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Investigating the Impact of Aggregate Household Wealth Changes: Permanent Versus Transitory Wealth Effects on Consumption and Taxable Income

A Dissertation
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Markland Howard Tuttle
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Dedication

This dissertation is dedicated to my wife and my parents. Their faith, dedication, encouragement, and love made it all possible,

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Abstract

This dissertation examines the permanent and transitory effects of aggregate wealth changes on aggregate consumption and the distribution of taxable income, while controlling for other important macroeconomic factors. In the three essays presented, the first investigates the relationship between consumption, wealth, and disposable income. In addition, the relationship between the disaggregated components of consumption (non-durable, durable, and services consumption), wealth, and disposable income is explored. Through the use of cointegration techniques and Vector Error-Correction Models, the permanent and transitory responses of *all* series are investigated. The findings suggest that aggregate consumption, wealth, and disposable income are endogenous in the long run. Therefore, all three series permanently adjust to changes in any one of these series. Once consumption is disaggregated, non-durable consumption and durable consumption are endogenous. Structural breaks are found in the long run relationships, but results are robust with the inclusion of these breaks.

The second essay disaggregates wealth into assets and liabilities. The permanent and transitory impacts of asset and liabilities changes on consumption are examined. Results demonstrate that disaggregating wealth has no impact on the long run endogeneity of aggregate consumption. Further, assets are endogenous, responding to changes in consumption, disposable income, and assets in the long run.

The final essay examines the role of wealth in determining the distribution of taxable income. In particular, changes in the share of Adjusted Gross Income reported by the top 0.5 percent of households (AGI Share) are investigated. Wealth is a significant contributor to permanent changes in the AGI share, with increases in wealth having a

positive effect on the share of income held by households in the top 0.5 percent of the AGI distribution. Further, the capital gains tax and the top marginal income tax rate have a permanent negative effect on the AGI share. Further, ninety-five the ninety-seven percent of these permanent changes occur within two years. In addition, wealth and the capital gains tax rate create transitory changes in the AGI share.

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Introduction

This dissertation looks at the role of wealth in the macroeconomy, and how households in the aggregate respond to wealth changes. Total nominal aggregate household wealth at the end of 2001 equaled 41 trillion dollars, which is just over four times the size of nominal GDP for that year. In terms of household income, household wealth was five-and-one-half times larger that same year. This amassed wealth represents a possibly important resource for households. Given this, a change in aggregate household wealth has the potential to have substantial impacts on the macro economy. Two potential areas where wealth can have important consequences are the purchases of goods and services by households and the distribution of taxable income. The first two essays study the effect of wealth changes on total consumption and the disaggregated components of aggregate consumption in the U.S. The third essay examines wealth's role in affecting the division of Adjusted Gross Income between the wealthy and all remaining households.

The first essay addresses the recent debate concerning the effect of wealth changes on consumption. Recent research supports the classic notion that changes in aggregate wealth create permanent changes in consumption. In this research, it is estimated that a one dollar increase in wealth permanently creates four cents in new consumption in the long run. The direction of causality is unidirectional; a change in consumption has no impact on wealth in the short run or long run. Contrary to these findings, some current researchers fail to find a permanent change in consumption from changes in wealth. Aggregate wealth changes have only a transitory effect on

consumption. In fact, aggregate consumption permanently impacts wealth. This inconsistency of results warrants further investigation into the relationship between wealth and consumption.

The first essay contributes to the literature by studying the long run and short run relationships between consumption and wealth. This relationship is considered for aggregate consumption and also for the disaggregated components of consumption from the National Income and Product Accounts. These components include non-durable consumption, durable consumption, and services consumption. This essay estimates the permanent and transitory effects of wealth on aggregate household spending using these measures of aggregate consumption.

The second essay investigates the importance of assets and liabilities for the relationships found in the first essay. In balance sheet accounting, an equal change in assets and liabilities has the same impact on real wealth, in absolute value. Yet, the second essay recognizes that an equal change in assets and liabilities may not have equivalent impacts on consumption in absolute value. Changes in assets and liabilities may have different permanent and transitory effects on household consumption. In addition, if consumption changes create permanent adjustments in wealth, the second essay identifies whether both assets and liabilities are permanently affected, and how these effects differ.

The first two essays examine the aggregate behavior of consumption from changes in wealth and the components of wealth, i.e. assets and liabilities. Therefore, these two essays offer evidence concerning the recent debate on the effects of wealth changes on consumption. It also illustrates the relative importance of assets versus

liabilities. The third essay moves away from the behavior of aggregate consumption, and turns to the influence of wealth on the reporting of taxable income.

This final essay analyzes the role of wealth in determining the permanent and transitory movements in the share of total Adjusted Gross Income reported by 'ultra-rich' households. 'Ultra-Rich' households are defined as those that are in the upper 0.5 percent of the AGI distribution (the AGI share). Wealth represents an important income-generating resource for this small group of tax filers, and changes in wealth can have important impacts on the AGI and tax payments distributions. In addition to wealth, the role of the top marginal income tax rate and top capital gains tax rate in influencing the AGI share is also estimated. In addition, this essay analyzes the issue of permanent versus transitory responses of this AGI share from changes in the top capital gains and top marginal income tax rates.

The three essays contained in this dissertation employ time-series econometric methods. As is common in macroeconomic research, the methods use a non-structural modeling approach. The focus here is to identify the key relationships among the variables over time, rather than impose and test a specific structural model. Further, these techniques permit the endogenous response of all variables. More importantly, they enable the examination of permanent and transitory responses of *all* variables in the empirical specification. Use of these methods enables the attainment of this dissertation's objective – contributing to the current literature by examining the permanent and transitory responses of household consumption and the distribution of taxable income to aggregate wealth changes.

Essay One

Aggregate Wealth and Consumption: New Evidence on Wealth Effects

Introduction

The large growth in equities and housing prices in the late 1990s accounted for the large growth in total wealth. At the same time, domestic output experienced substantial growth, eclipsing recent historical rates of growth in GDP. Expanding consumption fueled a significant portion of this. A long tradition of research posits a link between wealth and consumption - the "wealth effect." The empirical research dates back to Ando and Modigliani (1963), and posits that increases in wealth may create changes in consumption beyond the effect of disposable income. The most recent estimates of the relationship between wealth and consumption, the wealth effect, is that a one-dollar increase in household wealth permanently creates approximately four cents of new consumption spending (Davis and Palumbo, 2001 or Mehra, 2001). Conversely, recent research by Ludvigson and Steindel (1999) discover a wealth effect on consumption that is, at best, temporary.

This raises the timely question – to what extent was the robust increase in consumption experienced in the 1990's attributable to the large growth of household wealth over this same period? The average change in real wealth between 1995:1 and 1999:4 was 5.8 times higher than between 1952:2 and 1994:4. Over this same period, real consumption grew at an average rate that was 2.3 times higher than between 1952:2 and 1994:4. Since consumption constitutes, on average, two-thirds of total output, large increases in wealth that lead to increases in consumption can produce large changes in total output. For example, Poterba (2000) notes that as much as two to three percent of

GDP growth in 1999 could be due to the rise in household wealth during the previous four years.

Beginning in late 2000, some worried about a "reverse" wealth effect, and the possible drag it may create on total output. Equity prices started falling during the second quarter of 2000. Housing prices continue to increase, but the declines in equity values were significant enough to decrease aggregate wealth. Indeed, from the second quarter through the fourth quarter of 2001, aggregate output decreased, supporting the notion that declines in total wealth may have a negative impact on total output.

This essay focuses on the some of the more recent empirical investigations of the wealth effect. For purposes of exposition in this essay, the two competing lines of thought are termed as "Endogenous Consumption" and "Endogenous Wealth" papers. Both groups start with the basic Life-Cycle/Permanent Income Hypothesis (LCPIH), but the conclusions of these two lines of research are juxtaposed to one another. The Endogenous Consumption research empirically estimates a long run wealth effect in consumption, or that consumption is endogenous. This endogeneity of consumption leads to the conclusion that a one dollar change in wealth *permanently* increases consumption by almost four cents in the long run. Conversely, Endogenous Wealth papers empirically find no long run wealth effect on consumption; it is *wealth* that permanently responds to changes in consumption. Therefore they find that it is wealth that is endogenous in the long run. In this view, increases in wealth induce only short-run, or temporary, increases in aggregate consumption. The conclusions of these two bodies of research, concerning the long run evolution of consumption, contradict each

other. This research assesses the impact that wealth has on consumption, paying particular attention to this ongoing debate.

Literature Review

Some of the earliest empirical findings of a wealth effect date back to the seminal research of Ando and Modigliani (1963). Their work develops the Life-Cycle model where disposable income and wealth are important determinants of consumption. They empirically estimate a marginal propensity to consume from wealth between 0.036 and 0.089, while controlling for the effects of household income. Their findings have proven robust, being observed in multiple studies across various time frames. For example, Davis and Palumbo (2001) provide more recent estimates of the wealth effect, using current time series techniques. Their estimated marginal propensity to consume from wealth is 3.9 cents per dollar of wealth created. Empirical evidence regarding wealth effects on consumption is robust across international borders. In a study by Brodin and Nymoen (1992), the authors find significant wealth effects in Norwegian consumption, with a wealth elasticity estimate of 0.27 for overall consumption.[1] Further, an analysis by Horioka (1996) and another by Ogawa, Kitasaka, Yamaoka, and Iwata (1996) look at the consumption behavior of Japanese households. Both find similar wealth effects. Horioka estimates a marginal propensity to consume (MPC) from wealth between 0.016 and 0.041. Ogawa, Kitasaka, and Yamaoka find a MPC from changes in liquid wealth of 0.048.

[1] Their income elasticity estimate ranges between 0.54 and 0.55. Also, this wealth elasticity measure is relatively robust to those found using U.S. data. Ludvigson and Steindel (1999) estimate an elasticity of 0.29 and Lettau and Ludvigson (2003) estimate an elasticity of 0.30. Ludvigson and Steindel (1999) estimate a MPC out of wealth of 0.046.

Moving beyond the effects of total wealth on aggregate consumption, recent research has hinted at differences in wealth effects across different components of consumption. Ruiter and Smant (1999) estimate the elasticity of durable consumption with respect to wealth of 0.36 to 0.46 in the Netherlands, which is substantially larger than the wealth effect on total consumption. Patterson (1985), adjusting for household durables, uncovers significant wealth effects in consumption less durables. Further, using a Vector Autoregression (VAR) and a Vector Error Correction Model (VECM), Ludvigson and Steindel (1999) note the timing of wealth effects. They find that wealth effects on durables consumption and non-durable plus services consumption occur within a few quarters of an exogenous shock to wealth.

Davis and Palumbo (2001) and Mehra (2001) are the two most recent papers that fall under the Endogenous Consumption category. They estimate that changes in wealth permanently induce more consumption in the long run, and the full effect of changes in wealth on consumption is felt after several quarters, or even years. These two papers demonstrate that a one dollar increase in wealth creates approximately almost four cents in new consumption, and two-thirds to nine-tenths of this effect occurs after two years. They also estimate an elasticity of consumption with respect to wealth of 0.19. The conclusion of their research supports the traditional notion of the wealth effect - that changes in wealth lead to substantial permanent changes in aggregate consumption.

The Endogenous Wealth literature includes the work of Ludvigson and Steindel (1999), Lettau and Ludvigson (2003), and Lettau, Ludvgison, and Barczi (2001). They estimate parameter values in the long run relationship between wealth and consumption that are similar to those of the Endogenous Consumption research. The conclusion of the

Endogenous Wealth literature contradicts that of the Endogenous Consumption literature, however. Their findings suggest that consumption and disposable income are exogenous in the long run. Therefore, the traditional wealth effect does not exist. In contrast to Davis and Palumbo, it is wealth that adjusts in the long run to changes in consumption, disposable income, and wealth, not consumption. Therefore, any changes in wealth have only temporary, short run effects on consumption.[2]

Given this recent evidence, the current literature has found inconclusive results concerning the speed and pattern of long run adjustment of consumption to changes in wealth. One possible reason for these differing results may be that Davis and Palumbo (2001) and Mehra (2001) use aggregate consumption in their paper, while Ludvigson and Steindel and Lettau and Ludvigson use non-durables plus services. Therefore, the different results may be caused by the measure of consumption utilized. Consequently, investigation of the effects of wealth on all forms of consumption is warranted.

Another possible reason for the different conclusions, as noted by the Endogenous Wealth research, is the use of single-equation error-correction techniques by Davis and Palumbo. The single-equation method implicitly assumes that consumption only responds to changes in wealth or disposable income in the long run. The possibility does exist that wealth (as is shown by the Endogenous Wealth literature) and personal income also respond to changes in any of the three variables in the system too. Therefore, Endogenous Wealth authors suggest a multivariate approach is warranted when investigating the relationship between consumption, wealth, and disposable income.

[2] The Endogenous Wealth literature also finds that changes in wealth have a temporary impact on disposable income.

Theoretical Background

The Endogenous Consumption and Endogenous Wealth literatures use the Life-Cycle/Permanent Income Hypothesis (LCPIH) as the foundation for their empirical investigations of aggregate consumption behavior. These two lines of research employ non-structural approaches to their empirical investigations. However, as Ludvigson, Steindel, and Lettau (2002) note, empirically imposing structure in aggregate econometric models creates numerous problems, the most notable of which are those of Lucas (1976). Their empirical methods are non-structural and avoid the Lucas Critique, but the LCPIH serves to guide their analysis.

The LCPIH is based upon utility-maximizing behavior of households, who seek to smooth consumption over their respective lifetimes. In the utility-maximizing framework of the LCPIH, households seek to maximize lifetime welfare (W). Households increase lifetime welfare through consumption, given by c_t; future consumption is discounted for the rate of time preference, θ, which is assumed constant. The estimated remaining lifespan of the household is T time periods. In Equation (1.1), consumption is separable between periods, therefore, utility and the marginal utility from consumption in any time period are independent across the periods.[3]

$$W = \sum_{t=0}^{T} \frac{u(c_t)}{(1+\theta)^t} \tag{1.1}$$

Households face a lifetime budget constraint, which represents the total resources available over the remaining T periods in their lifespan. The total present value of

[3] This is a common assumption in the LCPIH. See Fisher (1930), Branson (1989), Hall (1978), or Romer (1996) for more details. Later theoretical investigations relax this assumption, which are addressed following the LCPIH discussion.

consumption must equal total discounted lifetime income and the current value of assets or wealth. Income earned at time t is denoted by y_t, and the current value of total wealth or assets is given by w_0. Future income and consumption are discounted by some discount rate r, which is assumed constant. Thus, the lifetime budget constraint is given by:

$$\sum_{t=0}^{T} \frac{c_t}{(1+r)^t} = w_0 + \sum_{t=0}^{T} \frac{y_t}{(1+r)^t} \tag{1.2}$$

Maximization of (1.1) with respect to (1.2) solves the basic household problem. In the LCPIH, households smooth consumption over their respective lifetimes, adjusting consumption to permanent shocks in their resources. Specifically, consumption depends on the present value of future income, current assets or wealth, rate of time preference, and the discount rate. Current consumption is positively related to beginning of period wealth, disposable income, and the rate of time preference, and negatively related to the discount rate. In general notation, current household consumption is given by Equation (1.3).

$$c_t = \Omega_t \nu_t \tag{1.3}$$

Here, c_t is consumption in time period t, ν_t is the present value of future resources, and Ω_t is the discount factor based upon the household's rate of time preference. Specifically:

$$\nu_t = w_0 + \sum_{t=0}^{T} \frac{y_t}{(1+r)^t} \tag{1.3a}$$

Household resources can be further developed, since current income, y_0, is known. A common assumption is that households expect future income to grow

proportionately to current income by a factor β over the future *T-1* time periods, so the total proportionate future growth is denoted by $\beta(T-1)$. Using this, Equation (1.3a) becomes:

$$v_t = w_0 + y_0 + \beta(T-1)y_0 = w_0 + [1+\beta(T-1)]y_0 \tag{1.3b}$$

Substituting Equation (1.3b) into Equation (1.3), produces a restatement of the consumption function, Equation (1.4). It is important to note that Equation (1.4) represents the long run relationship between consumption, disposable income, and wealth. In Equation (1.4), current period consumption depends positively on current period personal income and beginning of period wealth, with marginal propensities to consume out of income and wealth of α_0 and α_1, respectively.[4]

$$\begin{gathered} c_t = \Omega_t[1+\beta(T-1)]y_0 + \Omega_t w_0, \text{ or} \\ c_t = \alpha_0 y_t + \alpha_1 w_{t-1} \end{gathered} \tag{1.4}$$

Households in the LCPIH plan consumption based upon Equation (1.4). However, actual current consumption ($\hat{c}_t$) may differ from planned consumption. Changes in current income or wealth induce changes in consumption, but households may not fully, or immediately, respond. The difference between current consumption and planned consumption is the amount of disequilibrium that exists, given by Equation (1.5). This framework lends itself nicely to current time-series econometric techniques. Equation (1.5) can be empirically estimated using cointegration techniques. Also, the short run, immediate impacts from changes in consumption, disposable income, wealth, or any disequilibrium that exists can be estimated using error-correction models.

[4] This is due to the stock nature of wealth. Beginning of period wealth at time t is the same as end of period wealth at time t-1.

$$\hat{c}_t - c_t = \varepsilon_t \tag{1.5}$$

Carroll (2001) notes that, following the establishment of the LCPIH model, empirical researchers using micro-level data failed to confirm some of its conclusions. He notes that these empirical investigations find that "households simply spent all of their current income." These investigations assumed certainty equivalence. In his empirical work, he includes income uncertainty into the LCPIH to better describe the behavior of moderately impatient consumers.

Carroll's empirical evidence provides one possible reason for endogenous wealth findings. He suggests households engage in buffer-stock, or precautionary savings, due to income uncertainty. Therefore wealth and consumption are positively related. The higher the income uncertainty, the greater the buffer-stock savings needed to insure against this uncertainty. Therefore, a change in income itself creates a permanent change in wealth through this buffer-stock savings.

Further, he suggests that there should be a long run tradeoff between wealth and consumption. Households hold an amount of wealth, or targeted wealth, that is proportional to permanent income. If a shock to savings occurs, increasing the ratio of wealth-to-permanent-income, households consume more using this extra wealth. Therefore, wealth and consumption should, at the very least share some short run relationship.

Another area of recent research eases the time-separability assumption under the LCPIH. When households consume goods, their total consumption this period may have important impacts in later periods. In the theoretical literature, if the utility from consumption in any one period is dependent upon a stock of consumption in any previous

period, the household is said to exhibit "habits" in consumption. With the inclusion of habits, households derive their utility from the excess of current consumption minus the previous stock of habits, eliminating the separability assumption.

There are several theoretical investigations in recent years into the behavior of households when habits exist. This essay focuses on the theoretical investigations that use habits to explain the behavior of consumption only.[5] The Alessie and Lusardi (1997) investigation into habits finds that consumption depends on lifetime resources of the household, as with the LCPIH. Not surprisingly, once habits are introduced in the household's utility, consumption also depends on previous consumption. In addition, when habits are non-existent, household savings is determined by future expected income only. With the inclusion of habits, the household's savings decisions are conditional on previous savings and current income changes as well.

In the same paper, Alessie and Lusardi introduce income uncertainty into the household's consumption decision. The household's consumption decision with habits and income uncertainty is similar to the decision excluding income uncertainty. This general form of consumption is given in Equation (1.6). Household consumption, C_t, is a function of previous consumption, permanent income, Y_{pt}, and some risk premium, Γ_{j-1}. In Equation (1.6), r is the real interest rate, $\psi^* w_j$ is the discounted present value of expected future income innovations, and γ is the degree of habit persistence. If $\gamma = 0$, there is no habit formation, and if $\gamma = 1$ there is permanent habit persistence. Note that the risk premium is increasing in income uncertainty and decreasing in habit persistence.

[5] Deaton (1992) discusses several theoretical models of consumption including habit formation.

Thus, more income uncertainty reduces current consumption, but an increase in the degree of habit persistence reduces the influence of the risk premium on consumption.

$$C_t = \theta C_{t-1} + (1-\theta)Y_{pt} - \frac{r\theta}{\gamma}\sum_{\tau=t+1}^{\infty}\left(\frac{\theta}{\gamma}\right)^{t-\tau}\sum_{j=t+1}^{\tau}\Gamma_{j-1}[\underset{(-)}{\gamma}, \underset{(+)}{\psi} * w_j]$$

$$\theta = \frac{\gamma}{(1+r)} \tag{1.6}$$

The influence of habits and income uncertainty on savings is similar. The risk premium has a positive influence on household savings. This greater future income uncertainty creates an increase in current savings, since current savings may be needed to fund greater amounts of future consumption, if future income falls. Naturally household consumption and savings move in opposite directions, so an increase in habit persistence affects savings negatively through the risk premium.

Although Alessie and Lusardi provide great insights into the behavior of consumption under income uncertainty with habit formation, household income is exogenous. Secklin (2001) introduces the household's labor decision with habit formation, and the consumption decision is made under the condition of wage uncertainty. Secklin's findings suggest that wage uncertainty and habit formation limit the size of current period substitution between consumption and leisure. When the persistence of habits increases, the intra-period marginal rate of substitution between consumption and leisure increases. In addition, households are less likely to substitute between current and future leisure than in a world without consumption habits.

Lupton (2001) also looks at the role of habits in the household's savings decision in the Life-Cycle consumption model. In particular, how do habits affect the choice

between risky assets and assets with less risk? Households with greater habits will choose to purchase less risky assets, and larger habits also reduce the MPC out of wealth. Previous consumption creates a "habit liability" that reduces net wealth into effective wealth. Once we reduce net wealth to effective wealth, the behavior of habit-forming and non-habit forming households are nearly equal.

Finally, Smith (2002) examines the impact of durability and habits on consumption. The nature of durability mitigates the impact of habits on household consumption. As with Alessie and Lusardi, consumption is increasing in household wealth and income and decreasing in the income risk premium. The addition of durability has a negative impact on current consumption.

One theme is apparent in the theoretical investigations into household consumption. Household consumption depends upon current income, future income, and wealth. Adding income uncertainty does not change this result, but alters it by adding a risk premium to current consumption. In addition, the inclusion of habits reduces the impact of changes in income and wealth on consumption. However, the basic tenets of the LCPIH hold – household consumption is positively related to changes in income and wealth over long periods of time.

Contribution

This essay contributes to the current literature by spanning the gap between the Endogenous Consumption and Endogenous Wealth research. The methods employed in this essay address the criticisms of the Endogenous Wealth research directed at the Endogenous Consumption papers. The results of this study provide greater insights into

the long run and short run evolution of consumption, wealth, and disposable income. To properly address the difference between the measures of consumption used between the Endogenous Consumption and Endogenous Wealth research, wealth effects on aggregate consumption and also on disaggregated consumption are evaluated. Further, this essay extends the literature by examining whether substitution effects exist in the long run relationship. Finally, this essay also evaluates potential structural breaks in the long run relationship.

Specifically, this essay investigates the behavior of aggregate consumption and each of the disaggregated components of consumption (or "consumption categories"). These disaggregated components include non-durable consumption, services consumption, and durable consumption. The Endogenous Wealth literature criticizes the use of aggregate consumption, due to the inclusion of durable consumption in that measure. They contend that durable consumption is adequately controlled for by its inclusion in wealth, and instead use a measure of consumption that is non-durable consumption plus services consumption. This essay investigates the long run and short run behavior of *all* consumption categories, and therefore is the least restrictive method. This study demonstrates that the inclusion of durable consumption in wealth is not a sufficient control for its behavior. In addition, the use of the non-durable plus services consumption measure places unsound restrictions on the cointegration, or long run, relationship. Procedures here allow for possible long run substitution effects across components of consumption. Findings establish that important substitution effects indeed do exist, and that the exclusion of these effects creates a large omitted variables bias in the disposable income and wealth parameters.

The Endogenous Wealth research routinely criticizes the Endogenous Consumption literature for using an empirical method that restricts the long run adjustment of wealth and disposable income to zero (as they demonstrate in their research). Therefore, this essay uses the same empirical methodology of the Endogenous Wealth literature. This methodology allows for the long run endogenous response of all variables in the long run, and this essay examines the long run and short run dynamics of *all* consumption categories. Thus, the methodology employed in this essay is the least restrictive. In fact, the methods are even less restrictive then the Endogenous Wealth literature. Procedures here allow for the long run adjustment of *all* consumption categories, wealth, and income in the long run relationship. As is typical with time-series econometrics (and these two competing lines of research), procedures here do not impose a particular structural model. By using the least restrictive methodology, these methods are less susceptible to a Lucas Critique argument (Lucas, 1976).[6]

Another contribution of this research is the inclusion of structural break tests in the cointegration, or long run relationships. Lettau and Ludvigson conduct such tests, but conclude that structural breaks do not exist. This essay employs a different procedure that simultaneously tests for cointegration and structural breaks. Results indicate possible structural breaks in the long run.

[6] Lucas (1976) notes that parameters from structural macroeconomic models may vary based upon policy rules. Using these structural system of equations can then result in parameter instability and suspect results.

Empirical Methods

Empirical Strategy

The procedures here use the same methodology as the Endogenous Wealth literature. Instead of using single-equation error-correction methods (which assumes consumption only responds to wealth or income shocks), a multivariate method is used. Yet, the empirical methods here are even less restrictive then the Endogenous Wealth literature by allowing for important substitution effects between consumption components. The findings demonstrate that the specification employed removes these inappropriate restrictions imposed by the Endogenous Wealth literature.

The overall goals of this essay are:

1. Determine if a long run relationship exists between measures of consumption, wealth, and disposable income, and for disaggregated consumption categories, wealth, and income.
2. Identify the long run differences in effects of wealth and disposable income for each consumption subcomponent.
3. Examine the timing and pattern of the aggregate response of each consumption measure to changes in wealth (i.e., determine if consumption is influenced by wealth in the short run only, or both the short run and long run).

Cointegration techniques provide the means to evaluate the long run response of each form of consumption to changes in wealth, and provide evidence for the first point. The results from cointegration estimations for all forms of consumption provide evidence on the second point. Finally, Vector Error-Correction Model (VECM) methodology provides evidence on the timing and short run/long run issues in point three.

As with any research that employs time-series data, care must be taken. Granger and Newbold (1974) identified the dangers of using such data, and noted that Ordinary Least Squares Regression (OLS) can create misleading results. Granger and Newbold introduce the concept of spurious regression by demonstrating that use of OLS with non-stationary time-series data can lead to the identification of relationships that do not exist. Thus, if any series contains a unit root (i.e. is non-stationary), the possibility of spurious regression exists. Therefore, the first step in the assessment is to identify the properties of each variable, and determine if any variable is non-stationary.

Next, the possible existence of a long run relationship must be evaluated. Variables integrated of the same order are cointegrated if their linear combination produces a variable of a lower order of integration. If the variables move together through time (are cointegrated), the possibility of a spurious result, as identified by Granger and Newbold, is eliminated. However, other problems arise, such as biased and inefficient results. The cointegration techniques developed recently, such as Johansen's test (Johansen, 1991) for cointegration and Dynamic OLS (DOLS) (Stock and Watson, 1993), correct for these problems.[7]

Data for the study span fifty years. Thus, there is a possibility of structural change over the sample period. To examine this possibility of structural breaks and test for cointegration at the same time, Gregory and Hansen's test (1996a, 1996b) is used. The Gregory-Hansen test recursively checks for structural breaks and for cointegration based upon the existence of said break. The least restrictive form of the test permits the

[7] The DOLS method is discussed further under the Structural Break Test section.

inclusion of a structural break in the constant and parameters. The long run relationship estimated using DOLS is then re-estimated with any possible breaks.

After the long run relationships are estimated, the empirical procedures then shift to focus on short run relationships and the long run endogeneity of all variables. Multi-equation Vector Error-Correction Models (VECM) are used to estimate the pattern of dynamic short run responses to changes in a measure of consumption, wealth, or disposable income. These VECM estimates provide evidence concerning the timing of wealth effects – whether consumption adjusts in the short run (within a few quarters) and/or over the long run to changes in a given variable. Further, the VECM methodology examines the duration of any consumption response to changes in wealth. If consumption responds in the short run only (i.e., is exogenous), the duration of any possible wealth effects are temporary. If consumption responds to changes in wealth in the long run (as in the Endogenous Consumption research), then changes in wealth have permanent effects on consumption. A statistically significant adjustment parameter signals the endogeneity of consumption, and the existence of long-term effects of wealth on consumption (the wealth effect). As in the Endogenous Wealth literature, the long run adjustment of consumption, wealth, and income are *all* possible in the VECM. A statistically significant adjustment parameter on a variable indicates a permanent effect on that variable from a change in any variable in the VECM. Attention turns next to data used in this empirical investigation of wealth effects.

Data Used

To empirically study wealth effects, data are needed for several key variables. They can be subcategorized into four groups: consumption variables, wealth, income, and

deflators. These series are collected for the fifty-year period, beginning in the first quarter of 1952 and extending through the second quarter of 2002.[8] All series are quarterly, and come from two sources. The income, consumption, and deflator series come from the Federal Reserve Bank of St. Louis's FRED®, and wealth is available from the Board of Governors of the Federal Reserve.[9]

The consumption series include aggregate consumption, non-durable consumption, services consumption, and durables consumption. The income series used here is real disposable personal income. All consumption and income variables are provided (in FRED) in real terms using 1996 dollars. In addition, the GDP deflator and civilian population were obtained from the St. Louis Federal Reserve. Civilian population is used to adjust consumption, income and wealth variables for population changes.

The wealth measure is obtained from *The Balance Sheet of the United States*.[10] Assets are broken into tangible assets and financial assets. Tangible assets include housing, such as owner-occupied, unoccupied secondary homes, homes for sale, and vacant property. Housing assets are included at market value. Other tangible assets, such as equipment and durable goods, are valued at replacement cost. Financial assets include equities, mutual funds, demand deposits and currency, bonds, and other securities.[11] These are also listed at current market value. Also under wealth, liabilities include

[8] This was the last available observation when this research began.
[9] FRED® data sources are the Bureau of Economic Analysis and the Bureau of Labor Statistics.
[10] *The Balance Sheet of the United States* includes the balance sheet for households and nonprofit organizations, non-financial corporate business, and non-farm non-corporate businesses. The balance sheet for households and nonprofit organizations is used by the Endogenous Wealth and Endogenous Consumption research and in this essay.
[11] Bonds include domestic corporate securities, corporate securities, and foreign securities.

mortgages and home equity loans, consumer credit, and bank loans, and other miscellaneous entries. Wealth is deflated by the GDP deflator into 1996 dollars and also adjusted for population changes. Further, following previous studies, these balance sheet variables are lagged one period, so that wealth, assets, or liabilities in any quarter represents the beginning of quarter values.[12] Given these data, attention turns to testing the stationarity of each series. The unit root tests, addressed in the next section, provide this necessary information.

Unit Root Tests

To test if any series are stationary in their respective levels, three unit root tests are utilized: the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981), the Phillips-Perron (PP) test (Phillips-Perron, 1988), and the KPSS test (Kwiatkowski, et. al., 1992).[13] Under the ADF and PP tests, the null hypothesis is the existence of a unit root, or non-stationary series. The null hypothesis in the KPSS test is one of stationarity. As Kwiatkowski, et. al. (1992) point out, the ADF and PP tests suffer from low power. In addition, using tests with differing null hypotheses provides better information about the properties of each series.

