the control variables in model (4) substantially differ across sample periods, we also estimate the model using sub-sample periods 1994-1997 and 1998-2003, without further dividing the sample period and causing a more serious small sample problem. The split sample results in Table 6 replicate the estimates with interaction dummies as in Table 4. It confirms that the excess sensitivity is closely related to the pre-crisis era young with low liquid assets or low income but is absent for this group after the crisis; and that excess sensitivity is absent for the old, even the pre-crisis era old with low liquidity or low income.

4.2 More evidence of liquidity constraints after the crisis

There is further evidence suggesting that between 1994-2003 liquidity was the tightest in the year 1999 for the young government employees. The average nominal monthly salary for the young households in our data sample was 1442 thousand won for 1998 and 1459 thousand won for 1999, reflecting the salary freeze mentioned earlier. The average expenditure on nondurables for the young households was 1100 thousand won in 1998, while the same expenditure for 1999 was 1297, a nearly 18% increase over 1998. One may speculate that the above evidence is a result of borrowing by the young households in 1999. Examination of household finance balances shows that it is not the case. In 1999, the young households did not borrow much more than they did in previous years. The increase in consumption is mostly financed by a decrease in family savings. In 1999, 22% of the young households saved less than 10% of their disposable income (in liquid and illiquid assets) and 52% of them had liquid assets less than 10% of the disposable income. In comparison, from 1994 to 1998 14% of the young households saved less than 10% of their disposable income and 26% of them had liquid assets less than 10% of the disposable income. By all accounts, in 1999 the young households experienced tighter liquidity than they did between 1994 and 1998.

To examine in greater detail how consumption behavior changed after the financial crisis, in

Table 7 we report estimates of excess sensitivity Á in (1) for components of nondurable consumption. Food and apparel show excess sensitivity for the entire sample period for all households and for the young households. Compared with the pre-crisis era, the estimate of excess sensitivity of apparel for the young households is much smaller and not statistically signi¯cant after the crisis. The post-crisis era point estimate of excess sensitivity of food expenditure by the young households is slightly smaller than the pre-crisis one. But unlike the pre-crisis estimate, the post-crisis estimate of excess sensitivity in food is not statistically signi¯cant at the 10% level. We conclude that the change in consumption behavior after the ¯nancial crisis is category-speci¯c, but overall there is a tendency towards greater consumption smoothing after the ¯nancial crisis.

4.3 Robustness check: Kalman filtering of measurement errors

It has been noted that the PSID U.S. household consumption expenditure data contain a great deal of noise (see Runkle 1991). We are not concerned with measurement errors in the salary of the head of the households, which is public information and can be veri¯ed by the case worker. Measurement errors in the level of consumption expenditure are more troublesome because they render spurious negative serial correlation in consumption growth and inconsistent estimates of parameters in the dynamic panel regression model of consumption growth. There are reasons to believe that measurement errors in consumption expenditure are small for the Korean household data. First, the data are monthly instead of quarterly or annual (as in the case of the PSID). Second, the data are gathered by case workers who visit the sampled households two or three times a week to inspect the entries in the account-book. Nonetheless, we will examine whether the results reported earlier in the paper still hold in the presence of measurement errors in consumption expenditure.

Without making distributional assumptions on the model, the basic approach to measurement errors is through instrumental variables. In the PSID data, Altonji and Siow (1987) found instruments for noisy income, Dynan (2000) did so for noisy consumption expenditure on food. The parameters of interest are estimated through two stage least squares or Generalized Method of Moments (GMM), where both depend on the instruments employed. There are several difficulties with the instrumental variables approach. First, in the regression with two lags of consumption growth, the period t equation involves measurement errors of consumption expenditure in period $t-3$. For relatively short panels, using lagged variables to serve as instruments exacerbates the shortage of data. Second, instruments are often weak and lead to inefficient estimation. Given our knowledge of the range of the measurement errors, we use the Kalman filter approach, which requires making normality assumption about the model. But Maximum Likelihood Estimation (MLE) based on the Kalman filter will produce more efficient estimates than instrumental variables methods if the distributional assumption is a reasonably good description of the data.

Denote the observed consumption growth from $t-1$ to t as c^*_{it}, the true unobserved consumption growth as c_{it}, and the measurement error in the logarithm of the level of period t consumption as $\tau_t \sim N(0; \kappa^2)$. The regression model (1) is based on the assumption that the standard deviation of the measurement error κ equals to zero. In the presence of the measurement errors, by our notation

$$c^*_{it} = c_{it} + \tau_{it} - \tau_{it-1}; \tag{5}$$

where c_{it} is given in (1). Substituting c_{it} in (1) by c^*_{it} using (5) yields a regression of c^*_{it} with a moving average error term which is typically handled through instrumental variables or GMM. However, the equations can be reviewed as a state-space model, with (5) being the observation equation and (1) being the state equation. Under the normality assumption, we can evaluate the likelihood using a Kalman filter. The derivation on the filter is similar to that for the ARMA model (see Hamilton 1994). In Appendix 2 we offer a description of the Kalman filter in the context of the present model and the form of the likelihood function.

Table 1 shows that the average standard deviation of the measured consumption growth is

0:322. As we noted earlier, given the method of data collection, the standard deviation of measurement error · is likely to be much less than this number. When we set · at various levels between 0:01 and 0:2, the results reported hold qualitatively. For example, recall that in (2) the estimate for the whole sample the estimate of excess sensitivity parameter is $\hat{Â}$ = 0:029 (with standard error 0:012). With · set at 0:05, 0:1, and 0:15, the Kalman ¯lter-based MLEs of $\hat{Â}$ are 0:036(0:013), 0:036(0:012), and 0:036(0:013), respectively. For the young households, the OLS estimate in Table 2 is 0:058(0:018). With · set at 0:05, 0:1, and 0:15 the MLEs of $\hat{Â}$ are 0:063(0:016), 0:063(0:018), and 0:065(0:020), respectively. These results suggest that the presence of measurement errors does not qualitatively change the conclusion of the paper.

