Seminar in Applied Econometrics

An Econometric Analysis of Japanese Consumption

by

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Contents

1. PREFACE

The improvement in consumption levels in Japan during the post-war period (especially the high-growth period, 1960-75) was truly remarkable. In 1960, Japan's consumption level was just over one-third that of the United States and lower than that of most of the other developed countries as well, but because the level of consumption in Japan showed by far the highest growth rate among developed countries, Japan was able not only to increase its consumption level to nearly three-quarters of the US level but also become one of the six most affluent countries in the developed world.

One of the key elements of such rapid growth in consumption can be seen when looking at the decline in Japan's Engel coefficient, i.e. the budget share of food, beverages, and tobacco. It was a full 44% in 1960 but had declined to 28% by 1975 and to 18% by 1991. Thus it declined by more than one-half in just 29 years, with most of the decline occurring during the high growth period. Moreover, Japan's Engel coefficient showed significant improvement during the 1960-75 period even when compared to that of the United States, declining from 2.1 times to 1.6 times to that of the US level (Horioka 1994).

The purpose of this paper is to analyse the consumption pattern of Japan after the high-growth period, that is 1976-2001. The first two chapters present a theoretical and econometrical framework to the analysis. The following section provides an empirical time series investigation of the various well-accepted consumption model using the statistical software *Stata 7.0* and *E-Views 3.1*. The last part will discuss in a cross-section context the share of various consumption categories in Japan for the year 1999.

2. THEORETICAL BACKGROUND

2.1. Keynes

The consumption function as it exists today stems from the "fundamental psychological law" stated by Keynes (1936) that "men are disposed, as a rule and on the average, to increase their consumption as their income increases, but not by as much as the increase in their income". Keynes listed a number of "principal objective factors" and modifications of this function, the most important of which, in terms of future economic investigation, can be summarized here:

1. The correct income variable should be personal disposable income, not national income (although Keynes did not use these exact terms).

2. [For]"the wealth-owning class... changes in the money-value of wealth... should be classified amongst the major factors capable of causing short-period changes in the propensity to consume"

3. The short-run marginal propensity to consume (mpc) is less than the long-term mpc because "a man's habitual standard of life usually has the first claim on his income, and he is apt to save the difference which discovers itself between his actual income and the expense of his habitual standard", while over a longer period of time, his standard of living will become more flexible.

4. Even in the long run, "as a rule, a greater proportion of income [will be] saved as real income increases". That is the proportion of income consumed to decrease as income increases, i.e. $d(C/Y)/dY < 0$, implying an income elasticity of consumption less than one, and from this follows the argument that redistribution of income in favour of the poor will raise aggregate demand.

In the notation which has become standard for this model I denote consumption by C and income by Y and write the consumption function as:

$$C = f(Y), \text{ with } 0 < \frac{dC}{dY} < 1 ,$$

that is consumption increases as income increases, but not by as much as the increase in income. Both time series and cross-section data are relevant to an investigation of the exact form of the consumption function. Time series data from the national income accounts permit the determination of a relation explaining variations in aggregate consumers' expenditure. Cross-section analysis, based on data collected from sample surveys of households, is often concerned with the role of other factors additional to income, such as age, household composition, and so forth.

For both types of data the simplest formulation of the consumption function, useful at least as a first approximation, is the standard linear regression model:

$$C = a + bY + e \quad ,$$

where e is a random disturbance term. Here *C/Y*, the share of consumption in income or average propensity to consume (apc), decreases as income rises provided that $a > 0$. The marginal propensity to consume (mpc) is assumed to satisfy $0 < b < 1$.

Statement 1 suggests that the appropriate income variable to use in empirical work is personal income, for it is constructed in terms of an individual determining the scale of consumption having net income in mind. Further, the absence of money illusion can be incorporated in this simple linear relation. The saving-consumption decision is assumed independent of the aggregate price level, hence the variables of the consumption function should be entered in real rather than nominal terms (statement 2). Of course with cross-section data it can be reasonably assumed that prices do not vary across the sample, but with aggregate time series data an important first step is to deflate the current values of observed variables by an appropriate price index, to ensure that the correct statistical specification is employed. Statement 3 and 4 will be part of the empirical section.

2.2. The Relative Income Hypothesis

Duesenberry (1949) attempted to explain these findings by a reformulation of consumption theory rather than a contribution to statistical methodology. His "relative income" hypothesis has consequences for both cross-section and time-series data. The cross-section effect derives from the hypothesis that a person's consumption behaviour is a function of his position in the income distribution or his "relative income", thus individual consumption behaviour is assumed to be interdependent, not independent. The time series effect depends on the idea that consumption behaviour is not readily reversible, and so people react differently to upward and downward income changes rather than having a simple consumption-income relationship equally applicable to income movements in either direction.

As a simple illustration of the relative income hypothesis, I shall express the *i*th household's consumption-income ratio as a function of its relative income:

$$\frac{C_{it}}{Y_{it}} = a + b\frac{\overline{Y}_{.t}}{Y_{it}} ,$$

where $\overline{Y}_{.t}$ is the mean income of the group to which it belongs. Thus with $b > 0$ the share of consumption in income or mpc declines as individual income increases. Equally, writing

$$C_{it} = aY_{it} + b\overline{Y}_{.t}$$

shows that, at a point in time, the cross-section regression within a group has an mpc equal to a, and the function supports the declining share hypothesis, having a positive intercept term $b\overline{Y}_{.t}$. On aggregating over both individual households and groups, however, we see that the aggregate variables $C_t = \sum C_{it}$ and $Y_t = \sum Y_{it}$ satisfy the relation $C_t = (a + b)Y_t$, thus the aggregate time series model not only yields an mpc of $(a + b)$, greater than the cross-section mpc, but also implies that the share of consumption in income remains constant as income increases over time (that is *d(C/Y)/dY* = 0, which contrasts sharply with Keynes's analysis).

2.3. Past Habits

Brown (1952) suggested that the influence of past habits is continuous in both directions rather than discrete and irreversible. He represented the dependence on past behaviour by including a lagged dependent variable of consumption:

$$C_t = a + bY_t + dC_{t-1} \text{ , } 0 < d < 1 \text{ ,}$$

which modifies the Duesenberry pattern of behaviour to give continuous partial adjustment of consumption habits. Kuznets (1942) and Goldsmith (1955) empirically obtained similar results using a model without an intercept to demonstrate that the long-run mpc is equal to the apc.

3. ECONOMETRIC FRAMEWORK

3.1. Assumptions

A time series is a sequence of numerical data in which each item is associated with a particular instant in time. One can quote numerous examples: daily closing prices of stock indices, weekly measures of money supply, monthly unemployment and quarterly consumption as we will develop in this paper. An analysis of a single sequence of data is called univariate time-series analysis. An analysis of several sets of data for the same sequence of time periods is called multivariate time-series analysis or, more simply, multiple time-series analysis. The purpose of time-series analysis is to study the dynamics or temporal structure of the data.

Most aggregate time series such as income and consumption are not stationary because they exhibit time trends. But many time series with trend can be reduced to stationary processes. A process is called trend stationary if it is stationary after subtracting from it a (usually linear) function of time (which is the index t). If a process is not stationary but its first difference, $y_t - y_{t-1}$, is stationary, $\{y_t\}$ is called first-difference stationary. The usual assumptions are:

(1) Constant and finite mean, i.e. $m(t) = E(Y_t)$
(2) Constant and finite variance, i.e. $s^2(t) = \text{var}(Y_t)$
(3) Autocovariances depend only on r and not on t, i.e. $g(t, t-r) = \text{cov}(Y_t, Y_{t-r})$

$\Rightarrow$ series is mean reverting, not trending, has limited memory.

For a strictly stationary time series the distribution of Y_t is independent of t. Thus it is not just the mean and variance that are constant. All higher order moments are independent of t, so are all higher order moments of the joint distribution of any combinations of the variables X_t, X_{t+1}, X_{t+2}, ... In practice this is a very strong assumption, and it is useful to define stationarity in a less restrictive way. This definition is in terms of first and second moments only.

A time series is said to be weakly stationary if its mean is constant and its autocovariance function depends only on the lag, that is,

$$E[Y_t] = m \text{ and } \text{cov}[Y_t, Y_{t+r}] = g(r)$$

3.2. R-squared

Time-series observations normally show a strong trend (upward or downward) and strong seasonal effects. Any model that is able to pick up these effects will have a high R^2. The question is: How good and reliable is this? Note that the criterion on which the usual R^2 is based is the residual sum of squares from the model relative to the residual sum of squares from a naive alternative (that consists of the estimation of the mean only):

$$R^2 = 1 - \frac{RSS}{S_{yy}} ,$$

where $S_{yy} = \sum (y_t - \bar{y})^2$ and *RSS* is the residual sum of squares. Thus the "norm" R^2 judges a model compared with a naive model, where only the mean is estimated. In time-series models with strong trends and seasonals, this is not a meaningful alternative. The meaningful alternative is a random walk with drift, or with seasonal data, or with both. Harvey (1984) suggests two alternatives R^2 measures. One is

$$R_D^2 = 1 - \frac{RSS}{\sum_{t=2}^{T} (\Delta y_t - \overline{\Delta y_t})^2}$$

The denominator $\sum_{t=2}^{T} (\Delta y_t - \overline{\Delta y_t})^2$ is the residual sum of squares from a random walk with drift, that is, $y_t = y_{t-1} + b + e_t$, t=2,...,T. For most time-series data this is the "naive alternative". With seasonal data, Harvey suggests

$$R_S^2 = 1 - \frac{RSS}{RSS_0} \quad ,$$

where RSS is, as before, the residual sum of squares from the model and RSS_0 is the residual sum of squares from the naive model - which in this case is the random walk with drift and seasonal dummies, that is,

$$\Delta y_t = a_1 S_1 + \cdots + a_k S_k + e_t \quad ,$$

where S_1, S_2, ..., S_k are the k seasonal dummies. For quarterly data k=4. A model for which $R_S^2 < 0$ should be discarded as useless. The software *Stata 7.0* and *E-Views 3.1* do not give these alternative R^2 but only the usual R^2 mentioned above. As a result, the reader ought to be careful with the interpretation of the given R^2.

3.3. Dickey-Fuller Tests

The Dickey-Fuller (DF) test statistics are derived from the estimation of the first-order autoregressive model:

$$y_t = q\, y_{t-1} + e_t$$

If $q = 1$, then $\Delta y_t = (y_t - y_{t-1}) = e_t$. This is what we call a unit root. We can distinguish four typical types of unit-root series, requiring different DF critical-value tables (Maddala 2001):

(1) random walk: $\Delta y_t = (q - 1) y_{t-1} + e_t$
(2) random walk with drift: $\Delta y_t = m + (q - 1) y_{t-1} + e_t$
(3) random walk with drift and time trend: $\Delta y_t = m + bt + (q - 1) y_{t-1} + e_t$
(4) same as (3), but with a lag number > 1: $\Delta y_t = m + bt + (q - 1) y_{t-1} + \Sigma d_i \Delta y_{t-i} + e_t$

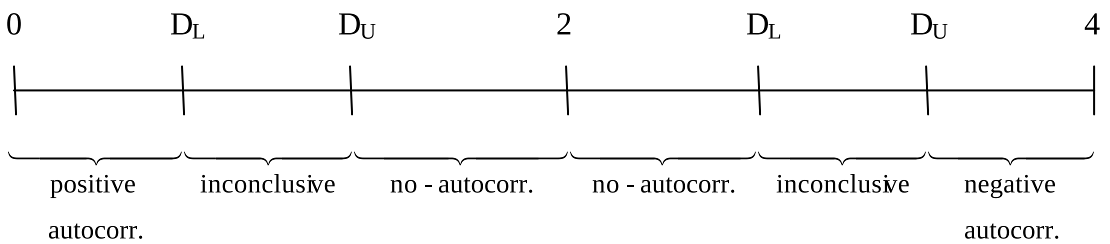
The DF and the augmented Dickey-Fuller (ADF) tests are frequently used in testing for unit roots although there are several problems (size distortions and low power) with these tests. With the ADF test there is also the problem of selection of lag length. When $q < 1$, but close to 1 (such as 0.95), the theory will predict the variable to be stationary. However, using *Stata 7.0,* the ADF test accepts the hypothesis of a unit root. In the experimental test, I shall discuss more on ADF tests.

3.4. Further Tests

The regressions computed in this paper mainly used the method of Ordinary Least Squares (OLS). With time series analysis the first test to do is a ADF test to eliminate a non-stationary trend as discussed above. In order to test whether there is a problem of cointegration, the stationarity of the error terms should be tested.

The major OLS assumptions that can be relaxed are homoskedasticity, i.e. $\text{var}(e_i) \neq \text{var}(e_j)$, and non-autocorrelation of error terms, i.e. $e_t = re_{t-1} + u_t$, where $0 < |r| < 1$. We can test the first violation by using the Cook and Weisberg test for heteroskedasticity[1]. The null hypothesis is error terms of constant variance. Not accepting it means the error terms are heteroskedastic. If it is the case, in *Stata 7.0* the command *robust* should be used to integrate in the regression a constant variance of errors[2].

For the autocorrelation of errors, one should use the Durbin-Watson test which computes a test for first-order serial correlation in the disturbance. The *d*-statistics given by Durbin-Watson is as follow (Brülhart 2002):



where L and U stands for lower and upper-values taken out of the tables at 1% significance points.

If there is a positive or a negative autocorrelation of errors, one should use either the Prais-Winsten or Cochrane-Orcutt regression[3]. It estimates a linear regression that is corrected for first-order serial-correlated residuals. The command *robust* can be added to reflect heteroskedasticity[4].

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[1] The same test was derived by Breusch and Pagan.

[2] The command *robust* will not be used when the regression is homoscedastic as it might change *t*-statistic significantly.

[3] In *Stata 7.0* the command for a Prais-Winsten regression is *prais y x,* and for a Cochrane-Orcutt regression is *prais y x, corc.*

[4] Note that all estimates from *prais* are conditional on the estimated value of rho. This means that robust variance estimates in this case are only robust to heteroskedasticity and are not generally robust to misspecification of the functional form or omitted variables.

4. TESTING THE THEORY

4.1. Data & Description of the Variables

In this chapter all data have been computed from *DataStream*.

4.1.1. Consumption

These data come from the "Family Income and Expenditure Survey" and was conducted by the Statistics Bureau of the Ministry of Public Management, Home Affairs, Posts and Telecommunications. The sampling covers the period 15.01.1976 to 15.12.2001, on a monthly base, of about 8000 workers' households[5] around the country excluding agricultural, forestry and fishery households and non-workers' households[6].