The basic structure of the ADF test is given by Equation (1.7), where the property of each series is considered separately. The ADF test adjusts the original Dickey-Fuller test by adding *k* lags of first differences of the series in question to control for serial correlation, since the underlying data generating process may be more complicated than an AR(1) process (Harris, 1995). The number of lagged first differences is determined by

[12] Descriptive Statistics are provided in Table A1.1, and the Correlation Matrix is in Table A 1.2. An example from the *Balance Sheet of the United States* is given in the Table A 1.3.
[13] Specifically, each series is tested using its non-log, dollar levels.

the Schwarz Information Criteria for each series. The null hypothesis under the ADF and PP tests is a unit root process, where the parameter estimate δ equals zero, and the test statistic is the associated t-statistic. Since y_t may be ~I(1), the normal critical values of the t-distribution no longer apply. MacKinnon (1991) provides the critical values for the ADF test.

$$\Delta y_t = \mu + \gamma t + \delta y_{t-1} + \sum_{1}^{k} \Delta y_{t-k} + \varepsilon_t \tag{1.7}$$

The PP test estimates Equation (1.7), omitting the lagged first difference terms. A nonparametric correction is used to account for higher-order serial correlation instead of adding lags of first differences, as in the ADF test. Specifically, the Newey-West (1988) procedure is used here to obtain a consistent long run variance estimate, which is used to adjust the t-statistic. As with the ADF test, MacKinnon critical values are used to test the null of a unit root.

The KPSS test differs from the previous two tests in that the null hypothesis is that the series is trend stationary. Under the KPSS test, each series can be decomposed into a deterministic trend and a random walk, by assumption:

$$y_t = \gamma t + r_t + \varepsilon_t \tag{1.8}$$

where r_t is a random walk,

$$r_t = r_{t-1} + u_t \tag{1.9}$$

In Equation (1.8), t is a deterministic trend, ε_t is assumed to be stationary, and u_t in Equation (1.9) is $\text{iid}(0, \sigma_u^2)$. Under the null hypothesis $\sigma_u^2 = 0$, and y_t is a stationary series. The critical values are provided by KPSS (Table 1, pg. 166). As with the ADF

and PP test, the KPSS test statistic depends on the lag truncation chosen. As Kwiatkowski, et. al. note, a lag truncation of four may result in large size distortions, while 12 may result in low power, making a lag truncation parameter of eight a "compromise" (1992, pg. 175). Therefore, the KPSS test employed here uses a lag truncation parameter of eight.

The results of all unit root tests are given in Tables 1.1a and 1.1b. In Table 1.1a, all variables are tested in levels. In all three tests, test results indicate each variable contains a unit root. From Table 1.1b, where each variable is measured in first differences, each series appears stationary. Thus, as is common with time-series data, all variables are integrated of order one, or contain a unit root. Therefore, estimating any equation with variables containing a unit root using OLS may produce spurious results. However, if the variables are cointegrated, as found in previous studies, the problem of spurious estimates is mitigated. The next section examines the long run, or cointegration relationship of the variables.

Cointegration Tests

As Granger and Newbold (1974) noted, estimation via OLS of relationships between cointegrated variables does not produce spurious results, since they are bound together through time. However, results can be biased and inefficient. The Johansen test for cointegration (Johansen, 1991) provides a correction for these problems. The Johansen test serves as the primary test for cointegration. As a secondary test, Gregory and Hansen's (1996a, 1996b) test for cointegration in the presence of a structural break, is utilized. Gregory and Hansen (1996a, 1996b) support this strategy of pre-testing for cointegration.

Table 1.1a
Unit Root Tests
Variables in Levels
(8 Lags in the ADF and KPSS Tests)

Variable	Constant Only			Constant and Time Trend		
	ADF Test Statistic (5% CV = -2.88)	PP Test Statistic (5% CV = -2.88)	KPSS Test Statistic (5% CV = 0.46)	ADF Test Statistic (5% CV = -3.43)	PP Test Statistic (5% CV = -3.43)	KPSS Test Statistic (5% CV = 0.15)
Aggregate Consumption	1.59	1.91	2.27	-0.57	-0.50	0.32
Non-Durable Consumption	1.39	1.57	2.17	-0.08	-0.24	0.29
Services Consumption	0.95	-2.88	2.31	-1.96	-1.29	0.32
Durable Consumption	1.91	2.72	2.12	-0.08	0.37	0.36
Disposable Personal Income	1.13	1.25	2.31	-1.17	-1.62	0.15
Wealth	0.65	1.04	1.99	-1.25	-1.08	0.42
ADF and PP tests the null of a unit root, while KPSS tests the null of a stationary series.						

Table 1.1b
Unit Root Tests
Variables in First Differences
(8 Lags in the ADF and KPSS Tests)

Variable	Constant Only			Constant and Time Trend		
	ADF Test Statistic (5% CV = -2.88)	PP Test Statistic (5% CV = -2.88)	KPSS Test Statistic (5% CV = 0.46)	ADF Test Statistic (5% CV = -3.43)	PP Test Statistic (5% CV = -3.43)	KPSS Test Statistic (5% CV = 0.15)
Δ Aggregate Consumption	-4.04	-11.17	0.39	-4.42	-11.26	0.09
Δ Non-Durable Consumption	-4.11	-11.54	0.35	-4.38	-11.62	0.14
Δ Services Consumption	-3.40	-11.82	0.31	-3.60	-11.90	0.06
Δ Durable Consumption	-3.75	-15.38	0.56	-4.36	-15.64	0.10
Δ Disposable Personal Income	-4.11	-15.77	0.22	-4.27	-10.25	0.08
Δ Wealth	-3.67	-14.52	0.30	-3.86	-15.87	0.08
ADF and PP tests the null of a unit root, while KPSS tests the null of a stationary series. Δ Represents the first difference operator.						

The Johansen test uses an adjusted Vector Autoregression (VAR) model to test for cointegration. Under the Johansen test, an unrestricted VAR model, given by Equation (1.10), is transformed into Equation (1.11). In Equation (1.10), the Y_t is a (k x 1) matrix of variables, the A_i matrices are (k x k) matrices containing autoregressive coefficients, j is the number of lags, and ε_t is ~ iid (0,Ω). In Equation (1.11), Δ indicates the first difference operator, the Γ_i are the transformed matrices of coefficients, σ_t is ~ iid (0,Ω), and Π is the "constant dynamic adjustment of first differences of variables… to levels regardless of the time difference" (Charemza and Deadman, 1997, pg. 171-172). The matrix Π is the product of two separate matrices, or Π=αβ'. It is the Π matrix that identifies the pattern of long run adjustment of all variables (α) and the long run relationship, or cointegration relationship (β), between all variables. The rank of matrix Π determines the number of long run relationships between the variables, or number of linear combinations that create a stationary process (the definition of cointegration).

$$Y_t = A_0 + \sum_{i=1}^{j} A_i Y_{t-i} + \varepsilon_t \tag{1.10}$$

$$\Delta Y_t = A_0 + \Pi Y_{t-1} + \sum_{i=1}^{j-1} \Gamma_i \Delta Y_{t-i} + \sigma_t \tag{1.11}$$

Cointegration is tested between consumption, disposable income, and wealth, and is also tested between disaggregated consumption components, disposable income, and wealth. The cointegration test for disaggregated components includes all consumption categories. In this case, only one cointegration test needs to be performed when using disaggregated consumption, since the Johansen test estimates the number of relationships

that create stationary variables. Therefore the result from the Johansen test is the same, regardless of variable ordering.

Prior to the Johansen test, it is important to determine the appropriate number of lags (j) to include in Equation (1.11). An appropriate number of lags must be added to ensure that the residual matrix, ε_t, is ~ iid $(0,\Omega)$. One common method is to estimate VARs with various lag lengths and use either the Akaike Information Criterion (AIC) (Akaike, 1974) or the Schwarz Criterion (SC) (Schwarz, 1978) as a starting point to determine the appropriate number of lags.[14] It's important to note that the SC and AIC provide a starting point only. The number of lags indicated might still be insufficient to remove residual serial correlation, which invalidates the results of the Johansen test. Table 1.2 provides the number of lags indicated by each criterion. The results indicate that in every case, one or two lags are appropriate to start with when testing for cointegration. This essay starts with two lags in all specifications.

It is important to note that the interpretation of the parameter values depends upon the response of consumption in the long run. If consumption is the only variable that adjusts to changes in wealth or disposable income in the long run, then these cointegration equations represent the long run response of aggregate consumption to changes in wealth or disposable income only. If, as Lettau and Ludvigson (2003) find, wealth is the only variable that adjusts to changes in the long run, then it is incorrect to conclude that the parameter values represent the long run marginal propensity to consume out of disposable income and wealth. So, adjustment of all variables to the cointegration

[14] Generally the AIC and SC give different results. In particular, due to the nature of these criteria, the AIC suggests a larger number of lags than the SC.

Table 1.2 **Akaike Information and Schwarz Criterion**		
VAR	Number of lags indicated by:	
	AIC	SC
Total Consumption	2	1
Disaggregated Consumption	2	1

relationships must be further investigated before any conclusions about the MPC out of wealth or income can be reached. In this essay, the parameters in the cointegration equations will continue to be addressed as MPCs, but only to compare the estimates to results in previous literature.

Panel A of Table 1.3 gives the results of the Johansen test for total consumption, using two lags in the test VAR. At a 95% level of confidence, there are zero stable long run relationships between the variables. The ten percent critical values are 18.60 (Eigen test) and 26.79 (Trace test), so the result marginally rejects cointegration at a ninety percent level of confidence. Other authors test for cointegration using the Engle-Granger method (see Mehra 2001), and find a stable long run relationship.[15] An insufficient number of lags may be one possible reason for the conclusion of no cointegration. The Johansen test, as mentioned, relies on residuals that are "white noise". It is possible that using two lags leaves a significant amount of autocorrelation in the residuals, which invalidates the results. Given this, the Johansen test is estimated extending the lag length in the test VAR. Panel B of Table 1.3 gives the results from the Johansen test that uses three lags in the test VAR.[16] The estimated cointegration relationship indicates parameters on income and wealth of 0.723 and 0.039, respectively. Parameter results are consistent using two or three lags. This result is then used to construct the Error-Correction Term (ECT) for consumption, disposable income, and wealth in the absence of structural breaks.

How do cointegration results in Table 1.3 compare to previous results? Mehra (2001), using aggregate consumption in the cointegrating equation, estimates parameters

[15] Ludvigson and Steindel find cointegration using non-durable plus services consumption.
[16] Conclusions from the cointegration tests are stable using three or more lags in the test VAR.

Table 1.3
Aggregate Consumption
Johansen Cointegration Test Results

Panel A: Two Lags in the Johansen Test

Number of Cointegration Equations (Null Hypothesis)	Eigen Statistic	5% Critical Value	Trace Statistic	5% Critical Value
$r = 0$	18.46	20.97	26.03	29.68
$r \leq 1$	4.57	14.07	7.57	15.41
$r \leq 2$	3.00	3.76	3.00	3.76

Cointegration Relationship:

Total Consumption	Disposable Income	Wealth
1.000	-0.724 (0.025)	-0.038 (0.004)

Panel B: Three Lags in the Johansen Test

Number of Cointegration Equations (Null Hypothesis)	Eigen Statistic	5% Critical Value	Trace Statistic	5% Critical Value
$r = 0$	23.14*	20.97	28.54	29.68
$r \leq 1$	3.51	14.07	5.40	15.41
$r \leq 2$	1.89	3.76	1.89	3.76

Cointegration Relationship:

Total Consumption	Disposable Income	Wealth
1.000	-0.723 (0.022)	-0.039 (0.004)

* indicates rejection of the null at a 95% level of confidence.
Standard error in parenthesis.
Critical values provided by Osterwald-Lenum (1992), Table 1.

on disposable income and wealth of 0.57 to 0.62 and 0.03 to 0.04, respectively. In the research here, the estimated wealth parameter (0.039) in the aggregate consumption equation lies inside these bounds. However, the parameter on disposable income (0.723) is substantially larger. Davis and Palumbo (2001) exclude income from transfer payments and estimate a disposable income parameter of 0.68, which is closer to that found here. Further, their estimated wealth parameter is 0.039, which matches across studies. Therefore, the aggregate consumption results here are generally consistent with recent research.

Table 1.4 contains the results from the Johansen test, using two lags, for cointegration between the disaggregated components of consumption, disposable income, and wealth. Compared with total consumption, the test strongly rejects a long run relationship at the ninety-five percent level of confidence. Therefore, disaggregation of consumption into its three subcategories eliminates the finding of cointegration. Further, adding additional lags to remove any remaining autocorrelation does not significantly change the results. Structural breaks in the series potentially are producing the finding of no cointegration. The next section of this study examines cointegration results when procedures allow for structural breaks in the long run relationship.

Structural Break Tests

The previous tests represent initial evidence about wealth effects on the components of consumption. They presume a constant relationship between the variables over the sample period. It is possible that some structural breaks have occurred over the fifty-year span represented by the data employed here. To investigate this, Gregory and

Table 1.4 **Disaggregated Consumption** **Johansen Cointegration Test Results**				
Number of Cointegration Equations (Null Hypothesis)	Eigen Statistic	5% Critical value	Trace Statistic	5% Critical Value
$r = 0$	24.46	33.46	48.07	68.52
$r \leq 1$	12.90	27.07	23.61	47.21
$r \leq 2$	6.85	20.97	10.70	29.68
$r \leq 3$	3.67	14.07	3.86	15.41
$r \leq 4$	0.19	3.76	0.19	3.76
Critical values provided by Osterwald-Lenum (1992), Table 1.				

Hansen's (1996a, 1996b) test (GH) for cointegration in the presence of possible structural breaks is used.

Equation (1.12) gives the general form of the test. In Equation (1.12), C_t is the measure of consumption (aggregate or consumption component) being investigated, $RDPI_t$ is real personal disposable income, RW_t is real wealth, and OC is (2 X 1) matrix of the remaining consumption measures. The matrix OC is included only when testing for structural breaks in the disaggregated consumption components. Also, in Equation (1.12), φ_t is a dummy variable, n is the number of observations, and τ indicates the period being investigated. The variable τ lies in the interval [0.15, 0.85], as suggested by Gregory and Hansen, and denotes the dependence of the parameter on the break point. Finally, δ is a (2 X 1) matrix of parameters, and i indicates that each parameter and break point is dependent on the measure of consumption investigated. Two versions of Equation (1.12) are estimated for the four cointegration relationships. The first version used here tests for cointegration in the presence of a structural break in the constant only (restricts $\varphi_{2\tau} = \varphi_{3\tau} = \varphi_{4\tau} = 0$), and the second tests for a break in all parameters.

$$C_t = \alpha_{0\tau}^i + \alpha_{1\tau}^i RDPI_t + \alpha_{2\tau}^i RW_t + \delta' OC + \alpha_{3\tau}^i \varphi_{1\tau}^i + \alpha_{4\tau}^i RDPI_t \varphi_{2\tau}^i + \alpha_{5\tau}^i RW_t \varphi_{3\tau}^i + \delta' OC \varphi_{4\tau}^i + \varepsilon_t^i$$

$$\text{where } \varphi_\tau^i = \begin{cases} 0 \ \ if \ \ t \le [n\tau] \\ 1 \ \ if \ \ t > [n\tau] \end{cases} \qquad (1.12)$$

One version of the GH test statistic uses the bias-corrected first-order serial correlation coefficient from Equation (1.12) to test for cointegration in the presence of a structural break. The recursive test statistic, which is Phillips's (1987) test statistic, is given by:

$$Z_{\alpha}(\tau) = n(\hat{\rho}_{\tau}^{*} - 1) \tag{1.13}$$

In Equation (1.13), $\hat{\rho}_{\tau}^{*}$ is the bias corrected first-order serial correlation coefficient, and n is the number of observations. The other version uses the Augmented-Dickey Fuller test statistic (ADF* test). However, the critical values for cointegration are different, since the model being tested has more parameters. Under the GH test, the null hypothesis is one of no cointegration. Cointegration exists in the presence of a possible structural break if the test statistic is less than the 95 % critical value.

These test statistics rely on time-series techniques that correct for parameter bias and serial correlation. Gregory and Hansen use Phillips's (1987) bias-correction to derive the corrected first-order serial correlation coefficient. In this dissertation, Stock and Watson's (1993) Dynamic OLS (DOLS) technique is utilized. There are many advantages to using DOLS over other correction methods. First, it provides a correction for regressor endogeneity, as do other methods. Second, it provides efficient estimation even when regressors are integrated of higher order. Also, it is computationally more convenient than other methods. Finally, DOLS is routinely used in empirical research, and is widely accepted.[17]

DOLS corrects for parameter and standard error bias through the addition of leads and lags of the first difference of all right-hand side variables. The specific functional form is contained in Equation (1.14). In Equation (1.14), C_t, $RDPI_t$, RW_t are as previously defined, Δ indicates the first difference operator, k is the lag length chosen based upon residual normality tests and Information Criteria (such as AIC or SC), and i

[17] This technique is used by Ludvigson and Steindel (1999), Davis and Palumbo (2001), and Lettau and Ludvigson (2003).

indicates each parameter's dependence on the measure of consumption used on the left-hand side. In addition, *OC* is a (2 X 1) matrix of the remaining consumption measures, ΔOC is a [2 X (2k+1)] matrix of leads, lags, and current value of the first difference of variables in the *OC* matrix, and θ is a [(2k+1) X 2] matrix of parameters.

$$C_t = \gamma_1^i + \gamma_2^i RDPI_t + \gamma_3^i RW_t + \delta' OC + \sum_{j=-k}^{k} \phi_j^i \Delta RDPI_{t-k} + \sum_{j=-k}^{k} \xi_j^i \Delta RW_{t-k} + \theta' \Delta OC + \varepsilon_t^i \qquad (1.14)$$

When estimating the GH test, Equation (1.12) is incorporated into Equation (1.14) through the inclusion of dummies and interaction terms. The test is estimated for a break in the constant only and a break in all parameters. The GH test results for aggregate consumption are contained in Table 1.5. The remaining tests for non-durable consumption, services consumption, and durable consumption are presented in Panels A, B, and C of Table 1.6.

As the Table 1.5 results for the GH test on consumption indicate, there is no real consensus as to when structural breaks occur. Two possible breaks appear in the cointegration relationship between aggregate consumption, disposable income, and wealth. The results from the Z_α test suggest a possible break around the 1991 recession, preceding the large increases in wealth that occurred in the 1990's.[18]

Recall that the Johansen method with three lags (or more) indicated cointegration exists for aggregate consumption. Rejection of the null hypothesis under the GH test indicates cointegration in the presence of a possible break. Therefore, there is only a possibility of a structural break existing. When cointegration is found, both

[18] In contrast, the ADF* test narrowly fails to identify cointegration at the ninety percent level in the constant only, but, as Gregory and Hansen note, the ADF* test suffers from low power compared to the alternative Z_α test.

Table 1.5
Gregory and Hansen Tests for Aggregate Consumption

Break in:	ADF* Statistic	Z_α Statistic
Constant	-4.64 (1994:2)	-78.41** (1993:3)
All Parameters	-4.77 (1992:4)	-89.80** (1990:4)

** signifies significance at the 95% level.
The 95% (90%) level of confidence critical values are –4.92 (-4.69) for the ADF* test and –46.98 (-42.49) for the Z_α test for breaks in the constant. The 95% (90%) level of confidence critical values are –5.50 (-5.23) for the ADF* test and –58.33 (-52.85) for the Z_α test when testing for a break in disposable income, and wealth. Critical values are provided by Gregory and Hansen (1996) Table 1, pg. 109.

Table 1.6
Gregory and Hansen Tests for Disaggregated Consumption

Panel A: Non-Durable Consumption

Break in:	ADF* Statistic	Z_α Statistic
Constant	-6.70** (1984:1)	-76.84** (1993:1)
All Parameters	-5.65 (1993:4)	-67.36 (1993:3)

Panel B: Services Consumption

Break in:	ADF* Statistic	Z_α Statistic
Constant	-3.59 (1980:1)	-25.14 (1964:2)
All Parameters	-3.68 (1980:1)	-24.43 (1964:2)

Panel C: Durable Consumption

Break in:	ADF* Statistic	Z_α Statistic
Constant	-2.98 (1964:3)	-42.40 (1964:4)
All Parameters	-4.13 (1974:1)	-37.26 (1990:4)

** signifies significance at the 95% level.
The 95% (90%) level of confidence critical values are –5.56 (-5.31) for the ADF* test and –59.40 (-54.38) for the Z_α test for breaks in the constant. The 95% (90%) level of confidence critical values are –6.41 (-6.17) for the ADF* test and -78.52 (-72.56) for the Z_α test when testing for a break in disposable income, wealth, and other consumption measures. Critical values are provided by Gregory and Hansen (1996) Table 1, pg. 109.

excluding and including structural breaks, Gregory and Hansen note that it is "inappropriate" to disregard the cointegration results excluding structural breaks (1996a, pg. 114). Also, as GH note, one should obviously examine the results of the post break period for economically viable results, given the nature of the GH test. Therefore, the behavior of aggregate consumption including and excluding structural breaks in the cointegration relationship is analyzed.

Turning to non-durable consumption, results indicate that cointegration does exist when a structural break is included. The ADF* test suggests a break in the constant after 1983, while the Z_α test suggests a later break in the constant, after 1992. Interestingly, both breaks occur at the end of aggregate sector recessions. Gregory and Hansen's results provide some guidance in choosing between the alternatives. From their Monte Carlo experiments, the power of the tests increases as the break falls later in the period. Therefore, the results from the Z_α test may be more reliable.

Turning to services consumption and durable consumption, the GH test fails to reject the null of no cointegration in the presence of possible structural breaks. Panels B and C of Table 1.6 provide results from these tests. Indeed, cointegration is strongly rejected for services consumption. The same is true for durable consumption. Therefore, the null hypothesis of no cointegration, both with and without structural breaks, is supported for services consumption and durable consumption.

The next section examines the parameters of the cointegration relationships in the presence of structural breaks. These parameter estimates are compared to findings in the previous section and current literature. The Long Run Adjustments and Short Run

Dynamics section examines the long run endogeneity of all variables and addresses the Endogenous Wealth and Endogenous Consumption debate.

Cointegration Results in the Presence of Structural Breaks

Aggregate Consumption

The cointegration results in the presence of structural breaks are presented in this section. Recall that the GH test for aggregate consumption suggested two possible structural breaks: 1990:3 (in all parameters) and 1993:2 (constant only). A break after 1990:3 in all parameters is added to the DOLS specification, and the results are in Table 1.7. In Table 1.7 Panel A, the first three rows of results are the pre-break parameters. The next three rows present post-break changes in the parameter values. Panel B details the post-break parameter values and parameter significance. Once this break is included in the specification, the wealth parameter estimated in the Johansen test in the previous section is reduced by over one-third in the period before the break (from 0.038 to 0.024). Also, the estimated parameter on disposable income in the period preceding 1990:4 (0.769) is robust to the earlier Johansen test estimate (0.724).

Results, however, are much different after the break. Following the break, the size of the wealth parameter is statistically zero. In addition, the parameter on disposable income after the break may initially seem economically implausible, being 1.375. However, this interpretation as the marginal propensity to consume out of disposable income critically depends on the adjustment of consumption and non-adjustment of wealth and disposable income in the long run.

The GH test also suggests a single break in the constant (in 1993). Given these results, another long run equation is estimated, with a break in the constant only,

Table 1.7 **Cointegration Results** **Aggregate Consumption** **(Break in all parameters in 1990)**		
Panel A: Pre-break Cointegration Parameters and Dummy Parameters		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.769**	0.031
Real Wealth	0.024**	0.008
Constant	26.21	33.89
φ_t * Real Disp. Personal Income (1990:4)	0.606**	0.131
φ_t * Wealth (1990:4)	-0.040**	0.010
φ_t * Constant (1990:4)	-2204.43**	495.45
** indicates significance at a 95% level of confidence		
Panel B: Post-break Cointegration Parameters		
Joint Parameter Values and Significance		
Variable	Marginal Effect	p-value
Real Disposable Personal Income	1.375	0.000
Real Wealth	-0.016	0.169
Constant	-2178.22	0.000
Entries are parameter values plus all dummy interactions. p-value gives the joint significance of all parameters.		

occurring after 1993:3. The results are given in Table 1.8. The results are more reasonable, given that the long run marginal propensity to consume out of disposable income is 0.775. As opposed to the previous results, the wealth parameter is 0.023 over the whole sample period, and is close to the pre-break wealth parameter in Table 1.7.

Non-Durable Consumption

Recall that previous results indicate cointegration exists for non-durable consumption, with a possible break in the constant (Panel A of Table 1.6). Given this, DOLS is used to estimate the long run relationship between non-durable consumption, disposable income, and wealth. The specifications allow for substitution effects between components of consumption, by adding services and durable consumption to the cointegration relationship. From the GH test, two possible breaks appear in the constant only: one after 1983 (Table 1.9,Panel A) and the other after 1992 (Table 1.9, Panel B). In either case, all parameters are statistically significant at a ninety-five percent level of confidence. The size of the marginal propensity to consume out of income is smaller for non-durable consumption when using the post 1992 break. In addition, the wealth effect is similar to that of aggregate consumption. Given the lack of cointegration in services and durable consumption, this result should not be surprising, since the long run relationship between non-durable and wealth should be manifested in aggregate consumption. Interestingly, this estimate of the wealth effect is robust when compared to previous literature with the inclusion of services and durable consumption into the long run relationship.

The results to this point give some interesting insight into the behavior of consumption. First, basic tests excluding structural breaks indicate cointegration exists

Table 1.8 **Cointegration Results** **Aggregate Consumption** **(Break in constant in 1993)**		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.775**	0.011
Real Wealth	0.023**	0.003
Constant	31.61**	14.62
φ_t * Constant (1993:3)	111.94**	14.39
** indicates significance at a 95% level of confidence		

Table 1.9 **Cointegration Results** **Non-Durable Consumption**		
Panel A: Break in Constant After 1983:4		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.365**	0.048
Real Wealth	0.028**	0.002
Services Consumption	-0.403**	0.085
Durable Consumption	-0.520**	0.103
Constant	237.94**	39.74
φ_{1t} * Constant (1984:1)	-43.27**	7.78
Panel B: Break in Constant After 1992:4		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.508**	0.045
Real Wealth	0.022**	0.004
Services Consumption	-0.621**	0.085
Durable Consumption	-0.543**	0.136
Constant	220.71**	52.93
φ_{1t} * Constant (1993:1)	52.56**	17.11
** indicates significance at a 95% level of confidence		

between aggregate consumption, disposable income, and wealth. The GH tests suggest a structural break around the 1991 recession. This test also rejects the null of no cointegration in the presence of structural breaks. The long run parameter on disposable income, assuming long run adjustment of consumption to disequilibrium, is estimated to be 0.723 to 0.775, which is larger than previous estimates. The estimated long run wealth effect on aggregate consumption is between 0.022 and 0.039, which is consistent with previous estimates.

When disaggregating consumption into non-durable, services, and durable consumption, cointegration is not evident under basic tests (no structural breaks). However, allowing for the possibility of structural breaks provides support for cointegration in non-durable consumption. GH tests suggest a break after 1992.

Cointegration estimates provide a wealth parameter of 0.022, and a parameter on disposable income of 0.508. These parameter results are significantly smaller than previous literature. Two factors may account for this. First, the measures of consumption differ. The Endogenous Wealth literature uses non-durable plus services consumption. This restricts the long run relationship between services consumption, income, and wealth to be the same as that between non-durable consumption, income, and wealth. Another way of interpreting this is that it imposes a parameter value of negative one on services consumption. As can be seen from Table 1.9, this imposes an apparent improper restriction. The parameter on services consumption (-0.621) is statistically greater than negative one (p-value of 0.000). Second, the analysis here addresses all subcomponents of consumption. This framework allows for potential substitution effects between non-durable consumption and services or durable

consumption. Results here indicate significant substitution effects exist across components of consumption. Results indicate that possibly large omitted variables bias potentially exists in specifications that do not incorporate these significant substitution effects. The wealth parameter here is approximately forty to fifty percent smaller than those in the Endogenous Wealth research. Also, the income parameter in Table 1.9 is sixteen percent smaller than that found in Ludvigson and Steindel (1999, see Table 3). The negative relationship between non-durable consumption, services consumption, and durable consumption bias the income and wealth parameters upward in the Endogenous Wealth literature.

In the remaining sections, the results are condensed. The endogenous responses of aggregate consumption and non-durable consumption are examined. Subsequent analyses in the next section build upon key specifications identified so far. More comprehensive estimation has been conducted using alternate break specifications, and results are generally robust. To preserve space and a focused discussion, these results for alternative specifications are presented in Appendix B.[19]

Long Run Adjustment and Short Run Dynamics

The existence of a long run relationship gives no information concerning the adjustment process, or long run versus short run behavior of the variables contained in the system. The classic notion of the wealth effect denotes the long run response of consumption to changes in household wealth. The adjustment of consumption and wealth is the center of the Endogenous Wealth and Endogenous Consumption debate. The next

[19] Specifically, results for aggregate consumption excluding any breaks and a break in 1993 in the long run relationship, and for non-durable consumption incorporating a break after 1992 are relegated to Appendix B.

step in this empirical section is to determine the adjustment of all variables in the cointegration relationships. These adjustment parameters provide evidence concerning the endogeneity of consumption.

A statistically significant adjustment parameter denotes permanent changes in that variable from changes in any variable in the cointegration relationship (i.e. it is endogenous). If a variable does not adjust (or has a statistically insignificant adjustment parameter), then changes in any of the variables create transitory responses only (i.e. is weakly exogenous). For example, household consumption may be exogenous and evolve as a random walk. In this case, wealth and/or disposable income may adjust to accommodate consumption. Ludvigson and Steindel (1999) find their measure of consumption (non-durable plus services consumption) does not respond to changes in wealth or disposable income in the long run. In fact, as in Hall (1978), they find that a random walk model predicts their measure of consumption better than their restricted VAR model. If consumption evolves as random walk and cointegration exists between the variables, then disposable income and/or wealth must adjust to changes in consumption in the long run. If this is true, then wealth can only influence consumption in the short run, in a temporary manner, or not at all. If consumption adjusts to changes in the cointegration relationship, then wealth and income changes have a permanent impact on consumption.

The next step in this investigation is to estimate the dynamic adjustment of all components in the long run. To accomplish this goal, three Vector-Error Correction Models (VECM) are estimated:

A. Aggregate consumption, disposable income, and wealth, excluding any breaks.

B. Aggregate consumption, disposable income, and wealth, including the 1993 break.

C. Non-durable consumption, disposable income, wealth, services consumption, and durable consumption, including the1993 break.

Results in this section are grouped into two sets – two VECMs for aggregate consumption and one for non-durable consumption. Specification A serves as a benchmark, both for specification B and for comparison to existing literature.[20]

The empirical method used here matches that of the Endogenous Wealth literature. In the Endogenous Wealth literature, the removal of the zero restriction on the adjustment of wealth and income resulted in the exogeneity of consumption. These VECMs provide results concerning the simultaneous adjustment of *all* variables in the cointegration relationship. Therefore, the restrictions of zero adjustment on income and wealth imposed in the Endogenous Consumption literature are removed.

The VECM, which estimates adjustment to long run equilibrium, is given in Equation (1.16). In Equation (1.16), Y_t is a (k x 1) matrix of variables, and j is the number of lags. Each model uses $j = 4$ lags, which is the general specification. The number of variables, k, is three in VECM A and B. In VECM C, k is equal to five. In Equation (1.16), Δ indicates the first difference operator, Γ_i is the transformed matrix of coefficients, and σ_t is ~ iid $(0,\Omega)$. The matrix Π is the product of two separate matrices, or $\Pi=\alpha\beta'$. It is the Π matrix that identifies the adjustment of all variables (α). The long

[20] To speed exposition, the results for aggregate consumption including a break in 1990 and those for non-durable consumption including a break in 1984 are provided in Appendix B. Overall, results for these two VECMs are robust to those of VECM A-C.

run relationship, or cointegration relationship (β) between all variables was estimated in the previous sections (for each specification). Therefore, each variable is allowed to adjust towards the long run relationship that exists between them.

$$\Delta Y_t = A_0 + \Pi Y_{t-1} + \sum_{i=1}^{j} \Gamma_i \Delta Y_{t-i} + \sigma_t$$

$$\text{or } \Delta Y_t = A_0 + \alpha\beta' Y_{t-1} + \sum_{i=1}^{j} \Gamma_i \Delta Y_{t-i} + \sigma_t \tag{1.16}$$

The main interest here is the statistical significance of the elements in the matrix of adjustment parameters (α). Specifically, if the adjustment parameter for any consumption series is statistically significant, then this indicates the particular series adjusts to changes in either disposable income or wealth in the long run. In other words, that measure of consumption exhibits a wealth effect, or changes in income and wealth have a permanent effect on that measure of consumption.