4.4 Another robustness check: Fixed effects panel data regressions

So far the empirical results in the paper pertain to pooled regression with panel data. These regressions do not take into account household-speci¯c factors uncaptured by the demographic variables. One possible scenario under which the unspeci¯ed heterogeneity among the young households produces a spurious excess sensitivity is as follows. Suppose there is no `within' household excess sensitivity, so a plot with the salary growth on the horizontal axis and consumption growth on the vertical axis consists of horizontal lines for di®erent households. However, suppose there is a positive correlation between the household-average consumption growth and household-average salary growth, then for the pooled regression under the wrong restriction of a common intercept, the slope of the salary growth-consumption growth graph would be positive rather than zero. To examine whether this is the reason for the estimated excess sensitivity, we will use the panel data feature of the data and allow for household ¯xed e®ects (i.e., allow for di®erent intercepts in the salary growth-consumption growth graph for di®erent households). As we noted in the introduction, the Korean household data set contains long panels (for up to 60 months). We now examine consumption sensitivity to expected income changes by taking advantage of these long panels through the introduction of household-speci¯c ¯xed e®ects in the regression. The results of the ¯xed e®ects model can serve as a robustness check for the results based on pooled data.

Kiviet 1995, and surveys by Chamberlain 1984 and Arellano 2003). In addition, the presence of measurement errors in the logarithm of consumption produces a spurious autocorrelation in consumption growth and inconsistent estimate of excess sensitivity. Are these de¯ciencies large enough to alter the conclusion of the paper based on OLS? Since the alternatives to OLS may require relinquishing a portion of data (for construction of instruments) or making additional modelling assumptions, and reduce e±ciency, it is of interest to quantify the de¯ciencies of OLS in a setting similar to the Korean household data.

The data and model in this study di®er from those studies in the econometrics literature in a number of ways. Because of the special features in this study it is not clear whether the standard procedure will result in seriously de¯cient estimates. Our model includes two lags of consumption growth and is signi¯cantly di®erent from the unit root model. The parameter of interest here is excess sensitivity instead of the autoregressive parameters. In comparison, the recent dynamic panel model literature focuses on the autoregressive parameter in unit root models. In addition, our data set consists of unbalanced panels of over eight hundred households, with one to ¯ve years of monthly observations on each household. The panels may be long enough so that the ¯nite sample bias and inconsistency of OLS estimate are quantitatively negligible. Because the exact ¯nite sample properties of the estimator are unknown for the parameter setting of the present problem, we will conduct the following Monte Carlo simulations. We simulate 1000 sets of data and examine the e®ects of ¯nite sample bias and measurement errors. To focus on the ¯nite sample bias of the dynamic model, we ¯rst simulate data from a model without measurement errors and compare the OLS of pooled regression on the simulated data with the data generating parameters. We repeat the procedure to explore the property of the estimates with household ¯xed e®ects. Lastly in both the pooled regression and the ¯xed e®ects model we add measurement errors in simulated data and examine the property of least squares estimates. We set the number of panels and the observation size similar to Korean household data, and data generating parameters similar to the least square estimates. The details of the Monte Carlo experiment are given in Appendix 3.

Our simulations show that for panels with the number of households and size of observation similar to those of the Korean data set, the OLS of pooled regression and the fixed effects estimates are quite close to the true data-generating parameters. We conclude that given the features of the Korean household data set, the known theoretical deficiencies of the OLS estimator do not materially affect the estimates of excess sensitivity in the pooled regression results reported in Tables 2 to 7 and the fixed effects estimates cited in the previous subsection.

5 Discussion and Comparison with Related Studies

5.1 Other theories on excess sensitivity

Besides liquidity constraint, a number of theories can explain excess sensitivity in household consumption. Baxter and Jermann (1999) built a general equilibrium model to examine a household's tradeoff among leisure, housework, and marketable work in response to wage fluctuations. In their model, in a period of high wage the household spends more time on work, and less time on housework and less housework leads to higher consumption expenditure. The intertemporal substitution of housework and consumption expenditure can yield a positive correlation between income and consumption expenditure, even when the wage changes are anticipated. However, this type of excess sensitivity does not explain the estimates based on the Korean data, for two reasons. First, the monthly variation in salary does not constitute a changing wage rate and does not represent time varying opportunity cost of housework. Second, three out of four of the Korean government employees have a non-working spouse. Hence there is no obvious correlation between the monthly variation in opportunity cost of housework and the head of household salary income.