In order to compare in real terms the different variables, nominal consumption has been deflated by a monthly consumer price index (CPI) conducted by the same bureau[7]. The consumption data are net of taxations and social security expenses in order to compare it with real disposable income.

4.1.2. Income

In macroeconomics one often mixes Income and GDP as for the expression of *Y*. However, it is important to cut a clear line between those two denominations. Income relates here to what Japanese workers' households receive each month from various sources (salary, dividend, interest, and so on). On the other hand GDP is the total amount of added value of goods and services created by producers with operations in Japan, including foreign-affiliated enterprises and foreign workers. With the study of consumption, from consumers' point of view, it is meaningful to take the real disposable income[8].

The difference between current and disposable income is taxation and social security expenses that a household pays. Japanese workers often receive bonuses in June or July and especially in December, which can count from a half to a three-month salary. On the other hand, as the Japanese fiscal year starts on April 1st, May is the month of payments of taxations and therefore the month of the lowest disposable income. The fourth quarter shows a seasonal tendency higher than the other three quarters[9].

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[5] On average: 7949 households (min: 7730 ; max: 8081)
[6] That is households of individual business owners, independent professionals and of the unemployed.
[7] Unless consumer savings go directly into the purchase of capital goods, the CPI is to be preferred to a GDP or GNP deflator. In Evans (1969) it was shown that the use of the GNP deflator instead of the consumption deflator will lower the estimate of the short-run mpc but will raise the sum of the coefficients and hence the estimate of the long-run mpc.
[8] The data were computed by the same bureau, for the same period, and with the same number of workers' households as consumption.
[9] May and June are computed together in the second quarter, therefore the month of the lowest disposable income, May, is corrected by the second/third highest, June.

For consistency, since disposable income ought to be deflated with the GDP deflator[10] and the latest is only quarterly available, monthly consumption and disposable income have been transformed to quarterly data. Note that the quarterly data have been computed on a three-month average basis, not on a sum of the three months, and therefore reflect monthly incomes and expenditures.

4.2 Tests

4.2.1. Deseasonalization

The plot of real disposable income and real consumption shows that the two series are drifting together before 1992, suggesting cointegration, but diverging between 1992 and 2001.

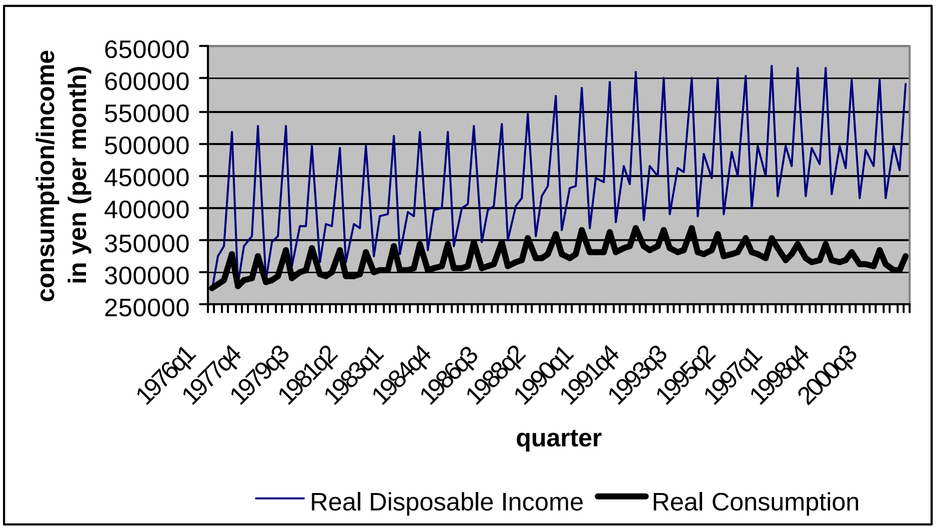

Figure 1: Trend of Consumption and Income (1976 - 2001)

The fourth-quarter clearly shows a seasonal tendency, suggesting the use of a deseasonalization adjuster. To test whether the series are stationary or not, one may use the ADF *t*-test without adapting it with the studied issue. The test with both series taken individually will highly reject the null hypothesis, i.e. unit root, non-stationary. The ADF *t*-test will in this problem gives a p-value for Z(t) of 0.0000 suggesting a stationary process of the two series[11]. However, by simply looking at the two graphs, one can clearly see the seasonal tendency and trend.

Several methods are appropriate for such a double problem. In Hayashi (2000) when discussing the cointegrated relationship between income and consumption he conducted an ADF with a constant and time trend to test whether the two series are individually I(1), i.e. first-order integrated. Since the series in the United States were also diverging at some point, he suggested to break down the series in two different tests. Using the option trend with the ADF *t*-test Hayashi obtained significant results with the first fragmented series but none with the series taken as a whole. One has to mention that the Japanese disposable income (with its multiple bonuses in the fourth-quarter) does not follow the same trend as in the United States and therefore the test suggested here by Hayashi cannot be applied.

[10] Income is reflected through production, that is GDP.
[11] All ADF *t*-test are grouped in table 1-4, page 12.

Other sources suggested two different way-outs. First the *E-Views 3.1* and *Stata 7.0*, besides the option trend, offer the option lags(4) in order to adapt the ADF *t*-test to the seasonal tendency[12]. The fourth quarter peaks now do not slant the series and the test indicates that the series are not stationary and therefore should be differentiated.

A second approach is to use a coefficient of deseasonalization. In Bourbonnais (2001), besides the Census X-11, two main sets of seasonality analysis are suggested, multiplicative and additive, using both the ratio to moving average[13]. Multiplicative methods are appropriate if the series can be decomposed into a product of the trend component and a seasonal component, while additive methods are appropriate if the series can be decomposed into a sum of the trend component and a seasonal component. The "band test" allow us to chose between those two methods. This consists to connect in the non-seasonalized graph the upper-values and then the lower-values with a line. If the two lines are parallel, the additive method should be used, otherwise the multiplicative would be appropriate.

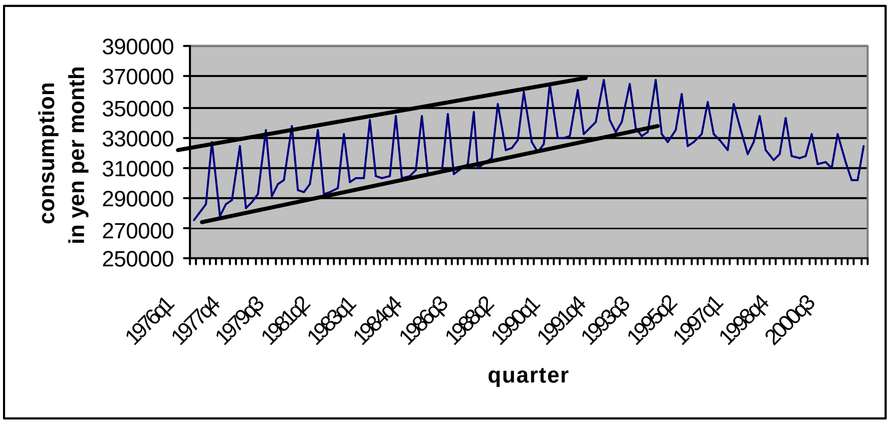

Figure 2: Trend of Consumption (1976 - 2001)

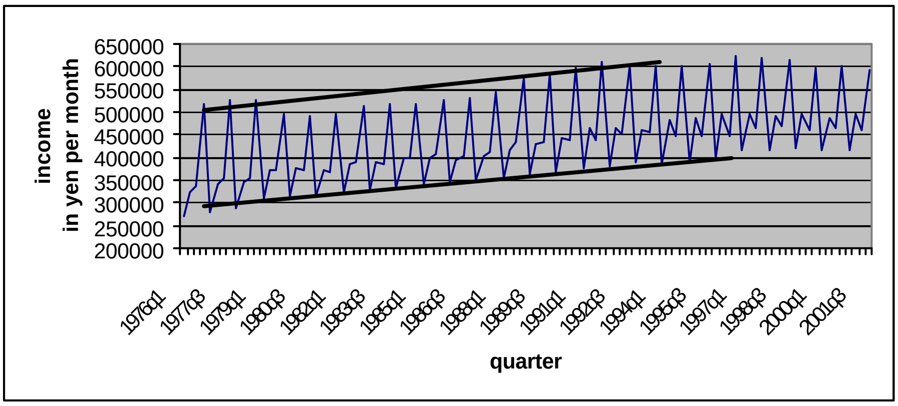

Figure 3: Trend of Income (1976 - 2001)

Visually, the additive ratio to moving average is appropriate and is described as follow:

[12] *E-Views 3.1* suggested in the help function to use at the same time the options trend and lags (4) when testing the relationship between income and consumption.

[13] The Census X-11 methods (multiplicative and additive) are the standard methods used by the U.S. Bureau of Census to seasonally adjust publicly released data. However, even though *E-Views 3.1* has the option for Census X-11, the computer was not able to compute it (not installed). The main difference between X-11 and the ratio to moving average methods is that the seasonal factors may change from year to year in X-11. The seasonal factors are assumed to be constant for the ratio to moving average method, which might distort the results.

1. Denote the series to be filtered as y_t. First compute the centered moving average of y_t as:

$$x_t = (0.5y_{t+2} + y_{t+1} + y_t + y_{t-1} + 0.5y_{t-2})/4, \text{ for quarterly series}$$

2. Take the difference $d_t = y_t - x_t$.

3. Compute the seasonal indices. For quarterly series, the seasonal index i_q for quarter *q* is the average of d_t using observations only for quarter *q*.

4. Adjust the seasonal indices so that they add up to zero. This is done by setting $s_j = i_j - \bar{i}$ where $\bar{i}$ is the average of all seasonal indices. These *s* are what are reported as scaling factors in *E-Views 3.1*. The interpretation is that the series *y* is s_j higher in period *j* relative to the adjusted series.

5. The seasonally adjusted series is obtained by subtracting the seasonal factors s_j from y_t.

When using the deseasonalization adjuster, the ADF *t*-test changes and allow us to use the normal ADF without any options. The results show that both series are non-stationary. Note that the *t*-test is stronger for the linear series 76-91 than the non-linear series 76-01, implying that when the series tend to diverge from the linear trend, ADF *t*-test has more problem to determine whether the series is stationary or not, since on average the non-linear series tend to go back to previous levels. The following table groups the different ADF *t*-test discussed above[14].

ydisp	Without deseasonalization	
	76-01	76-91
normal	-11.155 (0.0000)	-9.463 (0.0000)
trend	-17.021 (0.0000)	-12.063 (0.0000)
trend, lags(4)	-0.197 (0.9928)	-1.259 (0.8969)

overall	Without deseasonalization	
	76-01	76-91
normal	-6.945 (0.0000)	-5.586 (0.0000)
trend	-8.154 (0.0000)	-9.985 (0.0000))
trend, lags(4)	0.932 (0.9989)	-1.983 (0.6111)

ydispseas	With deseasonalization	
	76-01	76-91
normal	-2.630 (0.0869)	-2.303 (0.1709)
trend	-7.417 (0.0000)	-7.740 (0.0000)
trend, lags(4)	-0.098 (0.9944)	-1.704 (0.7484)

overallseas	With deseasonalization	
	76-01	76-91
normal	-2.781 (0.0610)	-1.775 (0.3927)
trend	-2.392 (0.3851)	-6.406 (0.0000)
trend, lags(4)	0.909 (0.9989)	-2.145 (0.5218)

Table 1 - 4: ADF *t*-test on data levels

[14] Note that *ydisp* stands for real disposable income, *overall* for real overall consumption, net of taxations and social security expenses, and *res* for residuals. The end-of-word *seas*, if added, denotes a deseasonalized series, and the letter *d* is added in front of a word if the series have been first-order differentiated (*t*-statistics are in parenthesis). There is 64 observations for the period 76-91, and 104 for the period 76-01.

For further analysis of the consumption function, I shall use the deseasonalized series. To establish cointegration, we must first check whether each series is integrated and contains a unit root. As a result, since both series are non-stationary, ADF *t*-tests on the first-differentiated series were conducted, presented in the following tables.

dydispseas	**With deseasonalization**	
	76-01	**76-91**
normal	-13.980 (0.0000)	-12.058 (0.0000)
trend, lags(4)	-5.240 (0.0001)	-4.199 (0.0045)

doverallseas	**With deseasonalization**	
	76-01	**76-91**
normal	-18.166 (0.0000)	-14.192 (0.0000)
trend, lags(4)	-5.152 (0.0001)	-3.934 (0.0109)

Table 5 - 6: ADF *t*-test on first-difference levels

4.2.2. Cointegration

One can assert now that real overall consumption and real disposable income are both integrated of the same order, i.e. I(1). However, in order to use the cointegration process, one has to demonstrate the stationary of the error terms.

resseas	**With deseasonalization**	
	76-01	**76-91**
normal	-2.915 (0.0436)	-9.581 (0.0000)

Table 7: ADF *t*-test on residuals

The results of the ADF *t*-test of the residuals (computed from an OLS on levels of data series) show that there is a cointegrating relationship between the two variables for the period 76-91. As expected, this result corroborates the fact that the visual drifts of the variables tend to have similar trends. However, when looking at a larger sample (76-01) this relationship is not maintain and therefore the conventional regression technique shall not be applied. The Johansen cointegration test allows us to assert that the period 76-91 is cointegrated at a 1% significant level, but the larger sample is not[15].

	Period 76-01	
Eigenvalue	0.085859	0.070986
Likelihood ratio	16.83042	7.584066
5% critical value	15.41	3.76
1% critical value	20.04	6.65
Hypothesized No. of CE(s)	None *	At most 1 **

	Period 76-91	
Eigenvalue	0.648631	0.04625
Likelihood ratio	68.87603	2.98325
5% critical value	15.41	3.76
1% critical value	20.04	6.65
Hypothesized No. of CE(s)	None **	At most 1

Table 8 - 9: Johansen Cointegration tests
*(**) denotes rejection of the hypothesis at 5%(1%) significance level.
Likelihood ratio test indicates one cointegrating equation(s) at 5% critical value.

[15] At a 5% significant level it is assumed that the two variables are cointegrated. This reflects the previous result of the ADF *t*-test on the residuals: significant at a 5% level but not at 1%. Note that the Johansen procedure used assumes a linear deterministic trend in the data. Moreover, the interpretation of the *t*-statistic and the R^2 should not be regarded as consistent since the two variables are cointegrated.