Beginning with a general model, the VECMs in specifications A through C are reduced to a parsimonious model. Insignificant lags (with t-statistics less than one in absolute value) that follow significant lags are eliminated. In each table of VECM results, the joint parameter value and significance of the included *j* lags are given for each variable in each equation. Thus, the joint significance of the included lags determines Granger-Causality in the short-run sense. The parameter on the ECT (Error-Correction Term) gives the long run adjustment (α) to changes in the equilibrium relationship between the variables. As a cross check on model reduction methods, the joint significance of the parameters restricted to zero (through reduction to a parsimonious model) is reported near the bottom of each table.

The VECMs are estimated using Full Information Maximum Likelihood (FIML). This accounts for endogeneity, and allows for system reduction to a parsimonious model. In a just identified model, FIML, two-stage least squares (2SLS), and instrumental variables (IV) estimation produce the same parameter estimates. However, FIML is superior to 2SLS and IV in over-identified systems, since it produces the most efficient estimates.[21] Therefore, FIML is the best approach when a restriction of parameters produces an over-identified system, which is the case here.

Aggregate Consumption

As a benchmark, the specification that excludes a structural break is examined. The dynamic responses of aggregate consumption, disposable income, and wealth are reported in Table 1.10 (for the most parsimonious model). The long run relationship used to derive the Error-Correction Term (ECT) comes from the Johansen Test using three lags (results given in Panel B of Table 1.3). Recall in this long run relationship, the long run MPCs out of income and wealth are 0.723 and 0.039 respectively.

In this specification without structural breaks, the long run dynamic response of aggregate consumption (given by the estimated parameter on the ECT) to changes in disposable income, wealth, and its own past changes is statistically significant (and the parameter value is -0.071). Therefore, consumption is endogenous in this VECM. This "no break" result may be compared to other recent studies. Davis and Palumbo (2001), using a sample from 1960:1 through 2000:1, estimate the dynamic response of aggregate consumption in a single-equation format. They find that aggregate consumption responds to changes in disposable income and wealth, with speeds of adjustment to changes in the

[21] For example, see Hamilton (1994).

Table 1.10 VECM A Aggregate Consumption (No Structural Breaks)						
Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags
$\Sigma\Delta C_{t-i}$ i=1 to j	(0.000)	3	(0.000)	4	(0.037)	1
$\Sigma\Delta RDPI_{t-i}$ i=1 to j	(0.041)	4	(0.000)	4	—	0
$\Sigma\Delta RW_{t-i}$ i=1 to j	—	0	(0.004)	2	(0.059)	3
Constant	(0.000)	—	(0.214)	—	(0.388)	—
ECT_{t-1}	**-0.071* (0.067)**	**—**	**-0.341** (0.000)**	**—**	**2.735** (0.000)**	**—**
Joint Significance of Restrictions (p-value):					0.987	
* and ** indicates significance at a 90% and 95% level of confidence respectively						

cointegration relationship between –0.13 to –0.21. Mehra (2001) estimates an adjustment parameter of –0.15, with an almost identical sample as Davis and Palumbo. These papers, by using an Error Correction Model (ECM), restrict wealth and disposable income to be weakly exogenous. In other words, they restrict the long run adjustment parameter of these variables to be zero and not adjusting to changes in the long run relationship. This restriction has a substantial impact on the results.

The technique used here is less restrictive than Davis and Palumbo's and Mehra's. Procedures here allow for the endogenous long run response of disposable income and wealth. Once the specification allows the endogenous response of disposable income and wealth, consumption still is found to respond in the long run. However, the speed of adjustment is smaller than values found in these recent papers. The predicted adjustment parameter on consumption is approximately one-third to two-thirds less than that in found in the Davis and Palumbo and the Mehra papers (-0.071 here versus –0.13 to –0.21 in Davis and Palumbo). Further, the evidence indicates that wealth and disposable income are in fact endogenous, adjusting to changes in the long run equilibrium. Therefore, results here indicate restricting these to zero (as in the Endogenous Consumption literature) is not appropriate.

The pattern of Granger-Causality in VECM A is as complex as the long run relationship between the variables. Consumption is the only variable that Granger-Causes ($\Rightarrow$) all series in the short run. The direction of causality between consumption and wealth is unidirectional, running from consumption to wealth. Also, wealth $\Rightarrow$ disposable income in the short run, but disposable income does not Granger-Cause wealth. Finally, wealth Granger-Causes itself.

In VECM B in Table 1.11, results are consistent with VECM A. The pattern of results, in terms of endogeneity and short-run Granger-Causality, match those of VECM A. Therefore, the inclusion of a break in the constant in the long run relationship has no effect on the dynamics of the systems, as should be expected. Thus in this specification, as with VECM A, evidence indicates that long run wealth effects in consumption exist. However, wealth and income are endogenous too, through the statistically and economically significant adjustment of the two series to changes in the long run equilibrium.

These two VECMs provide some interesting results that support some previous conclusions in the literature. First, as in the Endogenous Consumption literature, there appears to be a long run response in aggregate consumption to changes in wealth and disposable income. Yet, the estimated MPC out of wealth is not as large as that in Davis and Palumbo or Mehra, the Endogenous Consumption literature. The estimated MPC out of wealth here is between 0.023 to 0.039 cents per dollar increase in wealth. Also, allowance for endogenous adjustment of wealth and income reduces the value of the adjustment parameter, intimating a slower response of consumption in the long run. Thus, findings here are an important contribution to the current empirical wealth effect literature. Results here are consistent with previous research, but are established here with less restrictive empirical techniques.

Therefore, even after providing for structural breaks, the results still point to a long-term wealth effect in aggregate consumption. The methods used here are the least restrictive, but they still result in finding a long run response in consumption, i.e. consumption is endogenous. So, using the techniques from the Endogenous Wealth

Table 1.11 VECM B Aggregate Consumption (Break in 1993)						
Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags
$\Sigma\Delta C_{t-i}$ i=1 to j	(0.000)	3	(0.000)	4	(0.013)	1
$\Sigma\Delta RDPI_{t-i}$ i=1 to j	(0.038)	4	(0.000)	4	(0.278)	2
$\Sigma\Delta RW_{t-i}$ i=1 to j	—	—	(0.006)	2	(0.063)	3
Constant	11.34 (0.000)	—	2.33 (0.483)	—	64.52 (0.184)	—
ECT_{t-1}	**-0.084* (0.067)**	**—**	**-0.468** (0.000)**	**—**	**1.883** (0.037)**	**—**
Joint Significance of Restrictions (p-value):					0.996	
* and ** indicates significance at a 90% and 95% level of confidence respectively						

literature (which finds an endogenous response in wealth only) results here show that consumption also is endogenous. Further, the results demonstrate that this is a complex relationship, with disposable income and wealth responding to changes in the equilibrium relationship too.

Non-Durable Consumption

Recall that cointegration for non-durable consumption relied on allowance for a structural break in the long run relationship. Since the Z_α test is the more powerful of the GH tests (and the break after 1992 matches that in aggregate consumption), the Error-Correction Term (ECT) incorporating a break after 1992 is used.[22] The VECM for non-durable consumption models the effects of non-durable consumption, disposable income, and wealth on each other. This VECM also allows for the short run effects of changes in services and durables consumption on these variables. Also, by including services and durable consumption, these two measures of consumption are allowed to adjust to changes in the long run relationship between non-durable consumption, disposable income, and wealth. Previous tests in this essay indicate durable and services consumption are not cointegrated with wealth, disposable income, and other consumption. However, they may still respond to changes in the long run relationship. By doing this, the VECM here is the least restrictive by allowing the endogenous response of services and durable consumption.

Table 1.12 gives results from estimating the short run dynamics of non-durable consumption, disposable income, wealth, services consumption, and durable

[22] The results for non-durable consumption incorporating the break after 1983 are given in Appendix B.

Table 1.12
VECM C
Non-Durable Consumption
(Break in 1993)

Variable	ΔNDC Equation		ΔRDPI Equation		ΔRW Equation		ΔRSC Equation		ΔRDC Equation	
	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags
$\Sigma\Delta NDC_{t-I}$ I=1 to j	(0.360)	4	(0.056)	4	—	—	—	—	(0.268)	2
$\Sigma\Delta RDPI_{t-I}$ I=1 to j	—	—	(0.000)	4	—	—	—	—	(0.034)	2
$\Sigma\Delta RW_{t-I}$ I=1 to j	(0.010)	1	(0.001)	2	(0.094)	3	(0.071)	2	(0.070)	3
$\Sigma\Delta SC_{t-I}$ I=1 to j	(0.000)	2	(0.000)	4	(0.203)	1	(0.105)	3	(0.010)	4
$\Sigma\Delta DC_{t-I}$ I=1 to j	(0.000)	3	(0.000)	2	(0.340)	1	(0.000)	3	(0.081)	3
Const.	-1.32 (0.201)	—	-3.37 (0.527)	—	9.88 (0.861)	—	8.26 (0.000)	—	-2.66 (0.197)	—
ECT_{t-1}	**0.041** (0.050)**	—	**-0.610** (0.000)**	—	**4.727** (0.001)**	—	—	—	**-0.066* (0.066)**	—
Joint Significance of Restrictions (p-value): 0.990										
* and ** indicates significance at a 90% and 95% level of confidence respectively. NDC, SC, and DC denote Non-Durable Consumption, Services Consumption, and Durable Consumption.										

consumption. The specification allows for a break in the long run relationship after 1992. As with aggregate consumption, the results are those for a parsimonious specification

Using the methodology of the Endogenous Wealth literature results in the finding of endogeneity in non-durable *and* durable consumption. The Endogenous Wealth literature claims that consumption does not respond to wealth in the long run; rather wealth responds to changes in consumption. Contrary to findings in the Endogenous Wealth literature, non-durable consumption does respond to changes in wealth in the long run. Therefore, a permanent wealth effect exists for non-durable and durable consumption. In addition, the Endogenous Wealth literature contends that durable consumption is adequately controlled for through its inclusion in real wealth, and do not enter it directly in their empirical specification. Results here indicate that this restriction ignores important economic effects from the VECM and the evolution of consumption. In fact, based on the Error-Correction Term (ECT), the adjustment of durable consumption is larger, in absolute value, then the adjustment of non-durable consumption, suggesting that the response in durables to changes in the long run relationship are larger than that of non-durable consumption.

The pattern of Granger-Causality between the variables also contradicts the Endogenous Wealth results. The Endogenous Wealth literature finds that lagged consumption and wealth are statistically significant in the consumption equation. Non-durable consumption in VECM C does not Granger-Cause itself. Rather, non-durable consumption is Granger-Caused by wealth, services consumption, and durable consumption. Also in VECM C, every variable Granger-Causes disposable income. In the Endogenous Wealth literature, income is Granger-Caused by consumption only. In

fact, disposable income is the only variable Granger-Caused by non-durable consumption here.

The one variable that exhibits long run exogeneity in VECM C (in Table 1.12) is services consumption. Services consumption does not adjust to changes in any of the variables in the long run, including itself. Yet, services consumption does not appear to evolve as a simple random walk, since other variables (wealth and durable consumption) Granger-Cause services in the short run. In VECM C, wealth Granger-Causes all variables; wealth contains important information concerning the short run and long run evolution of all variables, except services consumption. On the other hand, no other variable is the Granger-Cause of wealth. This emphasizes the important role of wealth in the evolution of all forms of consumption.

Results here for disaggregated consumption differ noticeably from those of Ludvigson and Steindel (LS) (1999), and Lettau and Ludvigson (LL) (2003). First, in their cointegration relationship, they restrict the influence of income and wealth on services and non-durable consumption to be equal. However, it has been demonstrated here that the effects of wealth and disposable income on these consumption components are not equal. Also, the long run substitution between services and non-durable consumption does not have a value of negative one, as imposed by the Endogenous Wealth literature. Further, their procedures exclude long run substitution effects between non-durable and durable consumption. These past studies restrict to zero effects that are statistically and economically important here, and suffer from an omitted variables problem in the cointegration relationship. Results here show substitution effects are significant and should be incorporated to avoid omitted variables bias. Once the

substitution effects are included, the wealth effect is 0.022, which is considerably smaller that the LS estimate of 0.046.

Recall that LS and LL find that wealth is the only variable that adjusts in the long run to changes in disposable income and their measure of consumption. It should not be surprising that the Ludvigson and Steindel results differ, given that some important substitution effects are omitted. Using a VECM, they find that the adjustment parameter on wealth is 0.476. Procedures here (VECM C) find an adjustment parameter that is as much as ten times larger. Finally, LS's VECM excludes the short run and long run response of durable consumption by failing to include it in their specification. The LL study also finds a long run adjustment in wealth only in their VECM, with an estimated adjustment parameter of 0.358, and an estimated long run wealth elasticity of consumption of 0.30.[23] As with the LS study, they also exclude any substitution effects between non-durable, services, and durable consumption, which were found to be significant here.

Lettau and Ludvigson (2003) also test for structural breaks in their specification using Hansen's (1992) test, but they fail to find any significant parameter changes over their sample (1953:1 – 2001:4). However, provision for structural breaks is critical for the finding of cointegration for non-durable consumption in this study. Recall that excluding structural breaks from the cointegration test led to a conclusion of no cointegration between the variables. The next section examines the sensitivity of the no cointegration result to the empirical specification through a series of robustness checks.

[23] This is close to Ludvigson and Steindel's elasticity estimate of 0.29.

Assessing the overall evidence, results here indicate there is a complex relationship between each subcomponent of consumption, disposable income, and wealth. Aggregate consumption, from the findings, is cointegrated with income and wealth, and reacts to changes in either variable over the long run. Therefore, the classic inference of a long run wealth effect is supported by these results, with a current estimate between 0.028 and 0.039. Contrary to earlier research results, wealth *and* disposable income also respond to changes in consumption in the long run.

Non-durable consumption, like aggregate consumption, reacts to changes in disposable income and wealth in the long run. Further, results indicate that non-durable consumption also responds to changes in services and durable consumption. As with VECM A and B, income and wealth are found to be endogenous. Further, durables consumption is found to respond to changes in the long run as well. Yet, this long run response in non-durable consumption and durable consumption is dependent upon the structural break being modeled into the long run relationship.

Final Robustness Checks

The finding of a long run response in non-durable consumption runs counter to the findings of Luvigson and Steindel and Lettau and Ludvigson. There are two possible reasons for this result. First, the measure of consumption used by these two Endogenous Wealth papers is non-durable plus services consumption. Second, they omit durable consumption from the cointegration relationship. The final robustness checks here analyze whether these differences can account for the dissimilar results.

The long run relationship is re-estimated using DOLS, as in the Endogenous Wealth literature, but now using non-durable plus services consumption as the dependent

variable. Further, relevant substitution effects between the two and durable consumption are excluded (consistent with the literature). Panel A in Table 1.13 reports the results from this cointegration equation, and the results of the cointegration test. Results suggest that cointegration exists, but at the ninety percent level of confidence. The estimated wealth parameter, however, is substantially smaller than that found in both Endogenous Wealth papers (0.024 here, compared to 0.046 in the previous research). It is consistent with those reported here. In addition, the income parameter is biased by the exclusion of durable consumption, but values differ only slightly. Thus the differences in findings do not appear to be driven by differences in the consumption measure.

Recall that previous results indicated that the use of non-durable plus services consumption by the Endogenous Wealth literature improperly restricts the long run parameter on services consumption to negative one. It is possible that the inclusion of durable consumption creates this result. The next check moves services consumption to the right-hand side of the DOLS equation, while excluding durable consumption. The results are reported in Table 1.14, Panel A. Restricting the parameter on services consumption can be rejected at a ninety-nine percent level of confidence. Also, the null hypothesis of no cointegration is rejected at a ninety-five percent level of confidence. Therefore, the Endogenous Wealth result of cointegration depends upon the improper restriction being imposed on services consumption. Cointegration is found in Panel B of Table 1.13 when the restriction on services consumption is imposed, but once the restriction is removed cointegration is not found (Panel B of Table 1.14).

Do these restrictions in the long run relationship result in the Endogenous Wealth finding of *exogenous* consumption and *endogenous* wealth? To answer this question, two

Table 1.13
Robustness Checks A
Non-Durable Plus Services Consumption

Panel A: Cointegration Parameters

Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.652**	0.015
Real Wealth	0.024**	0.004
Constant	188.66**	19.78

** indicates significance at a 95% level of confidence

Panel B: Cointegration Test Results (ADF test using one lag)

	Test Without Constant		Test With Constant	
Cointegration Test for the Relationship in Panel A:	Test Statistic	5% Critical Value	Test Statistic	5% Critical Value
Error Correction Term	-3.20	-3.27	-3.70	-3.80

Critical Values are from Phillips and Ouliaris (1990). The 10% critical value is –2.99 for the test excluding a constant, and –3.52 when the constant is included.

Table 1.14
Robustness Checks B
Non-Durable Consumption

Panel A: Cointegration Parameters

Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.358**	0.056
Real Wealth	0.019**	0.002
Services Consumption	-0.461**	0.103
Constant	389.63**	35.07

** indicates significance at a 95% level of confidence

Panel B: Cointegration Test Results (ADF test using one lag)

	Test Without Constant		Test With Constant	
Cointegration Test for the Relationship in Panel B:	Test Statistic	5% Critical Value	Test Statistic	5% Critical Value
Error Correction Term	-3.28	-3.74	-3.85	-4.16

Critical Values are from Phillips and Ouliaris (1990). The 10% critical value is –3.44 for the test excluding a constant, and –3.84 when the constant is included.

VECMs are estimated, VECM EW1 and VECM EW2. The first, VECM EW1, restricts the parameter on services in the cointegration relationship to take the value of –1, which is the Endogenous Wealth restriction. This VECM contains the dynamic behavior of non-durable plus services consumption, disposable income, and wealth. The second, VECM EW2, is the least restrictive. It models the dynamic behavior of non-durable consumption, disposable income, and wealth, and adds the Error-Correction Term derived from the results in Table 1.13. The results from these two VECMs are presented in Table 1.15. For exposition purposes, only the adjustment terms are presented, since this is the crux of the debate.

Indeed, these restrictions have a substantial impact on the pattern of endogeneity. In VECM EW1, which incorporates the Endogenous Wealth restriction (using non-durable plus service consumption), the adjustment of non-durable plus services consumption is statistically zero. Once this restriction is removed in VECM EW2, non-durable consumption is endogenous. In fact, the results for the included variables are relatively robust to the estimates of VECM C. Therefore, it appears that the improper long run restriction on services consumption suppresses the adjustment of non-durable consumption, resulting in the exogeneity of consumption.

Conclusion

Results here indicate that changes in aggregate household wealth can have substantial impacts on aggregate demand, through the consumption channel. Further, changes in wealth also influence work effort or disposable income, given the endogenous response of disposable income. These effects on consumption are permanent, and results

Table 1.15 **Robustness Checks** **Results from VECM EW1 and VECM EW2**						
Variable	Δ (NDC + SC) Equation		ΔRDPI Equation		ΔRW Equation	
	Parameter Estimate	p-value	Parameter Estimate	p-value	Parameter Estimate	p-value
EW1 ECT_{t-1} (includes all Endogenous Wealth restrictions)	-0.005	0.857	-0.411	0.000	3.213	0.002
EW2 ECT_{t-1}	0.053	0.065	-0.403	0.001	5.373	0.001

here suggest that a one-dollar increase in wealth creates 2.3 to 3.9 cents of new consumption. Further, wealth and disposable income also are permanently affected from changes in either of these two or consumption.

There appears to be significant long run substitution between non-durable consumption, services consumption, and durable consumption. With the inclusion of these substitution effects, the effects of wealth and disposable income differ significantly from earlier research. Changes in wealth not only permanently affect aggregate consumption, but also the division of consumption between its three components.

This essay bridges the gap between two competing lines of research regarding the timing and duration of wealth effects. The current debate centers on the long run endogeneity of consumption to changes in wealth, disposable income, and itself. The Endogenous Wealth literature purports that wealth, and only wealth, adjusts to changes in the cointegration relationship between the three variables, or is endogenous. In this essay, despite the use of methodology from the Endogenous Wealth literature, results still reveal the endogenous response of consumption. This differs from the Endogenous Wealth results, and supports the conclusion of the Endogenous Consumption literature. Yet, results also point to the endogeneity of wealth and disposable income.

This research also examines the long run dynamics of disaggregated consumption. Cointegration exists for non-durable consumption, but only if structural breaks are addressed. Services and durable consumption do not show cointegration. However, non-durable consumption and durable consumption are endogenous, adjusting to changes in the equilibrium relationship between the variables. These findings contradict previous research that finds a long run response in wealth only. Further, the results here indicate

that previous research omits relevant variables in the long run relationship. In particular, significant substitution between the disaggregated components of consumption is ignored in previous studies.

Also adding to the complexity is the possibility of structural breaks in the long run relationship between aggregate consumption, disposable income, and wealth. The finding of structural breaks in the long run relationships counters the findings in Lettau and Ludvigson. In fact, the finding of cointegration between non-durable consumption, disaggregated consumption, income, and wealth relies on the provision for structural breaks. The general results for aggregate consumption, however, are not dependent on structural breaks in the cointegrating vector.

The findings here reinforce the idea that aggregate wealth plays an important role in determining consumption in the long run. The size of the wealth parameter in the long run aggregate consumption relationship is slightly smaller than previously estimated. Therefore the rise in equity and housing prices as experienced in the late 1990s can add significantly to aggregate demand.

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Appendix A

Table A 1.1 Descriptive Statistics (Billions of 1996 Dollars)		
Variable	Mean	Standard Deviation
ΔAggregate Consumption (ΔRC)	19.872	27.147
ΔNon-Durable Consumption (ΔRNDC)	4.289	9.250
ΔServices Consumption (ΔRSC)	11.932	9.589
ΔDurable Consumption (ΔRDC)	3.897	12.869
ΔDisposable Personal Income (ΔRDPI)	21.008	42.032
ΔWealth (ΔRW)	118.035	506.364
Δ denotes the first-difference operator		

Table A 1.2 Correlation of Variables						
	ΔRC	ΔRNDC	ΔRSC	ΔRDC	ΔRDPI	ΔRW
ΔRC	1	0.759	0.632	0.809	0.423	0.268
ΔRNDC	0.759	1	0.446	0.378	0.483	0.270
ΔRSC	0.632	0.446	1	0.234	0.374	0.276
ΔRDC	0.809	0.378	0.234	1	0.136	0.077
ΔRDPI	0.423	0.483	0.374	0.136	1	0.330
ΔRW	0.268	0.270	0.276	0.077	0.330	1
Δ denotes the first-difference operator						

Table A 1.3
Balance Sheet of the United States[1]
For the Year Ended December 31, 2001
(Billions of U.S. Dollars)

Assets			
Households[2,3]	12,576.70		
Nonprofit Organizations	1,204.00		
Real Estate		13,780.70	
Equipment and Software Owned by Nonprofit Organizations[4]		120.10	
Consumer Durable Goods[4]		2,829.70	
Tangible Assets			16,730.60
Foreign Deposits	53.50		
Checkable Deposits and Currency	349.10		
Time and Savings Deposits	3,250.60		
Money Market Fund Shares	1,174.30		
Deposits		4,827.60	
Open Market Paper	53.30		
U.S. Government Securities	844.00		
Municipal Securities	596.70		
Corporate and Foreign Bonds	763.80		
Mortgages	112.20		
Credit Market Instruments		2,370.00	
Corporate Equities[2]		6,076.60	
Mutual Funds Shares[2]		2,955.20	
Security Credit		454.30	
Life Insurance Reserves		880.00	
Pension Fund Reserves		8694.00	
Investment in Bank Personal Trusts		912.00	
Equity in Non-corporate Business[6]		4,877.10	
Miscellaneous Assets		354.90	
Financial Assets[4]			32,402.00
Total Assets			**49,132.00**

Table A 1.3, Continued			
Liabilities			
Home Mortgages[7]	5,379.40		
Consumer Credit	1,703.30		
Municipal Securities[8]	154.30		
Bank Loans n.e.c.	55.50		
Other Loans and Advances	263.20		
Commercial Mortgages[8]	124.70		
Credit Market Instruments		7,680.40	
Security Credit		196.40	
Trade Payables[8]		144.70	
Deferred and Unpaid Life Insurance Premiums		19.10	
Total Liabilities (less)			**8,040.6**
Total Net Wealth			**41,091.80**

1. Includes households, farm households, and nonprofit organizations. 2. At market value. 3. Includes owner-occupied homes, farmhouses, mobile homes, second homes not rented, vacant homes for sale, and vacant land. 4. At replacement (current) cost. 5. Value based on market value of equities held and the book value of other assets held by mutual funds. 6. Net worth on noncorporate businesses and owner's equity in farm business and unincorporated security brokers and dealers. 7. Includes loans made under home equity lines of credit and home equity loans secured by junior liens. 8. Liabilities of nonprofit organizations.

Table A 1.4a
VECM A
Aggregate Consumption
Full Results
(No Breaks, ECT Derived from Johansen Test using 3 lags)

Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
ΔC_{t-1}	0.207**	0.077	0.710**	0.097	3.127**	1.505
ΔC_{t-2}	0.207**	0.084	0.608**	0.105	-0.445	1.638
ΔC_{t-3}	0.383**	0.092	0.173	0.116	0.910	1.812
ΔC_{t-4}	0.050	0.093	0.208*	0.117	0.954	1.824
$\Delta RDPI_{t-1}$	-0.075	0.055	-0.435**	0.069	-0.985	1.081
$\Delta RDPI_{t-2}$	-0.142**	0.062	-0.100	0.078	-1.320	1.213
$\Delta RDPI_{t-3}$	-0.091	0.061	-0.136*	0.076	-0.466	1.191
$\Delta RDPI_{t-4}$	-0.081	0.051	-0.079	0.064	-0.421	0.998
ΔRW_{t-1}	0.003	0.004	0.003	0.005	-0.047	0.078
ΔRW_{t-2}	-0.000	0.004	-0.153**	0.005	0.098	0.077
ΔRW_{t-3}	-0.003	0.004	-0.002	0.005	0.159*	0.082
ΔRW_{t-4}	-0.003	0.004	-0.002	0.005	0.052	0.082
Constant	11.42*	2.77	4.16	3.49	64.84	54.37
ECT_{t-1}	**-0.080***	**0.044**	**-0.350****	**0.056**	**2.540****	**0.872**
* and ** indicates significance at a 90% and 95% level of confidence respectively						

Table A 1.4b
VECM A
Aggregate Consumption
Parsimonious Results
(No Breaks, ECT Derived from Johansen Test using 3 lags)

Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
ΔC_{t-1}	0.220**	0.070	0.708**	0.095	2.988**	1.420
ΔC_{t-2}	0.217**	0.076	0.600**	0.102	—	—
ΔC_{t-3}	0.346**	0.083	0.153	0.109	—	—
ΔC_{t-4}	—	—	0.193*	0.112	—	—
$\Delta RDPI_{t-1}$	-0.067	0.051	-0.431**	0.068	—	—
$\Delta RDPI_{t-2}$	-0.122**	0.056	-0.095	0.076	—	—
$\Delta RDPI_{t-3}$	-0.084*	0.048	-0.135*	0.076	—	—
$\Delta RDPI_{t-4}$	-0.071	0.046	-0.076	0.062	—	—
ΔRW_{t-1}	—	—	0.003	0.005	-0.047	0.072
ΔRW_{t-2}	—	—	-0.015**	0.005	0.085	0.069
ΔRW_{t-3}	—	—	—	—	0.166**	0.072
Constant	11.38**	2.70	4.28	3.43	37.68	43.54
ECT_{t-1}	**-0.071***	**0.039**	**-0.341****	**0.053**	**2.735****	**0.770**
Joint Significance of Restrictions (p-value):					0.987	
* and ** indicates significance at a 90% and 95% level of confidence respectively						

Table A 1.5a
VECM B
Aggregate Consumption
Full Results
(Break in 1993)

Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error	Parameter Estimate	Standard Error
ΔC_{t-1}	0.213**	0.078	0.766**	0.094	3.440**	1.548
ΔC_{t-2}	0.212**	0.084	0.660**	0.102	-0.110	1.680
ΔC_{t-3}	0.387**	0.094	0.242**	0.113	1.605	1.865
ΔC_{t-4}	0.055	0.094	0.272**	0.114	1.542	1.874
$\Delta RDPI_{t-1}$	-0.078	0.056	-0.469**	0.067	-1.243	1.109
$\Delta RDPI_{t-2}$	-0.139**	0.062	-0.120	0.075	-1.866	1.231
$\Delta RDPI_{t-3}$	-0.091	0.061	-0.159**	0.074	-0.838	1.214
$\Delta RDPI_{t-4}$	-0.076	0.051	-0.063	0.061	-0.680	1.010
ΔRW_{t-1}	0.003	0.004	0.002	0.005	-0.085	0.079
ΔRW_{t-2}	0.000	0.004	-0.014**	0.005	0.076	0.077
ΔRW_{t-3}	-0.002	0.004	-0.001	0.005	0.127	0.082
ΔRW_{t-4}	-0.002	0.004	-0.000	0.005	0.018	0.082
Constant	11.12**	2.79	2.26**	3.38	64.75	55.66
ECT_{t-1}	**-0.089***	**0.051**	**-0.471****	**0.062**	**1.507**	**1.024**
* and ** indicates significance at a 90% and 95% level of confidence respectively						

Table A 1.5b
VECM B
Aggregate Consumption
Parsimonious Results
(Break in 1993)

Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Parameter Estimate	Standard Error	Parameter Estimate	Parameter Estimate	Standard Error	Parameter Estimate
ΔC_{t-1}	0.236**	0.072	0.765**	0.093	3.766**	1.506
ΔC_{t-2}	0.224**	0.077	0.654**	0.099	—	—
ΔC_{t-3}	0.353**	0.085	0.235**	0.106	—	—
ΔC_{t-4}	—	—	0.269**	0.109	—	—
$\Delta RDPI_{t-1}$	-0.079	0.053	-0.468**	0.066	-1.009	0.940
$\Delta RDPI_{t-2}$	-0.131**	0.057	-0.120	0.073	-1.205	0.954
$\Delta RDPI_{t-3}$	-0.080*	0.048	-0.160**	0.073	—	—
$\Delta RDPI_{t-4}$	-0.064	0.046	-0.061	0.059	—	—
ΔRW_{t-1}	—	—	0.002	0.004	-0.085	0.072
ΔRW_{t-2}	—	—	-0.014**	0.005	0.087	0.073
ΔRW_{t-3}	—	—	—	—	0.158**	0.074
Constant	11.34**	2.72	2.33	3.31	64.52	48.35
ECT_{t-1}	**-0.084***	**0.046**	**-0.468****	**0.060**	**1.883****	**0.894**
Joint Significance of Restrictions (p-value):					0.996	
* and ** indicates significance at a 90% and 95% level of confidence respectively						

Table A 1.6a
VECM C
Non-Durable Consumption
Full Results
(Break in 1993)

Variable	ΔNDC Equation		ΔRDPI Equation		ΔRW Equation		ΔRSC Equation		ΔRDC Equation	
	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.
ΔNDC_{t-1}	-0.06	0.08	0.72**	0.36	-3.67	5.42	-0.09	0.10	-0.09	0.10
ΔNDC_{t-2}	-0.07	0.08	0.16	0.36	1.58	5.45	0.07	0.10	0.07	0.10
ΔNDC_{t-3}	0.02	0.08	0.51	0.36	-0.53	5.52	0.05	0.10	0.05	0.10
ΔNDC_{t-4}	-0.14*	0.08	0.40	0.33	-3.17	5.02	-0.08	0.09	-0.08	0.09
$\Delta RDPI_{t-1}$	0.01	0.02	-0.43**	0.08	-0.76	1.14	-0.00	0.02	-0.00	0.02
$\Delta RDPI_{t-2}$	-0.00	0.02	-0.10	0.08	-1.53	1.27	-0.02	0.02	-0.02	0.02
$\Delta RDPI_{t-3}$	0.00	0.02	-0.22**	0.09	0.03	1.31	-0.01	0.02	-0.01	0.02
$\Delta RDPI_{t-4}$	-0.01	0.02	-0.17**	0.08	-0.02	1.20	-0.02	0.02	-0.02	0.02
ΔRW_{t-1}	0.00**	0.00	0.00	0.01	-0.02	0.08	0.00*	0.00	0.00*	0.00
ΔRW_{t-2}	-0.00	0.00	-0.02**	0.01	0.11	0.08	0.00	0.00	0.00	0.00
ΔRW_{t-3}	-0.00	0.00	-0.01	0.01	0.14*	0.09	0.00	0.00	0.00	0.00
ΔRW_{t-4}	0.00	0.00	-0.00	0.01	0.06	0.09	-0.00	0.00	-0.00	0.00
ΔRSC_{t-1}	0.23**	0.07	1.16**	0.29	5.30	4.43	0.08	0.08	0.08	0.08
ΔRSC_{t-2}	0.10	0.07	0.78**	0.30	-1.57	4.59	-0.02	0.08	-0.02	0.08
ΔRSC_{t-3}	0.04	0.07	0.34	0.30	2.19	4.55	0.19**	0.08	0.19**	0.08
ΔRSC_{t-4}	0.06	0.07	0.82**	0.30	-3.96	4.60	-0.07	0.08	-0.07	0.08
ΔRDC_{t-1}	0.18**	0.05	0.61**	0.21	3.68	3.16	0.15**	0.06	0.15**	0.06
ΔRDC_{t-2}	0.13*	0.05	0.76**	0.22	1.66	3.35	0.11*	0.06	0.11*	0.06
ΔRDC_{t-3}	0.15*	0.06	0.20	0.24	3.41	3.67	0.20**	0.07	0.20**	0.07
ΔRDC_{t-4}	0.04	0.06	-0.16	0.24	3.90	3.66	-0.01	0.06	-0.01	0.06
Const.	**0.04**	**0.03**	**-0.64****	**0.11**	**4.37****	**1.65**	**-0.01**	**0.03**	**-0.01**	**0.03**
$\mathbf{ECT_{t-1}}$	-1.9	1.37	-6.54	5.93	75.36	89.75	8.85**	1.58	8.85**	1.58

* and ** indicates significance at a 90% and 95% level of confidence respectively.
NDC, SC, and DC denote Non-Durable Consumption, Services Consumption, and Durable Consumption.