The excess sensitivity by the young households is often attributed to their high expected income growth, high risk, and low liquidity. [6] Neither argument is convincing for young Korean government employees who have a fairly predictable career path and certain near term future earnings. As is noted earlier, for the sample as a whole there does not seem to be a shortage of liquidity that prevents consumption smoothing. We ¯nd that this conclusion holds even for the young government employees. Empirically, precautionary saving takes the form of bu®er stock for young households, as Deaton (1991) and Carroll (1997) argued, and can lead to excess sensitivity to expected income changes as liquidity constraints do. Excess sensitivity in the bu®er stock model is due to possible liquidity constraints in the future. The problem that Korean government employees face is di®erent from the typical setting for U.S. households where wage variations contain temporary and permanent components. For the latter case an optimizing agent facing liquidity constraint in his life-cycle may build a bu®er stock against the temporary °uctuations in income. For the Korean government employees however, monthly income variation is large but certain. This means that the monthly salary growth is not correlated with the conditional variance of consumption growth. It remains to be examined whether innovations to permanent income are large enough to make an optimizing household build a bu®er stock, thereby generating a positive correlation between monthly consumption and income variation. One scenario of precautionary saving causing estimated excess sensitivity is that a decrease in lifetime income uncertainty in 1999 reduces the precautionary savings, making young households behave as liquidity constrained, which is inconsistent with our estimates. Simulation from an optimal consumption model with parameters calibrated to the Korean government employees is a useful future research project.

We conclude that the liquidity constraints, intertemporal substitution of housework and consumption expenditure, and precautionary savings do not explain all aspects of the empirical ¯nd-

[6] For some examples of empirical analysis of U.S. household data on precautionary saving, see Deaton (1991), Dynan (1993), Carroll (1997), and Parker and Preston (2005). Carroll (1997) noted that both the precautionary saving and the shadow cost of liquidity constraints are decreasing function of the \cash-on-hand". Dynan (1993) used the cross time variance in place of the conditional variance and run a cross-section regression of the ¯rst order condition of consumption optimization. She found limited e®ect of precautionary motive for U.S. households. Parker and Preston (2005) estimated a ¯rst order condition using the CEX data and concluded that the precautionary and liquidity constraints accounted for a large portion of the expected consumption growth.

ings made in the Korean household data. An alternative explanation is that some households do not optimally smooth consumption in some period of time because the e®ort required in executing the optimal consumption plan exceeds the bene¯t. We will elaborate on the theory in the next subsection, in light of evidence found in related empirical studies.

5.2 Reconciling with empirical findings in the existing literature

A number of novel approaches were developed to take advantage of special cases where certain income changes are known to be anticipated by households. Using the CEX data set, Souleles (1999) and Parker (1999) found that household consumption responds to predictable income variations induced by income tax rebates and social security taxes. Shapiro and Slemrod (1995) found that in the Survey of Consumers, a large faction of households answered that they plan to spend the small extra take-home pay resultant from a change in tax withholding rule, and that the planned spending is not correlated with the indicator of liquidity constraint. Shea (1995) used union contracts to predict wage income of the primary earners of U.S. PSID households, and found excess sensitivity of food consumption to expected wage growth. However, tax rebates are infrequent events and the variation in wages between union contracts is small. The excess consumption sensitivity found in these studies may be related to these features of data.

Two recent studies made use of data sets where households experience regular, large, and predictable changes in income. Browning and Collado (2001) examined Spanish panel data from 1985 to 1995 (with up to eight quarters for each household) and found no signi¯cant di®erence in consumption between households that receive a seasonal bonus and those that do not. Hsieh (2003) found that the Alaskan household consumption expenditures do not respond to the regular payments of the Alaska Permanent Fund. These studies support the conclusion that household consumption does not respond to regular and anticipated changes in income. An explanation suggested in these studies is that consumers may deviate from optimal consumption smoothing when the welfare cost of non-optimal consumption is low. Occasional and temporary failures in consumption smoothing are less costly than regular and persistent failures. If this theory is correct, one would expect to observe failure of consumption smoothing in high frequency data. Examining daily household expenditure data, Stephens (2003) found that the consumption expenditures of social security recipients tend to be abnormally high within a few days following the arrival of the social security check. Stephens' finding is consistent with the theory of Browning-Collado and Hsieh, but it can also be explained by liquidity constraints which he found to have a marginal effect.

5.2.1 Comparing results on quarterly and monthly Data

To compare with the studies by Browning and Collado (2001) and Hsieh (2003) who used quarterly data of different countries, we time-aggregate the monthly household data to quarterly data. Monthly data are preferable to quarterly data because they involve less time-aggregation. Christiano, Eichenbaum, and Marshall (1991) showed that if the utility function is time-separable, time-aggregation may result in spurious rejection of random walk in consumption. Under time-nonseparablity the theoretical implication of time-aggregation on estimation of excess sensitivity is more complicated.

For the whole sample the quarterly-data-based regressions with household demographics and seasonal dummies produce results that agree with those of Browning and Collado (2001) and Hsieh (2003) who used quarterly data of different countries. The addition of the lag of consumption growth rate of quarter $t - 1$ (which is highly significant) does not change the insignificance of predictable income growth, but raises the R^2 of the regression and eliminates the serial correlation in the regression residuals. The estimates of the excess sensitivity parameter ϕ based on quarterly data differ from those of monthly data. For the whole sample, the parameter ϕ is positive but not statistically significant, which is in agreement with the finding of Browning and Collado (2001) for the Spanish household data and Hsieh (2003) for the Alaskan household data, but is in contrast to the signi¯cant estimate for monthly data. The contrast between the estimated excess sensitivity based on the monthly and quarterly data is consistent with the cost-bene¯t analysis of consumption smoothing discussed in section 5.3.

5.2.2 Joint estimation of excess sensitivity and intertemporal-dependency in consumption

The existing literature conventionally estimates excess sensitivity and intertemporal-dependency of consumption separately. For example, Dynan's (2000) model of intertemporal-dependence of consumption growth does not allow for excess sensitivity while Souleles (1999), Parker (1999), Browning and Collado (2001) and Hsieh (2003) estimated excess sensitivity without considering intertemporal-dependence of consumption. Limitation in data is an important motivation for employing restricted models. The studies on excess sensitivity use data of very limited panel feature and in quarterly or annual frequencies.