Having in mind that the two series are cointegrated for the period 76-91, an OLS on levels of data series is applicable. The coefficient of the regression is of **0.4301507** (24.01), that is the quarterly marginal propensity to consume (mpc) is equal to 0.43. Moreover, the regression is homoscedastic with no autocorrelation of the error terms[16].

4.2.3. Error Correction Model

Once the quarterly mpc was computed one wonders what is the short-run adjustment parameter. Since both variables are I(1) and cointegrated, the short-run disequilibrium relationship can be described by the error correction model (ECM). This is known as the Granger representation theorem and takes the general form (Brülhart 2002):

$$\Delta y_t = \sum_{i=1}^{P_y} d_i \Delta y_{t-i} + \sum_{i=1}^{P_x} g_i \Delta x_{t-i} - l u_{t-1} + v_t$$

where u_{t-1} is the disequilibrium error computed from the OLS cointegration regression (i.e. extent of departure from the long-run relationship between x and y), and $0 \leq |l| \leq 1$ is the short-run adjustment parameter. A first attempt with only one lag was performed. However the results were not satisfying as the l coefficient was not significantly different from zero implying the two variables were not cointegrated (Bourbonnais 2000). Looking at the correlogram of the disequilibrium error, I noticed that more lagged should have been included. In *Stata 8.0* a lag-order selection statistics reports the final prediction error (FPE), Akaike's information criterion (AIC), the Bayesian information criterion (BIC), and the Hannan and Quinn information criterion (HQIC). All predicted a number of lag as large as 16[17]. However, the l coefficient was still not significant with 16 lags and had the wrong sign. I have tried then with several different lags, but none were conclusive[18]. This can be interpreted as real disposable income is not the only variable in the model, and thus this lack of explanatory variables gives a non-significant coefficient of l. The sign, however, is negative from the second lag which implies there is an error correction mechanism (that is the variables tend to a long-term relationship).

4.2.4. Short and Long-run

Keynes's fourth statement predicted a negative relationship between the apc and disposable income, i.e. $d(C/Y)/dY < 0$. For consistency only the period 76-91 has been computed since it has been demonstrated that the two variables are cointegrated. The result of the regression shows a coefficient of -8.84e-07 (-18.48) which is highly significant and with the expected negative sign. This conclusion underlies that Keynes's statement was correct and Duessenberry's was not.

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[16] P-value of the Cook-Weisberg heteroskedasticity test: 0.5590, implying homoskedasticity. The Durbin-Watson autocorrelation test: 2.40048 which is below the DL (2.5978) described in the theory, implying non-autocorrelation of the error term. See the annex for the correlogram of the error-term.

[17] BIC predicted a number of lag of 17.

[18] 16 lags: 1.406548 (0.81); 14 lags: 0.480776 (0.53); 10 lags: -0.2838217 (-0.73); 7 lags: -0.3194889 (-1.14); 6 lags: -0.342654 (-1.24); 5 lags: -0.2743507 (-1.03); 4 lags: -0.3807905 (-1.54); 3 lags: -0.2662712 (-1.04); 2 lags: -0.2205204 (-0.86); 1 lag: 0.0806047 (0.39). Note that the sign should be negative.

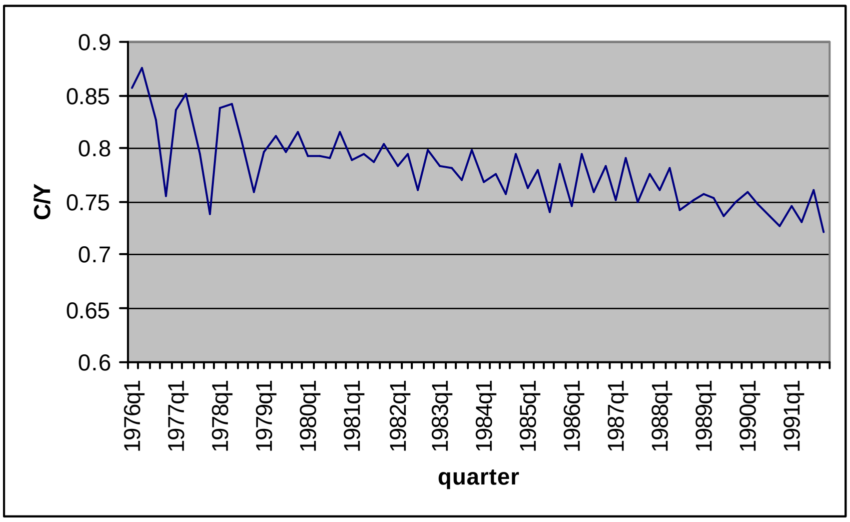

Figure 4: Trend of apc (1976 - 1991)

We can think of the short-run consumption function approaching the long-run function in at least two ways. If income is growing over time, each short-run function (with the same slope) will have a higher intercept as last period's consumption increases. If we consider the relevant levels of income at each time period, the points on the short-run functions trace out a long-run function that goes through the origin and has a slope equal to the apc. This process is illustrated in Figure 5. If income remains constant over time, we can think of the slope of the short-run consumption function as increasing continuously as time progresses until it finally merges with the long-run function. This process is shown in Figure 6. The two figures illustrate how the mpc approaches the apc over time. In the long run, after the consumer has become fully accustomed to receiving a given amount of additional income, he will spend the same proportion of this income as of all his other income.

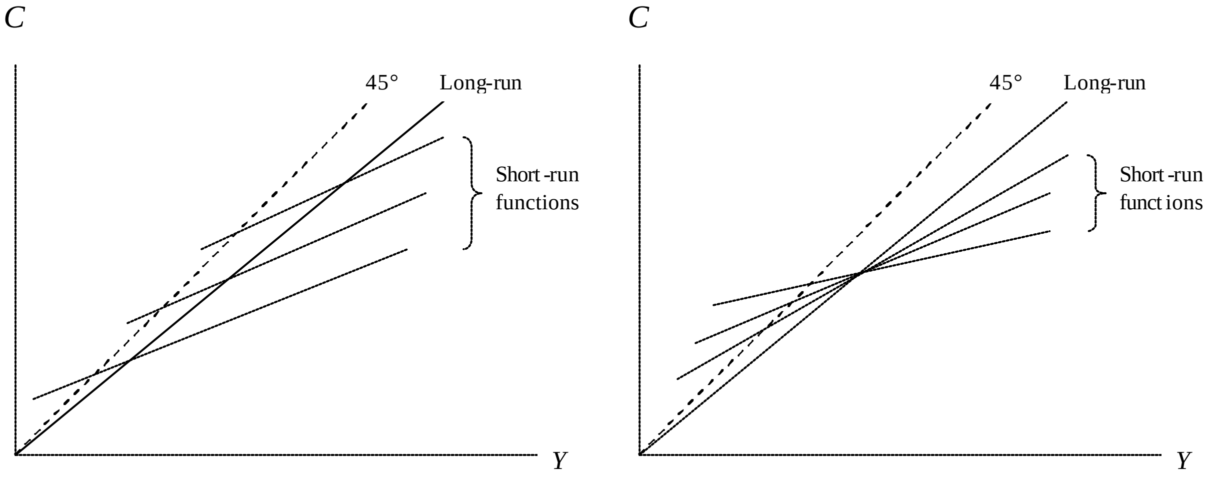

Figure 5 - 6: Dynamics of short-run functions

This view of the mpc has been advanced most strongly by Friedman (1957), but it also incorporated in the work of Duessenberry (1949), and others. Friedman showed how this concept of consumer behaviour logically leads to the conclusion that the long-run mpc must be equal to the apc. It is of interest to compare both yearly and quarterly functions to see if the mpc of the first four quarters is approximately equal to the mpc estimated from the yearly function.

quarterly	yearly	long-run
0.4301507	0.5065242	0.7747747
(24.01)	(20.88)	(196.04)

Table 10: Various mpc's computed

This provides an additional check of internal consistency of the estimates and also may be useful in determining the approximate magnitudes of some of the biases. The coefficients of the variables in all the consumption functions chosen for comparison are highly significant in all cases and give reasonable values of the short/middle-run and long-run mpc's[19]. One can assert that the short-run marginal propensity to consume is less than the long-term mpc which corroborates Keynes's third statement. Note that the short-run adjustment parameter (using the ECM) ought to be smaller than the quarterly coefficient. The following graph show the trend of the computed long-term consumption and consumption[20].

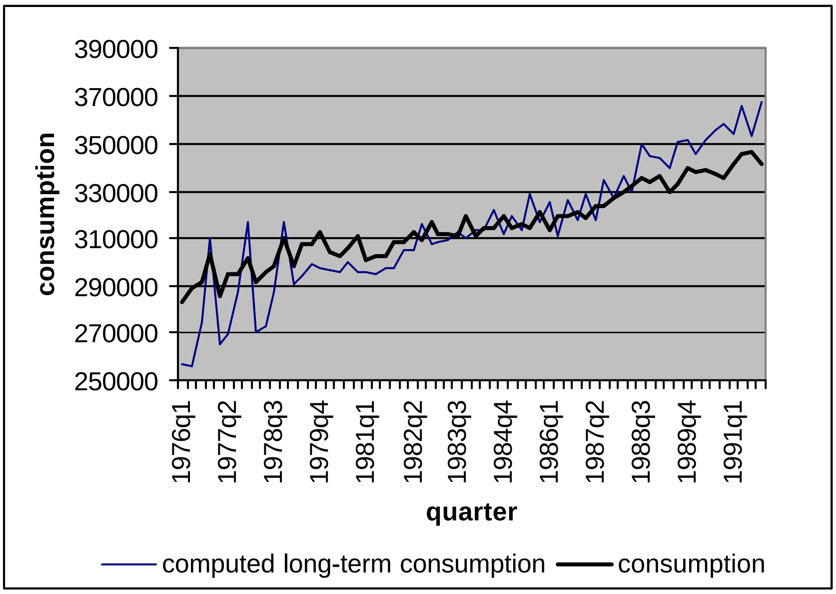

Figure 7: Trend of consumption and computed long-term consumption (1976 - 1991)

4.2.5. Past Habits

Besides Keynes's fundamental consumption regression, one of the most commonly estimated forms of the consumption function is Brown's past habit model, that is:

$$C_t = a + bY_t + dC_{t-1} + u_t$$

[19] The long-run equation is an OLS regression without the intercept. Quarterly data have been used to compute it since it has four-times more observations. Note that the yearly-based long-term coefficient is of 0.7317906 (151.17)

[20] Note that the slope of the computed consumption is bigger than consumption. That is since the slope of disposable income is bigger than consumption.

The following table maintains the assumption that long-term mpc is bigger than the short-term. However, as for the lagged consumption, it seems that the influence of the previous quarter has a stronger impact on today's consumption compared with the previous year.

	quarterly	**yearly**
Y_t	0.2265756 (6.14)	0.3179475 (4.91)
C_{t-1}	0.5074759 (6.47)	0.340912 (2.49)

Table 11: Coefficients of Brown's regression

In time-series analysis multi-colinearity often occurs when several of the variables in a given function have very similar trends or other movements throughout the entire sample period. In this case it is not possible in a statistical sense to determine which of the independent variables is actually causing the dependent variable to change. In the case of the consumption function, both income and lagged consumption follow smooth upward patterns. Either variable could be used to explain a large part of the movements in consumption, and it is often not possible to sort out the independent contributions of each variable.

Finally, Kuznets (1942) and Goldsmith (1955) assert that a model without an intercept, that is $C_t = bY_t + dC_{t-1} + u_t$, will demonstrate that the long-run mpc is equal to the apc. The following table reproduces the computed coefficients.

	quarterly	**yearly**
Y_t	0.1151312 (2.87)	0.1101398 (1.84)
C_{t-1}	0.8538025 (16.45)	0.8581899 (10.36)

Table 12: Coefficients of Kuznets and Goldsmith's regression

Having in mind the problem of multi-colinearity, one can assert that the income coefficient is again underestimated. In this chapter, the time-series breakdown was introduced to reproduce for the period 1976-91 a Japanese long-term mpc of 0.77 and a quarterly mpc of 0.43. When taking a closer look at figure 2 and 3, it is worth noting that the period 1992-2001 is far from the Keynesian consumption pattern as real disposable income is stagnating and real consumption is decreasing. The ADF *t*-test of the deseasonalized variables show that income is stationary on data levels, i.e. I(0), and consumption is first-difference stationary, i.e. I(1), therefore the process of cointegration cannot be applied[21]. The structural basement of the Japanese economy has collapsed in the early 1990s. As a result, Japanese workers' households have received constant real disposable income for the last ten years, but have decreased their real consumption expenditures in order to save more for the uncertain future.

[21] See the annex for the detailed ADF *t*-test results.

5. CROSS-SECTION ANALYSIS

5.1. Data & Description of the Variables

The following analysis is based on a survey conducted by the Ministry of Public Management, Home Affairs, Posts and Telecommunications. The data were obtained in three kinds of forms, namely, Household Schedule, Family Account Book and Yearly Income Schedule. Enumerators fill in the Household Schedule with the number of household members, occupation and industry of earners, type of the dwelling, etc. Households are requested to fill in the Family Account Books with daily incomes and expenditures for six months. Furthermore, by using the Yearly Income Schedule yearly income is surveyed by self-entry for all households. The survey covers about 8000 two-or-more-person workers' households, however only the averages for the year 1999 were available. The analysis will stress on the following variables.

5.1.1. Consumption

Classified in 11 different groups[22]:

- Food
- Housing
- Fuel (& Light & Water Charges)
- Furniture (& Household Utensils)
- Clothing (& Footwear)
- Medical Care
- Transportation (& Communication)
- Education
- Reading (& Recreation)
- Other (Expenses)
- Non-consumption (including taxations and social security expenses)

A first remark has to be made for *housing*. Considered as part of the category *housing*, expenditures on house in which one currently dwells and in which one does not currently dwell as well as expenditure on housing lot and related services. However, expenditures on house for rent, a business expense, is excluded of any category. The purchase, construction, expansion and renovation of house or land is deemed "purchase of property" while the repayment of housing loan is deemed "repayment of loans on land and house". Such expenses are not included in housing expenses but in *non-consumption expenditures*. As a result the category *housing* shares only 7.1% of workers' income.