Table A 1.6b
VECM C
Non-Durable Consumption
Parsimonious Results
(Break in 1993)

Variable	ΔNDC Equation		ΔRDPI Equation		ΔRW Equation		ΔRSC Equation		ΔRDC Equation	
	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.
ΔNDC_{t-1}	-0.03	0.07	0.75**	0.34	—	—	—	—	0.09	0.13
ΔNDC_{t-2}	-0.05	0.07	0.23	0.33	—	—	—	—	0.10	0.13
ΔNDC_{t-3}	0.07	0.06	0.46	0.33	—	—	—	—	—	—
ΔNDC_{t-4}	-0.10	0.06	0.40	0.31	—	—	—	—	—	—
$\Delta RDPI_{t-1}$	—	—	-0.43**	0.07	—	—	—	—	-0.04	0.03
$\Delta RDPI_{t-2}$	—	—	-0.09	0.07	—	—	—	—	-0.07**	0.03
$\Delta RDPI_{t-3}$	—	—	-0.23**	0.08	—	—	—	—	—	—
$\Delta RDPI_{t-4}$	—	—	-0.16**	0.07	—	—	—	—	—	—
ΔRW_{t-1}	0.00**	0.00	0.00	0.01	-0.02	0.08	0.00*	0.00	0.00	0.00
ΔRW_{t-2}	—	—	-0.02**	0.01	0.10	0.07	0.00	0.00	-0.00	0.00
ΔRW_{t-3}	—	—	—	—	0.15**	0.07	—	—	-0.01**	0.00
ΔRW_{t-4}	0.24**	0.06	1.10**	0.28	5.20	4.07	0.05	0.07	0.22**	0.11
ΔRSC_{t-1}	0.10	0.06	0.75**	0.29	—	—	-0.07	0.07	0.08	0.11
ΔRSC_{t-2}	—	—	0.17	0.26	—	—	0.15**	0.07	0.22**	0.11
ΔRSC_{t-3}	—	—	0.68**	0.26	—	—	—	—	0.14	0.10
ΔRSC_{t-4}	0.18**	0.05	0.63**	0.20	2.81	2.94	0.15**	0.05	-0.12	0.08
ΔRDC_{t-1}	0.12**	0.05	0.72**	0.21	—	—	0.09*	0.05	0.10	0.08
ΔRDC_{t-2}	0.11**	0.05	—	—	—	—	0.18**	0.05	0.12	0.08
ΔRDC_{t-3}	**0.04****	**0.02**	**-0.61****	**0.10**	**4.73****	**1.35**	—	—	**-0.07***	**0.04**
ΔRDC_{t-4}	-1.32	1.03	-3.37	5.32	9.88	56.31	8.26**	1.34	-2.66	2.06
Const.	-0.03	0.07	0.75**	0.34	—	—	—	—	0.09	0.13
ECT_{t-1}	-0.05	0.07	0.23	0.33	—	—	—	—	0.10	0.13
Joint Significance of Restrictions (p-value): 0.990										
* and ** indicates significance at a 90% and 95% level of confidence respectively. NDC, SC, and DC denote Non-Durable Consumption, Services Consumption, and Durable Consumption.										

Appendix B

As noted in the text, this section includes the VECM results for aggregate consumption and disaggregated consumption. Specifically, Table B 1.1 presents the VECM results for aggregate consumption incorporating a break in the cointegration relationship after 1990:3. Specifically, the break after 1990:3 occurs in all parameters. Table B 1.2 presents the VECM results for non-durable consumption, where the cointegration relationship contains a break in the constant only after 1983:4.

In Table B 1.1, the aggregate consumption results in the ΔC equation are relatively robust to those found in the main body of this study. All three variables adjust with respect to changes in the long run equilibrium between the three. The overall pattern of parameter significance is similar to VECM A and B, including both long run adjustment and Granger-Causality. However, it is important to note, that the ECT of VECM B contains a long run wealth parameter that is statistically zero after 1990:3, and a disposable income parameter that is 1.375. Therefore, although consumption does respond to changes in the long run relationship between the three variables, this response is from changes in disposable income and consumption only after the break. In addition, wealth responds to changes in the relationship between the three variables. This provides some interesting insight in this specification. After 1990, consumption decisions are driven by past consumption and disposable income changes – it appears that wealth plays a passive role only. The only difference between the two is that in VECM B, wealth does not Granger-Cause itself in the short run, which reinforces the passive nature of wealth evolution.

In addition, the finding of long run endogeneity, or long run adjustment of durable consumption and non-durable consumption remains when a structural break after 1983 is included in the long run relationship, and results are contained in Table B 1.2. Further, as found in VECM C, the adjustment of durable consumption is larger, in absolute value, than the adjustment of non-durable consumption, suggesting that the response in durables to changes in the long run relationship is larger than that of non-durable consumption. Therefore, although durable consumption doesn't appear cointegrated with these variables, the result here suggests that there is some kind of relationship between them. Further, there are no major changes in the pattern of Granger-Causality between the variables. Therefore, the long run break in the cointegration relationship plays an important role in the pattern of endogenous response. Finally, the long run exogeneity of service consumption remains when the structural break after 1983 is included.

Table B 1.1 VECM D Aggregate Consumption (Break in 1990)						
Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags
$\Sigma\Delta C_{t-i}$ i=1 to j	(0.000)	3	(0.000)	4	(0.008)	1
$\Sigma\Delta RDPI_{t-i}$ i=1 to j	(0.055)	4	(0.000)	4	(0.299)	1
$\Sigma\Delta RW_{t-i}$ i=1 to j	(0.209)	1	(0.011)	4	(0.246)	3
Constant	11.46 (0.000)	—	4.49 (0.151)	—	43.72 (0.338)	—
ECT_{t-1}	**-0.082* (0.065)**	**—**	**-0.524** (0.000)**	**—**	**2.300** (0.008)**	**—**
Joint Significance of Restrictions (p-value):					0.992	
* and ** indicates significance at a 90% and 95% level of confidence respectively						

Table B 1.2
VECM E
Non-Durable Consumption
(Break after 1983)

Variable	ΔNDC Equation		ΔRDPI Equation		ΔRW Equation		ΔRSC Equation		ΔRDC Equation	
	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags	Joint Sig. (p-value)	# of Lags
$\Sigma\Delta NDC_{t-I}$ I=1 to j	(0.20)	4	(0.06)	1	—	—	—	—	(0.23)	2
$\Sigma\Delta RDPI_{t-I}$ I=1 to j	—	—	(0.00)	3	(0.20)	2	—	—	(0.03)	2
$\Sigma\Delta RW_{t-I}$ I=1 to j	(0.01)	1	(0.00)	2	(0.02)	4	(0.07)	2	(0.05)	3
$\Sigma\Delta SC_{t-I}$ I=1 to j	(0.00)	2	(0.00)	4	(0.22)	1	(0.11)	3	(0.01)	4
$\Sigma\Delta DC_{t-I}$ I=1 to j	(0.00)	3	(0.00)	2	(0.27)	1	(0.00)	3	(0.07)	3
Const.	-1.41 (0.17)	—	-4.48 (0.41)	—	24.20 (0.68)	—	8.28 (0.00)	—	-2.59 (0.21)	—
ECT_{t-1}	**0.05** (0.02)**	—	**-0.37** (0.00)**	—	**5.54** (0.00)**	—	—	—	**-0.069** (0.04)**	—
Joint Significance of Restrictions (p-value): 0.991										

* and ** indicates significance at a 90% and 95% level of confidence respectively.
NDC, SC, and DC denote Non-Durable Consumption, Services Consumption, and Durable Consumption.

Table B 1.3a VECM D Aggregate Consumption Full Results (Break in 1990)						
Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.198**	0.075	0.684**	0.086	3.695**	1.506
ΔC_{t-2}	0.195**	0.082	0.563**	0.094	0.193	1.639
ΔC_{t-3}	0.393**	0.092	0.258**	0.105	1.526	1.839
ΔC_{t-4}	0.066	0.094	0.320**	0.107	1.361	1.871
$\Delta RDPI_{t-1}$	-0.072	0.054	-0.433**	0.062	-1.352	1.085
$\Delta RDPI_{t-2}$	-0.158**	0.063	-0.207**	0.072	-1.565	1.264
$\Delta RDPI_{t-3}$	-0.097	0.061	-0.185**	0.069	-0.739	1.212
$\Delta RDPI_{t-4}$	-0.080	0.051	-0.085	0.058	-0.604	1.009
ΔRW_{t-1}	0.005	0.004	0.011**	0.004	-0.114	0.075
ΔRW_{t-2}	0.003	0.004	0.000	0.004	0.028	0.079
ΔRW_{t-3}	-0.001	0.004	0.007	0.005	0.100	0.081
ΔRW_{t-4}	-0.001	0.004	0.007	0.005	-0.005	0.081
Constant	11.54**	2.76	4.50	3.15	57.68	55.06
ECT_{t-1}	**-0.103****	**0.049**	**-0.523****	**0.055**	**1.720***	**0.969**
* and ** indicates significance at a 90% and 95% level of confidence respectively						

Table B 1.3b VECM D Aggregate Consumption Parsimonious Results (Break in 1990)						
Variable	ΔC Equation		ΔRDPI Equation		ΔRW Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.211**	0.073	0.683**	0.085	3.837**	1.441
ΔC_{t-2}	0.199**	0.078	0.562**	0.093	—	—
ΔC_{t-3}	0.364**	0.086	0.258**	0.104	—	—
ΔC_{t-4}	—	—	0.322**	0.106	—	—
$\Delta RDPI_{t-1}$	-0.060	0.052	-0.433**	0.061	-0.969	0.931
$\Delta RDPI_{t-2}$	-0.126**	0.058	-0.207**	0.071	—	—
$\Delta RDPI_{t-3}$	-0.077	0.048	-0.186**	0.069	—	—
$\Delta RDPI_{t-4}$	-0.068	0.046	-0.085	0.057	—	—
ΔRW_{t-1}	0.005	0.004	0.011**	0.004	-0.107	0.072
ΔRW_{t-2}	—	—	0.000	0.004	0.007	0.075
ΔRW_{t-3}	—	—	0.007	0.005	0.104	0.075
ΔRW_{t-4}	—	—	0.007	0.005	—	—
Constant	11.46**	2.71	4.49	3.11	43.72	45.52
ECT_{t-1}	**-0.082***	**0.044**	**-0.524****	**0.055**	**2.300****	**0.856**
Joint Significance of Restrictions (p-value):					0.992	
* and ** indicates significance at a 90% and 95% level of confidence respectively						

Table B 1.4a
VECM E
Non-Durable Consumption
Full Results
(Break after 1983)

Variable	ΔNDC Equation		ΔRDPI Equation		ΔRW Equation		ΔRSC Equation		ΔRDC Equation	
	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.
ΔNDC_{t-1}	-0.06	0.08	0.69*	0.38	-4.22	5.29	-0.09	0.10	0.07	0.13
ΔNDC_{t-2}	-0.08	0.08	0.04	0.38	0.24	5.33	0.05	0.10	0.24*	0.13
ΔNDC_{t-3}	0.02	0.08	0.34	0.38	-1.75	5.37	0.03	0.10	-0.03	0.14
ΔNDC_{t-4}	-0.14*	0.08	0.30	0.35	-4.18	4.90	-0.09	0.09	-0.11	0.12
$\Delta RDPI_{t-1}$	0.01	0.02	-0.38**	0.08	-0.73	1.10	0.00	0.02	-0.03	0.03
$\Delta RDPI_{t-2}$	-0.00	0.02	-0.03	0.09	-1.47	1.21	-0.01	0.02	-0.08**	0.03
$\Delta RDPI_{t-3}$	-0.00	0.02	-0.14	0.09	0.10	1.26	-0.01	0.02	-0.03	0.03
$\Delta RDPI_{t-4}$	-0.01	0.02	-0.11	0.08	-0.04	1.15	-0.01	0.02	0.00	0.03
ΔRW_{t-1}	0.00**	0.00	0.01	0.01	0.01	0.08	0.00**	0.00	0.00	0.00
ΔRW_{t-2}	-0.00	0.00	-0.02**	0.01	0.15*	0.08	0.00	0.00	-0.00	0.00
ΔRW_{t-3}	-0.00	0.00	-0.00	0.01	0.19**	0.09	0.00	0.00	-0.01**	0.00
ΔRW_{t-4}	0.00	0.00	-0.00	0.01	0.11	0.09	0.00	0.00	0.00	0.00
ΔRSC_{t-1}	0.23**	0.07	1.08**	0.31	5.12	4.31	0.07	0.08	0.25**	0.11
ΔRSC_{t-2}	0.10	0.07	0.69**	0.32	-1.96	4.47	-0.03	0.08	0.11	0.11
ΔRSC_{t-3}	0.04	0.07	0.23	0.31	2.06	4.42	0.18**	0.08	0.25**	0.11
ΔRSC_{t-4}	0.05	0.07	0.82**	0.32	-4.46	4.49	-0.07	0.08	0.21*	0.11
ΔRDC_{t-1}	0.18**	0.05	0.51**	0.22	3.33	3.06	0.15**	0.06	-0.13*	0.08
ΔRDC_{t-2}	0.13**	0.05	0.72**	0.23	1.15	3.28	0.11*	0.06	0.11	0.08
ΔRDC_{t-3}	0.14**	0.06	0.16	0.25	2.72	3.59	0.19**	0.07	0.13	0.09
ΔRDC_{t-4}	0.04	0.06	-0.23	0.25	3.27	3.57	-0.02	0.06	-0.05	0.09
Const.	**0.04***	**0.02**	**-0.42****	**0.11**	**5.90****	**1.48**	**0.02**	**0.03**	**-0.06***	**0.04**
$\mathbf{ECT_{t-1}}$	-1.90	1.36	-5.92	6.21	75.65	87.60	8.88**	1.58	-3.12	2.21

* and ** indicates significance at a 90% and 95% level of confidence respectively.
NDC, SC, and DC denote Non-Durable Consumption, Services Consumption, and Durable Consumption.

Table B 1.4b
VECM E
Non-Durable Consumption
Parsimonious Results
(Break after 1983)

Variable	ΔNDC Equation		ΔRDPI Equation		ΔRW Equation		ΔRSC Equation		ΔRDC Equation	
	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.	Par. Est.	Stan. Err.
ΔNDC_{t-1}	-0.04	0.07	0.69*	0.36	—	—	—	—	0.10	0.13
ΔNDC_{t-2}	-0.06	0.06	—	—	—	—	—	—	0.20	0.13
ΔNDC_{t-3}	0.06	0.06	—	—	—	—	—	—	—	—
ΔNDC_{t-4}	-0.11**	0.06	—	—	—	—	—	—	—	—
$\Delta RDPI_{t-1}$	—	—	-0.38**	0.07	-1.11	0.90	—	—	-0.04	0.03
$\Delta RDPI_{t-2}$	—	—	-0.00	0.07	-1.24	0.91	—	—	-0.07**	0.03
$\Delta RDPI_{t-3}$	—	—	-0.11	0.07	—	—	—	—	—	—
$\Delta RDPI_{t-4}$	0.00**	0.00	0.01	0.01	-0.01	0.07	0.00*	0.00	0.00	0.00
ΔRW_{t-1}	—	—	-0.01**	0.01	0.14*	0.07	0.00	0.00	-0.00	0.00
ΔRW_{t-2}	—	—	—	—	0.19**	0.07	—	—	-0.01**	0.00
ΔRW_{t-3}	—	—	—	—	0.09	0.07	—	—	—	—
ΔRW_{t-4}	0.24**	0.06	1.04**	0.29	4.89	4.01	0.05	0.07	0.22**	0.10
ΔRSC_{t-1}	0.11	0.06	0.65**	0.30	—	—	-0.07	0.07	0.08	0.11
ΔRSC_{t-2}	—	—	0.06	0.27	—	—	0.15**	0.07	0.21**	0.11
ΔRSC_{t-3}	—	—	0.73**	0.27	—	—	—	—	0.15	0.10
ΔRSC_{t-4}	0.18**	0.05	0.52**	0.21	3.21	2.88	0.15**	0.05	-0.12	0.07
ΔRDC_{t-1}	0.12**	0.05	0.71**	0.22	—	—	0.09*	0.05	0.10	0.08
ΔRDC_{t-2}	0.11**	0.05	—	—	—	—	0.18**	0.05	0.12	0.08
ΔRDC_{t-3}	**0.05****	**0.02**	**-0.37****	**0.09**	**5.54****	**1.24**	—	—	**-0.07****	**0.03**
ΔRDC_{t-4}	-1.41	1.03	-4.48	5.47	24.20	57.62	8.28**	1.34	-2.59	2.05
Const.	-0.04	0.07	0.69*	0.36	—	—	—	—	0.10	0.13
$\mathbf{ECT_{t-1}}$	-0.06	0.06	—	—	—	—	—	—	0.20	0.13
Joint Significance of Restrictions (p-value): 0.991										
* and ** indicates significance at a 90% and 95% level of confidence respectively. NDC, SC, and DC denote Non-Durable Consumption, Services Consumption, and Durable Consumption.										

Essay Two

Wealth and Consumption: Assessing the Influence of Assets and Liabilities

Introduction

The previous essay establishes the importance of wealth (equal to assets minus liabilities) on total household consumption in the long run. Fluctuations in aggregate wealth impact consumption in the short run and long run. Through this wealth effect, changes in wealth have implications for aggregate output, since aggregate consumption constitutes two-thirds of total output. Therefore, changes in wealth can have meaningful effects on aggregate real output.

However, using wealth in the empirical analysis may impose unrealistic econometric restrictions. Wealth, in the accounting identity, is simply assets minus liabilities. Using an aggregate wealth measure in the analysis imposes the restriction that assets and liabilities have the same effect, in absolute value, on consumption. However, aggregate consumption may be more sensitive to asset changes than to liability changes, or vice-versa. This essay investigates these issues by disaggregating wealth into assets and liabilities. This study evaluates their respective effects in the long relationship with consumption and income. In addition, since wealth affects different components of consumption differently, the effects from changes in assets and liabilities on these components may be different.

Falling asset prices in the year 2000 may partly explain the current slowdown in aggregate output. Equal changes in assets and liabilities in absolute value lead to equivalent reductions in aggregate wealth, ceteris paribus. This decline in wealth may have been transmitted through the wealth effect, causing diminished or smaller growth in consumption. At the same time, decreases in wealth can be attributed to rising consumer credit, also reducing consumption through the wealth effect. Some research demonstrates

the importance of financial assets in household consumption, but excludes other assets. Still others, such as Modigliani, claim that real estate prices are more important, through the use of homeowner equity loans to finance consumption (Boston Globe, 2002). Given evidence that wealth and consumption are positively related, do changes in assets have an equal effect in absolute value on household consumption as changes in liabilities? Are the consequences of falling values of financial assets upon aggregate consumption the same as rising debt levels? These questions cannot be answered by using disposable income and wealth only as determinants of consumption. A clearer understanding of the effects of assets or liabilities on consumption can only be derived by estimating the separate effects of assets and liabilities, while controlling for personal income. This essay investigates the relationship between disposable income, total assets, total liabilities, and the respective components of consumption. The goal is to determine whether assets and liabilities affect each component of consumption differently.

Literature Review

Many "wealth" studies actually focus on assets (or categories of assets), rather than net wealth (assets less liabilities). Among studies that focused on assets, several have shown different impacts from different asset types. Several empirical studies have shown that changes in different measures of assets influence consumption. Carruth and Henley (1990), using a very specific definition of wealth (defined as net financial assets plus housing stock), find important effects on consumption. An analysis of Japanese households by Ogawa, Kitasaka, Yamaoka, and Iwata (1996) shows that the impacts of liquid versus illiquid wealth on consumption differ. However, these studies use only

subsets of wealth or assets, not total aggregate assets or liabilities, possibly excluding important information. Therefore, these papers may omit relevant information, and not fully capture the "true" effect of asset changes on consumption.

Bosworth (1975) finds differing effects on consumption from stock price changes versus those from non-equity wealth.[24] Further, he finds that the effects on consumption from stock price changes and non-equity wealth are limited to consumption of non-durables plus services. For equity wealth, Bosworth's parameter estimates range from 0.046 for aggregate consumption and 0.059 for non-durable plus services consumption. For non-equity wealth, every dollar increase creates 6.9 cents of new consumption. More recently, Poterba and Samwick (1995) find evidence that changes in lagged stock market prices induce short run changes in aggregate consumption, durable consumption, non-durable consumption, and services consumption. A one dollar increase in stock prices leads to 6.4 cents of new consumption, 13.9 cents of new durable consumption, 5.4 cents of new non-durable consumption, and 2.5 cents in new services consumption. Poterba and Samwick use equity prices, which constitute only a subset of aggregate assets in the household balance sheet. In addition, the conflicting evidence concerning the effect of assets on durable consumption warrants further study.

The liquidity hypothesis analyzed by Mishkin (1976, 1977, and 1978) supports the view that households respond differently to changes in household assets than to changes in liabilities. Mishkin theoretically develops the Liquidity Model to investigate the behavior of consumer durables. Using data spanning from the early fifties through the early seventies, Mishkin empirically finds the response of durable consumption is larger

[24] Non-equity wealth is defined as aggregate wealth less assets held in stocks.

for liability changes than for asset changes. Looking at demand by households for long-lived assets, Mishkin attributes some historical movements in aggregate demand to changes in the aggregate balance sheet. Mishkin's research is among the first to identify the different effects of assets and liabilities on consumption, but it investigates the behavior of durable consumption only. Important substitution effects between components of consumption (non-durable, durable, and services consumption), which were found in the previous essay, are omitted from Mishkin's analysis.

Evidence supporting Mishkin's liquidity hypothesis is mixed, however. McCarthy (1993) finds no long run effects from changes in assets and liabilities on durables consumption. In fact, the causality appears to run bi-directional; the household balance sheet affects durable purchases, but durable purchases also determine the aggregate balance sheet. Also, McCarthy (1997) suggests that household debt has little influence over consumer spending in the short run. In other words, total liabilities may exert no transitory influence on consumption, contrary to Mishkin's results. However, the existence of any cointegration relationship between consumption and liabilities is not investigated, and, if any exists, is omitted from McCarthy's 1997 paper.

To conclude, some of the past literature looks at the response of consumption to individual balance sheet components only. These papers risk creating omitted variable bias by excluding some components of assets and liabilities. Others, like Mishkin and McCarthy, use total assets and liabilities, but investigate their influence on consumer durables only. The use of durable consumption only ignores important substitution effects between consumption categories. Further, the conflicting evidence between Mishkin's and McCarthy's results requires further investigation.

Contribution

This essay contributes to the current field of knowledge in several ways. First, the separate effects of assets and liabilities on long run consumption are investigated. Previous research investigates the effects of certain categories of assets on consumption, omitting possibly relevant effects. Aggregate wealth is disaggregated here, so the relationship between consumption and all components of assets and liabilities is examined. Research such as Bosworth's, which disaggregates stock market assets from wealth, still imposes the restriction that non-stock assets and liabilities affect consumption equally.

In addition, total consumption is replaced by its disaggregated components; cointegration is tested for accordingly. Further, these long run relationships are tested for the existence of any structural breaks. The disaggregated analysis of Mishkin and McCarthy ignores important substitution effects identified in Essay One. Here, the effects of assets and liabilities on *all* disaggregated components of consumption are examined, allowing for substitution effects between components of consumption.

Finally, the short run dynamics of consumption, income, assets, and liabilities are investigated. The previous literature ignores the possible long run endogeneity of disposable income or balance sheet categories. Vector Error-Correction Model (VECM) methodology is used to investigate the long run endogeneity (endogenous response) of all variables in the long run relationship.

This essay provides evidence on the behavior of consumption, allowing separate influence from assets and liabilities. First, the long run influences of assets and liabilities on consumption concurrently are investigated. Also, any relevant substitution effects are

considered when consumption is disaggregated. Finally, investigations into the permanent and transitory effects of assets and liabilities on aggregate consumption are considered. The findings suggest that liabilities play no significant role in determining aggregate consumption, if there is no change in technology. In addition, excluding liabilities from the cointegration relationship induces almost no omitted variable bias. Assets appear to play a key role in determining future consumption, and appear to drive the wealth effect identified in Essay One.

Empirical Methods

Properties of Assets and Liabilities

The empirical investigation in this essay utilizes the variables from the same sources as Essay One. As previously mentioned, the *Balance Sheet of the United States* details aggregate wealth, assets, and liabilities. Assets are broken into tangible assets and financial assets. Tangible assets include housing, such as owner-occupied, unoccupied secondary homes, homes for sale, and vacant property. Housing assets are included at market value. Other tangible assets, such as equipment and durable goods, are valued at replacement cost. Financial assets include equities, mutual funds, demand deposits and currency, bonds, and other securities; and these are also listed at current market value. Also under wealth, liabilities include mortgages and home equity loans, consumer credit, bank loans, and other miscellaneous entries.[25] Aggregate consumption and its disaggregated components, disposable income, GDP deflator, and population are gathered from the Federal Reserve Bank of St. Louis's FRED.

[25] See Table A 1.3 of Essay One for all balance sheet categories.

This essay disaggregates wealth into its two major subcategories, assets and liabilities. Assets and liabilities are deflated using the GDP deflator. In addition, assets and liabilities in any quarter are measured as beginning-of-period values. Therefore, as in the previous essay, the sample range runs from 1952:2 to 2002:2. All variables are in real terms and are adjusted for population changes.

Descriptive statistics are given in the Appendix.[26] The correlation matrix in Table 2.1 reveals interesting patterns. The pattern of correlation for assets closely resembles that between wealth and all other variables in Essay One. The correlation of real liabilities with all other variables, especially the consumption variables, is negligible. Therefore, the pattern of correlation in the disaggregated wealth series foretells some possible interesting results. Might aggregate assets be the prime driver of consumption and consumption categories?

Further, if we examine the relationship between liabilities and assets with aggregate wealth in Table 2.1, we see a strong correlation between assets and wealth. In fact, assets and wealth are highly correlated, having an estimated correlation of 0.997. Liabilities, on the other hand are not highly correlated with either assets or wealth. This pattern of correlation can also be seen in Figure 2.1. The high degree of correlation between assets and wealth can be seen in the identical movements of wealth and assets over time, which is not apparent between liabilities and wealth. Further, liabilities are approximately one-sixth the size of assets, so assets should dictate most of the movements in wealth.

[26] Real liabilities appears to contain two unit roots. The descriptive statistics are meaningful for stationary series only, since the means are non-reverting and the variances depend upon time. Given this, the descriptive statistics of the second difference of liabilities and first difference of all other variables are given. See Unit Root Tests for further details.