It is critical that intertemporal-dependence of consumption and excess sensitivity are estimated jointly in this study. Compared with quarterly or annual data, the monthly consumption is more likely to be intertemporal-dependent. The lags of consumption growth should be included to avoid mis-speci¯cation of the model and inconsistency of the estimate for excess sensitivity. Long panels of Korean household data o®er a rare opportunity for estimation with the presence of household ¯xed e®ects, which as suggested in the previous section, rules out a spurious estimate for excess sensitivity. The longer panels are also useful in estimating the time-dependency in consumption.

We ¯nd evidence of intertemporal local durability in nondurable goods. In regressions of consumption growth, the coe±cients for the lags of consumption growth are negative and highly signi¯cant, and inclusion of the lags of consumption growth substantially raises the R^2s of the regressions. The inclusion of the ¯rst lag slightly reduces the slope coe±cient of the predictable income growth, while the inclusion of the second lag has little e®ect on the estimated excess sensitivity. More importantly, the estimated local durability is a key determinant of the cost and consumption differ across households and vary over time. Our estimates are consistent with the notion that the old are willing to make more effort smoothing consumption than the young. After the crisis, households became more careful in consumption planning. Even though the welfare loss of non-optimal consumption smoothing was not very large, tightening of resources prompted households to reduce the inefficiency.

6 Concluding Remarks

The existing studies on household consumption expenditure find excess sensitivity of consumption to irregular changes in expected income, but not to regular and large changes in expected income. These studies are based on quarterly data or annual data with relatively short panels. The Korean household data set used for this study has some important and unique features: it is in monthly frequency, contains long panels (up to five years), and most importantly, contains large and predictable variations in income. By examining monthly consumption expenditure of households headed by government employees, we find that excess sensitivity within a subgroup of households (young, with low liquid assets or low income) and a sub-sample period (before the Asian financial crisis).

These results provide an under-recognized perspective to household consumption behavior. We argue that consumption smoothing takes effort to plan and discipline to execute. Even in the absence of liquidity constraints, households may fail to smooth consumption optimally in every short time interval because the effort involved is more than the welfare gained. It is possible that some households do not keep a close track of their monthly spending unless the salary income for the month is abnormally low. This would explain the excess sensitivity to negative growth in salary income found in Table 2. Empirical evidence suggests that excess consumption sensitivity is unlikely due to liquidity constraints, despite its association with young age, low liquid assets and low income. It is quite possible that these characteristics are correlated with poor consumption planning. The contrast in the estimates of excess sensitivity before and after the Asian ¯nancial crisis can be interpreted as evidence that some households are less willing to make the e®ort to achieve optimal smoothing in a time of prosperity, but may be more willing to do so after a time of hardship.

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Appendix 1: Some Facts about the Korean Household Data

The Family Income and Expenditure Survey tracks income and expenditure of a representative sample of urban Korean households. The initial survey was conducted in 1951 on 70 households in Pusan city, and in 1954 to 1959 was expanded to 200 households of salaried workers in Seoul. Before 1963, the survey was conducted by the Bank of Korea and since 1963, by the National Statistics Office (NSO), with the scope of the survey expanded to the urban areas of the whole country. From 1967 to 1974, data were collected via diary method for food consumption for about 1800 households, the other items via interviews. Since 1975, the majority of the survey data have been collected through account-books. Each household is followed monthly for up to five years. Recent wholesale sample changes occurred in the beginning of 1998 and the beginning of 2003.

The survey is designed to sample in proportion to the distributions of all types of the Korean urban households. The average sampling rate is $1/1439$ in 2000, and the total sample number is about $5,500$ households. All information is gathered by NSO officers who visit the sampled households two or three times a week to inspect the entries in the account-book. The survey items fall into three main categories: demographic information, income variables, and expenditure variables. The survey covers households with two or more people who are residents in seventy-two cities in Korea. Farmers, fishermen, and foreigners are excluded from the survey. Income variables include salary, allowances, bonuses, and other income for each household member as well as several types of earnings of financial assets. Recorded expenditures include those on food, housing, utilities, apparel and shoes, education, and other items; non-consumption expenditures include taxes, public pension, social insurance, etc.

We use the same definition of nondurable consumption given by Parker (1999) and Hsieh (2003) and constructed nondurable consumption as the sum of the following items: food; home-keeping (including utilities and small appliances but excluding furniture and major appliances); apparel; transportation & communication (excluding purchasing of new and used vehicles); personal care & entertainment (including items such as personal care, tobacco and smoking, and reading materials, but excluding entertainment equipments).

Appendix 2: Kalman Filtering of Measurement Errors in Consumption Expenditure

We denote the measurement error in the logarithm of period t consumption expenditure by household i as τ_{it}, $\tau_{it} \sim N(0, \kappa^2)$. We set the standard deviation of measurement errors κ at various values and estimate through MLE other parameters of the model. The observed consumption growth c^*_{it} $(t = 1, \cdots, T_i)$ is given by

$$c^*_{it} = c_{it} + \tau_{it} - \tau_{it-1}. \tag{7}$$

The true but unobserved consumption growth c_{it} is a scalar latent variable and evolves according to

$$c_{it} = h_1 c_{it-1} + h_2 c_{it-2} + b' q_{it} + \nu_{it}, \tag{8}$$

where $b' = (\phi, \mu)'$, $q_{it} = (y_{it}, x_{it})$, $\nu_{it} \sim N(0, \omega^2)$, z_{it} is a vector of wage growth rate y_{it} and other control variables in x_{it} excluding the lags of consumption growth. In the ensuing discussion we drop household index i and only keeps the time subscript.