A second remark is worthwhile. The category *other expenses* includes various types of expenditures such as beauty expenses, personal effects, cigarettes, social expenses and money sent. This group is the largest with 25.6% of all expenditures in 1999. Therefore, one should

[22] The words which are not in parenthesis are the names given to the categories for the econometrical tests.

not jump to any conclusion when a coefficient of this explanatory variable is larger than average.

5.1.2. Income

Income here is to be considered as prior to any payments of taxations or social security, and has been coded to include open-groups. However, in the first analysis, in order to test Duessenberry's assumption, the median disposable income of each income category was used.

5.1.3. Age

In order to include the shape of the age curve[23], the variable age-squared has also been introduced. Depending on the analysis, age and age-squared were coded as it is expressed below.

5.1.4. Family Composition

The 4th analysis will test whether the number of children and the level of education of the eldest is significant or not[24] and is coded as follow:

Income per month (thousands of yen)			Age				Education		Children	
1st analysis	Code	3rd & 4th analysis	2nd analysis	Code	Code^2	3rd analysis	4th analysis	Code	4th analysis	Code
<200	10	<200	<25	1	1	<30	Preschool	100	1	1
200-250	20	200-300	25-29	2	4	30-39	Elem+JHS	200	2	2
250-300	30	300-400	30-34	3	9	40-49	SHS	300	>3	3
300-350	40	400-500	35-39	4	16	50-59	Univ+Coll	400		
350-400	50	500-600	40-44	5	25	60-69	Others	500		
400-450	60	600-800	45-49	6	36	>70				
450-500	70	800-1000	50-54	7	49					
500-550	80	1000-1250	55-59	8	64					
550-600	90	1250-1500	60-64	9	81					
600-650	100	>1500	65-69	10	100					
650-700	110		>70	11	121					
700-750	120									
750-800	130									
800-900	140									
900-1000	150									
1000-1250	160									
1250-1500	170									
1500-2000	180									
>2000	190									

Table 13: Variable coding

[23] The theory predicts that the age for maximum consumption is at around 50 years old, and the average consumption expenditures decrease passing this age.
[24] The workers' households with no children are thus not considered in the 4th analysis.

5.2.Tests

5.2.1. 1st Analysis

$$C_i = f(Income)$$

Duessenberry (1949) maintained that the aggregate time series model yields an mpc greater than the cross-section mpc. Several problems arise when one is willing to test this assumption. First of all, the studied Japanese time series model showed problems of consistency and had to be broken down in two distinct periods. Secondly, the series showed unusually seasonal tendencies and had to be deseasonalized. Finally, one cannot compare two models when the number of observations is different, and should not compare two different types of model, such as time series and cross-section. With all this in mind, the following table reproduced the results of the time series model and the cross-section model:

	time series n = 64	**cross-section n = 17**
with a constant (short-term)	0.5065242 (20.88)	0.5958333 (34.40)
without a constant (long term)	0.7747747 (196.04)	0.7371857 (40.31)

Table 14: Duessenberry's assumption

In theory, Duessenberry showed the inequality between the two mpc's. However, it has been demonstrated above that empirically the time series model does not always yield an mpc greater than the cross-section mpc. This short analysis was put in place for the sake of testing Duessenberry's assumption, but for the reason mentioned above it should not be taken seriously. The following four cross-section analysis are of greater interest. Note that all explanatory variables have been coded, therefore the coefficient are interesting only for the magnitude of each group, and not for the calculation of any mpc's. In this analysis and in the third one, income has to be considered as overall income (not disposable income).

The following graph shows the share of each category in 1999 consumption expenditures. One can easily notice that the categories *food*, *other* and *non-consumption* account for 60% of one worker's household.

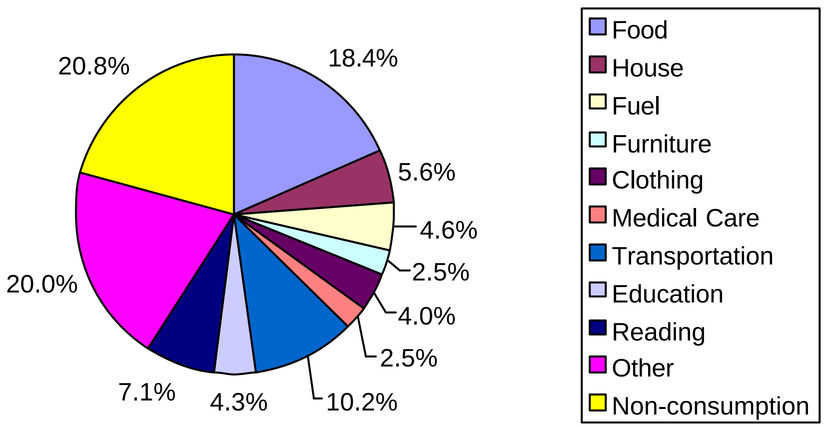

Figure 8: Share of each category (1999)

Since the size of each category is not equivalent, the coefficient of income, if significative, will not tell much. In order to measure the income-elasticity for each category, one has to divide the obtained coefficient by its overall share, that is to compute the relative increase in expenditure for an increase in income.

N = 19

Dependent Variable	Regression	Coeff. Income	Share	Relative Coeff.	R^2
Overall	OLS, robust	2228.535 (9.34)	100%	1.00	0.8928
Food	OLS	353.0495 (28.68)	18.4%	0.86	0.9798
Housing	OLS	-20.12298 (-1.49)	5.6%	-0.16	0.1152
Fuel	OLS, robust	63.14719 (11.66)	4.6%	0.62	0.9325
Furniture	OLS, robust	71.0193 (8.74)	2.5%	1.26	0.8981
Clothing	OLS, robust	147.5233 (6.26)	4.0%	1.65	0.8114
Medical Care	OLS, robust	40.53298 (5.21)	2.5%	0.73	0.7141
Transportation	OLS, robust	277.3825 (7.17)	10.2%	1.22	0.8299
Education	OLS	169.8686 (18.49)	4.3%	1.77	0.9526
Reading	OLS, robust	231.2439 (13.23)	7.1%	1.47	0.9464
Other	OLS	894.9832 (10.02)	20.0%	2.00	0.8552
Non-Consumption	OLS, robust	1077.901 (5.36)	20.8%	2.32	0.7690

Table 15: Regression on income

Except for the category *housing*, income is significant for all categories. Looking at the relative coefficient, one can notice that the expenditures in *non-consumption* will increase relatively more than the other categories when income raises. This indicates that the marginal taxation rate increases as income increases. Besides the broad category *other*, the groups *education* and *clothing* show the higher income-elasticity, that is when income increases, those two categories will raise their expenditures more than the average, which implies that they are luxury goods. On the other hand, food for instance with a relative coefficient at 0.86 is categorised as a normal good. The Engel coefficient, i.e. the budget share of food and beverages drops from a share of 28% for the poorest to a share of 18% for people with an income over 2'000'000 yen per month.

5.2.2. 2nd Analysis

$$C_i = f(Age, Age^2), \quad N = 11$$

Dependent Variable	Coeff. Age	Coeff. Age^2	R^2
Overall	72985.23 (6.43)	-5204.497 (-5.65)	0.8589
Food	17719.91 (8.63)	-1220.221 (-7.32)	0.9240
Housing	-8785.706 (-6.01)	569.0816 (4.80)	0.8787
Fuel	3211.644 (7.75)	-218.4044 (-6.49)	0.9108
Furniture	1953.021 (7.75)	-113.979 (-5.58)	0.9445
Clothing	2701.001 (4.50)	-173.1259 (-3.55)	0.8078
Medical Care	-941.1573 (-2.76)	93.81235 (3.39)	0.6822
Transportation	7402.753 (3.82)	-625.3438 (-3.97)	0.6642
Education	13677.27 (3.59)	-1158.501 (-3.75)	0.6381
Reading	6095.26 (5.49)	-396.352 (-4.40)	0.8563
Other	29951.13 (3.54)	-1961.455 (-2.86)	0.7079
Non-Consumption	36140.64 (5.88)	-2919.317 (-5.85)	0.8132

Table 16: Regression on age

First of all, it is of importance to have in mind that there are only eleven observations for age and therefore the results might not reflect the real trend. However, even with such a small number of observations, all variables tend to have a high correlation with age and age-squared. Since all the regressions are homoscedastic, a simple OLS regression was used. The following graph shows the relationship between age and general consumption.

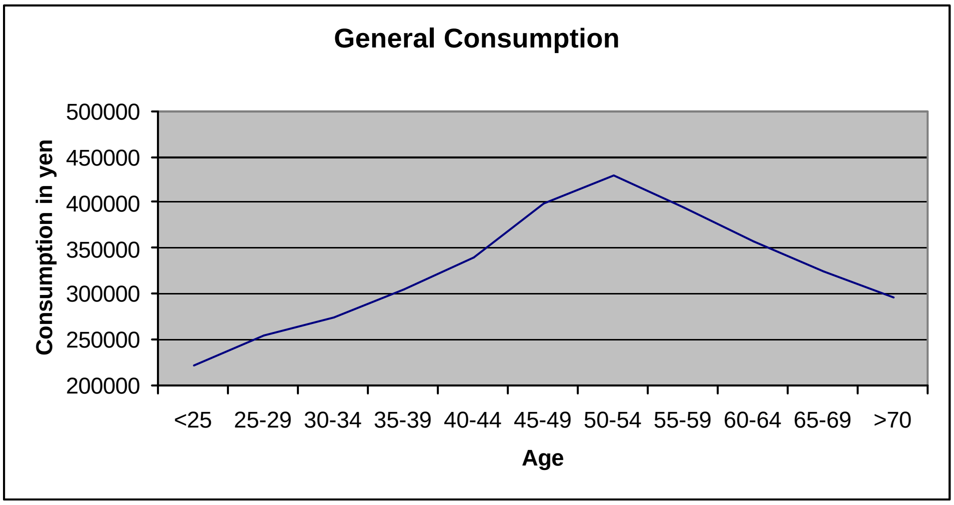

Figure 9: Breakdown of overall consumption by age

The categories *housing* and *medical care* have a sign opposite to what we would have expected, that is a positive relationship between age and consumption. This can be explained by the fact that, first, young people cannot usually afford to purchase a property and second housing as included in "business expenses" is more often part of experienced workers' contracts[25].

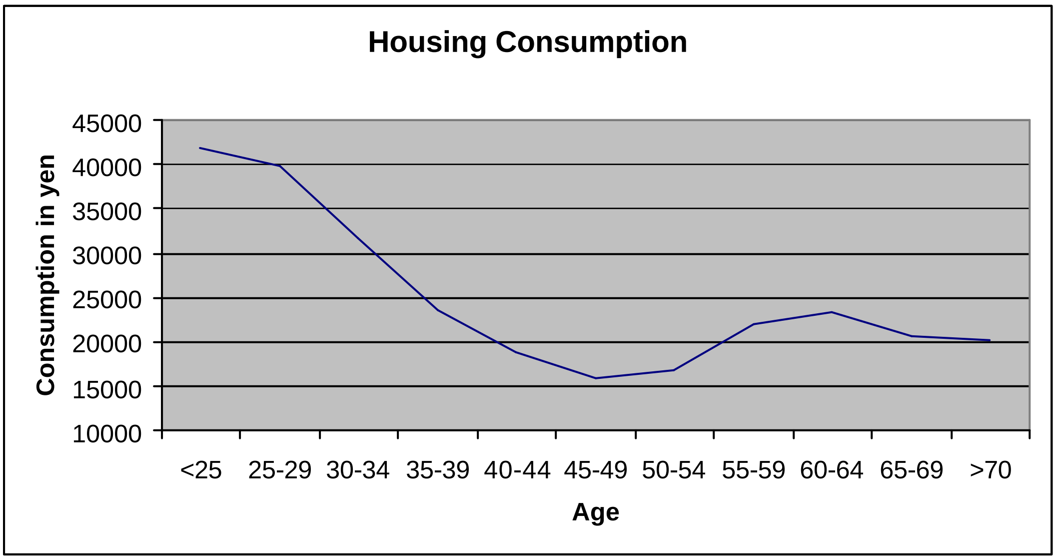

Figure 10: Breakdown of housing consumption by age

When overall consumption tends to decrease after passing 50 years old, the medical care expenditures increase to match the fact that older people are inclined to spend more on medical care than average.

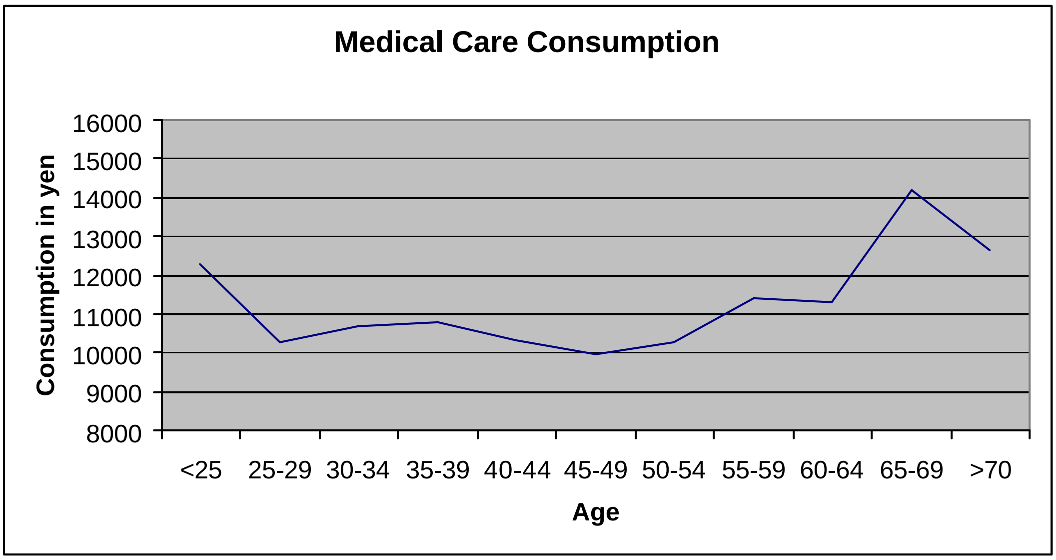

Figure 11: Breakdown of medical care consumption by age

[25] See the description of the consumption variable for a discussion of "business expenses".

5.2.3. 3rd analysis

$$C_i = f(Age, Age^2, Income), \quad \text{N} = 60$$

In this section, age and income variables have been grouped to smaller entities but overall the number of observations has increased to 60, which gives a stronger base for analysis.