Table 2.1
Correlation of Variables

Panel A: Correlation between consumption, consumption components, income, assets, and liabilities

	ΔRC	ΔRNDC	ΔRSC	ΔRDC	ΔRDPI	ΔRA	Δ^2RL
ΔRC	1	0.759	0.632	0.809	0.423	0.282	0.074
ΔRNDC	0.759	1	0.446	0.378	0.483	0.286	0.033
ΔRSC	0.632	0.446	1	0.234	0.374	0.285	-0.037
ΔRDC	0.809	0.378	0.234	1	0.136	0.090	0.124
ΔRDPI	0.423	0.483	0.374	0.136	1	0.338	0.089
ΔRA	0.282	0.286	0.285	0.090	0.338	1	0.141
Δ^2RL	0.074	0.033	-0.037	0.124	0.089	0.141	1

Panel B: Correlation between Assets, Liabilities, and Wealth

	Δ^2RL	ΔRA	ΔRW
Δ^2RL	1	0.141	0.099
ΔRA	0.141	1	0.997
ΔRW	0.099	0.997	1

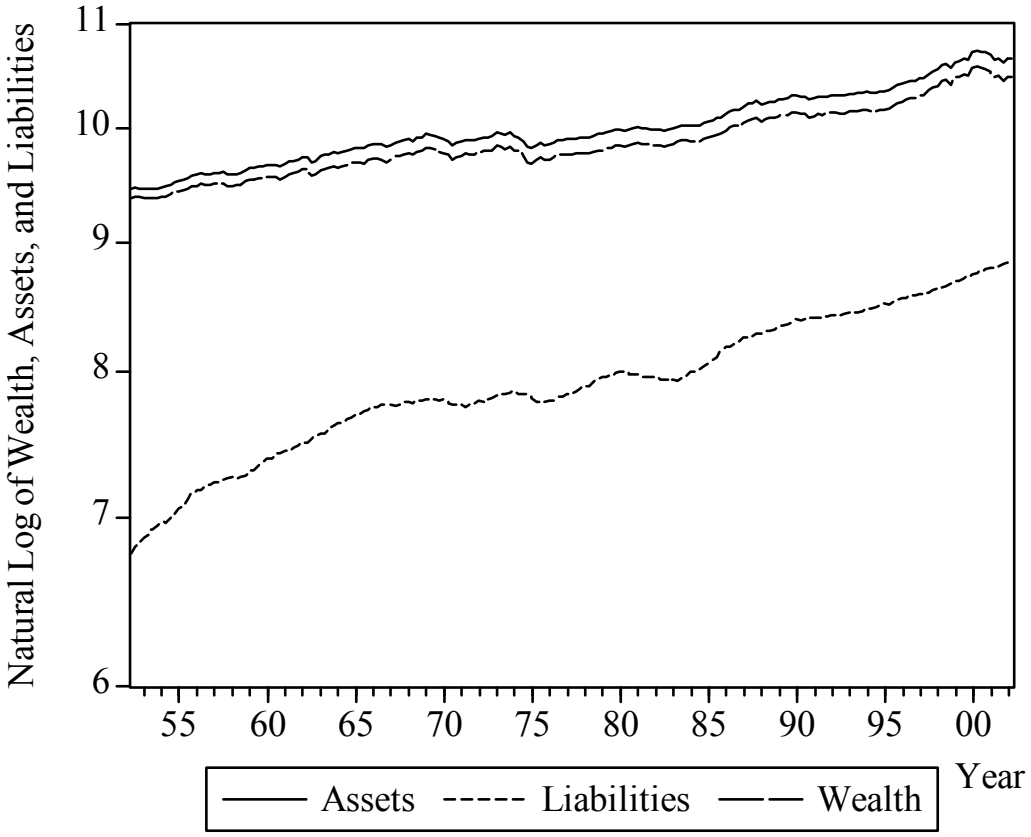


Figure 2.1
Assets, Wealth, and Liabilities - 1952:2 - 2002:2

Empirical Strategy

This essay seeks to examine the robustness of the results found in the previous essay. In the previous essay, wealth was found to share a long run relationship with income and consumption. Assessments of net wealth presume that changes in assets and liabilities have equal impacts (in absolute value) on consumption in the long run. In other words, a given increase in assets and an equal increase in liabilities leaves wealth unchanged, and therefore has no influence on consumption. However, this presumption may be inaccurate.

This essay examines the long run relationship between consumption, disposable income, assets, and liabilities. In addition, this essay also estimates the long run relationship between disaggregated components of consumption with income, assets, and liabilities. The robustness of these long run relationships is examined through a series of robustness tests that examine the sensitivity of the parameter estimates to the exclusion of liabilities. The empirical methodology and procedures match those of Essay One in the Empirical Results section. These include the use of cointegration tests, structural break tests, and VECMs.

Unit Root Tests

Before estimating any long run relationships, the order of integration for all variables must be examined. Essay One contains the unit root tests for all consumption measures and disposable income. The results from the unit root tests in Essay One indicated that all measures of consumption and disposable income contained one unit root. The order of integration of assets and liabilities are left to estimate.

As in Essay One, three principle unit root tests are used: the Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1981), the Phillips-Perron (PP) test (Phillips and Perron, 1988), and the KPSS test (Kwiatkowski, et. al., 1992). The null hypothesis under the first two tests is that a unit root exists in the data generating process, while the null hypothesis in the KPSS test is stationarity.

The results of unit root tests for assets and liabilities in levels are given in Table 2.2a. As expected, assets and liabilities contain at least one unit root. All tests indicate that assets and liabilities in levels are non-stationary. The next set of unit root tests estimates the properties of the variables in first differences. Table 2.2b gives the results of the ADF, PP, and KPSS tests for the first difference of assets and liabilities. Taking the first difference of assets results in a stationary process (in all tests). This is not true of liabilities. The ADF and KPSS tests indicate that the first difference of real liabilities is not stationary, while the PP test indicates stationarity.[27] This is an interesting and surprising result. Estimation of the unit root tests on the second difference of liabilities (Δ^2 Liabilities) yields a stationary process. This result indicates that shocks to liabilities have a persistent impact on the *change* in liabilities. The evolution of liabilities differs substantially from assets.

Figures 2.2a, 2.2b, and 2.2c provide graphical evidence confirming the non-stationary result for the first difference in liabilities. Figure 2.2a is the graph of liabilities in levels. The graph uses a logarithmic scaling, so the slope of the line represents growth rates. One can see that the period from around 1965 to1985 is characterized by a

[27] The KPSS test has greater power than the ADF or PP test. Given the results of the KPSS and ADF tests, the first difference of liabilities is treated as a non-stationary series. The results from the Johansen test validate this treatment.

Table 2.2a
Unit Root Tests
Variables in Levels
(8 Lags in the ADF and KPSS Tests)

Variable	Constant Only			Constant and Time Trend		
	ADF Test Statistic (5% CV = -2.88)	PP Test Statistic (5% CV = -2.88)	KPSS Test Statistic (5% CV = 0.46)	ADF Test Statistic (5% CV = -3.43)	PP Test Statistic (5% CV = -3.43)	KPSS Test Statistic (5% CV = 0.15)
Assets	0.92	1.46	2.02	-0.99	-0.72	0.429
Liabilities	2.01	3.68	2.15	0.58	1.62	0.47

ADF and PP tests the null of a unit root, while KPSS tests the null of a stationary series.

Table 2.2b
Unit Root Tests
Variables in Differences
(8 Lags in the ADF and KPSS Tests)

Variable	Constant Only			Constant and Time Trend		
	ADF Test Statistic (5% CV = -2.88)	PP Test Statistic (5% CV = -2.88)	KPSS Test Statistic (5% CV = 0.46)	ADF Test Statistic (5% CV = -3.43)	PP Test Statistic (5% CV = -3.43)	KPSS Test Statistic (5% CV = 0.15)
Δ Assets	-3.58	-14.36	0.38	-3.85	-14.49	0.08
Δ Liabilities	-1.85	-11.57	0.84	-2.73	-12.46	0.216
Δ^2 Liabilities	-4.96	-39.15	0.03	-5.01	-39.15	0.02

ADF and PP tests the null of a unit root, while KPSS tests the null of a stationary series.
Δ Represents the first-difference operator.

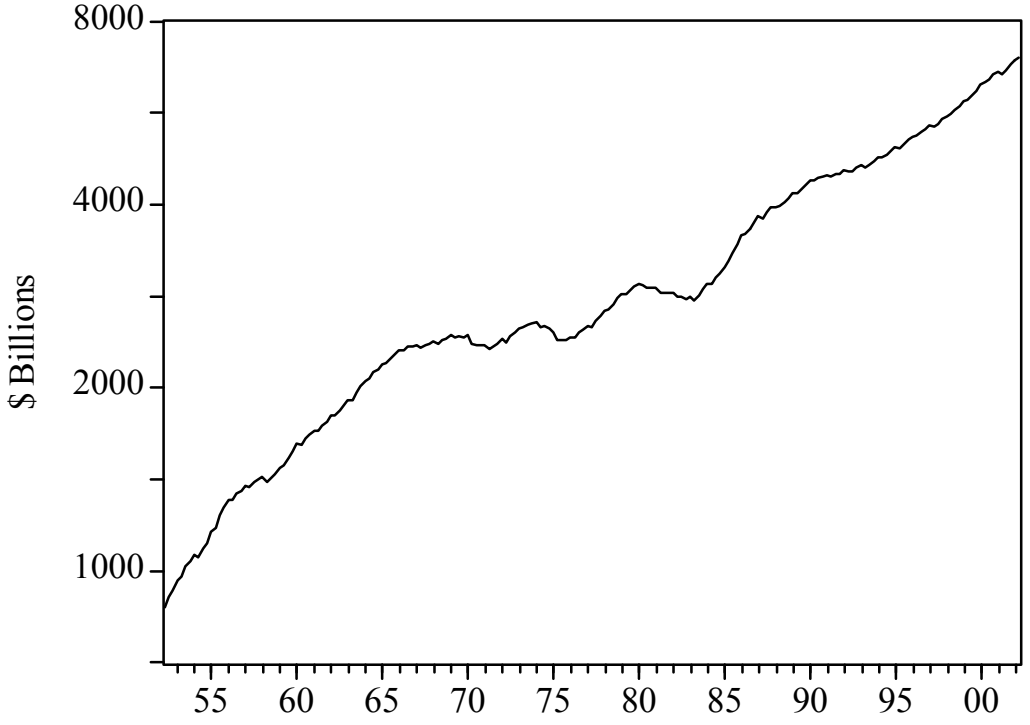


Figure 2.2a
Real Household Liabilities - 1952:2 - 2002:2

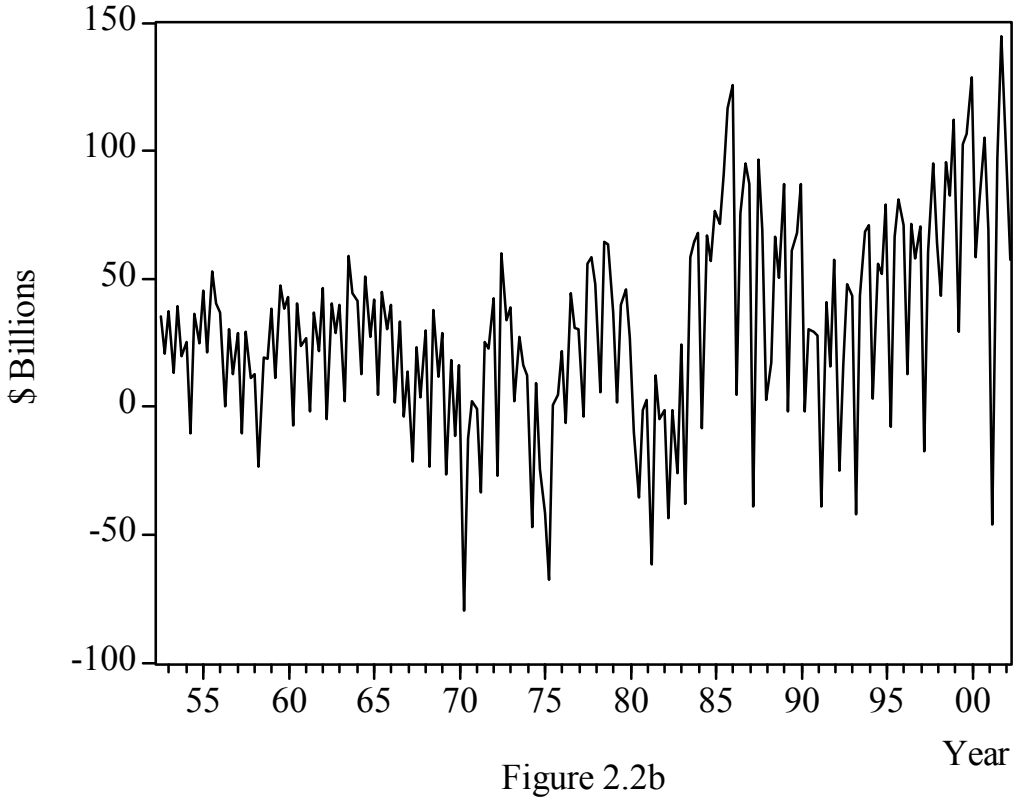


Figure 2.2b
First Difference of Real Household Liabilities - 1952:2 - 2002:2

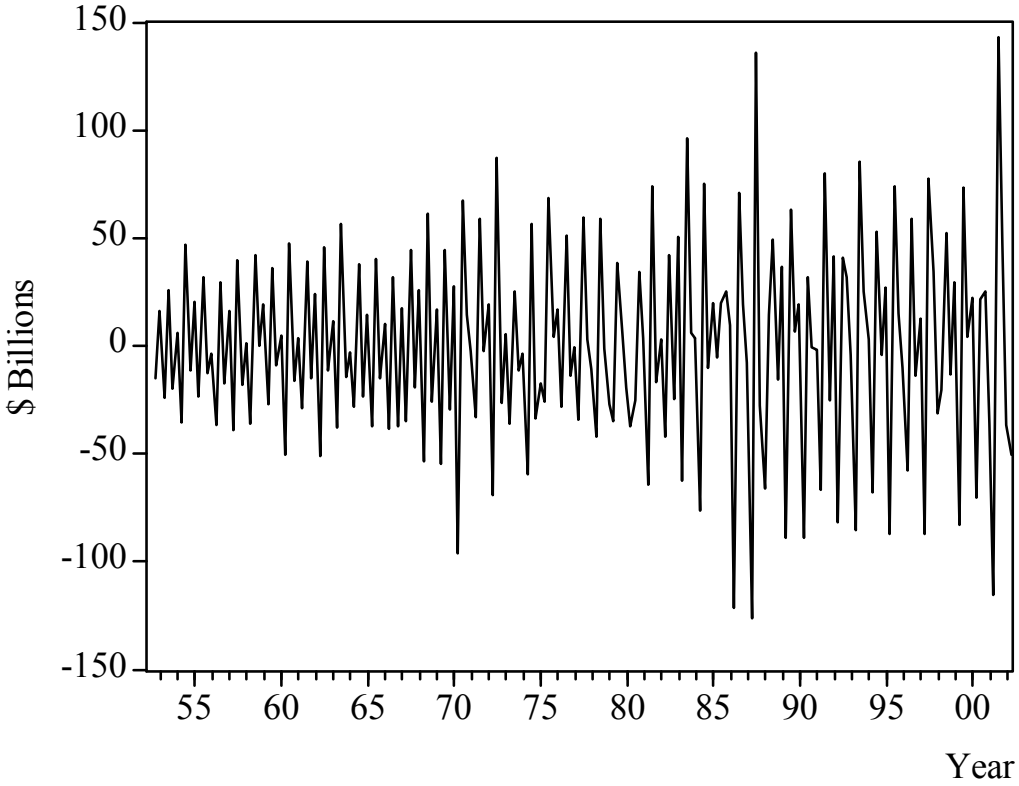


Figure 2.2c
Second Difference of Real Household Liabilities - 1952:2 - 2002:2

different growth rate in liabilities than the remaining periods. The differences in growth rates between decades can be clearly seen in Figure 2.2b, which is a graph of the first differences of real liabilities. In fact, there appears to be a trend in the rate of change in liabilities beginning in the early 1990's, and the variability seems to increase through the sample. Finally, in Figure 2.2c, taking the second difference in liabilities appears to result in a stationary process. Given these results, the empirical methods will be slightly modified from Essay One. All cointegration tests include the first difference of liabilities, since the first difference of liabilities contains a unit root, or ~I(1). All other variables are included in levels in the cointegration tests.

Cointegration Tests

In Essay One, cointegration initially was tested using the Johansen procedure (Johansen, 1991). This procedure is used in this essay (see Cointegration Tests in Essay One for fuller discussion). The Akaike Information Criterion (AIC) (Akaike, 1974) and the Schwarz Criterion (SC) (Schwarz, 1978) are used to find the number of lags to start with for the Johansen test.[28] Table 2.3 gives the results of AIC and SC, which indicates the appropriate number of lags.

The AIC and SC results diverge significantly, unlike those contained in essay one.[29] The SC results are similar to Essay One. The AIC results suggest a large number of lags. It is important to note that the SC and AIC provide a starting point only. The number of lags indicated might still be insufficient to remove residual serial correlation, which invalidates the results of the Johansen test. This essay begins with the number of

[28] Generally the AIC and SC give different results. In particular, due to the nature of the criteria, the AIC usually suggests a larger number of lags than the SC.
[29] Robustness tests indicate that using the level of liabilities does not alter the results of Table 2.3. Therefore, using the first difference of liabilities has no impact on the suggested lag length.

Table 2.3 Akaike Information and Schwarz Criterion		
VAR	Number of lags indicated by:	
	AIC	SC
Total Consumption	At least 38	1
Disaggregated Consumption	At least 24	1

lags suggested by the SC, and then adds lags until the results are no longer substantially altered by the addition of these lags.

The cointegration results for aggregate consumption are given in Panel A of Table 2.4, and the test VAR employs twelve lags. As found in the previous essay, the results suggest one cointegration or long run relationship between the four variables. Normalizing on consumption, the parameter estimate for disposable income is relatively robust compared to Essay One (-0.689 compared with –0.723 in Essay One). In addition, the parameter on assets (-0.036) closely resembles that found on wealth (-0.039). Aggregate liabilities, on the other hand, have no significant influence on the long run relationship, with the estimated parameter being zero statistically. Therefore, as seen in the simple correlation matrix, the role of liabilities appears limited in determining the value of consumption, at least in the long run given the results so far.

Since the long run parameter on real liabilities is statistically zero, the cointegration space can be restricted, namely restricting the coefficient on liabilities to zero. The feasibility of the restriction can then be tested. Testing the null hypothesis of a parameter value of zero for liabilities in the long run relationship results in a failure to reject, with an associated p-value of 0.711.

Table 2.4, Panel B gives the results of the Johansen test, where liabilities are restricted to zero. However, liabilities are not fully excluded from the test VAR; they are still included as an exogenous variable. Results prove to be highly robust to the results in Panel A. The parameter estimates on the remaining variables in the cointegration relationship are almost identical to those in Panel A of Table 2.4, and one long run relationship is found. In fact, given the low correlation between liabilities and

Table 2.4
Aggregate Consumption
Johansen Cointegration Test Results

Panel A: Johansen Test Including Liabilities from the Cointegration Space

Number of Cointegration Equations (Null Hypothesis)	Eigen Statistic	5% Critical Value	Trace Statistic	5% Critical Value
r = 0	35.51*	27.07	53.03*	47.21
r ≤ 1	9.84	20.97	17.52	29.68
r ≤ 2	7.33	14.07	7.69	15.41
r ≤ 3	0.36	3.76	0.36	3.76

Cointegration Relationship:

Total Consumption	Disposable Income	Assets	ΔLiabilities
1.000	-0.689 (0.015)	-0.036 (0.003)	0.156 (0.417)

Panel B: Johansen Test Excluding Liabilities from the Cointegration Space

Number of Cointegration Equations (Null Hypothesis)	Eigen Statistic	5% Critical Value	Trace Statistic	5% Critical Value
r = 0	43.35*	20.97	43.36*	29.68
r ≤ 1	6.78	14.07	6.89	15.41
r ≤ 2	0.11	3.76	0.11	3.76

Cointegration Relationship:

Total Consumption	Disposable Income	Assets
1.000	-0.682 (0.016)	-0.038 (0.003)

* indicates rejection of the null at a 95% level of confidence.
Standard error in parenthesis.
Critical values provided by Osterwald-Lenum (1992), Table 1.

consumption, previous studies that use assets only to investigate wealth effects may suffer from little omitted variable bias, if any.

The Johansen test appears to confirm the results of the unit root tests, specifically the finding of two unit roots in aggregate liabilities. Taking the first difference of liabilities does not create a stationary series. As noted in Harris (1995), the inclusion of a variable that is ~I(0) (or stationary) results in identification of an additional cointegrating vector, since that variable by itself creates a stationary variable. Note that results in both panels of Table 2.4 suggest one cointegrating vector. If the first difference of real liabilities were indeed stationary, then the number of cointegrating vectors between the two tests should differ, since liabilities is included in one test and excluded from the other.[30]

Given the evidence from the correlation matrix and the Johansen test for aggregate consumption, an alteration is made to the cointegration estimation. In this alteration, the Johansen test is estimated excluding liabilities from the long run relationship. However, the results are still conditioned on liabilities by leaving it in the specification as an exogenous variable. Results of the Johansen test, excluding liabilities from the long run relationship, become stable after the use of fourteen lags in the test VAR. This is consistent with the lag length used for the aggregate consumption test. The results are given in Table 2.5.

[30] To see this, assume that the first difference of liabilities is stationary, then results in Panel A of Table 2.4 should indicate at least one cointegrating vector. When liabilities are excluded from the cointegrating vector in Panel B, then the indicated number of vectors should be one less than that in Panel A, since it would exclude a stationary variable. This is not the case here – both tests indicate one cointegration relationship. ΔLiabilities is not ~I(0), it is ~I(1), since both Johansen tests indicate one cointegration relationship.

Table 2.5
Disaggregated Consumption
Johansen Cointegration Test Results

Number of Cointegration Equations (Null Hypothesis)	Eigen Statistic	5% Critical Value	Trace Statistic	5% Critical Value
$r = 0$	37.48*	33.46	75.72*	68.52
$r \leq 1$	23.73	27.07	38.24	47.21
$r \leq 2$	8.70	20.97	14.51	29.68
$r \leq 3$	5.74	14.07	5.81	15.41
$r \leq 4$	0.07	3.76	0.07	3.76

Cointegration Relationship:

Non-Durable Consumption	Disposable Income	Assets	Durable Consumption	Services Consumption
1.000	-0.738 (0.098)	-0.029 (0.004)	0.823 (0.246)	1.053 (0.163)

* indicates rejection of the null at a 95% level of confidence.
Standard error in parenthesis.
Critical values provided by Osterwald-Lenum (1992), Table 1.

Disaggregating wealth into assets and liabilities also has a substantial impact on the long run parameter estimates in the disaggregated consumption cointegration relationships. The parameter on disposable income (0.738) is larger than the range of estimates in Essay One (0.365 to 0.508), and it is close to that found in the Endogenous Wealth literature (≈0.718).[31] The parameter on assets closely matches that found on wealth in Essay One – a range of 0.022 to 0.028 for wealth compared with 0.029 above. Thus far, disaggregating wealth into assets and liabilities has led to some interesting contributions and results. First, examining the properties of the variables reveals that assets, like wealth, contain one unit root, but liabilities, which are nearly one-sixth the size of assets, has two unit roots. Further, in the long run relationships estimated, liabilities appear to play no major role in determining the evolution of assets, consumption, or disposable income. In addition, disaggregating wealth into assets and liabilities results in finding cointegration between disaggregated consumption components, assets, and disposable income. This differs from results in Essay One, but only when liabilities are excluded from the cointegration relationship. Recall that when assets are replaced with wealth, as in Essay One, the Johansen test fails to indicate a single cointegration relationship.

Finally, there appears to be little bias from excluding liabilities from the cointegration relationships. This should not be surprising considering the small

[31] Recall that the Endogenous Wealth literature finds an endogenous response in wealth only. Consumption does not respond to changes in wealth or disposable income in the long run. Changes in wealth have on temporary impacts on consumption.

correlation between liabilities and all forms of consumption. So, the results here indicate that the use of assets instead of wealth does not materially alter the results.

Structural Break Tests

Significant structural breaks were found in the cointegration relationships in Essay One (see Structural Break Tests section in Essay One). However, the structural breaks had no substantial impact on the general results. It is possible that disaggregating wealth into assets and liabilities will alter the results of the tests. Therefore, the Gregory-Hansen tests for cointegration in the presence of structural breaks are re-estimated for the cointegration relationships in Tables 2.4, Panel B and 2.5.

Table 2.6 provides the results of the Gregory-Hansen test for the cointegration relationship containing aggregate consumption, disposable income, and assets. Substituting assets for wealth slightly alters the results of the test, but the general conclusions still hold. Tests indicate a potential break in the constant around the end of 1993 or a break in all parameters at the end of 1990. Therefore, using assets instead of wealth seems to generate robust results.

The similarity of break test results for aggregate consumption carries over to disaggregated consumption in Table 2.7. Again, using assets instead of wealth does not substantially alter the break test results. As was found in Essay One, breaks appear in the constant only after 1983 and after 1992 in the long run relationship between disaggregated consumption, income, and assets.

Therefore, the results here are robust to those in Essay One, even with the exclusion of liabilities from these relationships. Again, none of these structural break

Table 2.6 **Gregory and Hansen Tests of Consumption**		
Break in:	ADF* Statistic	Z_α Statistic
Constant	-4.57 (1994:2)	-75.12** (1994:1)
All Parameters	-4.73 (1982:4)	-88.67** (1990:4)
** signifies significance at the 95% level. The 95% (90%) level of confidence critical values are –4.92 (-4.69) for the ADF* test and –46.98 (-42.49) for the Z_α test for breaks in the constant. The 95% (90%) level of confidence critical values are –5.50 (-5.23) for the ADF* test and –58.33 (-52.85) for the Z_α test when testing for a break in disposable income, and wealth. Critical values are provided by Gregory and Hansen (1996) Table 1, pg. 109.		

Table 2.7 **Gregory and Hansen Tests of Non-Durable Consumption**		
Break in:	ADF* Statistic	Z_α Statistic
Constant	-6.73** (1984:1)	-78.01** (1992:4)
All Parameters	-4.48 (1987:2)	-18.64 (1985:2)
** signifies significance at the 95% level. The 95% (90%) level of confidence critical values are –5.56 (-5.31) for the ADF* test and –59.40 (-54.38) for the Z_α test for breaks in the constant. The 95% (90%) level of confidence critical values are –6.41 (-6.17) for the ADF* test and -78.52 (-72.56) for the Z_α test when testing for a break in disposable income, wealth, and other consumption measures. Critical values are provided by Gregory and Hansen (1996) Table 1, pg. 109.		

results should be surprising, given the cointegration evidence. The next step is to determine the parameter estimates in the presence of the structural breaks.

Cointegration Results in the Presence of Structural Breaks

It should not be surprising that the cointegration results incorporating structural breaks are almost identical to those in Essay One, given the results in this essay up to this point. The results for aggregate consumption, incorporating the break after 1993 identified by the Gregory-Hansen test, are provided in Table 2.8. Indeed, they are relatively robust to the cointegration results in Essay One. The income parameter is 0.764. Further, the estimated assets parameter is 0.021. In fact, the parameter results on income and assets are almost equivalent to those in Table 1.8.

The results for cointegration of the disaggregated relationships, incorporating structural breaks, are given in Tables 2.9 and 2.10. The range of income parameters estimates is slightly offset from those in Essay One, ranging from 0.396 to 0.532 (compared to 0.365 to 0.508 in Essay One). Also, the range of asset parameters is smaller than the wealth parameters in Essay One: from 0.019 to 0.024, compared with 0.022 to 0.028.

As in Essay One, there appear to be important substitution effects between the consumption categories. In fact, the exclusion of liabilities from the cointegration relationship has some substantial effects on the range of possible substitution effects. The range of parameters in Tables 2.5, 2.9, and 2.10 on durable goods consumption is –0.476 to –0.823 and –0.477 to –1.053 for services consumption.

The cointegration results and subsequent long run parameters differ substantially from previous literature. Previous research estimates the range of wealth/asset

Table 2.8 **Cointegration Results** **Aggregate Consumption** **(Break after 1993)**		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.764**	0.023
Real Assets	0.021**	0.004
Constant	62.42**	19.88
φ_t * Constant (1994:1)	103.30**	24.78
** indicates significance at a 95% level of confidence		

Table 2.9 **Cointegration Results** **Non-Durable Consumption** **(Break after 1983)**		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.396**	0.052
Real Assets	0.024**	0.002
Services Consumption	-0.477**	0.092
Durable Consumption	-0.476**	0.118
Constant	262.14**	41.11
φ_{It} * Constant (1984:1)	-44.67**	7.90
** indicates significance at a 95% level of confidence		

Table 2.10 **Cointegration Results** **Non-Durable Consumption** **(Break in 1992)**		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.532**	0.055
Real Assets	0.019**	0.004
Services Consumption	-0.687**	0.101
Durable Consumption	-0.503**	0.160
Constant	242.08**	56.57
φ_{It} * Constant (1992:4)	43.54**	19.24
** indicates significance at a 95% level of confidence		

parameters in the cointegration relationship for aggregate consumption to be between 0.046 and 0.064, compared to 0.021 to 0.038 here. Also, cointegration is found between disaggregated components of consumption, which includes durable consumption. The range of wealth/assets parameters for disaggregated consumption is 0.025 to 0.139, compared to 0.019 here.

The finding of cointegration for disaggregated consumption, including durable consumption, runs counter to McCarthy's examination. McCarthy finds weak evidence of cointegration. In addition, Mishkin finds that aggregate liabilities play an important role in determining durable consumption, but aggregate liabilities have no influence on the long run behavior of durable consumption in this essay.

The empirical evidence thus far provides some interesting insights. It appears that liabilities play only a passive role in the evolution of consumption, income, and assets over the long run. Cointegration estimates here are relatively robust to those in Essay One, even when aggregate liabilities are excluded from these long run relationships. So, liabilities seem to play no role at all in the determination of consumption in the long run. However, liabilities may still prove to be a viable determinant of consumption in the short run. The next section models the short run dynamics and long run adjustment of aggregate consumption, disposable income, assets, and liabilities through the VECM methodology.

Long Run Adjustment and Short Run Dynamics

This section examines the dynamic behavior of aggregate consumption. In total, two VECMs are estimated. The first VECM incorporates the long run relationship estimated in Panel B of Table 2.4, where the long run relationship between consumption,

income, and assets excludes any structural breaks. The second VECM uses the error-correction term (ECT) derived from the long run relationships that incorporate a structural break after 1993 from Table 2.8.

As in Essay One, the VECM methodology begins with four lags of all variables in the long run relationship. Further, liabilities are added to the VECM specification, but still excluded from the ECT. Therefore, liabilities are allowed to respond in the long run to changes in the relationship between assets, income, and consumption.

The two VECMs are then reduced to a parsimonious model, as in Essay One. The results in Tables 2.11 and 2.12 give the joint significance of the restrictions imposed through this model reduction in the next to last row of each table. Further, the joint significance of the included parameters is presented, which gives the short-run Granger Causality of the included lags.

Table 2.11 contains the results for the VECM that excludes structural breaks in the ECT. As found in Essay One, consumption and disposable income are endogenous in the long run to changes in the equilibrium relationship. This result indicates that a change in aggregate assets has a permanent impact on the long run evolution of income and consumption. In addition, disaggregating wealth once again reveals the importance of assets. Here, assets, like wealth, adjust to changes in all variables in the long run. Aggregate liabilities are exogenous on the other hand. Further, disaggregating wealth into assets and liabilities has no effect on the endogeneity of aggregate consumption. The short-run Granger Causality results support the weak role of liabilities in determining consumption. Not only do liabilities play no apparent role in the long run evolution of consumption, assets, or income, but liabilities are the Granger-Cause of liabilities only.

Table 2.11 VECM F Aggregate Consumption								
	ΔRC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
Variable	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags
$\Sigma\Delta RC_{t-I}$ i=1 to j	(0.000)	3	(0.000)	2	(0.012)	1	(0.000)	4
$\Sigma\Delta RDPI_{t-i}$ i=1 to j	(0.031)	4	(0.000)	1	—	—	(0.002)	3
$\Sigma\Delta RA_{t-I}$ i=1 to j	—	—	(0.012)	2	(0.031)	3	(0.000)	4
$\Sigma\Delta^2 RL_{t-I}$ i=1 to j	—	—	(0.415)	4	—	—	(0.000)	4
Constant	(0.000)	—	(0.048)	—	(0.344)	—	(0.006)	—
ECT_{t-I}	**-0.083 (0.030)**	—	**-0.283 (0.000)**	—	**2.513 (0.001)**	—	—	—
Joint Significance of Restrictions (p-value):							0.872	
* and ** indicates significance at a 90% and 95% level of confidence respectively								

The results in VECM F support the impotence of liabilities in determining consumption, assets, and income. In addition, if one thinks of assets as the prime driver of wealth in the short run and long run, the pattern of Granger-Causality exactly matches that in VECM A (see Table 1.10) from Essay One.

VECM G, in Table 2.12, incorporates a break in the constant in the ECT after 1993:4. The pattern of long run endogeneity is preserved, with consumption, income, and assets responding to changes in the long run relationship. Also, liabilities remain exogenous, as found in VECM F. Finally, the Granger-Causality results are similar to the previous VECMs, except for assets. As in VECM F, assets Granger-Cause assets, but so do liabilities. Therefore, the evidence suggests that liabilities may play some role in determining assets in the short run. Therefore, the effect of liabilities in VECM F or VECM G is transitory, at best.