Denote $z_t = (c_t, c_{t-1}, \tau_t, \tau_{t-1})'$, equations (7) and (8) can be written in matrix form as

$$c^*_t = A z_t, \tag{9}$$

and

$$z_t = H z_{t-1} + B q_t + \eta_t, \tag{10}$$

where $\eta_t \sim N(0, \Omega)$,

$$A' = \begin{pmatrix} 1 \\ 0 \\ 1 \\ -1 \end{pmatrix};\ H = \begin{pmatrix} h_1 & h_2 & 0 & 0 \\ 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \end{pmatrix};\ B = \begin{pmatrix} b' \\ 0 \\ 0 \\ 0 \end{pmatrix};\ \eta_t = \begin{pmatrix} \nu_t \\ 0 \\ \tau_t \\ 0 \end{pmatrix};\ \Omega = \begin{pmatrix} \omega^2 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & \kappa^2 & 0 \\ 0 & 0 & 0 & 0 \end{pmatrix}.$$

We define

$$\hat{c}^*_{t|t-1} = \mathbb{E}(c^*_t \mid t-1),\ \hat{z}_{t|t-1} = \mathbb{E}(z_t \mid t-1),\ \hat{z}_{t|t} = \mathbb{E}(z_t \mid t),\ \hat{\sigma}^2_{t|t-1} = \mathbb{E}[(c^*_t - c^*_{t|t-1})^2 \mid t],$$

$$\hat{P}_{t|t-1} = \mathbb{E}[(z_t - z_{t|t-1})(z_t - z_{t|t-1})' \mid t-1],$$

where "$\mathbb{E}(\cdot \mid t)$" corresponds to expectation conditional on $c^*_t, c^*_{t-1}, \cdots$. For jointly normal-distributed variables, it is equivalent to linear projection onto $c^*_t, c^*_{t-1}, \cdots$. By model assumptions,

$$\hat{c}^*_{t|t-1} = A\hat{z}_{t|t-1} = \hat{c}_{t|t-1}, \tag{11}$$

$$c^*_t - \hat{c}^*_{t|t-1} = A(z_t - \hat{z}_{t|t-1}). \tag{12}$$

From (12),

$$\hat{\sigma}^2_{t|t-1} = \mathbb{E}(c_t^* - \hat{c}^*_{t|t-1})^2 = A\hat{P}_{t|t-1}A'. \tag{13}$$

It is easy to verify that

$$\hat{z}_{t|t} = \hat{z}_{t|t-1} + \mathbb{E}[(z_t - \hat{z}_{t|t-1})(c_t^* - \hat{c}^*_{t|t-1})]\{\mathbb{E}[(c_t^* - \hat{c}^*_{t|t-1})^2\}^{-1}(c_t^* - \hat{c}^*_{t|t-1}). \tag{14}$$

In (14), the first term is the estimate of period-t state before observing period-t data. The second term represents the update after the observation.

The mean squared error of the updated projection is

$$\begin{aligned} \hat{P}_{t|t} &= \mathbb{E}[(z_t - \hat{z}_{t|t})(z_t - \hat{z}_{t|t})'] \\ &= \hat{P}_{t|t-1} - \mathbb{E}[(z_t - \hat{z}_{t|t-1})(c_t^* - \hat{c}^*_{t|t-1})]\{\mathbb{E}[(c_t^* - \hat{c}^*_{t|t-1})^2]\}^{-1}\mathbb{E}[(c_t^* - \hat{c}^*_{t|t-1})(z_t - \hat{z}_{t|t-1})']. \end{aligned}$$

Note that

$$\hat{z}_{t+1|t} = H\hat{z}_{t|t} + Bq_{t+1}. \tag{15}$$

It follows that

$$\begin{aligned} \hat{P}_{t+1|t} &= \mathbb{E}[(z_{t+1} - \hat{z}_{t+1|t})(z_{t+1} - \hat{z}_{t+1|t})'] && (16) \\ &= H\hat{P}_{t|t}H' + \Omega. && (17) \end{aligned}$$

To sum up, the filter updates $(\hat{z}_{t|t-1}, \hat{P}_{t|t-1})$ to $(\hat{z}_{t|t}, \hat{P}_{t|t})$, and the AR structure of the model gives prediction $(\hat{z}_{t+1|t}, \hat{P}_{t+1|t})$ and completes the recursive loop. When we move to $t = T$ then all the conditional moments are functions of $\gamma = (h_1, h_2, b, \omega)$ and initial state $z_{1|0}$ and $P_{1|0}$.

Note that the Kalman filter applies to each household (so we put household index i back into the notion). For MLE, one can choose γ to maximize

$$L(Y|\gamma, z_{1|0}, P_{1|0}) \propto \prod_{i=1}^{N}\prod_{t=1}^{T_i} |\hat{\sigma}_{it|t-1}|^{-1} exp(-(c_{it}^* - \hat{c}_{it|t-1})^2/(2\hat{\sigma}^2_{it|t-1}));$$

The initial state $z_{1|0}$ and $P_{1|0}$ can be assumed as functions of parameters γ. For prediction of the initial state $z_{i1|0}$, we assume initial observations are without errors $(z_{i1|0} = (c_{i0}^*, c_{i,-1}^*, 0, 0))$. Setting $z_{i1|0}$ to a different value (say $(0, 0, 0, 0)$) produces a similar result. We assume $P_{1|0}$ is a matrix with elements of large values (we set it at unity).