Dependent Variable	Regression	Coeff. Age	Coeff. Age^2	Coeff. Income	R^2
Overall	OLS, robust	20659.72 (0.49)	-3810.87 (-0.77)	4487.358 (8.96)	0.7561
Food	OLS, robust	16462.8 (7.75)	-2019.918 (-6.52)	675.5609 (26.38)	0.9366
Housing	OLS, robust	-16376.85 (-2.81)	1719.332 (2.43)	98.31545 (1.45)	0.4113
Fuel	OLS	3364.708 (4.97)	-380.1607 (-4.01)	124.6362 (15.14)	0.8289
Furniture	OLS, robust	1501.346 (2.06)	-148.6911 (-1.27)	123.1354 (12.90)	0.7952
Clothing	OLS, robust	-3303.349 (-0.91)	429.7107 (0.92)	333.0736 (8.17)	0.6692
Medical Care	OLS, robust	-3738.783 (-3.49)	512.8196 (3.59)	115.2737 (10.09)	0.7134
Transportation	OLS, robust	-12204.93 (-0.73)	987.8232 (0.51)	698.6341 (3.53)	0.3795
Education	OLS, robust	20514.46 (7.59)	-3144.17 (-7.89)	243.7387 (6.05)	0.6578
Reading	OLS, robust	-7342.816 (-1.12)	882.5125 (1.14)	609.0838 (8.04)	0.7109
Other	OLS, robust	21682.29 (1.78)	-2717.584 (-1.74)	1500.205 (9.19)	0.7458
Non-Consumption	OLS, robust	38152.54 (3.84)	-5891.116 (-4.19)	1708.611 (11.54)	0.8270

Table 17: Regression on age and income

With more observations the regressions become heteroskedastic and therefore the OLS was in ten out of the eleven cases adjusted with the *robust* command. First of all, one can note that except for the category *housing* income is always a significant factor for the determination of consumption. However, even though the signs stay the same, as for the age and age-squared variables the impact is lower than expected and is significant in only six out of the eleven regressions. This might be the result of multi-colinearity between income and age which can be explained by the fact that in Japan large companies follow the triple principle: seniority-based wage system, lifetime employment and unionism. The seniority-based wage system means that the longer one works for a specific company, the higher the income one receives. Therefore there is a strong relationship between age and income[26]. Moreover, as one can see on the following figures, there is a larger dispersion in age compared to income, that is the coefficient for age will be less significant[27].

[26] In *Stata 7.0* the command *vif*, which calculates the variance inflation factor for the independent variables specified in the fitted model, computed a mean vif of 16.31 implying high multi-colinearity, especially since age-squared is perfectly correlated with the variable age.
[27] *Stata 7.0* takes the codes indicated above for the scales of the explanatory variables.

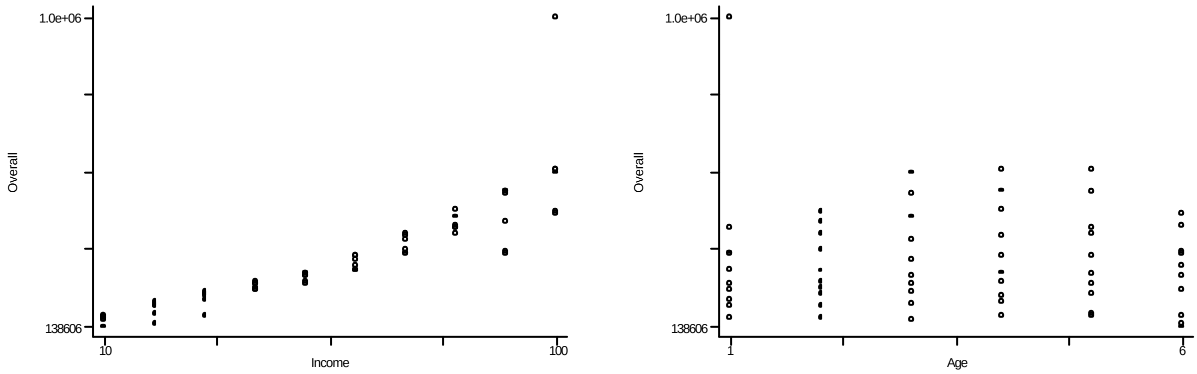

Figure 12 - 13: Income and age distribution

5.2.4. 4th analysis

$$C_i = f(Children, Education, Income), \quad N = 150$$

Dependent Variable	Regression	Coeff. Children	Coeff. Education	Coeff. Income	R^2
Overall	OLS, robust	7962.813 (1.26)	171.8814 (5.21)	4221.751 (23.03)	0.8163
Food	OLS, robust	9187.397 (9.04)	38.58507 (6.66)	620.6672 (20.57)	0.8113
Housing	OLS, robust	-101.042 (-0.09)	-35.1802 (-5.45)	23.14982 (0.69)	0.1820
Fuel	OLS	1905.858 (8.06)	12.51027 (9.28)	65.98612 (9.40)	0.6577
Furniture	OLS, robust	-237.004 (-0.75)	2.233849 (1.40)	120.4733 (8.43)	0.4619
Clothing	OLS, robust	-831.8619 (-2.29)	-5.19541 (-2.55)	304.7768 (22.73)	0.8575
Medical Care	OLS, robust	572.4554 (1.51)	-9.596638 (-4.44)	65.79839 (5.84)	0.2807
Transportation	OLS, robust	1316.764 (0.75)	20.17403 (1.95)	449.7743 (7.46)	0.4334
Education	OLS, robust	12940.61 (3.31)	83.4779 (3.84)	544.5716 (4.46)	0.2703
Reading	OLS, robust	819.8321 (0.99)	-29.4431 (-2.90)	596.8813 (10.12)	0.6504
Other	OLS, robust	-18128.44 (-6.47)	100.7372 (7.94)	1392.624 (15.22)	0.7707
Non-Consumption	OLS, robust	-4596.395 (-1.85)	10.29091 (0.79)	2153.589 (21.61)	0.8647

Table 18: Regression on children, education and income

Except the category *housing* all eleven other variables have a highly significative correlation with income[28]. The explanatory variable *education* was mainly introduced to test the assumption that as the level of education in one workers' household increases the expenditures for education will also increase since private institutions in Japan can get extremely costly.

[28] Note that the category *fuel* is as in the 3rd analysis homoscedastic, and therefore the *robust* command has not been used.

Except the categories *other* and *non-consumption*, which are always the category with the bigger share, the category *education* encounters an important increase of its expenditures when the level of education of workers' children increases. However, education is not the only category to be influenced by the level of education of worker's children. Nine out of the eleven variables are highly correlated with it.

As for the impact of having more children, the expected categories *food* and *education* are the ones which have the absolute and relative stronger correlation with the explanatory variable *children*. Nevertheless, only four categories are significatively related to the number of children in one's workers' household. Note that there should not be a problem of multi-colinearity since the variable *education* reflects the level of education of the eldest independent of the number of children.

6. CONCLUSION

The investigation of Japanese consumption pattern since 1976 showed that Japan, which pursued the well-accepted Keynesian consumption model until the early nineties, has encountered an unprecedented divergence of consumption to its disposable income. The crisis striking for more than a decade now has forced the Japanese to save more than before which illustrates the fear of a country that has not seen its real national income increase more than a percent and a half per year since 1991[29].

Summing up, this paper set a specific econometric discussion on unit root tests, the deseasonalization process, and cointegration. The various time series tests confirmed that the neo-classical consumption functions were not always empirically valid, but offered a short and long-run perspective of the Japanese marginal propensity to consume. The cross-section analysis allowed the reader to take a closer look at the income-elasticity of various consumption categories, the relative importance of the family composition and the curve of the age factor.

[29]Except 1996: 3.3%. Note that the average for the period 76-91 was of 4.1%, and the high-growth period (60-75) of 7.7%

7. REFERENCES

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8. ANNEXES

TABLE 1 - 2:

76-01

dfuller ydisp

Dickey-Fuller test for unit root Number of obs = 103

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-11.155	-3.509	-2.890	-2.580

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller ydisp, trend

Dickey-Fuller test for unit root Number of obs = 103

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-17.021	-4.039	-3.450	-3.150

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller ydisp, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 99

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-0.197	-4.042	-3.451	-3.151

* MacKinnon approximate p-value for Z(t) = 0.9928

. dfuller overall

Dickey-Fuller test for unit root Number of obs = 103

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-6.945	-3.509	-2.890	-2.580

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller overall, trend

Dickey-Fuller test for unit root Number of obs = 103

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		---------- Interpolated Dickey-Fuller ---------		
Z(t)	-8.154	-4.039	-3.450	-3.150

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller overall, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 99

---------- Interpolated Dickey-Fuller ---------

```
          Test       1% Critical    5% Critical    10% Critical
        Statistic       Value          Value          Value
------------------------------------------------------------------------------
 Z(t)       0.932        -4.042         -3.451         -3.151
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.9989
```

76-91

```
. dfuller ydisp91

Dickey-Fuller test for unit root                 Number of obs   =        63

                      ---------- Interpolated Dickey-Fuller ---------
          Test       1% Critical    5% Critical    10% Critical
        Statistic       Value          Value          Value
------------------------------------------------------------------------------
 Z(t)      -9.463        -3.562         -2.920         -2.595
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller ydisp91, trend

Dickey-Fuller test for unit root                 Number of obs   =        63

                      ---------- Interpolated Dickey-Fuller ---------
          Test       1% Critical    5% Critical    10% Critical
        Statistic       Value          Value          Value
------------------------------------------------------------------------------
 Z(t)     -12.063        -4.121         -3.487         -3.172
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller ydisp91, trend lags(4)

Augmented Dickey-Fuller test for unit root       Number of obs   =        59

                      ---------- Interpolated Dickey-Fuller ---------
          Test       1% Critical    5% Critical    10% Critical
        Statistic       Value          Value          Value
------------------------------------------------------------------------------
 Z(t)      -1.259        -4.130         -3.491         -3.175
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.8969

. dfuller overall91

Dickey-Fuller test for unit root                 Number of obs   =        63

                      ---------- Interpolated Dickey-Fuller ---------
          Test       1% Critical    5% Critical    10% Critical
        Statistic       Value          Value          Value
------------------------------------------------------------------------------
 Z(t)      -5.586        -3.562         -2.920         -2.595
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller overall91, trend

Dickey-Fuller test for unit root                 Number of obs   =        63

                      ---------- Interpolated Dickey-Fuller ---------
          Test       1% Critical    5% Critical    10% Critical
        Statistic       Value          Value          Value
------------------------------------------------------------------------------
 Z(t)      -9.985        -4.121         -3.487         -3.172
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller overall91, trend lags(4)

Augmented Dickey-Fuller test for unit root       Number of obs   =        59

                      ---------- Interpolated Dickey-Fuller ---------
          Test       1% Critical    5% Critical    10% Critical
```

Statistic	Value	Value	Value
Z(t) -1.983	-4.130	-3.491	-3.175

* MacKinnon approximate p-value for Z(t) = 0.6111

<u>TABLE 3 - 4:</u>

76-91

. dfuller ydispseas

Dickey-Fuller test for unit root Number of obs = 63

Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -2.303	-3.562	-2.920	-2.595

---------- Interpolated Dickey-Fuller ---------

* MacKinnon approximate p-value for Z(t) = 0.1709

. dfuller ydispseas, trend

Dickey-Fuller test for unit root Number of obs = 63

---------- Interpolated Dickey-Fuller ---------

Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -7.740	-4.121	-3.487	-3.172

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller ydispseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 59

---------- Interpolated Dickey-Fuller ---------

Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -1.704	-4.130	-3.491	-3.175

* MacKinnon approximate p-value for Z(t) = 0.7484

. dfuller overallseas

Dickey-Fuller test for unit root Number of obs = 63

---------- Interpolated Dickey-Fuller ---------

Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -1.775	-3.562	-2.920	-2.595

* MacKinnon approximate p-value for Z(t) = 0.3927

. dfuller overallseas, trend

Dickey-Fuller test for unit root Number of obs = 63

---------- Interpolated Dickey-Fuller ---------

Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -6.406	-4.121	-3.487	-3.172

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller overallseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 59

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.145	-4.130	-3.491	-3.175

* MacKinnon approximate p-value for Z(t) = 0.5218

76-01

. dfuller ydispseas

Dickey-Fuller test for unit root Number of obs = 103

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.630	-3.509	-2.890	-2.580

* MacKinnon approximate p-value for Z(t) = 0.0869

. dfuller ydispseas, trend

Dickey-Fuller test for unit root Number of obs = 103

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-7.417	-4.039	-3.450	-3.150

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller ydispseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 99

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-0.098	-4.042	-3.451	-3.151

* MacKinnon approximate p-value for Z(t) = 0.9944

. dfuller overallseas

Dickey-Fuller test for unit root Number of obs = 103

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.781	-3.509	-2.890	-2.580

* MacKinnon approximate p-value for Z(t) = 0.0610

. dfuller overallseas, trend

Dickey-Fuller test for unit root Number of obs = 103

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.392	-4.039	-3.450	-3.150

* MacKinnon approximate p-value for Z(t) = 0.3851

. dfuller overallseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 99

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	0.909	-4.042	-3.451	-3.151

* MacKinnon approximate p-value for Z(t) = 0.9989

<u>TABLE 5 - 6:</u>

76-01

. dfuller doverallseas

Dickey-Fuller test for unit root Number of obs = 102

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-18.166	-3.509	-2.890	-2.580

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller doverallseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 98

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-5.152	-4.044	-3.452	-3.151

* MacKinnon approximate p-value for Z(t) = 0.0001

. dfuller dydispseas

Dickey-Fuller test for unit root Number of obs = 102

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-13.980	-3.509	-2.890	-2.580

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller dydispseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 98

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-5.240	-4.044	-3.452	-3.151

* MacKinnon approximate p-value for Z(t) = 0.0001

76-91

. dfuller doverallseas

Dickey-Fuller test for unit root Number of obs = 62

---------- Interpolated Dickey-Fuller ---------

Test Statistic		1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-14.192	-3.563	-2.920	-2.595

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller doverallseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 58

	---------- Interpolated Dickey-Fuller ---------		
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -3.934	-4.132	-3.492	-3.175

* MacKinnon approximate p-value for Z(t) = 0.0109

. dfuller dydispseas

Dickey-Fuller test for unit root Number of obs = 62

	---------- Interpolated Dickey-Fuller ---------		
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -12.058	-3.563	-2.920	-2.595

* MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller dydispseas, trend lags(4)