The implications for past and future research are interesting. Studies that have examined the effects of assets only on consumption do not appear to suffer from any major omitted variable bias by excluding liabilities. Further, future researchers wishing to examine the long run relationship between different forms of assets, consumption, and income may do so without the fear of possibly introducing sizeable bias. Therefore, the results here set the stage for investigation into the separate effects of housing assets and financial assets, if any, on consumption.

Another important result is the robustness of endogeneity results for consumption. In fact, disaggregating wealth into assets and liabilities does not alter consumption endogeneity. The results from Essay One carry through this essay: consumption responds to changes in assets/wealth in the long run. The importance of assets in

Table 2.12 VECM G Aggregate Consumption (Break after 1993)								
	ΔRC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
Variable	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags
$\Sigma\Delta RC_{t-I}$ i=1 to j	(0.000)	3	(0.000)	4	(0.005)	1	(0.000)	4
$\Sigma\Delta RDPI_{t-i}$ i=1 to j	(0.013)	4	(0.000)	3	(0.171)	2	(0.002)	3
$\Sigma\Delta RA_{t-I}$ i=1 to j	—	—	(0.008)	2	(0.025)	3	(0.000)	4
$\Sigma\Delta^2 RL_{t-I}$ i=1 to j	—	—	—	—	(0.011)	2	(0.000)	4
Constant	(0.000)	—	(0.897)	—	(0.095)	—	(0.008)	—
ECT_{t-1}	**-0.095 (0.047)**	—	**-0.517 (0.000)**	—	**1.933 (0.032)**	—	—	—
Joint Significance of Restrictions (p-value):							0.999	
* and ** indicates significance at a 90% and 95% level of confidence respectively								

influencing consumption must be a concern for policymakers, especially in the current environment of volatile equity and housing prices.

Conclusion

These results here pave the way for future research through several means. First, the long run relationship between consumption, income, and disaggregated assets can be examined without the fear of omitted variable bias through the exclusion of liabilities. The long run parameters in the cointegration relationships are relatively robust to those found in the first essay. Second, the endogeneity of assets and income has been shown repeatedly, demonstrating the improper restrictions imposed by employing an Error-Correction Model. Also, the presence of structural breaks in the long run relationships is found, but does not alter the major findings. Finally, another important finding is the endogeneity of consumption. This result is robust throughout both essays, despite the different econometric specifications and tests.

In conclusion, the empirical estimates lend credence to the idea that policymakers must consider the role of household wealth and/or assets when conducting policy. This essay does not answer the question of how long it takes for permanent changes in consumption to be realized from changes in assets. Nor does it address the relative importance of stock market assets versus housing assets in consumption decisions. It does, however, demonstrate that household assets play a role in determining consumption in the long run. In the short run, Granger-Causality is unidirectional, from consumption to wealth. Therefore, the increase in the value of financial assets that existed in the late nineties (followed by the large stock market downturn and large increases in housing

values) can have substantial impacts on aggregate consumption in the long run. Since consumption constitutes two-thirds of total output, these changes in asset values can create substantial changes in total output.

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Appendix A

Table A 2.1 Descriptive Statistics		
Variable	Mean	Standard Deviation
ΔAssets	148.49	516.72
Δ^2Liabilities	0.11	45.53

Table A 2.2a
VECM F
Aggregate Consumption
Full Results

Variable	ΔC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.22**	0.08	0.69**	0.10	3.98**	1.50	0.48**	0.07
ΔC_{t-2}	0.20**	0.09	0.49**	0.12	0.40	1.82	0.07	0.08
ΔC_{t-3}	0.40**	0.10	0.11	0.12	0.32	1.88	0.07	0.09
ΔC_{t-4}	0.05	0.10	0.18	0.12	1.46	1.88	0.17**	0.09
$\Delta RDPI_{t-1}$	-0.08	0.06	-0.40**	0.07	-1.44	1.08	-0.08	0.05
$\Delta RDPI_{t-2}$	-0.14**	0.06	-0.06	0.08	-1.37	1.21	0.01	0.06
$\Delta RDPI_{t-3}$	-0.08	0.06	-0.13	0.08	-0.04	1.20	-0.15**	0.05
$\Delta RDPI_{t-4}$	-0.09*	0.05	-0.06	0.07	-0.52	1.02	-0.03	0.05
ΔRA_{t-1}	0.00	0.00	0.00	0.01	-0.03	0.08	-0.00	0.00
ΔRA_{t-2}	-0.00	0.00	-0.02**	0.01	0.10	0.08	-0.00	0.00
ΔRA_{t-3}	-0.00	0.00	-0.00	0.01	0.20**	0.08	0.00	0.00
ΔRA_{t-4}	-0.00	0.00	-0.00	0.01	0.03	0.08	-0.02**	0.00
$\Delta^2 RL_{t-1}$	-0.04	0.08	0.15	0.10	-1.04	1.56	-0.74**	0.07
$\Delta^2 RL_{t-2}$	0.02	0.09	0.16	0.11	1.37	1.74	-0.64**	0.08
$\Delta^2 RL_{t-3}$	-0.05	0.09	0.14	0.12	-1.39	1.81	-0.61**	0.08
$\Delta^2 RL_{t-4}$	-0.01	0.08	0.18*	0.11	-1.71	1.61	0.24**	0.07
Constant	11.63**	2.89	7.20*	3.75	49.23	56.81	-6.47**	2.56
ECT_{t-1}	**-0.09****	**0.04**	**-0.32****	**0.06**	**2.41****	**0.85**	**0.04**	**0.04**
* and ** indicates significance at a 90% and 95% level of confidence respectively								

Table A 2.2b
VECM F
Aggregate Consumption
Parsimonious Results

Variable	ΔC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.22**	0.07	0.71**	0.10	3.68**	1.44	0.49**	0.07
ΔC_{t-2}	0.20**	0.08	0.47**	0.11	—	—	0.07	0.08
ΔC_{t-3}	0.36**	0.08	—	—	—	—	0.08	0.08
ΔC_{t-4}	—	—	—	—	—	—	0.16**	0.08
$\Delta RDPI_{t-1}$	-0.07	0.05	-0.39**	0.07	—	—	-0.07	0.05
$\Delta RDPI_{t-2}$	-0.13**	0.06	—	—	—	—	0.01	0.05
$\Delta RDPI_{t-3}$	-0.09*	0.05	—	—	—	—	-0.16**	0.05
$\Delta RDPI_{t-4}$	-0.08	0.05	—	—	—	—	—	—
ΔRA_{t-1}	—	—	0.00	0.01	-0.05	0.07	-0.01	0.00
ΔRA_{t-2}	—	—	-0.01**	0.01	0.10	0.07	-0.00	0.00
ΔRA_{t-3}	—	—	—	—	0.17**	0.07	0.00	0.00
ΔRA_{t-4}	—	—	—	—	—	—	-0.02**	0.00
$\Delta^2 RL_{t-1}$	—	—	0.16	0.10	—	—	-0.72**	0.07
$\Delta^2 RL_{t-2}$	—	—	0.18*	0.11	—	—	-0.64**	0.07
$\Delta^2 RL_{t-3}$	—	—	0.18	0.11	—	—	-0.58**	0.08
$\Delta^2 RL_{t-4}$	—	—	0.19*	0.10	—	—	0.27**	0.07
Constant	11.86**	2.69	6.50**	3.27	42.41	44.74	-6.76**	2.45
ECT_{t-1}	**-0.08****	**0.04**	**-0.28****	**0.05**	**2.51****	**0.76**	—	—

* and ** indicates significance at a 90% and 95% level of confidence respectively

Table A 2.3a
VECM G
Aggregate Consumption
Full Results
(Break after 1993)

Variable	ΔC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.23**	0.08	0.80**	0.10	4.12**	1.56	0.50**	0.07
ΔC_{t-2}	0.24**	0.10	0.67**	0.12	0.19	1.92	0.09	0.09
ΔC_{t-3}	0.42**	0.10	0.27**	0.12	0.68	1.98	0.11	0.09
ΔC_{t-4}	0.07	0.10	0.34**	0.12	1.75	1.98	0.20**	0.09
$\Delta RDPI_{t-1}$	-0.09	0.06	-0.48**	0.07	-1.53	1.12	-0.09*	0.05
$\Delta RDPI_{t-2}$	-0.15**	0.06	-0.15**	0.08	-1.67	1.27	-0.01	0.06
$\Delta RDPI_{t-3}$	-0.09	0.06	-0.21**	0.08	-0.24	1.25	-0.17**	0.06
$\Delta RDPI_{t-4}$	-0.09*	0.05	-0.07	0.06	-0.68	1.03	-0.04	0.05
ΔRA_{t-1}	0.00	0.00	0.00	0.01	-0.06	0.08	-0.01	0.00
ΔRA_{t-2}	-0.00	0.00	-0.01**	0.01	0.08	0.08	-0.00	0.00
ΔRA_{t-3}	-0.00	0.00	0.00	0.01	0.17**	0.08	0.00	0.00
ΔRA_{t-4}	-0.00	0.00	0.00	0.01	-0.01	0.08	-0.02**	0.00
$\Delta^2 RL_{t-1}$	-0.07	0.08	0.01	0.10	-0.40	1.58	-0.74**	0.07
$\Delta^2 RL_{t-2}$	-0.02	0.09	-0.01	0.11	2.10	1.77	-0.64**	0.08
$\Delta^2 RL_{t-3}$	-0.10	0.09	-0.05	0.11	-0.63	1.86	-0.61**	0.08
$\Delta^2 RL_{t-4}$	-0.05	0.08	0.01	0.10	-1.00	1.65	0.24**	0.07
Constant	10.34**	2.95	1.14	3.56	69.45	58.87	-6.66**	2.61
ECT_{t-1}	**-0.11***	**0.05**	**-0.52****	**0.07**	**1.51**	**1.08**	**-0.02**	**0.05**
* and ** indicates significance at a 90% and 95% level of confidence respectively								

Table A 2.3b
VECM G
Aggregate Consumption
Parsimonious Results
(Break after 1993)

Variable	ΔC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.24**	0.07	0.80**	0.09	4.31**	1.51	0.50**	0.07
ΔC_{t-2}	0.23**	0.08	0.69**	0.10	—	—	0.07	0.08
ΔC_{t-3}	0.39**	0.09	0.26**	0.11	—	—	0.08	0.08
ΔC_{t-4}	—	—	0.30**	0.11	—	—	0.16**	0.08
$\Delta RDPI_{t-1}$	-0.09	0.05	-0.48**	0.07	-1.36	0.95	-0.08*	0.05
$\Delta RDPI_{t-2}$	-0.15**	0.06	-0.16**	0.07	-1.24	0.96	0.00	0.05
$\Delta RDPI_{t-3}$	-0.09*	0.05	-0.19**	0.07	—	—	-0.16**	0.05
$\Delta RDPI_{t-4}$	-0.06	0.05	—	—	—	—	—	—
ΔRA_{t-1}	—	—	0.00	0.01	-0.07	0.07	-0.01	0.00
ΔRA_{t-2}	—	—	-0.01**	0.01	0.08	0.07	-0.00	0.00
ΔRA_{t-3}	—	—	—	—	0.19**	0.07	0.00	0.00
ΔRA_{t-4}	—	—	—	—	—	—	-0.02**	0.00
$\Delta^2 RL_{t-1}$	—	—	—	—	0.25	0.90	-0.72**	0.07
$\Delta^2 RL_{t-2}$	—	—	—	—	2.43**	0.90	-0.62**	0.07
$\Delta^2 RL_{t-3}$	—	—	—	—	—	—	-0.59**	0.08
$\Delta^2 RL_{t-4}$	—	—	—	—	—	—	0.26**	0.07
Constant	11.31**	2.74	0.41	3.19	80.86*	48.13	-6.59**	2.46
ECT_{t-1}	**-0.10****	**0.05**	**-0.52****	**0.06**	**1.93****	**0.90**	**—**	**—**

* and ** indicates significance at a 90% and 95% level of confidence respectively

Appendix B

The long run relationship in Table B 2.1 gives the estimated long run parameters in the presence of a structural break in all parameters after 1990:3. The results are almost identical to those in Table 1.7 in Essay One.

As noted in the text, this section includes the VECM results for aggregate consumption including a break in the cointegration relationship in all parameters. Specifically, Table B 2.2 presents the VECM results for aggregate consumption incorporating a break in the cointegration relationship after 1990:3.

The addition of a break in all parameters after 1990:3 does not noticeably alter results for aggregate consumption, as seen in VECM H. Consumption still responds in the long run to changes in income and assets. Recall that the parameter on assets after the break is statistically zero, therefore, consumption, income, and assets respond to changes in consumption and income only after the break. The addition of the break does not alter the long run endogeneity results of income, assets, or liabilities. The long run endogeneity of assets and income is preserved. The inclusion of the break does alter Granger-Causality results for assets. Assets no long Granger-Cause themselves, but are Granger-Caused by liabilities.

Table B 2.1 **Cointegration Results** **Aggregate Consumption** **(Break in 1990)**		
Variable	Parameter Estimate	Standard Error
Real Disposable Personal Income	0.763**	0.031
Real Assets	0.021**	0.006
Constant	63.72**	23.82
φ_t * Real Disp. Personal Income (1990:4)	0.576**	0.154
φ_t * Assets (1990:4)	-0.032**	0.010
φ_t * Constant (1990:4)	-2102.20**	565.80
** indicates significance at a 95% level of confidence		

Joint Parameter Values and Significance **Aggregate Consumption** **(Break in 1990)**		
Variable	Marginal Effect	p-value
Real Disposable Personal Income	1.339	0.000
Real Assets	-0.011	0.292
Constant	-2038.48	0.000
Entries are parameter values plus all dummy interactions. p-value gives the joint significance of all parameters.		

Table B 2.2
VECM H
Aggregate Consumption
(Break in 1990)

	ΔRC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
Variable	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags	Joint Significance (p-value)	# of Lags
$\Sigma\Delta RC_{t-i}$ i=1 to j	(0.000)	3	(0.000)	4	(0.004)	1	(0.000)	4
$\Sigma\Delta RDPI_{t-i}$ i=1 to j	(0.035)	4	(0.000)	4	(0.159)	1	(0.002)	2
$\Sigma\Delta RA_{t-i}$ i=1 to j	—	—	(0.018)	4	(0.133)	3	(0.000)	4
$\Sigma\Delta^2 RL_{t-i}$ i=1 to j	—	—	—	—	(0.007)	2	(0.000)	4
Constant	(0.000)	—	(0.206)	—	(0.192)	—	(0.006)	—
ECT_{t-1}	**-0.082*** **(0.071)**	—	**-0.547**** **(0.000)**	—	**2.553**** **(0.003)**	—	—	—
Joint Significance of Restrictions (p-value):							0.999	
* and ** indicates significance at a 90% and 95% level of confidence respectively								

Table B 2.3a
VECM H
Aggregate Consumption
Full Results
(Break in 1990)

Variable	ΔC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.22**	0.08	0.71**	0.09	4.26**	1.51	0.50**	0.07
ΔC_{t-2}	0.22**	0.09	0.59**	0.11	0.29	1.86	0.09	0.08
ΔC_{t-3}	0.41**	0.10	0.29**	0.11	0.36	1.96	0.12	0.09
ΔC_{t-4}	0.07	0.10	0.36**	0.11	1.46	1.95	0.21**	0.09
$\Delta RDPI_{t-1}$	-0.08	0.06	-0.44**	0.06	-1.56	1.09	-0.09*	0.05
$\Delta RDPI_{t-2}$	-0.16**	0.07	-0.22**	0.07	-1.28	1.29	-0.02	0.06
$\Delta RDPI_{t-3}$	-0.09	0.06	-0.21**	0.07	-0.10	1.23	-0.17**	0.06
$\Delta RDPI_{t-4}$	-0.09*	0.05	-0.10	0.06	-0.54	1.03	-0.04	0.05
ΔRA_{t-1}	0.01	0.00	0.01**	0.00	-0.09	0.08	-0.01	0.00
ΔRA_{t-2}	0.00	0.00	-0.00	0.01	0.04	0.08	-0.00	0.00
ΔRA_{t-3}	-0.00	0.00	0.01	0.01	0.15*	0.08	0.00	0.00
ΔRA_{t-4}	-0.00	0.00	0.01	0.01	-0.02	0.08	-0.02**	0.00
$\Delta^2 RL_{t-1}$	-0.08	0.08	-0.04	0.09	-0.17	1.58	-0.74**	0.07
$\Delta^2 RL_{t-2}$	-0.03	0.09	-0.07	0.10	2.41	1.78	-0.65**	0.08
$\Delta^2 RL_{t-3}$	-0.10	0.09	-0.07	0.11	-0.44	1.85	-0.62**	0.08
$\Delta^2 RL_{t-4}$	-0.05	0.08	-0.01	0.09	-0.82	1.64	0.23**	0.07
Constant	10.84**	2.90	3.31	3.33	65.59	57.74	-6.64**	2.57
ECT_{t-1}	**-0.10****	**0.05**	**-0.55****	**0.06**	**1.99****	**1.00**	**-0.04**	**0.04**

* and ** indicates significance at a 90% and 95% level of confidence respectively

Table B 2.3b
VECM H
Aggregate Consumption
Parsimonious Results
(Break in 1990)

Variable	ΔC Equation		ΔRDPI Equation		ΔRA Equation		Δ^2RL Equation	
	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.	Par. Est.	Std. Err.
ΔC_{t-1}	0.21**	0.07	0.71**	0.09	4.24**	1.44	0.50**	0.07
ΔC_{t-2}	0.20**	0.08	0.59**	0.09	—	—	0.07	0.08
ΔC_{t-3}	0.40**	0.09	0.26**	0.11	—	—	0.09	0.08
ΔC_{t-4}	—	—	0.34**	0.11	—	—	0.16**	0.08
$\Delta RDPI_{t-1}$	-0.07	0.05	-0.44**	0.06	-1.32	0.94	-0.08*	0.05
$\Delta RDPI_{t-2}$	-0.13**	0.06	-0.22**	0.07	—	—	0.01	0.05
$\Delta RDPI_{t-3}$	-0.08*	0.05	-0.20**	0.07	—	—	-0.16**	0.05
$\Delta RDPI_{t-4}$	-0.07	0.05	-0.09	0.06	—	—	—	—
ΔRA_{t-1}	0.00	0.00	0.01**	0.00	-0.09	0.07	-0.01	0.00
ΔRA_{t-2}	—	—	-0.00	0.00	0.01	0.07	-0.00	0.00
ΔRA_{t-3}	—	—	0.01	0.01	0.14**	0.71	0.00	0.00
ΔRA_{t-4}	—	—	0.01	0.00	—	—	-0.02**	0.00
$\Delta^2 RL_{t-1}$	—	—	—	—	0.49**	0.89	-0.72**	0.07
$\Delta^2 RL_{t-2}$	—	—	—	—	2.59**	0.90	-0.63**	0.07
$\Delta^2 RL_{t-3}$	—	—	—	—	—	—	-0.60**	0.08
$\Delta^2 RL_{t-4}$	—	—	—	—	—	—	0.26**	0.07
Constant	11.56**	2.71	3.93	3.10	59.60	45.51	-6.88**	2.46
ECT_{t-1}	**-0.08***	**0.05**	**-0.55****	**0.06**	**2.55****	**0.84**	**—**	**—**

* and ** indicates significance at a 90% and 95% level of confidence respectively

Appendix C

What Determines Liabilities?

The results here indicate that aggregate liabilities play no role in the long run evolution of consumption, disposable income, or assets. In addition, consumption, assets, and disposable income have no influence on aggregate liabilities in the long run. Liabilities respond to changes in liabilities, assets, consumption, and income in the short run only. How do aggregate liabilities evolve over time, and which variables play an important role in determining aggregate liabilities? This section estimates the influence of lagged changes in consumption, assets, income, and liabilities on the current changes in liabilities, and provides greater insight into the behavior of households.

Empirically, Equation (C2.1) is estimated. In Equation (C2.1), Δ signifies the difference operator, RC_t is real aggregate consumption, $RDPI_t$ is real disposable personal income, RA_t is real assets, and RL_t is real liabilities. Since liabilities appear to be exogenous in VECM F, these lagged changes can be modeled, without a sizeable fear of introducing endogeneity into the OLS estimation. Four lags of the first-difference of each variable in VECM F are introduced as shown in Equation (C2.1). Further, the Newey-West (1987) procedure is used to provide a robust variance estimate.

$$\Delta^2 RL_t = \alpha + \sum_{i=1}^{4} \theta_i \Delta RC_{t-1} + \sum_{i=1}^{4} \beta_i \Delta RDPI_{t-i} + \sum_{i=1}^{4} \mu_i \Delta RA_{t-i} + \sum_{i=1}^{4} \lambda_i \Delta^2 RL_{t-i} + \varepsilon_t \qquad \text{(C2.1)}$$

Equation (C2.1) describes the short run impacts of lagged changes in assets, consumption, disposable income, and changes in the change in the first difference of liabilities on aggregate liabilities. The results from estimating Equation (C2.1) are given in Table C 2.1. The table presents the joint value and significance of the four lags of each

variable. The joint significance is derived from the Wald test. Recall that liabilities are ~I(2). Therefore, the joint parameter values in Table C 2.1 give the effect that a change in the right hand side variable has on the *rate of change* of liabilities. For example a one-dollar increase in aggregate consumption creates a 0.87 increase in the change in liabilities. In other words, if liabilities were changing at a rate of one, then a one-dollar increase in consumption causes liabilities to change by 1.87. Examining Table C 2.1 gives some insight into the behavior of liabilities. The largest impact on liabilities comes from its own lagged values. Aggregate consumption is the only component that has a positive effect on the change in liabilities. Increases in income and assets tend to reduce the change in liabilities. In fact, one can recognize the inherent stability of liabilities through the joint action of all parameters. A one-dollar increase in all variables has a negative effect on the change in liabilities, reducing the rate of change by 1.123. Further, a one-dollar increase in the past rate of change in liabilities causes the current rate of change in liabilities to decrease by *more* than one. So, if consumption increases by one dollar, the change in liabilities increases by 0.87 dollars, which then reduces the change in liabilities by 1.45 over the next four quarters.

Therefore, the results show that all variables have significant effects on the change in liabilities. In fact, this set of four variables explains seventy-seven percent of the variation in the change in liabilities. Overall, changes in assets, disposable income, and liabilities have a negative impact on liabilities. Consumption is the only variable that exhibits a positive relationship with liabilities. Consequently, in periods where consumption growth is high, aggregate liabilities should increase. As consumption growth begins to slow, however, the negative influences of disposable income, assets,

and liabilities outweigh the change in consumption, causing liabilities to decrease. Therefore, this simple investigation describes a large share of the evolution of liabilities over time.

Table C 2.1 **Results from Equation (C2.1)**		
Variable	Joint Parameter Value	Joint Parameter Significance (p-value)
$\Sigma\Delta RC_{t-i,}$ i=1 to 4	0.871	0.000
$\Sigma\Delta RDPI_{t-i,}$ i=1 to 4	-0.303	0.002
$\Sigma\Delta RA_{t-i,}$ i=1 to 4	-0.024	0.000
$\Sigma\Delta^2 RL_{t-i,}$ i=1 to 4	-1.667	0.000
Adjusted R^2		0.77
Joint parameter value gives the summation of all four lags. The joint parameter significance gives the results from the Wald test.		

Essay Three

Marginal Tax Rates and Income Reporting Among the Ultra-Rich: Permanent and Transitory Effects

Introduction

In the last twenty years, there have been five major changes in federal marginal income tax rates. Most of these statutory changes altered the marginal rate for the wealthiest households. Tax debates center on taxation of the rich, and particularly how changes in tax rates influence their behavior. Since this group reports such a large share of total income and pays a large share of income taxes, it is important to understand how this small subset of households reacts to tax code changes. Feenberg and Poterba (2000) estimate that the top 0.5 percent of all income tax filers paid nearly one-fourth of all income taxes in 1995. Moreover, it is estimated that the top one percent of households paid 33.6 percent of all income taxes in 2000 and nearly 36 percent in 2001 (Joint Committee on Taxation, 2000 and 2001). Further, the wealthy report a large share of Adjusted Gross Income (AGI).[32] For example, the share of income reported by the top 0.5 percent of income tax filers was 13.5 percent of all income in 1999. In this literature (and this essay), the ultra-rich are defined as those households that lie in the top 0.5 percent of the distribution of Adjusted Gross Income (AGI share). This group includes roughly 700,000 households that reported AGI in excess of an estimated $430,000 in 1999.[33] Understanding the reporting behavior of the wealthy is important for policy makers when designing tax code changes, since they report such a large share of AGI and pay a large percentage of income taxes.

[32] Income in this essay refers to Adjusted Gross Income. AGI is the Internal Revenue Service's definition of income.

[33] Estimate using Feenberg and Poterba's (1993) methodology. Calculations are available upon request from the author.

The importance of the wealthy in the U.S. tax system cannot be denied. What is questioned is how this group responds to changes in tax rates. Particularly, recent research questions how reported AGI responds to changes in tax rates. Some have argued that tax rate changes have no effect on the wealthiest households' reporting of income. Others suggest that any induced changes are solely temporary in nature, inducing no long-term effects. Still others suggest permanent behavioral responses from tax rate changes. These changes can be due to altered tax avoidance behavior, tax evasion behavior, or change in work effort. Previous research findings also differ in the magnitude of these effects. Therefore, changes in the wealthiest households' reporting of income may be small or large, with estimated elasticities of income with respect to tax rate changes of zero, less than one, or greater than one; these changes may be temporary or permanent in nature.

More recent research provides evidence that permanent *and* transitory effects on the AGI share from changing tax rates exist (Bruce, Tuttle, and Garrison, 2003). These transitory effects include shifting the realization of income into adjacent periods to take advantage of changing tax laws. As Feenberg and Poterba (1993) note, the wealthiest households have greater opportunities to engage in such behavior.[34] However, changing tax rates can also create permanent changes in behavior. One possibility is the effect that changing tax rates may have on labor supplied by wealthy households. Also, changing tax rates can induce permanent changes in tax avoidance behavior. Ambiguity in the

[34] Examples include shifting of income payments from self-employment, delaying capital gains realizations, and engaging in legal tax avoidance.

current literature centers around this issue of temporary versus permanent changes in behavior from changes in the top marginal income tax and capital gains tax rates.

The contributions of this essay are three-fold. The use of time-series econometric techniques allows the measurement of such permanent and transitory effects. First, the long run effects are estimated for impacts of tax rate changes on the share of AGI reported by the top 0.5 percent of households. If a long run relationship exists, then this provides evidence that permanent behavior or reporting impacts exist. In addition to the long run effects, the transitory effects of tax changes on the share of income reported by the top 0.5 percent of filers are estimated. Empirically, the short run lead, lag, and current period effects of tax rate changes, or transitory effects are measured through an error correction model (ECM), while controlling for any permanent effects. Finally, this essay presents the idea that household wealth plays an equally important role in determining the top AGI share. Changes in wealth can alter the income and earnings decisions of the Ultra-Rich. Given the importance of wealth for this group, the omission of wealth can potentially bias the tax rate elasticities. An estimate of the relationships between the AGI share and tax rates provides a baseline assessment. Measures of wealth are then added, to check for robustness in the tax rates, and to demonstrate the importance of wealth in these particular households' decisions. Also, the endogeneity of all variables is examined, and formal tests of structural breaks are estimated. Finally, other measures are added to check the robustness of the net wealth elasticities. Dynamic simulations are provided to show the response of the AGI share to changes in taxes and wealth.

The results show that, in the long run, the top capital gains rate is the most important tax rate in determining the share of income reported by the top 0.5 percent of households, with an estimated elasticity between –0.42 and –0.55. Therefore a permanent ten percent increase in the top capital gains tax rate will permanently reduce the share of AGI reported by the top 0.5 percent of households by 4.2 to 5.5 percent. The top federal marginal income tax rate is less important in influencing long run behavior. The estimated long run elasticity of the AGI share with respect to changes in the top federal marginal income tax rate is between 0.0 and –0.15. Finally, real wealth proves to be equally important as tax rate changes, given a long run elasticity of 0.57 to 0.62. Therefore, the positive effects of increases in wealth on the AGI share can overcome the negative effect of an equal and simultaneous percentage increase in *both* tax rates. The estimated long run tax rate elasticities are relatively consistent with previous research. The next section presents the current debate and recent findings of tax rate effects on the distribution of AGI.

Literature Review

Feenberg and Poterba (1993 and 2000) calculate the share of AGI reported by the top 0.5 percent of households. Their estimates are calculated using the Internal Revenue Service's Treasury Tax Model database and Statistics of Income (SOI). They suggest that portions of the movement in their share measure are due to permanent changes in reporting behavior. Sustained increases in AGI share exist following the large tax rate reductions in the 1980s. They agree that short-run shifting of income does occur, but there are also permanent effects from tax rate changes. Further, the wealthy earn a large

share of income from capital gains. Yet, when they adjust their measure to exclude capital gains realizations, their conclusions are unaltered – changes in taxes appear to permanently affect the distribution of AGI less capital gains.

Slemrod (1996) and Goolsbee (1999, 2000a, and 2000b) suggest that increases in the share of income reported occur from income shifting, not permanent behavioral changes. Slemrod adjusts Feenberg and Poterba's share measure to account for changes in the treatment of capital gains, and estimates a set of time series equations to measure the effect of tax rates. Since the exclusion of macroeconomic factors may bias results, Slemrod add a measures of wage inequality, real stock prices, and the corporate AAA rate. He includes the top marginal income tax rate and capital gains rate to estimate their influence on the AGI share. To control for timing effects, he adds leads and lags of the changes in both tax rates. From his estimates, the capital gains rate plays a significant role in determining the AGI share, while the effects of income tax rate changes are questionable. Goolsbee (1999) looks at several tax rate changes and concludes the historical responsiveness of the rich is small, and that results from the 1980s are "atypical". Goolsbee (2000a, 2000b) estimates the absolute value of the elasticity of taxable income to the income tax rate to be between 0.0 and -0.4. He concludes, like Slemrod, the majority of the effects from tax rate changes occur from changes in the timing of the reporting of income (from labor or capital gains), not from permanent changes in behavior.

Bruce, Tuttle, and Garrison (2003) estimate AGI share elasticities from income and capital gains tax changes. They control for various economic factors, such as real GDP growth, productivity, globalization, and schooling. Like Slemrod, the authors also

allow for timing effects by adding lead and lag changes of both tax rates. They estimate an AGI share elasticity with respect to changes in the top capital gains tax rate between –0.41 and –0.51. Marginal income tax rates have a smaller effect upon the share of income reported, with an estimated elasticity between –0.27 and –0.31. These findings represent permanent changes and they are robust when controlling for various economic factors. Using dynamic time series analysis, they conclude that the major determinants of AGI share are changes in the capital gains rate and macroeconomic factors. In fact, they find a long-run, permanent relationship between the AGI share, the top federal marginal income tax rate, the top capital gains tax rate, and macroeconomic factors. The respective tax rates have a negative effect on AGI share, while output has a large positive effect and interest rates induce a negative response. Their research goes a long way in showing that tax rates and macroeconomic factors induce permanent changes in the top AGI share.