Appendix 3: A Monte Carlo Study on Finite Sample Properties of OLS Estimates of Dynamic Panel Data

As we noted in the introduction, OLS estimates for dynamic panel regression have several deficiencies. The finite sample bias of OLS of autoregressive model is well known (see e.g., MacKinnon and Smith 1998). For fixed effects models, OLS is inconsistent (see, e.g., Nickell 1981). The measurement errors in the level of consumption render negative serial correlation in observed consumption growth and inconsistency of OLS of the consumption growth equation. Finite sample properties of dynamic panel have been simulated in a number of studies with the focus on near unit root cases (e.g., Kiviet 1995 and Phillips and Sul 2003). Our data and model have several features that have not been the focus of the existing simulation studies on the first order autoregressive parameter with balanced panels. Our model includes two lags of consumption growth, and the data generating model is far from the unit root model. MacKinnon and Smith's (1998) simulation of the finite sample bias of OLS for different values of the AR(1) root suggests the bias of OLS for this data set should be small. More importantly, the parameter of interest here is excess sensitivity instead of the autoregressive parameters, and the nature of the finite bias of the former does not have a known pattern as that of the latter. Another difference between our problem and the existing simulation studies of finite sample properties on dynamic panel of balanced panels is that our data set consists of unbalanced panels of over eight hundred households, with one to five years of monthly observations on each household. Because of these special features of the data and model in this study, it is not clear whether the standard procedure will result in seriously deficient estimates. In the following, Monte Carlo simulations will show that given the nature of our data set, the problems with OLS of dynamic panel data regression are not serious enough to alter our conclusion.

The number of observations in the panels are: 400 households with 10 growth rates observations, 160 households with 22 observations, 100 households with 34 observations, 80 households with 46 observations, and 60 households with 58 observations. We simulate 1000 samples of panel data based on parameters similar to the estimates from the Korean household data. The pooled regression model is

$$c_{it} = a + \phi y_{it} + h_1 c_{it-1} + h_2 c_{it-2} + \nu_{it}. \tag{18}$$

The innovations in consumption growth in period t, $\nu_{it} = m_t + \vartheta_{it}$ contains a macroeconomic shock $m_t \sim N(0, 0.1^2)$ that affects all households in period t and an household specific shock $\vartheta_{it} \sim N(0, 0.2^2)$ that affects household i in period t. For data generation, we set $h_1 = -0.6$, $h_2 = -0.3$, and $a = 0$. The salary income growth data is generated from the model

$$y_{it} = -0.5 y_{it-1} + \delta_{it},$$

where $\delta_{it} \sim N(0, 0.2^2)$. The observed data are simulated from

$$c^*_{it} = c_{it} + \tau_{it} - \tau_{it-1}.$$

The standard deviation of the measurement error is $\tau_{it} \sim N(0, \kappa^2)$. For the fixed effects model

$$c_{it} = a_i + \phi y_{it} + h_1 c_{it-1} + h_2 c_{it-2} + \varepsilon_{it}, \tag{19}$$

all data generating parameters are the same as the pooled regression model except that we assign a_i a normal random number from $N(0; 0{:}1^2)$. The generated a_i is treated as ¯xed for household i. We will pick di®erent values for · and Á for data simulation. We report the mean and standard deviation of OLS of (18) and within group estimate of (19) over the 1000 simulated samples using the consumption growth data that contain measurement errors.

We simulate a combination of models: pooled (¯xed e®ects) regression without (with) measurement errors, each under a variety of parameter settings. The results are reported in the following table.

N=18,080	Á = 0:03		Á = 0:10		Á = 0:20	
	Mean	S.D.	Mean	S.D.	Mean	S.D.
Pooled Regression Estimates of Á						
· = 0	0.0299	0.0071	0.0998	0.0072	0.1997	0.0077
· = 0:1	0.0298	0.0079	0.0993	0.0081	0.1986	0.0084
· = 0:2	0.0296	0.0103	0.0985	0.0103	0.1971	0.0104
Fixed E®ects Estimates of Á						
· = 0	0.0295	0.0077	0.0988	0.0079	0.1978	0.0085
· = 0:1	0.0293	0.0085	0.0983	0.0086	0.1969	0.0090
· = 0:2	0.0291	0.0107	0.0977	0.0108	0.1957	0.0109

To mimic the split sample regressions (on the young households and pre- and post- Asian ¯nancial crisis periods), we conduct simulations using one-half and one-quarter of the household panels across all panel length. For example, one-quarter of panels ($N = 4520$) consist of 100 households with 10 observations, 40 households with 22 observations, 25 households with 34 observations, 20 households with 46 observations, and 15 households with 58 observations.

measurement error	$N = 9040$; Á = 0:10				$N = 4520$; Á = 0:20			
	Pooled		Fixed E®ects		Pooled		Fixed E®ects	
·	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
0	0.1000	0.0109	0.0987	0.0104	0.1998	0.0145	0.1981	0.0150
0.10	0.0992	0.0122	0.0986	0.0118	0.1983	0.0164	0.1969	0.0168
0.20	0.0982	0.0156	0.0983	0.0151	0.1964	0.0211	0.1955	0.0213

The OLS estimates of excess sensitivity show a slight downward bias. The t statistics are signi¯cant except for the case of weak excess sensitivity (Á = 0:03) with large measurement errors (· = 0:2). However, if the true data generating parameter shows strong excess sensitivity (Á = 0:20) then even when · = 0:2 and the number of households is cut by three-quarters across all panel length, the OLS estimates of the excess sensitivity are signi¯cant and are still quite close to the true parameter.