Augmented Dickey-Fuller test for unit root Number of obs = 58

	---------- Interpolated Dickey-Fuller ---------		
Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
Z(t) -4.199	-4.132	-3.492	-3.175

* MacKinnon approximate p-value for Z(t) = 0.0045
Residuals 76-91 seas

<u>TABLE 7:</u>

76-91

. dfuller res

Dickey-Fuller test for unit root Number of obs = 63

	Test Statistic	---------- Interpolated Dickey-Fuller --------- 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-9.581	-3.562	-2.920	-2.595

* MacKinnon approximate p-value for Z(t) = 0.0000

76-01

. dfuller res

Dickey-Fuller test for unit root Number of obs = 103

	Test Statistic	---------- Interpolated Dickey-Fuller --------- 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-2.915	-3.509	-2.890	-2.580

* MacKinnon approximate p-value for Z(t) = 0.0436

<u>TABLE 8 - 9</u>

76-01

Date: 05/30/03 Time: 14:38
Sample: 1976:1 2001:4
Included observations: 103
Test assumption:
Linear deterministic
trend in the data
Series: OVERALLSEAS YDISPSEAS
Lags interval: No lags

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.085859	16.83042	15.41	20.04	None *
0.070986	7.584066	3.76	6.65	At most 1 **

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 cointegrating equation(s) at 5% significance level

Unnormalized Cointegrating Coefficients:

OVERALLSEAS	YDISPSEAS
-8.04E-06	3.22E-06
5.36E-06	3.70E-07

Normalized Cointegrating Coefficients: 1 Cointegrating Equation(s)

OVERALLSEAS	YDISPSEAS	C
1.000000	-0.400858	-146830.7
	(0.10073)	
Log likelihood	-2198.649	

76-91

Date: 05/30/03 Time: 14:37
Sample: 1976:1 1991:4
Included observations: 63
Test assumption:
Linear deterministic
trend in the data
Series: OVERALLSEAS YDISPSEAS
Lags interval: No lags

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.648631	68.87603	15.41	20.04	None **
0.046250	2.983250	3.76	6.65	At most 1

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 1 cointegrating equation(s) at 5% significance level

Unnormalized Cointegrating Coefficients:

OVERALLSEAS	YDISP SEAS
-2.52E-05	1.18E-05
6.45E-06	8.58E-07

Normalized
Cointegrating

Coefficients: 1 Cointegrating Equation(s)		
OVERALLSEAS	YDISPSEAS	C
1.000000	-0.470423	-124717.4
	(0.01435)	
Log likelihood	-1302.056	

TABLE 10:

Quarterly

```
. reg   overallseas ydispseas

      Source |       SS       df       MS              Number of obs =      64
-------------+------------------------------           F(  1,    62) =  576.29
       Model |  1.3879e+10     1  1.3879e+10           Prob > F      =  0.0000
    Residual |  1.4932e+09    62  24084070.6           R-squared     =  0.9029
-------------+------------------------------           Adj R-squared =  0.9013
       Total |  1.5373e+10    63   244009007           Root MSE      =  4907.6

------------------------------------------------------------------------------
 overallseas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   ydispseas |   .4301507   .0179185    24.01   0.000     .3943322    .4659692
       _cons |   140983.9   7304.457    19.30   0.000     126382.5    155585.3
------------------------------------------------------------------------------

. hettest

Cook-Weisberg test for heteroskedasticity using fitted values of overallseas
     Ho: Constant variance
         chi2(1)      =     0.34
         Prob > chi2  =     0.5590

. dwstat
Durbin-Watson d-statistic(  2,    64) =   2.40048
```

Yearly

```
. prais overall ydisp, robust
Iteration 0:  rho = 0.0000
Iteration 1:  rho = 0.6914
Iteration 2:  rho = 0.7548
Iteration 3:  rho = 0.7707
Iteration 4:  rho = 0.7752
Iteration 5:  rho = 0.7766
Iteration 6:  rho = 0.7770
Iteration 7:  rho = 0.7771
Iteration 8:  rho = 0.7771
Iteration 9:  rho = 0.7771
Iteration 10:  rho = 0.7771
Iteration 11:  rho = 0.7771

Prais-Winsten AR(1) regression -- iterated estimates

Regression with robust standard errors                 Number of obs =      17
                                                       F(  2,    15) =23728.06
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.9963
                                                       Root MSE      =  1700.7

------------------------------------------------------------------------------
             |             Semi-robust
     overall |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ydisp |   .5065242   .0242617    20.88   0.000     .4548116    .5582367
       _cons |   97634.73   10984.22     8.89   0.000     74222.42      121047
-------------+----------------------------------------------------------------
         rho |   .7771288
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    0.465445
```

Durbin-Watson statistic (transformed) 1.098292

Long-run

quarterly, nocon

. reg overallseas ydispseas, nocon

```
      Source |       SS       df       MS              Number of obs =      64
-------------+------------------------------           F(  1,    63) =38432.10
       Model |  6.3842e+12     1  6.3842e+12           Prob > F      =  0.0000
    Residual |  1.0465e+10    63   166115665           R-squared     =  0.9984
-------------+------------------------------           Adj R-squared =  0.9983
       Total |  6.3946e+12    64  9.9916e+10           Root MSE      =   12889

------------------------------------------------------------------------------
 overallseas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   ydispseas |   .7747747   .0039521   196.04   0.000     .7668771    .7826724
------------------------------------------------------------------------------
```

APC

. reg C_Y ydispseas

```
      Source |       SS       df       MS              Number of obs =      64
-------------+------------------------------           F(  1,    62) =  341.45
       Model |  .058616888     1  .058616888           Prob > F      =  0.0000
    Residual |  .010643692    62  .000171672           R-squared     =  0.8463
-------------+------------------------------           Adj R-squared =  0.8438
       Total |   .06926058    63  .001099374           Root MSE      =   .0131

------------------------------------------------------------------------------
         C_Y |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   ydispseas |  -8.84e-07   4.78e-08   -18.48   0.000    -9.80e-07   -7.88e-07
       _cons |   1.138858   .0195017    58.40   0.000     1.099875    1.177842
------------------------------------------------------------------------------
```

TABLE 11

Quarterly

```
. prais  overallseas ydispseas loverallseas
Iteration 0:  rho = 0.0000
Iteration 1:  rho = -0.4311
Iteration 2:  rho = -0.5067
Iteration 3:  rho = -0.5121
Iteration 4:  rho = -0.5125
Iteration 5:  rho = -0.5125
Iteration 6:  rho = -0.5125
Iteration 7:  rho = -0.5125

Prais-Winsten AR(1) regression -- iterated estimates

      Source |       SS       df       MS              Number of obs =      63
-------------+------------------------------           F(  2,    60) = 2822.27
       Model |  8.1343e+10     2  4.0671e+10           Prob > F      =  0.0000
    Residual |   864652103    60  14410868.4           R-squared     =  0.9895
-------------+------------------------------           Adj R-squared =  0.9891
       Total |  8.2207e+10    62  1.3259e+09           Root MSE      =  3796.2

------------------------------------------------------------------------------
 overallseas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   ydispseas |   .2265756   .0368836     6.14   0.000     .1527973    .3003538
loverallseas |   .5074759   .0783783     6.47   0.000      .350696    .6642558
       _cons |    63910.2   11071.29     5.77   0.000     41764.31    86056.08
-------------+----------------------------------------------------------------
         rho |  -.5125137
------------------------------------------------------------------------------
Durbin-Watson statistic (original)    2.800995
Durbin-Watson statistic (transformed) 1.948829
```

Yearly

. reg overall ydisp loverall

```
      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  2,    13) =  410.86
       Model |  3.6006e+09     2  1.8003e+09           Prob > F      =  0.0000
    Residual |  56963301.3    13  4381792.41           R-squared     =  0.9844
-------------+------------------------------           Adj R-squared =  0.9820
       Total |  3.6576e+09    15   243837560           Root MSE      =  2093.3

------------------------------------------------------------------------------
     overall |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ydisp |   .3179475   .0647003     4.91   0.000      .178171     .457724
    loverall |    .340912   .1370782     2.49   0.027     .0447724    .6370515
       _cons |   72936.07   17613.86     4.14   0.001     34883.64    110988.5
------------------------------------------------------------------------------
```

TABLE 12

Quarterly

. reg overallseas ydispseas loverallseas, nocon

```
      Source |       SS       df       MS              Number of obs =      63
-------------+------------------------------           F(  2,    61) =       .
       Model |  6.3127e+12     2  3.1563e+12           Prob > F      =  0.0000
    Residual |  1.7934e+09    61  29399189.9           R-squared     =  0.9997
-------------+------------------------------           Adj R-squared =  0.9997
       Total |  6.3145e+12    63  1.0023e+11           Root MSE      =  5422.1

------------------------------------------------------------------------------
 overallseas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   ydispseas |   .1151312   .0400867     2.87   0.006      .034973    .1952895
loverallseas |   .8538025   .0519066    16.45   0.000     .7500088    .9575961
------------------------------------------------------------------------------
```

Yearly

. reg overall ydisp loverall, nocon

```
      Source |       SS       df       MS              Number of obs =      16
-------------+------------------------------           F(  2,    14) =86690.12
       Model |  1.6359e+12     2  8.1796e+11           Prob > F      =  0.0000
    Residual |   132095740    14  9435410.02           R-squared     =  0.9999
-------------+------------------------------           Adj R-squared =  0.9999
       Total |  1.6360e+12    16  1.0225e+11           Root MSE      =  3071.7

------------------------------------------------------------------------------
     overall |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ydisp |   .1101398   .0599239     1.84   0.087    -.0183842    .2386638
    loverall |   .8581899   .0828169    10.36   0.000     .6805654    1.035814
------------------------------------------------------------------------------
```

91-01

. dfuller overallseas

```
Dickey-Fuller test for unit root                   Number of obs   =        39

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.024            -3.655            -2.961            -2.613
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.2763
```

. dfuller ydispseas

```
Dickey-Fuller test for unit root                   Number of obs   =        39

                  ---------- Interpolated Dickey-Fuller ---------
            Test        1% Critical      5% Critical     10% Critical
          Statistic        Value            Value           Value
------------------------------------------------------------------------------
 Z(t)         -4.621        -3.655          -2.961          -2.613
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.0001
```

```
. dfuller  doverallseas

Dickey-Fuller test for unit root                   Number of obs   =        38

                  ---------- Interpolated Dickey-Fuller ---------
            Test        1% Critical      5% Critical     10% Critical
          Statistic        Value            Value           Value
------------------------------------------------------------------------------
 Z(t)        -11.484        -3.662          -2.964          -2.614
------------------------------------------------------------------------------
* MacKinnon approximate p-value for Z(t) = 0.0000
```

```
. reg  overallseas ydispseas

      Source |       SS       df       MS              Number of obs =      40
-------------+------------------------------           F(  1,    38) =    0.61
       Model |  91282891.2     1  91282891.2           Prob > F      =  0.4386
    Residual |  5.6597e+09    38   148938219           R-squared     =  0.0159
-------------+------------------------------           Adj R-squared = -0.0100
       Total |  5.7509e+09    39   147459877           Root MSE      =   12204

------------------------------------------------------------------------------
 overallseas |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
   ydispseas |  -.0964208   .1231627    -0.78   0.439    -.3457505     .152909
       _cons |   376347.4   59458.38     6.33   0.000     255980.2    496714.6
------------------------------------------------------------------------------
```

TABLE 14:

```
. reg overall ydisp

      Source |       SS       df       MS              Number of obs =      19
-------------+------------------------------           F(  1,    17) = 1183.49
       Model |  3.1260e+11     1  3.1260e+11           Prob > F      =  0.0000
    Residual |  4.4902e+09    17   264131168           R-squared     =  0.9858
-------------+------------------------------           Adj R-squared =  0.9850
       Total |  3.1709e+11    18  1.7616e+10           Root MSE      =   16252

------------------------------------------------------------------------------
     overall |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ydisp |   .5958333   .0173198    34.40   0.000     .5592917    .6323748
       _cons |   76052.99   8334.149     9.13   0.000     58469.47     93636.5
------------------------------------------------------------------------------
```

```
. reg overall ydisp, nocon

      Source |       SS       df       MS              Number of obs =      19
-------------+------------------------------           F(  1,    18) = 1624.83
       Model |  2.3908e+12     1  2.3908e+12           Prob > F      =  0.0000
    Residual |  2.6486e+10    18  1.4714e+09           R-squared     =  0.9890
-------------+------------------------------           Adj R-squared =  0.9884
       Total |  2.4173e+12    19  1.2723e+11           Root MSE      =   38359

------------------------------------------------------------------------------
     overall |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       ydisp |   .7371857   .0182883    40.31   0.000     .6987635    .7756079
```

```
------------------------------------------------------------------------------
```

CROSS-SECTION: TABLE 15

OVERALL

```
. reg overall income, robust

Regression with robust standard errors                 Number of obs =      19
                                                       F(  1,    17) =   87.18
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.8928
                                                       Root MSE      =   44724

------------------------------------------------------------------------------
             |               Robust
     overall |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   2228.535   238.6706     9.34   0.000     1724.984    2732.086
       _cons |     109618   18799.82     5.83   0.000     69953.89    149282.2
------------------------------------------------------------------------------
```

FOOD

```
. reg food income

      Source |       SS       df       MS              Number of obs =      19
-------------+------------------------------           F(  1,    17) =  822.53
       Model |  7.1047e+09     1  7.1047e+09           Prob > F      =  0.0000
    Residual |   146840091    17  8637652.42           R-squared     =  0.9798
-------------+------------------------------           Adj R-squared =  0.9786
       Total |  7.2515e+09    18   402863564           Root MSE      =  2939.0

------------------------------------------------------------------------------
        food |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   353.0495   12.31007    28.68   0.000     327.0775    379.0214
       _cons |   41879.58   1403.564    29.84   0.000     38918.32    44840.84
------------------------------------------------------------------------------
```

HOUSING

```
. reg housing income

      Source |       SS       df       MS              Number of obs =      19
-------------+------------------------------           F(  1,    17) =    2.21
       Model |  23081262.1     1  23081262.1           Prob > F      =  0.1551
    Residual |   177214295    17  10424370.3           R-squared     =  0.1152
-------------+------------------------------           Adj R-squared =  0.0632
       Total |   200295557    18  11127530.9           Root MSE      =  3228.7

------------------------------------------------------------------------------
     housing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |  -20.12298   13.52345    -1.49   0.155    -48.65497    8.409002
       _cons |   25508.77    1541.91    16.54   0.000     22255.63    28761.92
------------------------------------------------------------------------------
```