The possibility exists that a long run model containing only tax rates omits relevant factors that determine the AGI share, namely household wealth. If changes in tax rates truly change labor decisions among the wealthy, then omitting wealth may bias the income tax rate and capital gains rate elasticities. An increase in the top marginal income tax rate or capital gains rate can create a substitution effect between labor decisions and the realization of capital gains or savings. Increases in the top income tax rate can result in an increase in the consumption of real wealth. Increases in the top capital gains rate may reduce capital gains realizations, causing an increase in net wealth, or it could change current savings behavior. Therefore, omitting wealth measures can bias either of the tax rate elasticities, attributing a larger or smaller effect between income

tax rate or capital gains rate changes and the AGI share. Therefore, measures of real wealth will be added to address this issue. However, if wealth has only transitory effects, then we should find no significant long run relationship between the wealth measures and the AGI share. The tax rate elasticities should be robust. In such a case, wealth should be modeled into a short run model only.

As Feenberg and Poterba (1993) and Slemrod (1996) note, approximately 50 percent of all capital gains are reported by the top 0.5 percent of all households. Poterba (2000) notes those in the top 0.5 percent of the wealth distribution held 25.6 percent of all net wealth in 1998, and the top 5 percent held almost 60 percent. Also, Starr-McCluer (2002) shows that approximately 80 percent of households that earned over $250,000 of income in 1995 owned equities. Therefore, unlike most households, wealth plays an important role in the Ultra-Riches' earning decisions, and unfortunately, this information is not contained in tax return data.

Despite the large fluctuations in wealth over the sample period, the share owned by the top 0.5% of households remained relatively stable over the sample period, as shown in Table 3.1 (Poterba and Samwick, 1995 and Poterba, 2000). In addition, these same households held only six to ten percent of all housing equity between 1962 and 1998 (Poterba 2000), so housing wealth is a small share in these households' balance sheets. Therefore, to include the effect that changing wealth may have on the AGI share, two measures will be used: aggregate real wealth and aggregate real wealth less housing wealth.

A *potential* problem in this essay is that aggregate net wealth variables are used, not net wealth of the top 0.5 percent of households. Therefore, real net wealth is included

Table 3.1 Wealth Ownership of the Top 0.5 Percent of Households				
Year	Percent of Aggregate Wealth		Percent of Aggregate Housing Wealth	
	1962 Definitions	1992 Definitions	1962 Definitions	1992 Definitions
1962	23.5%	—	6.05%	—
1983	22.4%	23.7%	—	8.74%
1992	—	21.7%	—	10.48%
1998	—	25.6%	—	10.20%
Source: Poterba and Samwick (1995) and Poterba (2000)				

as a proxy. The use of a proxy that is not highly correlated with the true variable can cause biased and inefficient parameters. However, these deficiencies get smaller the greater the correlation between the two measures. Although aggregate wealth is not perfectly positively correlated with real wealth of the household sector in question, they should be highly correlated, since rich households hold a large share of aggregate wealth.

Empirical Methods and Data

As mentioned in the last section, recent research has presented various estimates of the response of the ultra-rich to changes in tax rates. The contribution of this essay is to provide further insight into the behavior of these households. Not only are long-run tax rate elasticities measured, but also short-run elasticities and the duration of these responses are estimated. To accomplish these goals, time series econometric techniques are employed. The marginal income tax and capital gains tax rates are included to determine whether they share a long-run relationship with AGI share, or, in other words, if they are cointegrated. These long-run effects arise from permanent changes in labor effort, reporting changes, or shifting of income by the wealthy due changes in tax rates.

The method employed here is Dynamic OLS (DOLS), as suggested by Stock and Watson (1993), which is a single-equation cointegration technique. The cointegrating equation is a single equation, and takes the following form:

$$LnAGI_t = \beta_0 + \beta_1 LnCG_t + \beta_2 LnIT_t + \beta_3 LnZ_t + X\alpha' + \omega_t \qquad (3.1)$$

where AGI_t is the share of income reported by the top 0.5 percent of tax filers, CG_t is the top federal capital gains rate, IT_t is the top federal marginal income tax rate, and Z_t represents the wealth series added to Equation (3.1). All variables are included in natural

logs. The X denotes a matrix of the lead, lag, and current values of the first differences of the natural log of each independent variable in the cointegrating equation. Although an included variable may be non-stationary, the problem of spurious results does not exist if the variables in Equation (3.1) share a long-run relationship. Further, since all variables are in natural logs, the parameters yield measures of elasticity.

Variables that are cointegrated produce consistent parameter estimates, and, in fact, the parameters are 'super consistent', converging at a faster rate than normal. The problem with previous methods, however, is the possibility of biased and inefficient estimates due to non-normal residuals and endogenous regressors. DOLS attempts to control for these deficiencies by adding the first differences of leads, lags, and current values of the right-hand side variables. Estimations contained in this essay add a lead, lag, and current value of the first difference of all independent variables (the X matrix in Equation 3.1). These additions are intended to remove bias caused by endogeneity and to correct for serial correlation (Patterson, 2000). Leads and lags are also added to ensure normally distributed residuals. Further, a robust covariance matrix is estimated using the Newey-West (1987) method to improve efficiency of the estimates.

It is reasonable to assume that these same tax rates have immediate impacts upon behavior, but these short-run influences are not necessarily identical to any long-term impacts from tax changes. Therefore, a two-step estimation process is called for, where the second stage is a model of the short-run responses. Therefore, once the long-run relationship is estimated, a short-run dynamic model, in the form of an error correction model (ECM) shown in Equation (3.2), is employed. All variables in Equation (3.2) are the first differences of natural logs, except for the error correction term (ECT).

$$\Delta AGI_t = \alpha_0 + \alpha_1 \Delta CG_{t+1} + \alpha_2 \Delta CG_t + \alpha_3 \Delta CG_{t-1} + \alpha_4 \Delta IT_{t+1} + \alpha_5 \Delta IT_t + \alpha_6 \Delta IT_{t-1} + \alpha_7 \Delta Z_{t+1} + \alpha_8 \Delta Z_t + \alpha_9 ECT_{t-1} + \eta_t \quad (3.2)$$

The ECM is estimated to uncover short run responses of the AGI share and speed of adjustment to the new long run equilibrium. This new long run equilibrium arises from changes in the right-hand side variables in the cointegrating relationship [Equation (3.1)] at time t-1. The disequilibrium that exists at time t from a change in the long run relationship at time t-1 is given by the lagged value of the error correction term (ECT). To capture the full effects of any short-run adjustments, leads, lags, and the current changes in each tax rate are added. Therefore, from employing this two-step method, the long run and short run dynamics of the percent of AGI reported by the top 0.5 percent of filers are captured. Finally, when wealth is modeled in the cointegrating equation, the ΔZ matrix is added to Equation (3.2) to include any short run wealth effects.[35]

The ultimate purpose is to differentiate between permanent changes in reporting behavior and transitory effects. If any permanent responses exist, then empirical results should confirm the existence of a cointegrating relationship. Specifically, the estimate of α_7 should lie in the interval (-1,0) and be statistically significant for cointegration to exist. The short-run elasticities from the ECM give some insight into the short-run, transitory effects.

The primary source for the AGI series is Feenberg and Poterba (2000), and is available for the years 1960 through 1996.[36] This series is supplemented through 1999 using the methodology described in Feenberg and Poterba (1993). The Internal Revenue Service *Statistics of Income Bulletin* (Internal Revenue Service, 2000-2001) provides the

[35] Specifically, changes in current period and last period wealth are added.
[36] The data series is available at http://www.nber.org/~taxsim.

data needed to supplement the AGI series, and interpolation is used to fill in the two missing observations in the 1960s.

Figures 3.1a and 3.1b are graphs of the individual tax rate and AGI series. These graphs provide some interesting insights. Figure 3.1a displays the AGI share and top marginal income tax rate. There have been five major changes in the top marginal income tax rate since 1960. The first three changes in 1964, 1982, and 1987 are marginal rate decreases, while those of 1992 and 1993 are rate increases. In fact, the historical movement in this rate has been generally downward through 1991, and rising after this date until the recent tax code changes. From the figure, it appears that rate decreases in the early 1960s and 1980s are associated with increases in the AGI share. Rate increases in the 1990s, however, do not seem to be followed by decreases in the AGI share.

The evidence concerning the relationship between the top AGI share and capital gains rate is less ambiguous. Large increases in the capital gains rate around 1970 and in 1986 are followed by large downward swings in the AGI share, as shown in Figure 3.1b. The top AGI share trends upward in the 1980s and late 1990s, following the decline in capital gains tax rates in 1979 and 1997. On the other hand, tax increases in the 1970s coincide with decreases in the AGI share. Therefore, the circumstantial evidence suggests the importance of the capital gains rate over the marginal income tax rate, but closer evaluation is warranted.

Two series were collected to control for the financial position of the wealthiest individuals. Aggregate wealth data are provided in the Federal Reserve's *Balance Sheet of the United States* (Federal Reserve, 2001). Net worth is adjusted by the GDP deflator to derive real net worth (RW). Additionally, this variable is adjusted for population

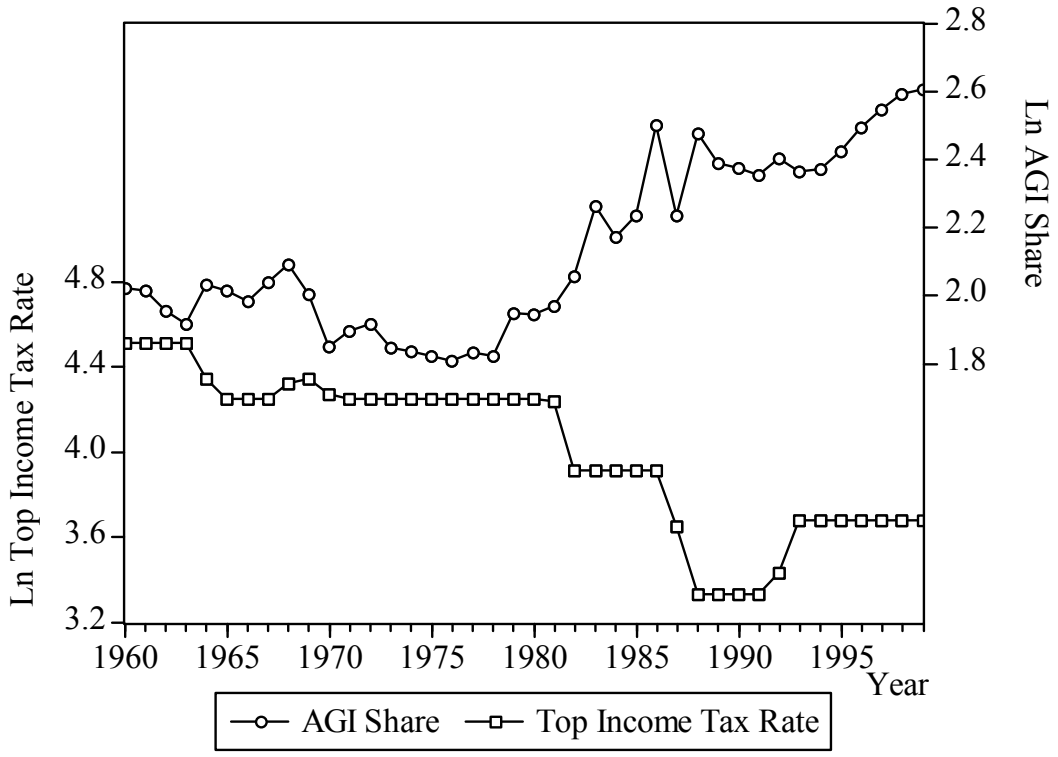


Figure 3.1a
Top AGI Share and Top Income Tax Rate - 1960 - 1999

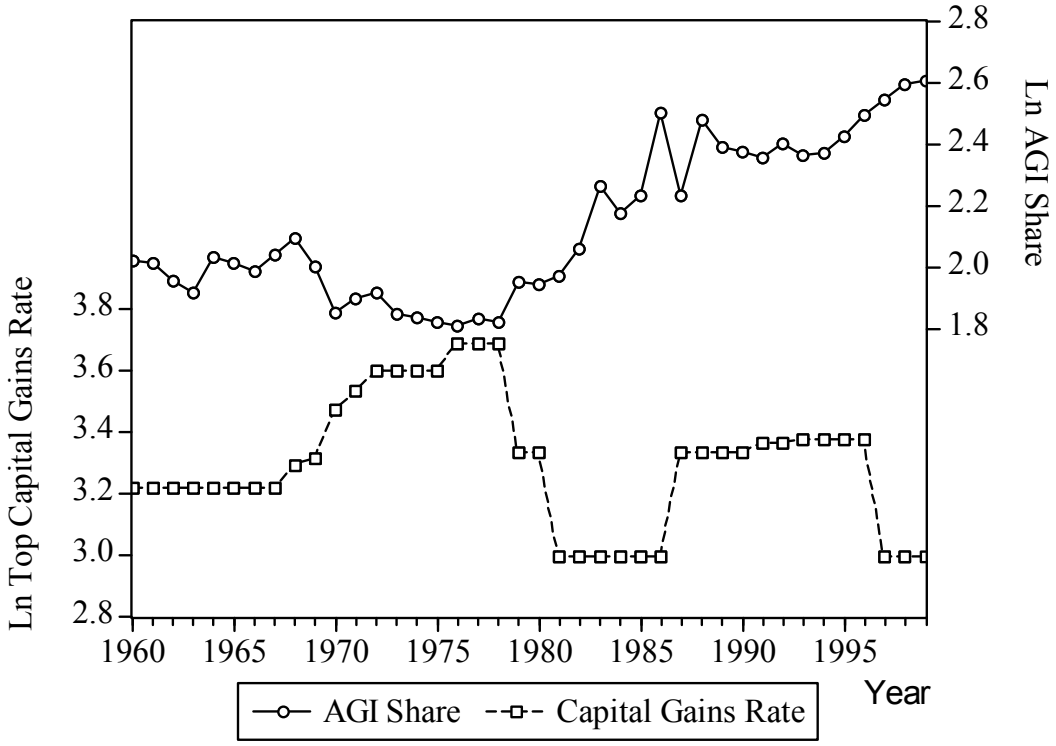


Figure 3.1b
Top AGI Share and Capital Gains Rate - 1960 - 1999

growth, to better match the indexing of the AGI series. To address the evidence provided by Starr-McCluer (2002), Poterba (2000), and Poterba and Samwick (1995), another measure of real wealth is included. This second measure is real wealth less housing wealth (RWH), and is measured as net wealth minus the aggregate value of housing assets plus the value of mortgages. This variable better measures the concentration of wealth among the richest households, since housing is a small portion of their wealth. Finally, the net wealth variables are lagged one period, so household decisions are based on the beginning-of-period wealth levels.

Figures 3.1c and 3.1d show AGI share with each measure of wealth. Although both measures of wealth trend upwards through the entire sample period, the majority of the growth takes place after 1986. In fact, the largest periods of growth correspond with the largest increases in the AGI share. There appears to be some positive relationship between the two measures of aggregate wealth and the share of income reported by the wealthiest households. Omission of the wealth term may have biased earlier results.

By now, the potential perils of using time series data are well established. Non-stationary data can produce spurious results, intimating statistical relationships that simply do not exist. Fortunately, methods exist to test for non-stationarity and control for the difficulties presented, such as employing DOLS and an ECM. To test the stochastic properties of the variables, Augmented Dickey-Fuller Tests (ADF) are estimated (Dickey and Fuller, 1979). Further, a second unit root test, the KPSS test, is employed, which tests the null of stationarity (Kwiakowski, et. al., 1992). Also, the possibility exists that the two-stage estimation may not be appropriate. If all variables are stationary in levels, then the behavior of the top AGI share can be modeled using a single equation approach.

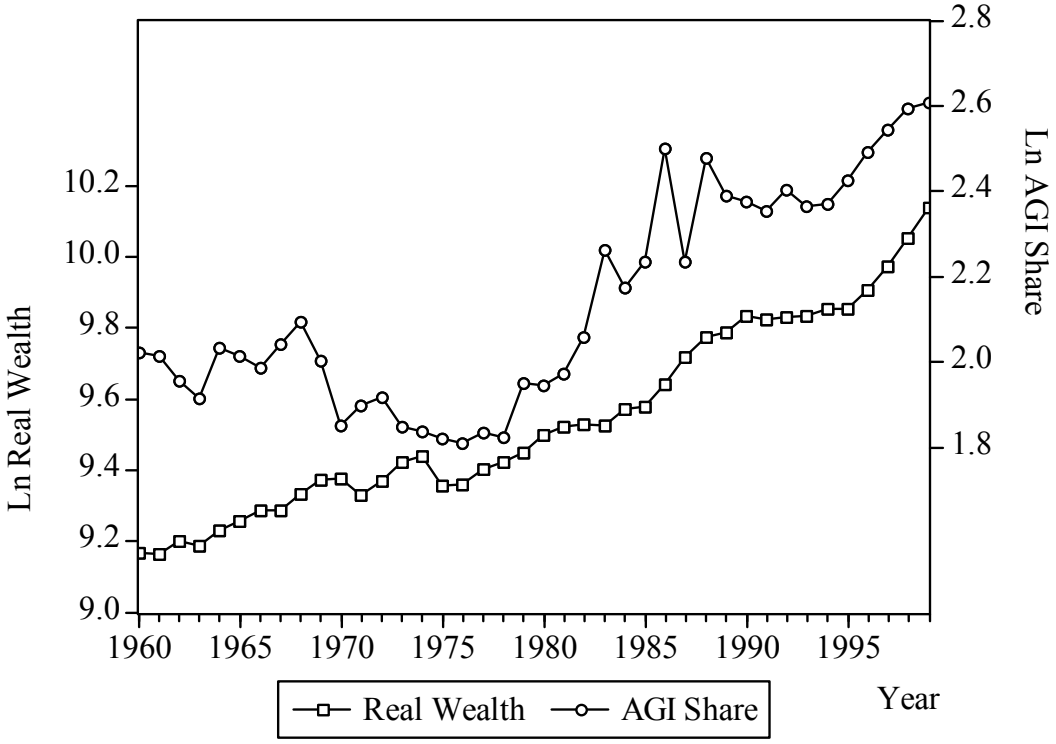


Figure 3.1c
Top AGI Share and Real Wealth - 1960 -1999

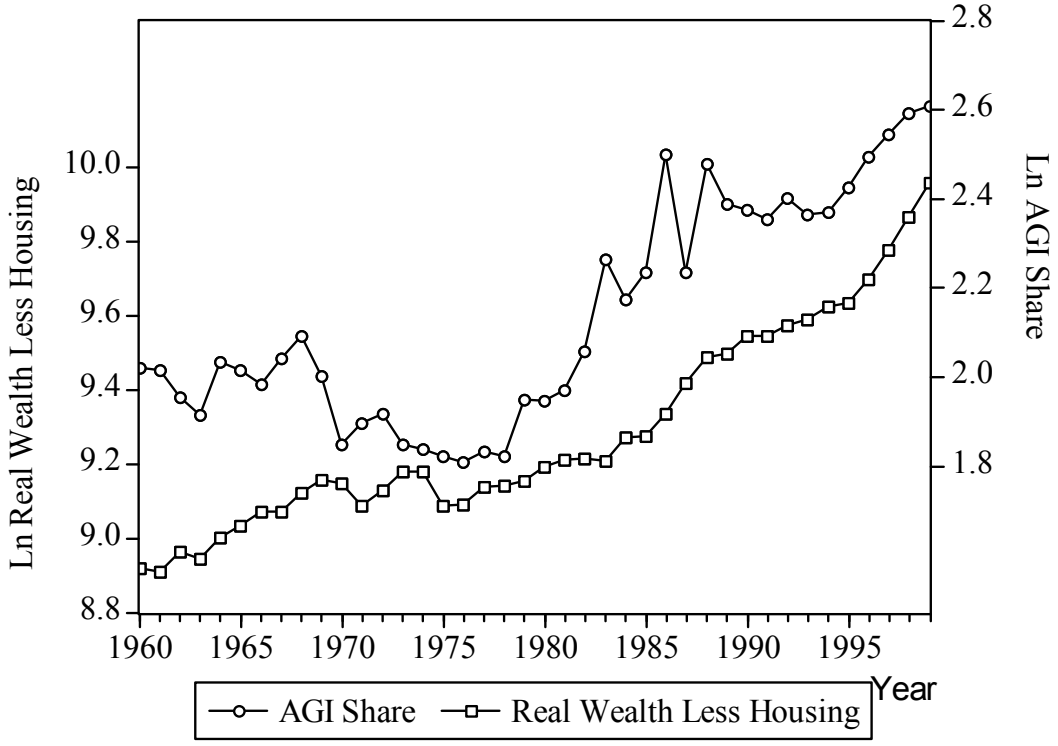


Figure 3.1d
Top AGI Share and Real Wealth Less Housing Wealth - 1960 - 1999

A constant and time trend are included in the ADF and KPSS tests for each variable. The results of the ADF tests in levels are presented in Table 3.2a. Since the data frequency is annual, a lag length of one is used for testing; this is sufficient to remove residual autocorrelation. From Table 3.2a, all variables appear non-stationary, and they are at least integrated of order one, or I(1). Thus, estimating a model using levels of the variables will provide spurious results if they do not share a long run relationship (i.e. they are not cointegrated).

A second round of ADF and KPSS tests are estimated for the first differences of all variables, using one lag in the specification. The purpose is to identify if all variables are I(1) or I(2). These results are contained in Table 3.2b. Indeed, all variables appear to be I(1), so all of the variables are stationary in first-differences. Therefore, if the variables are not cointegrated, using OLS can result in spurious estimation. On the other hand, if these variables are cointegrated, as was the case in Bruce, Tuttle, and Garrison (2003), then spurious estimates are no longer a problem.

Empirical Results

To estimate the permanent effect of tax rate changes on the AGI share, Equation (3.1) is estimated. Three estimations provide baseline results and are displayed in Table 3.3. The first specification, Specification A, restricts β_3 (the wealth parameter) to zero. In Specification A, the only determinants of AGI share in the long run are the two included tax rates. Next, Specifications B and C add measures of wealth to estimate the influence on the AGI share, and to check the robustness of the tax rate elasticities.

Specification A provides some interesting results. The elasticity of AGI share with regard to both tax rates is between –0.50 and –0.55, and the estimates are

Table 3.2a Unit Root Tests Variables in Levels				
	Augmented Dickey-Fuller Test		KPSS Test	
Series	Test Statistic	5% MacKinnon C.V.	Test Statistic	5% C.V.
AGI	-1.64	-3.53	0.38	0.146
CG	-1.75	-3.53	0.16	0.146
IT	-2.32	-3.53	0.16	0.146
RW	-1.05	-3.53	0.35	0.146
RWH	0.07	-3.53	0.42	0.146

Table 3.2b Unit Root Tests Variables in First Differences				
	Augmented Dickey-Fuller Test		KPSS Test	
Series	Test Statistic	5% MacKinnon C.V.	Test Statistic	5% C.V.
ΔAGI	-5.97	-3.53	0.07	0.146
ΔCG	-3.16*	-3.53	0.08	0.146
ΔIT	-4.08	-3.53	0.08	0.146
ΔRW	-4.07	-3.53	0.06	0.146
ΔRWH	-4.14	-3.53	0.11	0.146
*Null hypothesis rejected at a 90% level of confidence				

statistically significant. The top marginal income tax rate elasticity is slightly higher than that of the capital gains rate. Although the results are slightly higher than those in previous research, these results suggest some permanent response to changes in the two tax rates among the wealthy. From Specification A, a ten percent increase in either tax rate will decrease the top AGI share by five to five-and-a-half percent.

As noted, certain omitted variables may be biasing the tax rate elasticities. The amount of wealth held by the wealthiest households can serve as a source of capital gain income. If income tax rates are high enough, the households considered here can substitute capital gains realizations for labor earnings, thus creating a substitution effect. Further, they can reallocate earnings from forms taxable as income to those forms taxed at the capital gains rate. Thus if income rates are high enough, these households can draw upon their net wealth to take advantage of lower capital gains tax rates. Therefore, the top marginal income tax rate and wealth should be negatively correlated. Indeed, the measures are negatively correlated, with respective measures of ρ= -0.83 and ρ= -0.85. The relationship between wealth and the income tax rate indicates exclusion of wealth will bias the top marginal income tax elasticity of the AGI share elasticity downward. This will result in a larger income tax rate elasticity, in absolute value, if wealth is omitted. On the other hand, the capital gains rate and wealth measures are also negatively correlated, but the correlation values are much smaller (-0.13 to –0.24) than the correlation between the wealth measures and the top marginal income tax rate. Therefore, the effect of wealth on the capital gains rate elasticity is likely to be smaller.

As results in Table 3.3 show, when aggregate real wealth is added (Specification B), the estimate of the long run income tax elasticity falls from –0.547 to

Table 3.3 Cointegration Equations			
Variable	Specification A Long Run Elasticity (S.E.)	Specification B Long Run Elasticity (S.E.)	Specification C Long Run Elasticity (S.E.)
Constant	**5.996** (0.475)	-1.860 (2.169)	-1.231 (1.221)
Capital Gains Rate	**-0.503** (0.139)	**-0.464** (0.151)	**-0.424** (0.112)
Income Tax Rate	**-0.547** (0.068)	-0.113 (0.088)	**-0.147** (0.049)
Real Wealth	—	**0.624** (0.188)	—
Real Wealth minus Housing	—	—	**0.574** (0.109)
Schwarz Criteria	-1.141	-1.608	-1.899
Adjusted R^2	0.835	0.918	0.939
Jarque-Bera (p-value)*	0.849	0.829	0.904

Bold indicates significance at the 95% level of confidence
*Test of residual normality, where the null hypothesis is approximately normally distributed residuals.

–0.113. In addition, the statistical significance of the top marginal income tax rate deteriorates dramatically, and in fact it is now statistically insignificant. The exclusion of wealth appears to severely bias the long run income tax rate elasticity. The capital gains elasticity, however, appears robust. In fact, this estimated elasticity is closer to results found in previous work (Bruce, Tuttle, and Garrison 2003). The capital gains rate has a substantial impact on share of AGI reported, while the income tax rate plays no statistical role in the long run.

Real wealth does play an economically and statistically significant role in determining AGI share in the long run. The effect is larger than the combined effects of equal changes in the tax rates. The results in Specification B suggest that the effect of a given equal increase in both the top capital gains tax rate and top marginal income tax rate on the AGI share is nullified by an equal percentage increase in real wealth. Thus, as suspected, wealth appears to be an important determinant, and its exclusion results in substantial bias in the income tax rate elasticity.

Next, Specification C adjusts the real net wealth variable by removing from the wealth measure effects of changes in housing equity. As with the previous specification, the long run capital gains rate elasticity is relatively robust. However, it is immediately apparent that removing housing wealth has substantial impacts on the parameter estimate for the marginal income tax rate and its significance. The income tax rate in this specification is statistically significant. It still plays an economically limited role in determining AGI share in the long run when wealth is included. Additionally, this measure of long run wealth has a significant role in determining AGI share, but the parameter is slightly smaller. In this specification, the wealth parameter is equal, in

absolute value, to the sum of the top marginal income tax and capital gains tax rate parameters. Therefore, a percentage change in real wealth that exactly equals a given percentage change in *both* tax rates will have equal offsetting impacts on the AGI share in the long run. Using the Schwarz Criteria as a model selection parameter, this specification is the optimum and preferred of the three.

The pattern of short run, transitory responses is very different. ECM Specification A is the short run model pertaining to long run Specification A, where only taxes enter the long run relationship (the benchmark specification). Thus, the parameters in θ' in Equation (3.2) are restricted to zero. From Specification A in Table 3.4, current period short-run responses exist for the capital gains rate only (-0.386). Transitory, income-shifting effects (lagged and lead impacts) are non-existent for changes in either tax rate. Therefore, Specification A indicates there is not any apparent income shifting to take advantage of changing tax rates. A long-run relationship appears to exist between tax rates and the AGI share, as seen in the statistical significance and value of the adjustment parameter. Given the value of the adjustment parameter of –0.434, 90 percent of the disequilibrium created by changes in any of the tax rates is eliminated after 4 years.[37] Thus, Specification A indicates there are immediate responses in the top AGI share from capital gains rate adjustments, but adjustments to changes in the top federal marginal income tax rate are fully realized over a longer period. Whether these adjustments are due to changes in labor supply decisions or reporting cannot be inferred, but Specification A indicates some sort of permanent effect exists empirically.

[37] The proportion of the gap closed after n periods is approximately $1-(1+\alpha)^n$.

Table 3.4 Error-Correction Models			
Variable	Specification A Parameter Estimate (S.E.)	Specification B Parameter Estimate (S.E.)	Specification C Parameter Estimate (S.E.)
Constant	**0.051** (0.019)	-0.004 (0.015)	-0.002 (0.013)
ΔCapital Gains Rate Next Year	0.032 (0.157)	0.010 (0.095)	0.079 (0.086)
ΔCapital Gains Rate This Year	**-0.386** (0.124)	**-0.219** (0.094)	**-0.206** (0.085)
ΔCapital Gains Rate Last Year	0.097 (0.136)	**0.289** (0.106)	**0.293** (0.094)
ΔIncome Tax Rate Next Year	0.076 (0.160)	**0.262** (0.121)	0.153 (0.108)
ΔIncome Tax Rate This Year	-0.173 (0.144)	-0.033 (0.130)	-0.041 (0.118)
ΔIncome Tax Rate Last Year	-0.021 (0.169)	-0.027 (0.121)	-0.058 (0.109)
ΔWealth This Year	—	**1.030** (0.346)	—
ΔWealth Last Year	—	**0.900** (0.405)	—
ΔWealth Less Housing This Year	—	—	**0.930** (0.273)
ΔWealth Less Housing Last Year	—	—	**1.019** (0.324)
Adjustment Parameter	**-0.434** (0.179)	**-0.766** (0.148)	**-0.973** (0.157)
Adjusted R^2	0.313	0.587	0.663
Bold indicates significance at the 95% level of confidence			

ECM Specification B includes the first difference of real wealth, and is the short run model for long run Specification B. In ECM Specification B, there is a significant and negative effect from a changing capital gains rate in the current period. This is nearly offset by the lag effect of a capital gains rate change. Thus, when wealth is included in the analysis, results indicate that an increase in the capital gains rate induces income-shifting behavior in the form of delayed realization of capital gains in the short run. Also, the marginal income tax rate has a lead effect that is close to the lag effect from capital gains rate changes. Thus, the income tax rate has a short run impact on the AGI share only in this specification, through the shifting of income to take advantage of changing rates only.

Real wealth is added in ECM Specification B with a current change and lagged change component only. Recall that all net wealth measures are lagged one period, so that beginning of period values are measured. Both current period and lagged changes in real wealth have substantial impacts upon the share of income reported. The short run wealth elasticities are larger than any measure of tax rate elasticities and the long run wealth elasticity. These results suggest an overshooting, in the short run, of the AGI share above or below the new long run equilibrium after changes in wealth. In other words, a given percentage increase in wealth will create a larger temporary increase in the AGI share than the long run increase.

Finally, the adjustment parameter is statistically significant and larger in ECM Specification B than that in the previous ECM Specification A. Therefore, a long run relationship between the variables exists, so changes in real wealth and tax rates induce permanent responses in the AGI share. In fact, the speed of adjustment is relatively

quick, with almost 95 percent of the disequilibrium being removed after two years. Thus the permanent changes in the AGI share occur rapidly. If the top capital gains tax rate increases ten percent, then 94.5 percent of the approximate 4.6 percent permanent decrease in the AGI share (or a decrease of 4.35 percent), occurs within two years of the capital gains tax change. At the same time, the substantial transitory change in the top capital gains tax rate also occurs. This rapid permanent adjustment that is concurrent with the transitory effects may provide some evidence as to why it is so difficult to untangle the transitory and permanent effects from tax rate changes, since long run changes occur over the same period as short-term adjustments.

The results from the ECM Specification C appear robust, except for the income tax results. The significant lead effect of changes in the top marginal income tax rate found in the previous equation is absent. Also, the speed of adjustment is almost immediate, with 97.3 percent of the disequilibrium being eliminated in the first period and over 99.9 percent eliminated in just two years after a change in tax rates or non-housing wealth.[38] This result further supports the previous proposal of why debate exists over the timing of responses, since permanent and transitory reactions to changing rates occur over a relatively short period, creating ambiguous effects.