TABLE 1 - Summary Monthly Statistics: All Households Headed by Government Employees 1994-2003

Variable	Mean	Standard deviation
Head of household salary income	1,787	654
Head of household salary income and bonus	2,485	948
Wage income of other household members	451	894
Age	43.6	8.6
Family size	3.9	1.1
Food	485	255
Personal care and entertainment	466	611
Transportation and communication	236	196
Apparel	135	232
Home keeping	128	131
Non-Durable consumption	1,450	983
Number of observations	21,850	
Nondurable consumption growth	0.004	0.322
Head of household salary income growth	0.013	0.182
Number of observations of growth	18,616	

Note: The unit is one thousand Korean won (without adjustment for in°ation). Personal care and entertainment expenditures include items such as personal care, tobacco and smoking, reading materials but exclude entertainment equipment. Transportation excludes purchase of new and used vehicles, and communication includes phone charges and cellular phone charges. Home keeping includes utilities, fuel, and public services, excludes home furniture and major appliances. The head of household salary income growth rate and household nondurable consumption growth are in real terms. Outliers of growth rates (over three times the sample standard deviations) are excluded. Total is the average across households and over 10 years.

TABLE 2 - Response of Consumption to Anticipated Income Growth in Di®erent Groups, 1994-2003

Variable	y_t^+ and y_t^-	Split sample (i)		Split sample (ii)		Split sample (iii)	
	Full sample	Low liquidity	High liquidity	Low income	High income	Young age	Old age
y_t	i	0:042 (0.030)	0:027 (0.027)	0:046** (0.018)	0:020 (0.019)	0:058*** (0.018)	0:000 (0.017)
y_t^+	0:012 (0.020)						
y_t^-	0:051** (0.023)						
R^2	0:320	0:316	0:316	0:324	0:319	0:316	0:329
N	14,740	2,748	3,027	8,516	6,224		

TABLE 3 - Whole Sample: Slope of interaction of dummies with salary growth

Variable	(i)	(ii)	(iii)	(iv)
Low liq.	0.032 (0.029)			
High liq.	0.029 (0.027)			
Low income		0.045^{**} (0.018)		
High income		0.012 (0.018)		
Young			0.059^{***} (0.018)	
Old			-0.003 (0.017)	
94-97				0.046^{***} (0.017)
98-03				0.007 (0.018)
other	0.029^{*} (0.016)			
R^2	0.320	0.320	0.320	0.320
N	14,668	14,740	14,740	14,740

Note: The tables is based on results from equation (4). The tables present results with four different sub-sample group: low and high liquidity, low and high income, young and old, and two sub-sample dummies for $94-97$ and $98-03$. The variable `other' in the first column represents the salary growth that is not interacted with the dummies in the first column and any row. The difference in the number of observations between the first and rest of columns is due to omission of observations with missing liquidity data. The high and low liquidity groups are defined as the households with upper and lower 20% of the liquid asset-income ratio. The low (high) salary income observations are defined as those by households headed by government employees with salary income lower (higher) than that of the sample average of same year. All regressions contain consumption growth rates in month $t-1$ and $t-2$, demographic variables, and seasonal dummies. Standard errors presented in parenthesis are robust to heteroscedasticity of unknown form.

*** : Significant at 1%.

** : Significant at 5%.

* : Significant at 10%.

TABLE 4 - Whole Sample: Slope of interaction of dummies with salary growth

Variable	Low liquidity	Low income	young	young and low liq.	young and low inc.	old	old and low liq.	old and low inc.
d_{94-97}	0.123^{***}	0.061^{**}	0.097^{***}	0.179^{***}	0.110^{***}	-0.007	0.039	-0.082
	(0.049)	(0.027)	(0.023)	(0.059)	(0.030)	(0.024)	(0.082)	(0.052)
d_{98-03}	-0.026	0.024	0.008	-0.058	0.038	0.003	0.012	-0.010
	(0.036)	(0.028)	(0.027)	(0.054)	(0.034)	(0.024)	(0.045)	(0.045)
other	0.029^{**}	0.005	-0.003	-0.009	0.001	0.059^{***}	0.063^{***}	0.017
	(0.014)	(0.020)	(0.017)	(0.019)	(0.024)	(0.018)	(0.020)	(0.036)
R^2	0.321	0.320	0.321	0.320	0.321	0.320	0.320	0.320
N	14,668	14,740	14,740	14,668	14,740	14,740	14,668	14,740

Note: The table reports the estimates of the interaction of anticipated salary growth with variables in the column and the row. For example, the estimate in the first column and first row is the estimate of coefficient of interaction of salary growth with year 94-97 and low liquidity. The variable `other' in the ith column represents the salary growth not interacted with the dummies in the ith column and any row. The high and low liquidity groups are defined as the households with upper and lower 20% of the liquid asset-income ratio. The low (high) salary income observations are defined as those by households headed by government employees with salary and allowance lower (higher) than that of the sample average of same year. All regressions in the table contain consumption growth rates in month $t-1$ and $t-2$, demographic variables, and seasonal dummies. Standard errors presented in parenthesis are robust to heteroscedasticity of unknown form.

*** : Significant at 1%.

** : Significant at 5%.

* : Significant at 10%.