FUEL

```
. reg fuel income, robust

Regression with robust standard errors                 Number of obs =      19
                                                       F(  1,    17) =  135.91
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.9325
                                                       Root MSE      =  983.66

------------------------------------------------------------------------------
             |               Robust
        fuel |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   63.14719   5.416571    11.66   0.000     51.71923    74.57516
       _cons |   12952.75   434.4355    29.82   0.000     12036.18    13869.33
```

FURNITURE

```
. reg furnit income, robust

Regression with robust standard errors              Number of obs =      19
                                                    F(  1,    17) =   76.44
                                                    Prob > F      =  0.0000
                                                    R-squared     =  0.8981
                                                    Root MSE      =  1385.4

------------------------------------------------------------------------------
             |               Robust
      furnit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |    71.0193   8.123116     8.74   0.000     53.88102    88.15758
       _cons |   3554.123   607.9691     5.85   0.000      2271.42    4836.826
------------------------------------------------------------------------------
```

CLOTHING

```
. reg clothing income, robust

Regression with robust standard errors              Number of obs =      19
                                                    F(  1,    17) =   39.23
                                                    Prob > F      =  0.0000
                                                    R-squared     =  0.8114
                                                    Root MSE      =  4118.3

------------------------------------------------------------------------------
             |               Robust
    clothing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   147.5233   23.55393     6.26   0.000     97.82888    197.2178
       _cons |    2044.93   1854.495     1.10   0.286    -1867.712    5957.572
------------------------------------------------------------------------------
```

MEDICAL CARE

```
. reg medic income, robust

Regression with robust standard errors              Number of obs =      19
                                                    F(  1,    17) =   27.13
                                                    Prob > F      =  0.0001
                                                    R-squared     =  0.7141
                                                    Root MSE      =  1484.9

------------------------------------------------------------------------------
             |               Robust
       medic |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   40.53298   7.782327     5.21   0.000     24.11371    56.95226
       _cons |   6437.649   569.7267    11.30   0.000     5235.631    7639.667
------------------------------------------------------------------------------
```

TRANSPORTATION

```
. reg transp income, robust

Regression with robust standard errors              Number of obs =      19
                                                    F(  1,    17) =   51.36
                                                    Prob > F      =  0.0000
                                                    R-squared     =  0.8299
                                                    Root MSE      =  7272.7

------------------------------------------------------------------------------
             |               Robust
      transp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   277.3825   38.70666     7.17   0.000     195.7185    359.0464
       _cons |   15008.28   2948.711     5.09   0.000     8787.045    21229.52
------------------------------------------------------------------------------
```

EDUCATION

. reg educ income

```
      Source |       SS       df       MS              Number of obs =      19
-------------+------------------------------           F(  1,    17) =  341.85
       Model |  1.6448e+09     1  1.6448e+09           Prob > F      =  0.0000
    Residual |  81791677.5    17  4811275.15           R-squared     =  0.9526
-------------+------------------------------           Adj R-squared =  0.9498
       Total |  1.7265e+09    18  95919225.6           Root MSE      =  2193.5

------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   169.8686   9.187401    18.49   0.000     150.4849    189.2523
       _cons |   1053.877   1047.525     1.01   0.328    -1156.207    3263.961
------------------------------------------------------------------------------
```

READING

. reg read income, robust

```
Regression with robust standard errors                 Number of obs =      19
                                                       F(  1,    17) =  175.16
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.9464
                                                       Root MSE      =  3186.6

------------------------------------------------------------------------------
             |               Robust
        read |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   231.2439   17.47248    13.23   0.000     194.3802    268.1076
       _cons |   6553.456   1306.098     5.02   0.000     3797.831    9309.081
------------------------------------------------------------------------------
```

OTHER

. reg other income

```
      Source |       SS       df       MS              Number of obs =      19
-------------+------------------------------           F(  1,    17) =  100.38
       Model |  4.5657e+10     1  4.5657e+10           Prob > F      =  0.0000
    Residual |  7.7325e+09    17   454851707           R-squared     =  0.8552
-------------+------------------------------           Adj R-squared =  0.8466
       Total |  5.3389e+10    18  2.9661e+09           Root MSE      =   21327

------------------------------------------------------------------------------
       other |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   894.9832   89.33003    10.02   0.000     706.5133    1083.453
       _cons |  -5388.211   10185.19    -0.53   0.604    -26877.08    16100.66
------------------------------------------------------------------------------
```

NON-CONSUMPTION

. reg non_cons income, robust

```
Regression with robust standard errors                 Number of obs =      19
                                                       F(  1,    17) =   28.74
                                                       Prob > F      =  0.0001
                                                       R-squared     =  0.7690
                                                       Root MSE      =   34207

------------------------------------------------------------------------------
             |               Robust
    non_cons |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      income |   1077.901   201.0546     5.36   0.000     653.7124    1502.089
       _cons |  -20337.21    15026.3    -1.35   0.194    -52039.92     11365.5
------------------------------------------------------------------------------
```

TABLE 16

OVERALL

```
. reg overall age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   24.35
       Model |  3.5440e+10     2  1.7720e+10           Prob > F      =  0.0004
    Residual |  5.8222e+09     8   727775891           R-squared     =  0.8589
-------------+------------------------------           Adj R-squared =  0.8236
       Total |  4.1263e+10    10  4.1263e+09           Root MSE      =   26977

------------------------------------------------------------------------------
     overall|      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   72985.23   11347.26     6.43   0.000      46818.4    99152.06
        age2 |  -5204.497   920.9906    -5.65   0.000    -7328.305   -3080.688
       _cons |   128241.1   29626.71     4.33   0.003     59921.78    196560.4
------------------------------------------------------------------------------
```

FOOD

```
. reg food age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   48.65
       Model |  2.3192e+09     2  1.1596e+09           Prob > F      =  0.0000
    Residual |   190669873     8  23833734.1           R-squared     =  0.9240
-------------+------------------------------           Adj R-squared =  0.9050
       Total |  2.5098e+09    10   250982522           Root MSE      =  4882.0

------------------------------------------------------------------------------
        food |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   17719.91    2053.47     8.63   0.000      12984.6    22455.22
        age2 |  -1220.221   166.6681    -7.32   0.000    -1604.559   -835.8842
       _cons |   25565.44    5361.43     4.77   0.001     13201.96    37928.92
------------------------------------------------------------------------------
```

HOUSING

```
. reg housing age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   28.97
       Model |   699032582     2   349516291           Prob > F      =  0.0002
    Residual |  96532239.0     8  12066529.9           R-squared     =  0.8787
-------------+------------------------------           Adj R-squared =  0.8483
       Total |   795564821    10  79556482.1           Root MSE      =  3473.7

------------------------------------------------------------------------------
     housing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -8785.706   1461.112    -6.01   0.000    -12155.04   -5416.377
        age2 |   569.0816   118.5899     4.80   0.001     295.6129    842.5503
       _cons |   51508.58   3814.835    13.50   0.000     42711.55     60305.6
------------------------------------------------------------------------------
```

FUEL

```
. reg fuel age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   40.84
       Model |  79320753.1     2  39660376.6           Prob > F      =  0.0001
    Residual |  7769561.58     8  971195.198           R-squared     =  0.9108
-------------+------------------------------           Adj R-squared =  0.8885
       Total |  87090314.7    10  8709031.47           Root MSE      =  985.49

------------------------------------------------------------------------------
        fuel |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   3211.644     414.52     7.75   0.000     2255.759    4167.529
        age2 |  -218.4044   33.64415    -6.49   0.000     -295.988   -140.8209
       _cons |   9617.194   1082.276     8.89   0.000     7121.462    12112.93
------------------------------------------------------------------------------
```

FURNITURE

```
. reg furnit age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   68.09
       Model |  48826322.6     2  24413161.3           Prob > F      =  0.0000
    Residual |  2868500.17     8  358562.521           R-squared     =  0.9445
-------------+------------------------------           Adj R-squared =  0.9306
       Total |  51694822.7    10  5169482.27           Root MSE      =  598.80

------------------------------------------------------------------------------
      furnit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   1953.021    251.869     7.75   0.000      1372.21    2533.832
        age2 |   -113.979   20.44273    -5.58   0.001      -161.12   -66.83801
       _cons |   4358.364   657.6079     6.63   0.000     2841.917     5874.81
------------------------------------------------------------------------------
```

CLOTHING

```
. reg clothing age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   16.81
       Model |  68477964.1     2  34238982.1           Prob > F      =  0.0014
    Residual |  16290797.5     8  2036349.69           R-squared     =  0.8078
-------------+------------------------------           Adj R-squared =  0.7598
       Total |  84768761.6    10  8476876.16           Root MSE      =  1427.0

------------------------------------------------------------------------------
    clothing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   2701.001    600.231     4.50   0.002     1316.866    4085.137
        age2 |  -173.1259   48.71722    -3.55   0.007     -285.468   -60.78375
       _cons |   8439.964   1567.151     5.39   0.001     4826.108    12053.82
------------------------------------------------------------------------------
```

MEDICAL CARE

```
. reg medic age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =    8.59
       Model |  11299168.6     2  5649584.31           Prob > F      =  0.0102
    Residual |  5263727.02     8  657965.877           R-squared     =  0.6822
-------------+------------------------------           Adj R-squared =  0.6027
       Total |  16562895.6    10  1656289.56           Root MSE      =  811.15

------------------------------------------------------------------------------
       medic |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -941.1573   341.1881    -2.76   0.025    -1727.939   -154.3761
        age2 |   93.81235   27.69224     3.39   0.010     29.95394    157.6708
       _cons |   12629.39   890.8124    14.18   0.000     10575.18    14683.61
------------------------------------------------------------------------------
```

TRANSPORTATION

```
. reg transp age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =    7.91
       Model |   336655509     2   168327754           Prob > F      =  0.0127
    Residual |   170182900     8  21272862.5           R-squared     =  0.6642
-------------+------------------------------           Adj R-squared =  0.5803
       Total |   506838409    10  50683840.9           Root MSE      =  4612.3

------------------------------------------------------------------------------
      transp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   7402.753   1940.016     3.82   0.005     2929.069    11876.44
        age2 |  -625.3438   157.4597    -3.97   0.004    -988.4465   -262.2412
       _cons |   25920.66   5065.211     5.12   0.001     14240.26    37601.06
------------------------------------------------------------------------------
```

EDUCATION

```
. reg educ age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =    7.05
       Model |  1.1571e+09     2   578549682           Prob > F      =  0.0171
    Residual |   656152509     8  82019063.6           R-squared     =  0.6381
-------------+------------------------------           Adj R-squared =  0.5477
       Total |  1.8133e+09    10   181325187           Root MSE      =  9056.4

------------------------------------------------------------------------------
        educ |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   13677.27   3809.339     3.59   0.007     4892.917    22461.62
        age2 |  -1158.501   309.1817    -3.75   0.006    -1871.475   -445.5269
       _cons |  -14756.74   9945.851    -1.48   0.176    -37691.91    8178.435
------------------------------------------------------------------------------
```

READING

```
. reg read age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   23.84
       Model |   332019440     2   166009720           Prob > F      =  0.0004
    Residual |  55703732.1     8  6962966.51           R-squared     =  0.8563
-------------+------------------------------           Adj R-squared =  0.8204
       Total |   387723173    10  38772317.3           Root MSE      =  2638.7

------------------------------------------------------------------------------
        read |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |    6095.26   1109.914     5.49   0.001     3535.793    8654.727
        age2 |   -396.352   90.08521    -4.40   0.002    -604.0889   -188.6151
       _cons |   12157.99   2897.889     4.20   0.003      5475.45    18840.54
------------------------------------------------------------------------------
```

OTHER

```
. reg other age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =    9.69
       Model |  7.8259e+09     2  3.9129e+09           Prob > F      =  0.0073
    Residual |  3.2299e+09     8   403735318           R-squared     =  0.7079
-------------+------------------------------           Adj R-squared =  0.6348
       Total |  1.1056e+10    10  1.1056e+09           Root MSE      =   20093

------------------------------------------------------------------------------
       other |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   29951.13   8451.633     3.54   0.008     10461.63    49440.63
        age2 |  -1961.455   685.9694    -2.86   0.021    -3543.303   -379.6063
       _cons |  -7199.491   22066.47    -0.33   0.753    -58084.87    43685.89
------------------------------------------------------------------------------
```

NON-CONSUMPTION

```
. reg non_cons age age2

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     8) =   17.42
       Model |  7.4475e+09     2  3.7237e+09           Prob > F      =  0.0012
    Residual |  1.7103e+09     8   213785980           R-squared     =  0.8132
-------------+------------------------------           Adj R-squared =  0.7666
       Total |  9.1578e+09    10   915776419           Root MSE      =   14621

------------------------------------------------------------------------------
    non_cons |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   36140.64   6150.095     5.88   0.000      21958.5    50322.79
        age2 |  -2919.317   499.1671    -5.85   0.000    -4070.398   -1768.236
       _cons |  -6776.079   16057.36    -0.42   0.684    -43804.42    30252.26
------------------------------------------------------------------------------
```

TABLE 17:

OVERALL

```
. reg overall age age2 income, robust

Regression with robust standard errors               Number of obs =      60
                                                     F(  3,    56) =  159.25
                                                     Prob > F      =  0.0000
                                                     R-squared     =  0.7561
                                                     Root MSE      =   76224

------------------------------------------------------------------------------
             |               Robust
     overall |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   20659.72   41833.84     0.49   0.623    -63143.52      104463
        age2 |   -3810.87   4977.184    -0.77   0.447    -13781.37    6159.628
      income |   4487.358   500.8916     8.96   0.000     3483.952    5490.764
       _cons |   68011.59   56362.81     1.21   0.233     -44896.7    180919.9
------------------------------------------------------------------------------
```

FOOD

```
. reg food age age2 income, robust

Regression with robust standard errors               Number of obs =      60
                                                     F(  3,    56) =  251.08
                                                     Prob > F      =  0.0000
                                                     R-squared     =  0.9366
                                                     Root MSE      =  5501.7

------------------------------------------------------------------------------
             |               Robust
        food |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |    16462.8    2123.38     7.75   0.000     12209.16    20716.44
        age2 |  -2019.918   309.5891    -6.52   0.000    -2640.099   -1399.736
      income |   675.5609   25.61335    26.38   0.000     624.2512    726.8706
       _cons |   11924.59   3409.178     3.50   0.001     5095.185    18753.99
------------------------------------------------------------------------------
```