Are Wealth and Taxes Exogenous?

The possibility remains that, over long periods of time, changes in the AGI share may create changes in the top marginal income tax or capital gains tax rates. Further, tax rates and wealth may respond in the short run to changes in the AGI share too. For

[38] Statistically, the adjustment parameters in both ECM B and C are not statistically different from –1, with p-values on the null hypothesis of 0.13 and 0.86, respectively. Therefore, the results suggest that complete permanent adjustment in the AGI share occurs in the year immediately following any tax changes.

example, as the AGI share grows over the long run, taxes may rise or fall as policymakers respond to public pressures. Therefore, there remains the possibility that the top income tax rate, top capital gains rate, wealth, and/or the AGI share respond to changes in any of the other remaining variables (in the long run only, or both the long run and short run). If tax rates fail to adjust to changes in the AGI share in the long run, they are said to be weakly exogenous. If they fail to adjust to changes in the AGI share in the short run and long run, they are strictly exogenous.[39]

Specifically, a VECM(1) containing AGI share, the top marginal income tax rate, top capital gains tax rate, and real wealth, with one cointegrating relationship, is written as:

$$\begin{bmatrix} \Delta AGI_t \\ \Delta CG_t \\ \Delta IT_t \\ \Delta Z_t \end{bmatrix} = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} \end{bmatrix} \begin{bmatrix} \Delta AGI_{t-1} \\ \Delta CG_{t-1} \\ \Delta IT_{t-1} \\ \Delta Z_{t-1} \end{bmatrix} + \begin{bmatrix} \alpha_{11} \\ \alpha_{21} \\ \alpha_{31} \\ \alpha_{41} \end{bmatrix} \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \end{bmatrix} \begin{bmatrix} AGI_{t-1} \\ CG_{t-1} \\ IT_{t-1} \\ Z_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \varepsilon_3 \\ \varepsilon_4 \end{bmatrix} \qquad (3.3)$$

where the matrix of γs represents the short run relationship between the variables, the matrix of αs contains the long run adjustment of each variable to changes in any variable, and the β matrix contains the estimates from long run Specification B or C, depending on the specification. Weak exogeneity of the top capital gains rate, top marginal income tax rate, and real wealth exists when $\alpha_{21}= \alpha_{31}= \alpha_{41}=0$. A weakly exogenous variable does not respond to changes in other variables in the long run. If weak exogeneity exists in all but one of the variables, it is feasible then to estimate a reduced form model. In fact, if we fail to reject the null hypothesis of $\alpha_{21}= \alpha_{31}= \alpha_{41}=0$, it is appropriate to estimate a

[39] For further discussion, see Harris (1995).

single equation, in this case an error correction model, where the dependent variable is ΔAGI_t. Table 3.5 gives the results of joint tests for weak exogeneity for the VECM specification in Equation (3.3), where the Z_t variable represents real wealth or real wealth less housing, respectively. The null hypothesis of weak exogeneity of the top marginal income tax rate, top capital gains rate, and measure of real wealth is supported by the results in Table 3.5.

Tests for strong exogeneity of a variable involves testing the restriction that the particular variable is unaffected by changes in the remaining variables in both the long run and short run. For example, the test of strong exogeneity of the top capital gains tax rate tests the null hypothesis of $\gamma_{21}= \gamma_{23}= \gamma_{24}= \alpha_{21}=0$. Table 3.5 includes the joint test of strong exogeneity of the top marginal income tax rate, top capital gains tax rate, and respective wealth measures. Indeed, we fail to reject the null of strong exogeneity of these three variables. So, changes in the top marginal capital gains tax rate, top marginal income tax rate, and wealth appear unaffected by changes in the AGI share in the long run *and* short run. In other words, the AGI share solely responds to changes in other variables.[40]

Structural Breaks

The tax code changes of the 1980s marked a dramatic change in policy. Between 1980 and 1988, the top marginal income tax rate fell by sixty percent, when the top marginal income tax rate was reduced from 70 percent to 28 percent. Over this same period, the top capital gains rate fluctuated: it fell forty percent (from a 28 percent rate to

[40] When tested separately, the top marginal income tax rate, top capital gains tax rate, and wealth measures are weakly exogenous.

Table 3.5 **Joint Tests of Weak and Strong Exogeneity of Capital Gains Rate, Income Tax Rate, and Wealth**		
Test	**ECM B** (p-value)	**ECM C** (p-value)
Weak Exogeneity	0.254	0.146
Strong Exogeneity	0.162	0.180

a 20 percent rate in 1981); it then rose in 1987 back to 28 percent. Further, beyond the rate changes, other drastic tax code changes took place as well. These changes constituted the most extraordinary transformation in income taxation since its inception, and raise the possibility that some sort of break in the long run relationship, short run relationship, or both occurred.

To address this issue, Hao and Inder's (1996) OLS-based CUSUM test of long run Specifications A, B, and C is estimated. This test involves using fully-modified (FM) OLS residuals or asymptotically equivalent estimators, such as DOLS. The adjusted cumulative sums of the DOLS residuals are then compared to the critical values provided by Hao and Inder.[41] With this test, the entire sample period can be examined for the existence of any structural breaks. The structural break test results appear in Table 3.6.

Looking at long run Specification A (which contains no wealth measure), a structural break occurs at a 90 percent level of confidence. This proposed break occurs over the 1992-1994 period, or during the 1993 tax increase. In contrast, when measures of real wealth are included in the cointegrating relationship, the test fails to reject the null of no structural breaks. The maximum value of the test statistic occurs in 1968 (the year of President Johnson's tax surcharge) for both long run Specification B and long run Specification C, but is not large enough to warrant the treatment for a structural break in the long run relationship.

Next, the possibility of a short run structural break is addressed. CUMSUM tests of the error correction models are estimated. The results are contained in Figures 3.2a,

[41] The residuals are adjusted by the estimate of the long run variance and the square root of the sample size. Critical values are provided in Table 1 on pg. 184 by Hao and Inder (1996).

Table 3.6 **Test for Structural Breaks in the Long Run Relationships**		
	Test Statistic*	5% Critical Value
Specification A	1.011**	1.0413
Specification B	0.795	0.934
Specification C	0.541	0.934

*The test statistic is the largest absolute value of the adjusted cumulative sum of the DOLS residuals.
** The test indicates that a structural break occurred in 1992-1994 using a 90% level of confidence.

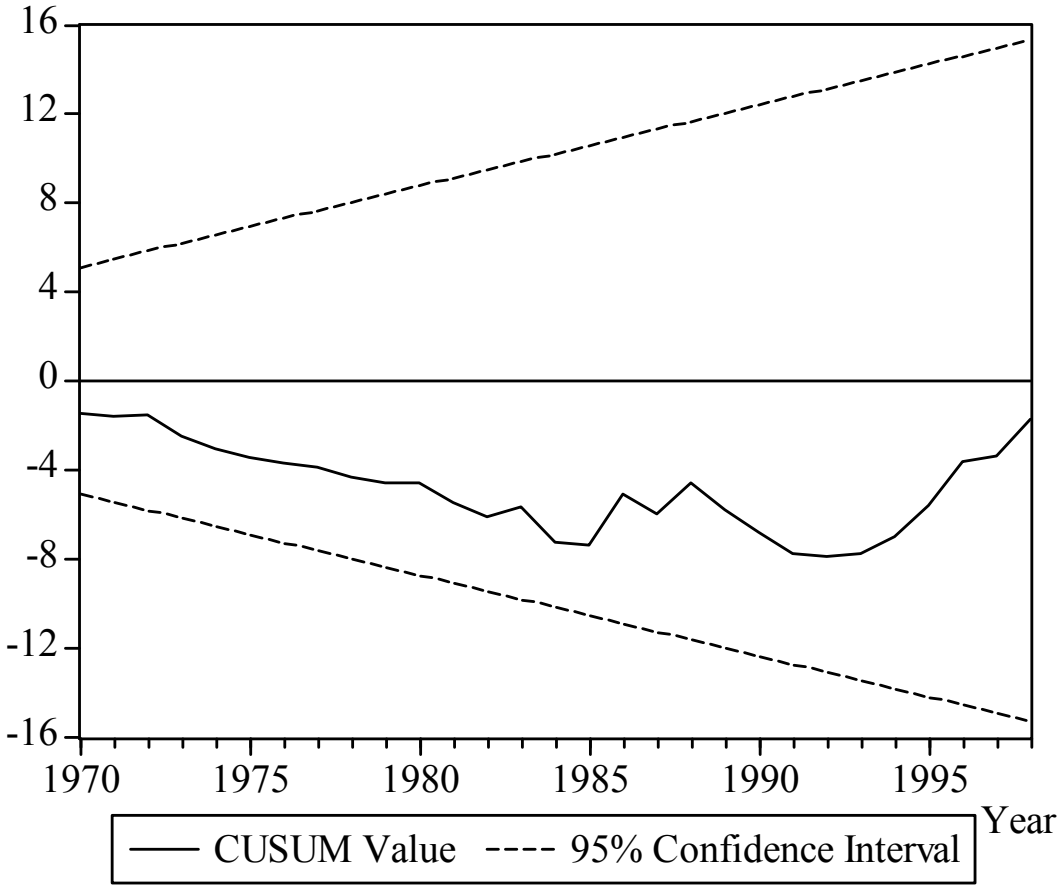
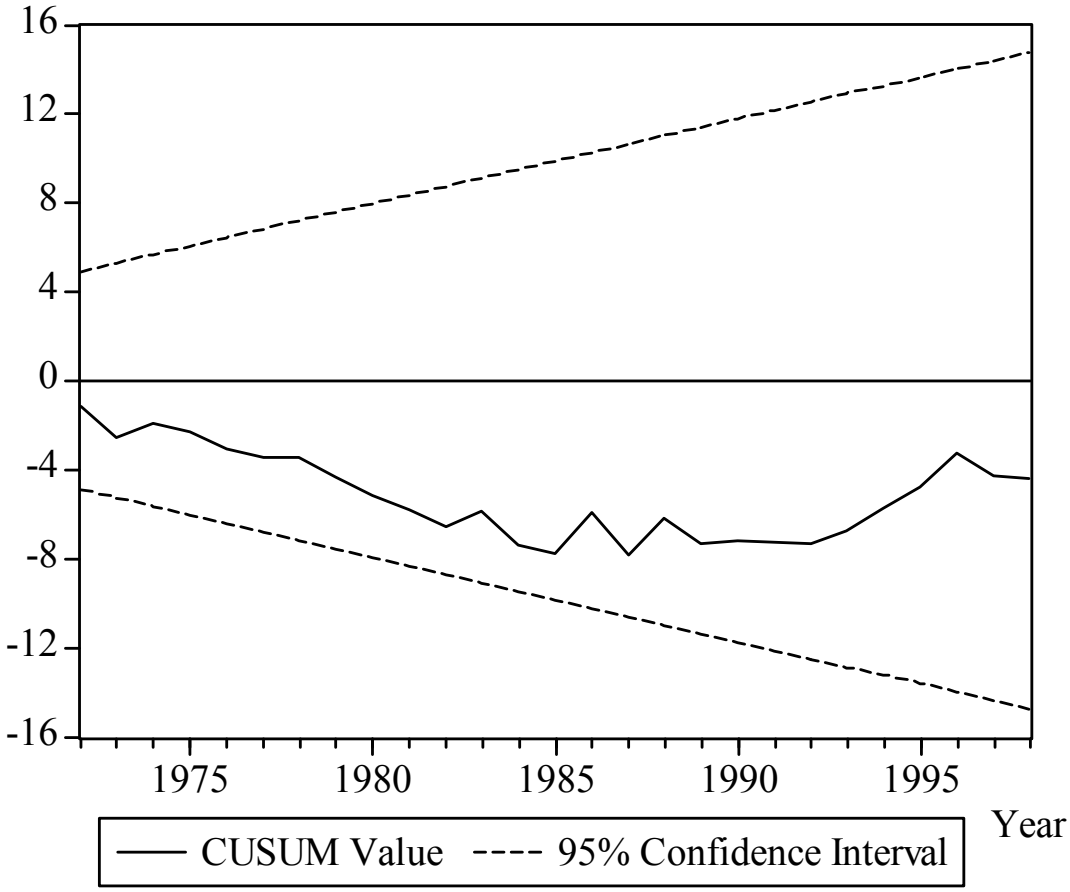


Figure 3.2a
CUSUM Test of ECM Specification A

3.2b, and 3.2c for ECM Specification A, B, and C respectively. These tests provide no evidence of structural breaks in any of the error-correction models, or short run relationships.

Robustness Checks

The possibility remains that the parameters on wealth are capturing the effect of other macroeconomic changes. To investigate the robustness of the wealth results, two long run models are estimated, where further macroeconomic variables are added. Specifically, real GDP and labor productivity are separately added to Specification C. The results are shown in Table 3.7. Adding either real GDP or labor productivity has little effect on the elasticity of the top AGI share with respect to real wealth or the top capital gains rate. However, the top federal marginal income tax rate elasticity does increase (in absolute value) when these two measures are added. Thus results here show that estimates of income tax elasticities are sensitive to specification. Potentially, influences not captured in earlier specifications may be biasing the income tax elasticity. Moreover, the income tax elasticity in Table 3.7 lies in the range found by Bruce, Tuttle, and Garrison (2003). Thus, the economically and statistically significant effects of real wealth and the top capital gains rate found in the early estimations are robust across various specifications, but the income tax elasticity appears to be sensitive to specification. Therefore, the role of wealth in determining the AGI share proves to be robust, and is important in determining the evolution of the share of income reported by the top 0.5 percent of households beyond the effects of other macroeconomics variables.



Firgure 3.2b
CUSUM Test of ECM Specification B

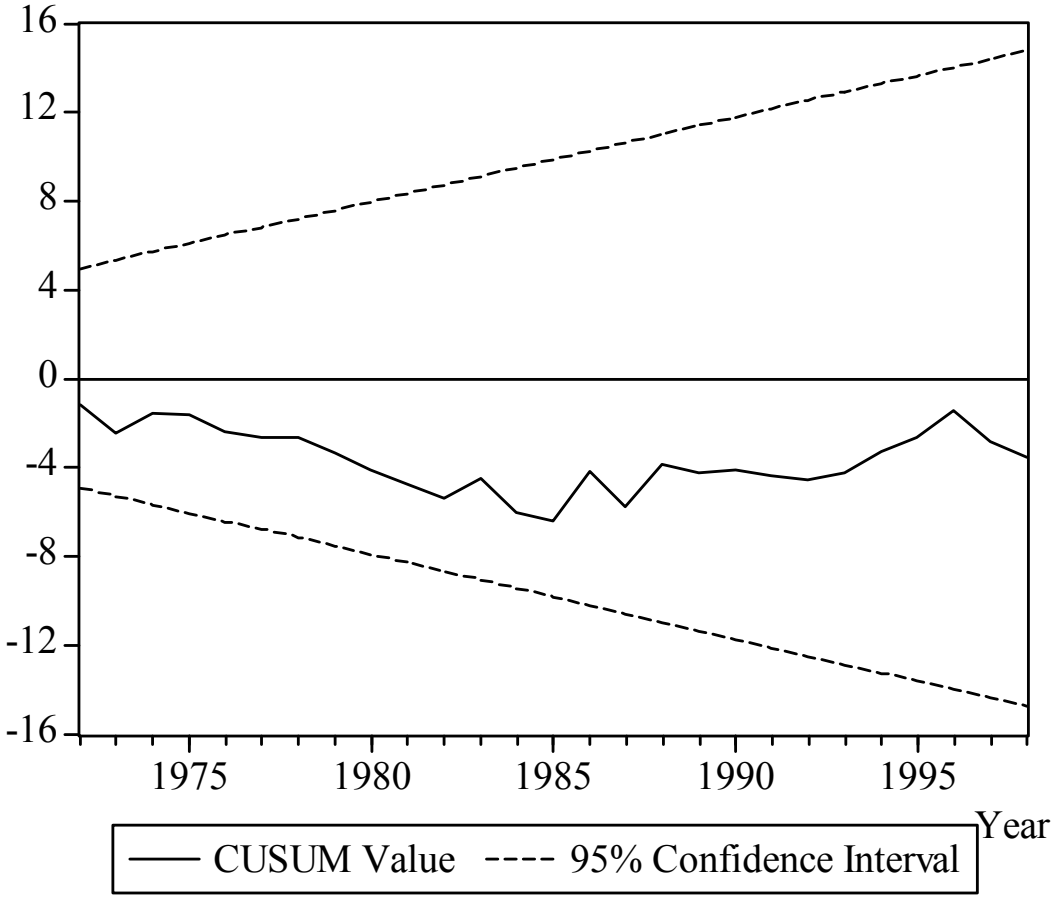


Figure 3.2c
CUSUM Test of ECM Specification C

Table 3.7 Alternate Long Run Equations		
Variable	Alternate Equation 1 Long-Run Elasticity	Alternate Equation 2** Long-Run Elasticity
Constant	-1.221	0.499
Capital Gains Rate	**-0.428**	**-0.453**
Income Tax Rate	**-0.191**	**-0.277**
Real Wealth minus Housing	**0.749**	**0.531**
Real GDP	*-0.170*	—
Labor Productivity	—	-0.166
Schwarz Criteria	-1.752	-2.153
Adjusted R^2	0.942	0.968
Jarque-Bera (p-value)*	0.369	0.915

Bold indicates significance at the 95% level of confidence
Italics indicate significance at the 90% level of confidence
* Test of residual normality, where the null hypothesis is approximately normally distributed residuals.
** 1 lead, current value, and 2 lags of first differences were added to ensure approximately normally distributed residuals

Dynamic Simulations

One final issue is to examine the dynamic effects that changes in tax rates or wealth have on the AGI share. Figures 3.3a, 3.3b, and 3.3c show the dynamic adjustment of the AGI share to a ten percent decrease in the top capital gains tax rate, top marginal income tax rate, and a ten percent increase in real non-housing wealth (given by ECM Specification C). A ten percent decrease in the top capital gains tax rate creates a volatile short run effect in the first two years, but after three years there is almost complete permanent adjustment. The concurrent transitory and long run permanent impacts from a capital gains rate change create this volatile movement in the AGI share. Conversely, with a ten percent decrease in the top marginal income tax rate, most of the permanent change in the AGI share occurs after only two years. Finally, Figure 3c is the dynamic adjustment of the AGI share from a ten percent *increase* in real non-housing wealth. The overshooting mentioned earlier is evident in Figure 3c, as the growth of the AGI share matches that of wealth in the first two years. After this, it corrects in the third year to its new long run value (above its initial value).

Importance of Wealth in Recent Tax Changes

During the late 1980s, there occurred a large upsurge in the share of AGI reported by the top 0.5 percent of income tax filers. In 1987 however, the capital gains rate increased forty percent. Based on Specification C, this capital gains rate shock should result in a long run decrease in the AGI share of approximately 16.5 percent. The real AGI share, however, fell just over eleven percent from 1986 through 1990. Given the long run elasticities, the share of AGI was buffered by the 12 percent growth in aggregate real wealth (or 13 percent growth of non-housing wealth) over the 1987 to 1990 period,

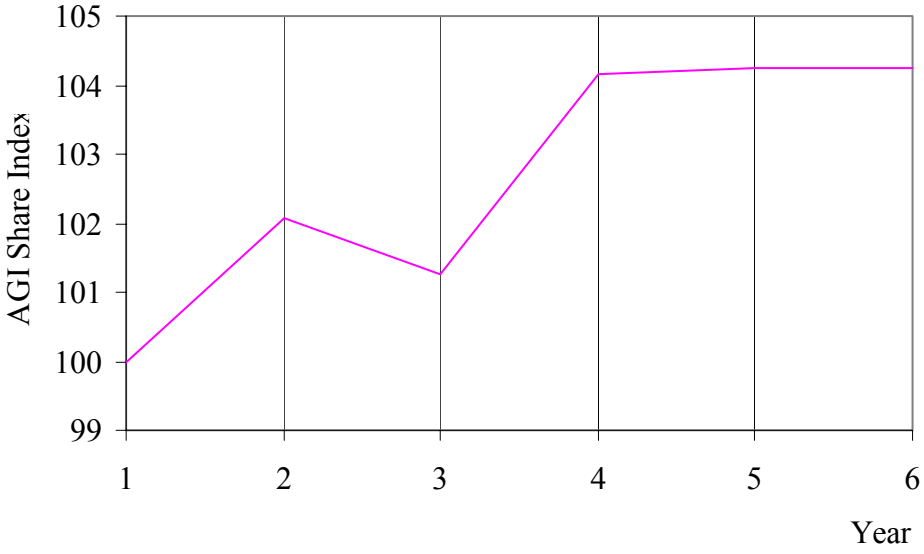


Figure 3.3a
AGI Share Response to a 10% Decrease in the Top Capital Gains Rate

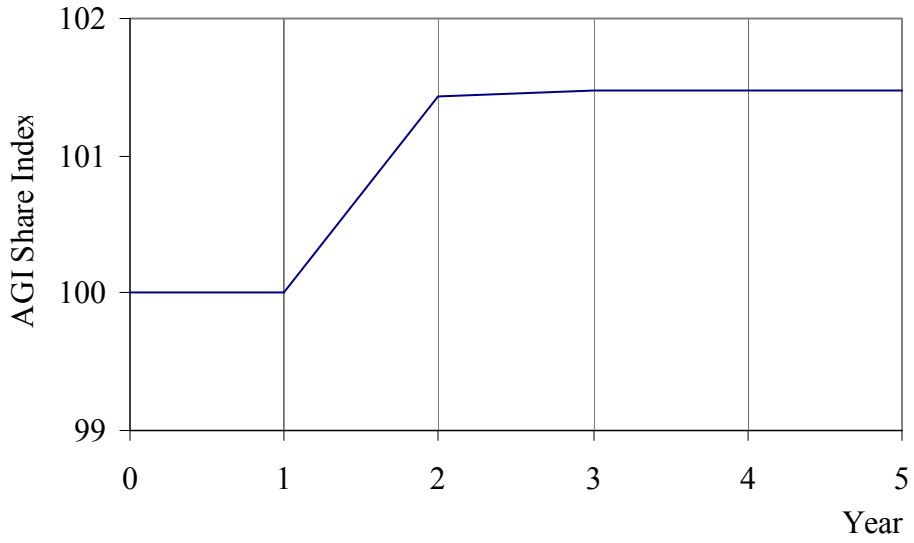


Figure 3.3b
AGI Share Response to a 10% Decrease in the Top Marginal Income Tax Rate

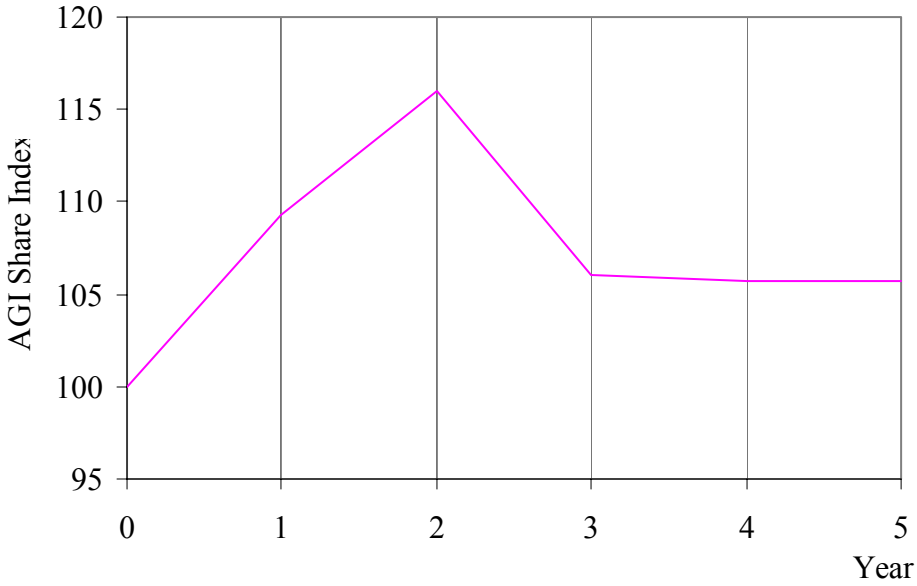


Figure 3.3c
AGI Share Response to a 10% Increase in Real Wealth
Less Housing

which translates into an approximate 7 percent increase in AGI share. Thus, as mentioned earlier, changes in real wealth partially offset impacts from the large increase in the capital gains rate. Thus, impacts on the AGI share are consistent with estimates here.

Using evidence from the middle-to-late nineties, one can see the possible cause for large revenue flows into the Treasury. Concurrent with the tax increase in 1993, the two measures of real wealth grew by 2.5 percent and 6 percent respectively from 1992 to 1994. These small increases in wealth could not offset the effects of the 24.5 percent increase in the top income tax rate and one percentage point increase in the capital gains rate.[42] By 1995, the situation was completely reversed. The first announced budget surplus occurred that year, coinciding with a 5.2 percent and 6.4 percent increase in the wealth measures, in that one year alone. In the same year, the AGI share reported by the top 0.5 percent of all households grew 5.5 percent. Therefore, it appears that changes in real wealth and the eight percentage point reduction in the capital gains rate in the late 1990s may be responsible for the large increase in the AGI share.

What does this evidence imply for policy makers? It appears that tax rates play an important role in determining the share of income reported by the ultra-rich, but real wealth fulfills an equally, if not more important, function. If fiscal policy is totally ineffective in altering aggregate income, lowering tax rates in a period of falling wealth, such as in 2001, may result in a declining share of AGI reported by top earners. Conversely, the negative effect of raising tax rates on the AGI share can be totally offset

[42] In 1993, the top federal marginal income tax rate increase 8.6 percentage points, from 31 percent to 36 percent plus a 10 percent surcharge, making the effective top rate 39.6 percent.

by robust growth in net wealth of these households in the long run. Therefore, from the evidence presented here, policy makers, who are concerned about income distribution, must pay attention to expected changes in real wealth when enacting tax rate changes. Over time, the positive permanent effect of wealth increases can easily negate the negative effects of tax rate increases on the AGI share.

Conclusion

The empirical evidence presented strengthens the view that tax rates are an important determinant of the share of AGI reported by the wealthiest households in both the short run and long run. The most influential tax rate appears to be the capital gains rate (estimated long run elasticity of -0.42 to -0.50). The top marginal income tax rate plays a lesser role in the long run (estimated income tax elasticity is between 0.00 and -0.15). Additionally, the evidence presented here illustrates the importance of wealth in the income and tax considerations of the ultra-rich. In fact, positive changes in wealth can dominate the negative effects of tax rate increases on the AGI share. A given percentage increase in aggregate household wealth (or non-housing wealth) and an equal percentage increase in both tax rates can actually result in a 0.3 percent increase, on average, in the share of income reported by the wealthiest households in the long run.

The short run evidence from the error correction models also reveals the importance of the capital gains tax over the income tax. Further, it appears that wealthy households adjust realizations of capital gains in the face of changing tax rates, but only current period and lag effects exist. In contrast, there are both economically and statistically significant current period and lag effects when controlling for wealth. These

changes in wealth induce the greatest AGI share changes in the short-run. In fact, these adjustments imply an overshooting of the AGI share above or below the new long run equilibrium in the short run from wealth changes.

Therefore, it appears that tax rates permanently influence the AGI share in the long run. Also, these permanent changes occur quickly, with 95 to 99.9 percent of these long run changes occurring within two years. The transitory effects from tax rate changes are relatively modest, when compared to the long run elasticities. Short run AGI share responses to changes in real wealth, however, are larger than the permanent effects. Evidence presented in this essay suggests that if policy makers are concerned about the distribution of income, they must pay particular attention to not only macroeconomic factors, but also to either actual or expected changes in real wealth when changing tax policies.

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Appendix

Table A 3.1
Correlation of Variables

	AGI	CG	IT	RW	RWH
AGI	1.00	-0.52	-0.83	0.73	0.87
CG	-0.52	1.00	0.18	-0.13	-0.24
IT	-0.83	0.18	1.00	-0.83	-0.85
RW	0.73	-0.13	-0.83	1.00	0.83
RWH	0.87	-0.24	-0.85	0.83	1.00

Conclusion

The essays contained in this dissertation demonstrate the importance of aggregate wealth for the macroeconomy of the U.S. All empirical investigations find a permanent effect from aggregate wealth changes on consumption, disaggregated consumption, and the distribution of taxable income. Given the size of aggregate wealth (4 times greater than annual output in 2001), small changes in wealth can have dramatic effects on the U.S. economy.

In the first essay, aggregate consumption permanently responds to wealth changes. The size of this effect is consistent with previous results in the literature – a one dollar increase in wealth creates nearly four cents in new consumption in the long run. Therefore, changes in wealth can have substantial impacts on aggregate consumption. However, changes in aggregate consumption have ramifications on aggregate wealth too. Permanent changes in wealth are created from changes in aggregate consumption. Therefore, the relationship between the two is bi-directional in the long run.

The first essay presents results that are different from that of the Endogenous Wealth literature. Wealth changes are shown to have permanent effects on non-durable and durable consumption in the first essay, once the disaggregated components of consumption are investigated. However, like the finding of the Endogenous Wealth literature, results here indicate a permanent change in wealth is found.

The second essay investigates how the components of wealth - assets and liabilities - affect aggregate consumption. Results indicate the permanent wealth effects on consumption found in the first essay are solely due to changes in assets. Aggregate liabilities changes have no permanent impact on consumption. Even with the exclusion

of aggregate liabilities from the long run relationship between consumption, income, and assets, the results in the second essay are relatively similar with those in the first essay.

The final essay examines the relationship between wealth and the distribution of Adjusted Gross Income. Wealth is found to play an important role in permanently affecting the share of Adjusted Gross Income (AGI share) reported by the top 0.5% of households. The top capital gains tax rate and top marginal income tax rate are also shown to create permanent changes in the AGI share. The empirical evidence presented also points to the substantial bias created in the income tax elasticity from the omission of wealth from the long run relationship. In addition, the permanent effects on AGI share due to increases in wealth can easily outweigh the effect from equivalent percentage increases in both tax rates. Further, almost all of the permanent change in the AGI share occurs within two years of wealth or tax rate changes. In the short run, the transitory response of the AGI share shows a distinct over-shooting from wealth changes. This over-shooting is relative to the permanent change in the AGI share from wealth changes. Given the evidence in the third essay, wealth is an important determinant of the distribution of AGI between the rich and remaining households.

These three essays contribute to the current literature through their investigations into the role of wealth in the U.S. economy. The evidence presented here demonstrates that wealth produces permanent effects on overall consumption movements. This wealth effect can be substantial, adding significantly to aggregate purchases of goods and services by households. Further, changes in wealth can also influence the distribution of purchases of goods and services by households, by creating more non-durable and durable consumption in the long run. Finally, the last essay indicates the important role

that changing wealth has on the share of AGI reported by the top 0.5% of households, relative to total taxable income. Given the evidence in this research, aggregate wealth can have substantial impacts on the macroeconomy. Further, these changes in wealth have temporary effects on consumption and taxable income, but the most important influence is in the long run. Wealth changes can permanently alter the macroeconomic environment, possibly transforming the structure of the U.S. economy.

Vita

Markland Tuttle was born in Kansas City, Kansas in 1970. In 1989, he graduated from high school in Conroe, Texas. He received a Bachelor of Business Administration degree in 1995 and a Master of Business Administration degree in 1997 from Sam Houston State University. Markland also served in the United States Army and Army Reserve as a Medical Specialist for eight years, achieving the rank of Sergeant. In August 2003, he received a Ph.D. in economics from the University of Tennessee, Knoxville.