TABLE 5 - Whole Sample: Slope of interaction of dummies with salary growth

Variable	y_t	Low liquidity	Low income	young	young and low liquidity	young and low income
$d_{94-97Q2}$	0.058^{***}	0.121^{**}	0.075^{***}	0.110^{***}	0.188^{***}	0.118^{***}
	(0.018)	(0.053)	(0.028)	(0.024)	(0.062)	(0.032)
$d_{97Q2-98}$	0.000	0.065	0.003	-0.006	0.055	-0.026
	(0.034)	(0.083)	(0.051)	(0.049)	(0.112)	(0.059)
d_{1999}	0.034	-0.007	0.050	-0.054	-0.050	0.007
	(0.042)	(0.075)	(0.070)	(0.059)	(0.115)	(0.085)
d_{00-03}	-0.014	-0.040	0.003	0.023	-0.079	0.048
	(0.022)	(0.044)	(0.034)	(0.034)	(0.067)	(0.042)
other		0.029^{**}	0.011	-0.003	-0.009	-0.006
		(0.014)	(0.019)	(0.017)	(0.019)	(0.027)
R^2	0.320	0.321	0.320	0.321	0.320	0.321
N	14,740	14,668	14,740	14,740	14,668	14,740

Note: The table reports the estimates of the interaction of anticipated salary growth with dummy variables in the column and the row. The variable `other' in the ith column represents the salary growth not interacted with the dummies in the ith column and any row. The high and low liquidity groups are defined as the households with upper and lower 20% of the liquid asset-income ratio. The low (high) salary income observations are defined as those by households headed by government employees with salary income lower (higher) than that of the sample average of same year. All regressions in the table contain consumption growth rates in month $t-1$ and $t-2$, demographic variables, and seasonal dummies. Standard errors presented in parenthesis are robust to heteroscedasticity of unknown form.

TABLE 6 - Split Sample Estimates: Young and old age

	Young					Old				
		group by inc.		group by liq.			group by inc.		group by liq.	
	94-97	94-03	94-97	94-03	94-97	94-97	94-03	94-97	94-03	94-97
y_t	0.096*** (0.024)					−0.004 (0.025)				
Low inc.		0.075*** (0.022)	0.109*** (0.031)				−0.018 (0.032)	−0.080 (0.053)		
High inc.		0.022 (0.031)	0.073* (0.040)				0.011 (0.022)	0.022 (0.028)		
Low liq.				0.038 (0.041)	0.178*** (0.060)				0.020 (0.042)	0.043 (0.083)
High liq.				0.045 (0.039)	0.076* (0.044)				0.012 (0.036)	0.014 (0.045)
other				0.070*** (0.023)	0.088*** (0.032)				−0.010 (0.022)	−0.019 (0.031)
R^2	0.321	0.316	0.321	0.316	0.321	0.324	0.328	0.325	0.328	0.324
N	3,476	7,754	3,476	7,738	3,466	3,063	6,986	3,063	6,930	3,040

Note: The table reports the estimates of the interaction of anticipated salary growth with variables in the first column, for two sub-sample periods. The variable 'other' in the ith column represents the salary growth not interacted with the dummies in the ith column and any row. The high and low liquidity groups are defined as the households with upper and lower 20% in terms of the liquid asset-income ratio. The low (high) salary income observations are defined as those by households headed by government employees with salary income lower (higher) than that of the sample average of same year. All regressions in the table contain consumption growth rates in month $t-1$ and $t-2$, demographic variables, and seasonal dummies. Standard errors presented in parenthesis are robust to heteroscedasticity of unknown form.

*** : Significant at 1%.

** : Significant at 5%.

* : Significant at 10%.

TABLE 7 - RESPONSE OF DIFFERENT COMPONENT CONSUMPTION GROWTH, 1994-2003

ALL HOUSEHOLDS

Variable	Food	Personal care and entertainment	Transportation and communication	Apparel	Home keeping
y_t	0.037^{***}	0.033	0.002	0.144^{**}	0.005
	(0.014)	(0.024)	(0.023)	(0.063)	(0.027)
R^2	0.307	0.315	0.266	0.345	0.323
N	12,241	15,516	13,801	11,564	16,006

YOUNG HOUSEHOLDS

Variable	Food	Personal care and entertainment	Transportation and communication	Apparel	Home keeping
y_t	0.049^{**}	0.021	0.006	0.242^{**}	0.032
	(0.019)	(0.036)	(0.032)	(0.084)	(0.037)
R^2	0.297	0.318	0.261	0.349	0.315
N	6,827	7,922	7,256	6,072	8,022

Note: This panel shows the response of components of household real monthly expenditure on non-durables to the anticipated head of household salary income growth. The difference in the number of component-wise observations is due to different number of missing data and omitted outliers. All regressions contain consumption growth rates in month $t-1$ and $t-2$, demographic variables, and seasonal dummies. Standard errors presented in parenthesis are robust to heteroscedasticity of unknown form.

YOUNG HOUSEHOLDS

Variable	Food	Personal care and entertainment	Transportation and communication	Apparel	Home keeping
$y_t \times d_{9497}$	0.054^{**}	0.104^{**}	0.069	0.386^{***}	0.083
	(0.025)	(0.047)	(0.045)	(0.105)	(0.051)
$y_t \times d_{9803}$	0.042	-0.088	-0.081^{**}	0.043	-0.033
	(0.031)	(0.057)	(0.041)	(0.134)	(0.052)
R^2	0.297	0.319	0.262	0.350	0.315
N	6,827	7,922	7,256	6,072	8,022

Note: The samples are based on sub-sample of young households. This table shows the response of different component of household real monthly consumption expenditure to the anticipated head of household salary income growth with different slope estimates. All regressions contain consumption growth rates in month $t-1$ and $t-2$, demographic variables, and seasonal dummies. Standard errors presented in parenthesis are robust to heteroscedasticity of unknown form.

*** : Significant at 1%. ** : Significant at 5%. * : Significant at 10%.