HOUSING

```
. reg housing age age2 income, robust

Regression with robust standard errors               Number of obs =      60
                                                     F(  3,    56) =    5.98
                                                     Prob > F      =  0.0013
                                                     R-squared     =  0.4113
                                                     Root MSE      =   11168

------------------------------------------------------------------------------
             |               Robust
     housing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -16376.85   5819.822    -2.81   0.007    -28035.36   -4718.348
        age2 |   1719.332   706.5324     2.43   0.018     303.9776    3134.687
      income |   98.31545    67.5886     1.45   0.151    -37.08079    233.7117
       _cons |   50689.55   8302.987     6.10   0.000     34056.67    67322.43
------------------------------------------------------------------------------
```

FUEL

```
. reg fuel age age2 income

      Source |       SS       df       MS              Number of obs =      60
-------------+------------------------------           F(  3,    56) =   90.43
       Model |   909526542     3   303175514           Prob > F      =  0.0000
    Residual |   187741316    56  3352523.49           R-squared     =  0.8289
-------------+------------------------------           Adj R-squared =  0.8197
       Total |  1.0973e+09    59  18597760.3           Root MSE      =  1831.0

------------------------------------------------------------------------------
        fuel |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   3364.708   677.6253     4.97   0.000     2007.261    4722.154
```

```
        age2 |  -380.1607   94.76272    -4.01   0.000   -569.9933   -190.3282
      income |   124.6362   8.229687    15.14   0.000    108.1501    141.1222
       _cons |   6156.371   1130.347     5.45   0.000    3892.014    8420.728
------------------------------------------------------------------------------
```

FURNITURE

```
. reg furnit age age2 income, robust

Regression with robust standard errors                 Number of obs =      60
                                                       F(  3,    56) =   65.45
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.7952
                                                       Root MSE      =  1913.0

------------------------------------------------------------------------------
             |               Robust
      furnit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   1501.346   730.0694     2.06   0.044    38.84134    2963.851
        age2 |  -148.6911   117.2261    -1.27   0.210   -383.5231    86.14097
      income |   123.1354   9.547059    12.90   0.000    104.0103    142.2604
       _cons |   730.7256   1043.794     0.70   0.487   -1360.245    2821.697
------------------------------------------------------------------------------
```

CLOTHING

```
. reg clothing age age2 income, robust

Regression with robust standard errors                 Number of obs =      60
                                                       F(  3,    56) =   98.50
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.6692
                                                       Root MSE      =  7015.6

------------------------------------------------------------------------------
             |               Robust
    clothing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -3303.349    3636.02    -0.91   0.368   -10587.17    3980.473
        age2 |   429.7107   467.5691     0.92   0.362   -506.9428    1366.364
      income |   333.0736   40.75094     8.17   0.000    251.4397    414.7076
       _cons |    4302.01   4759.186     0.90   0.370   -5231.785    13835.81
------------------------------------------------------------------------------
```

MEDICAL CARE

```
. reg medic age age2 income, robust

Regression with robust standard errors                 Number of obs =      60
                                                       F(  3,    56) =   40.95
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.7134
                                                       Root MSE      =  2334.7

------------------------------------------------------------------------------
             |               Robust
       medic |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |  -3738.783   1070.674    -3.49   0.001   -5883.601   -1593.965
        age2 |   512.8196   142.7443     3.59   0.001    226.8685    798.7707
      income |   115.2737   11.42903    10.09   0.000    92.37864    138.1688
       _cons |   10514.35   1582.034     6.65   0.000    7345.159    13683.55
------------------------------------------------------------------------------
```

TRANSPORTATION

```
. reg transp age age2 income, robust

Regression with robust standard errors                 Number of obs =      60
                                                       F(  3,    56) =   25.52
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.3795
                                                       Root MSE      =   29307

------------------------------------------------------------------------------
```

transp	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
age	-12204.93	16617.47	-0.73	0.466	-45493.71	21083.86
age2	987.8232	1953.536	0.51	0.615	-2925.579	4901.226
income	698.6341	197.6897	3.53	0.001	302.6141	1094.654
_cons	33015.45	22060.04	1.50	0.140	-11176.13	77207.03

EDUCATION

. reg educ age age2 income, robust

Regression with robust standard errors Number of obs = 57
F(3, 53) = 23.29
Prob > F = 0.0000
R-squared = 0.6578
Root MSE = 7557.1

educ	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
age	20514.46	2702.882	7.59	0.000	15093.17	25935.76
age2	-3144.17	398.322	-7.89	0.000	-3943.103	-2345.237
income	243.7387	40.30335	6.05	0.000	162.9004	324.577
_cons	-25467.89	4637.859	-5.49	0.000	-34770.26	-16165.52

READING

. reg read age age2 income, robust

Regression with robust standard errors Number of obs = 60
F(3, 56) = 76.90
Prob > F = 0.0000
R-squared = 0.7109
Root MSE = 11714

read	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
age	-7342.816	6575.969	-1.12	0.269	-20516.06	5830.433
age2	882.5125	775.3725	1.14	0.260	-670.7452	2435.77
income	609.0838	75.72576	8.04	0.000	457.3869	760.7808
_cons	11302.24	9130.514	1.24	0.221	-6988.379	29592.86

OTHER

. reg other age age2 income, robust

Regression with robust standard errors Number of obs = 60
F(3, 56) = 52.05
Prob > F = 0.0000
R-squared = 0.7458
Root MSE = 26505

other	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf. Interval]	
age	21682.29	12207.56	1.78	0.081	-2772.401	46136.98
age2	-2717.584	1557.6	-1.74	0.087	-5837.831	402.6632
income	1500.205	163.1849	9.19	0.000	1173.306	1827.103
_cons	-35791.96	17548.36	-2.04	0.046	-70945.55	-638.3707

NON-CONSUMPTION

. reg non_cons age age2 income, robust

Regression with robust standard errors Number of obs = 60
F(3, 56) = 54.99
Prob > F = 0.0000

R-squared = 0.8270
Root MSE = 24383

non_cons	Robust Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
age	38152.54	9936.282	3.84	0.000	18247.77	58057.3
age2	-5891.116	1407.522	-4.19	0.000	-8710.721	-3071.511
income	1708.611	148.1043	11.54	0.000	1411.922	2005.299
_cons	-63485.27	16293.88	-3.90	0.000	-96125.84	-30844.7

. vif

Variable	VIF	1/VIF
age	23.97	0.041721
age2	23.97	0.041721
income	1.00	1.000000
Mean VIF	16.31	

TABLE 18

OVERALL

. reg overall children level income, robust

Regression with robust standard errors Number of obs = 138
F(3, 134) = 191.60
Prob > F = 0.0000
R-squared = 0.8163
Root MSE = 57561

overall	Robust Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
children	7962.813	6312.441	1.26	0.209	-4522.095	20447.72
level	171.8814	32.99854	5.21	0.000	106.616	237.1467
income	4221.751	183.3525	23.03	0.000	3859.112	4584.39
_cons	61555.61	18314.29	3.36	0.001	25333.13	97778.09

FOOD

. reg food children level income

Source	SS	df	MS	
				Number of obs = 138
				F(3, 134) = 192.09
Model	5.3476e+10	3	1.7825e+10	Prob > F = 0.0000
Residual	1.2435e+10	134	92794781.9	R-squared = 0.8113
				Adj R-squared = 0.8071
Total	6.5910e+10	137	481095946	Root MSE = 9633.0

food	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
children	9187.397	1016.38	9.04	0.000	7177.175	11197.62
level	38.58507	5.795446	6.66	0.000	27.12269	50.04746
income	620.6672	30.1769	20.57	0.000	560.9825	680.3518
_cons	19928.42	3170.954	6.28	0.000	13656.83	26200.01

HOUSING

. reg housing children level income

Source	SS	df	MS	
				Number of obs = 138
				F(3, 134) = 9.94
Model	3.4346e+09	3	1.1449e+09	Prob > F = 0.0000
Residual	1.5437e+10	134	115204534	R-squared = 0.1820

```
-------------+------------------------------           Adj R-squared =  0.1637
       Total |  1.8872e+10   137   137751746           Root MSE      =  10733

------------------------------------------------------------------------------
     housing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    children |   -101.042   1132.476    -0.09   0.929    -2340.882    2138.798
       level |   -35.1802   6.457432    -5.45   0.000    -47.95188   -22.40853
      income |   23.14982   33.62387     0.69   0.492    -43.35233    89.65197
       _cons |   31132.69   3533.157     8.81   0.000     24144.72    38120.66
------------------------------------------------------------------------------
```

FUEL

```
. reg fuel children level income

      Source |       SS       df       MS              Number of obs =     138
-------------+------------------------------           F(  3,   134) =   85.83
       Model |  1.2940e+09     3   431347908           Prob > F      =  0.0000
    Residual |   673429535   134  5025593.54           R-squared     =  0.6577
-------------+------------------------------           Adj R-squared =  0.6501
       Total |  1.9675e+09   137  14361118.7           Root MSE      =  2241.8

------------------------------------------------------------------------------
        fuel |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    children |   1905.858   236.5309     8.06   0.000     1438.041    2373.675
       level |   12.51027   1.348711     9.28   0.000      9.84276    15.17779
      income |   65.98612    7.02274     9.40   0.000     52.09636    79.87587
       _cons |   9546.792   737.9413    12.94   0.000     8087.273    11006.31
------------------------------------------------------------------------------
```

FURNITURE

```
. reg furnit children level income, robust

Regression with robust standard errors                 Number of obs =     138
                                                       F(  3,   134) =   31.38
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.4619
                                                       Root MSE      =  3642.8

------------------------------------------------------------------------------
             |               Robust
      furnit |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    children |   -237.004   317.0967    -0.75   0.456    -864.1661     390.158
       level |   2.233849   1.598964     1.40   0.165    -.9286227     5.39632
      income |   120.4733   14.28669     8.43   0.000     92.21676    148.7299
       _cons |   3699.113   1035.608     3.57   0.000     1650.862    5747.365
------------------------------------------------------------------------------
```

CLOTHING

```
. reg clothing children level income, robust

Regression with robust standard errors                 Number of obs =     138
                                                       F(  3,   134) =  175.65
                                                       Prob > F      =  0.0000
                                                       R-squared     =  0.8575
                                                       Root MSE      =  3436.9

------------------------------------------------------------------------------
             |               Robust
    clothing |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    children |  -831.8619   363.0933    -2.29   0.024    -1549.997   -113.7266
       level |   -5.19541   2.037406    -2.55   0.012    -9.225044   -1.165775
      income |   304.7768   13.40835    22.73   0.000     278.2575    331.2962
       _cons |   2944.686   1130.203     2.61   0.010     709.3421    5180.031
------------------------------------------------------------------------------
```

MEDICAL CARE

```
. reg medic children level income
```

Source	SS	df	MS		
				Number of obs =	138
				F(3, 134) =	17.43
Model	675583908	3	225194636	Prob > F =	0.0000
Residual	1.7315e+09	134	12921894.2	R-squared =	0.2807
				Adj R-squared =	0.2646
Total	2.4071e+09	137	17570202.4	Root MSE =	3594.7

medic	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
children	572.4554	379.2776	1.51	0.134	-177.6896	1322.6
level	-9.596638	2.16266	-4.44	0.000	-13.874	-5.319274
income	65.79839	11.26097	5.84	0.000	43.52615	88.07064
_cons	8906.002	1183.29	7.53	0.000	6565.661	11246.34

TRANSPORTATION

. reg transp children level income, robust

Regression with robust standard errors — Number of obs = 138
F(3, 134) = 40.10
Prob > F = 0.0000
R-squared = 0.4334
Root MSE = 14902

transp	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
children	1316.764	1757.538	0.75	0.455	-2159.341	4792.868
level	20.17403	10.33672	1.95	0.053	-.2701937	40.61826
income	449.7743	60.27957	7.46	0.000	330.5519	568.9968
_cons	11779.26	4505.085	2.61	0.010	2868.984	20689.53

EDUCATION

. reg educ children level income, robust

Regression with robust standard errors — Number of obs = 135
F(3, 131) = 12.29
Prob > F = 0.0000
R-squared = 0.2703
Root MSE = 37592

educ	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
children	12940.61	3906.446	3.31	0.001	5212.731	20668.49
level	83.4779	21.75108	3.84	0.000	40.44908	126.5067
income	544.5716	122.1927	4.46	0.000	302.8452	786.2979
_cons	-39470.79	11640.38	-3.39	0.001	-62498.25	-16443.33

READING

. reg read children level income, robust

Regression with robust standard errors — Number of obs = 138
F(3, 134) = 95.91
Prob > F = 0.0000
R-squared = 0.6504
Root MSE = 12276

read	Coef.	Robust Std. Err.	t	P>|t|	[95% Conf.	Interval]
children	819.8321	824.8185	0.99	0.322	-811.5151	2451.179
level	-29.4431	10.14498	-2.90	0.004	-49.5081	-9.378096
income	596.8813	58.99029	10.12	0.000	480.2087	713.5538
_cons	4735.709	2389.274	1.98	0.050	10.14082	9461.277

OTHER

```
. reg other children level income, robust

Regression with robust standard errors               Number of obs =     138
                                                      F(  3,   134) =  100.38
                                                      Prob > F      =  0.0000
                                                      R-squared     =  0.7707
                                                      Root MSE      =   24284

------------------------------------------------------------------------------
             |               Robust
       other |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    children |  -18128.44    2803.47    -6.47   0.000    -23673.22   -12583.67
       level |   100.7372      12.68     7.94   0.000     75.65838     125.816
      income |   1392.624   91.47012    15.22   0.000     1211.712    1573.536
       _cons |   10166.47   7091.092     1.43   0.154    -3858.471    24191.42
------------------------------------------------------------------------------
```

NON-CONSUMPTION

```
. reg non_cons children level income, robust

Regression with robust standard errors               Number of obs =     138
                                                      F(  3,   134) =  168.00
                                                      Prob > F      =  0.0000
                                                      R-squared     =  0.8647
                                                      Root MSE      =   23644

------------------------------------------------------------------------------
             |               Robust
    non_cons |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    children |  -4596.395   2490.715    -1.85   0.067    -9522.595    329.8041
       level |   10.29091   13.00911     0.79   0.430    -15.43885    36.02067
      income |   2153.589   99.66076    21.61   0.000     1956.477    2350.701
       _cons |  -21633.67    7732.84    -2.80   0.006    -36927.88   -6339.466
------------------------------------------------------------------------------
```