Does Consumption Respond More to Housing Wealth Than to Financial Market Wealth?*

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Abstract

The strong consumption growth in a period of falling stock market and a moderate recession in the U.S. has sparked off a debate about the role of housing wealth as one of the determinants of consumption. The literature is divided over the issue whether the effect of change in the financial wealth on consumption is lower than the change in housing wealth. In this paper using Gonzalo-Ng (2001) variance decomposition framework we have shown that the net effect of housing wealth increase on consumption is higher than financial wealth. Using time varying parameter model we have also found that the housing wealth effect has increased overtime. This reflects the deregulation of the housing and mortgage market in US over the last three decades as the housing market has become more efficient.

Key words: Consumption, Wealth Effect, Beveridge-Nelson Cycle, State Space Model, Kalman Filter, Cointegration.

1 Introduction

There has been a consensus in economic literature and policymaking about household wealth being one of the determinants of consumption expenditure. This dates back to Keynes' General Theory. This so called wealth effect was formalized by Modigliani and his collaborators like Ando and Brumberg. Modigliani's life cycle model of consumer spending emphasized the critical role of household wealth in determining consumption. The recent behavior of consumer spending in the U.S. economy has renewed a great interest in the wealth effect.

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The traditional wealth effect estimate implies that for every dollar increase in wealth the consumption should increase by 2-10 cents[1]. This implies that the US economy should have witnessed a decline in consumption in the last two years as the net worth of household sector declined during this period. But on the contrary it has experienced a very robust consumption growth. One of the explanations of this puzzle has been the strong housing market in the US during the last 2-3 years. Alan Greenspan and some of the recent research have pointed out that the marginal propensity to consume out of housing wealth is higher than the marginal propensity to consume out of stock market wealth. Therefore, even during a period of falling stock market consumer spending may remain strong if the housing market is really strong.

There is no consensus in the literature about the relative magnitude of these two types of wealth effect. There is also no study which deals with the question of why does the responsiveness of consumption differ for different types of wealth. The objective of this paper is two-fold. First, we try to quantify the difference in the magnitude of the wealth effect arising out of housing wealth and financial wealth. Second, we analyze the importance of financial deregulation in the housing market on consumption and the dynamics of housing wealth. The issue of financial deregulation is very important for the housing market as it has gone through some big changes in the US economy for last thirty years.

The recession of 2001 was unique among all the recessions because housing market and financial markets were moving in the opposite direction and consumption growth was positive for the whole time period (see table 1). The only other recession when consumption growth was positive was in 1981-82. The strength in the housing market and aggressive monetary policy action by the Fed led to a big refinancing boom during the last two years. Mortgage refinancing has become easier because of the deregulation in the housing market over the last three decades. This deregulation has resulted in a lower fees for mortgage applications, lower downpayment for a house purchase and also easier availability of credit in the market. Recent Federal Reserve surveys have shown that this refinancing boom has supported the consumer spending in the US.

The effect of housing wealth on consumption has not been widely explored in the macroeconomic literature. Case (1992) found evidence of a substantial consumption effect during the real estate price boom in the late 1980s using aggregate data for New England. Case, Quigley and Shiller (2001)

[1] Poterba (2000)

in a recent study using panel data across US states and across OECD countries have shown that changes in housing wealth have greater effect on consumer spending than changes in stock market wealth. But the estimates of wealth effect in their paper is very sensitive to different specification of the model. They themselves conclude that their statistical results are variable depending on econometric specification, and so any conclusion must be tentative. Benjamin, Chinloy and Jud (2004)[2] have shown that the effect of a dollar increase in housing wealth on consumption is four times higher than a dollar increase in financial wealth. They estimate the wealth effect to be eight cents for housing wealth and two cents for financial wealth. Their financial wealth measure includes the stock of consumer durables. Their estimate of wealth effect is dependent upon the lagged value of the income and wealth variables as additional explanatory variables. Therefore, in a strict sense their estimate should not be called an estimate of wealth effect as proposed by Ando and Modigliani. Ludvig and Slok (2002) in a study on a panel of countries using panel cointegration have shown that the long-run impact of an increase in stock prices and housing prices on consumption is in general higher in countries with a market based financial system than bank based financial system. They also claim that the response of consumption to increase in housing wealth is lower than to increase in stock wealth. The problem with their approach is that they assume independence of error term across equations in their panel cointegration framework. We do not expect the error term across equations to be independent because the OECD countries are highly integrated.

In a different strand of research Lettau and Ludvigson (2003) claim that because of the large transitory component of stock market wealth, the wealth effect should be much smaller than the usual estimates. They argue that wealth effect should correspond to only that movement in wealth which is permanent. The usual estimates of wealth effect don't take into account the fact that the asset values can be decomposed into permanent and transitory components. Lettau and Ludvigson (2002,2003) have shown that stock market wealth can be forecasted by using the cointegration property of consumption, labor income and stock market wealth. They claim that the large transitory component of stock market wealth can be used to forecast the short-run behavior of the stock market and also can be used to shed light on the net wealth effect.

We argue that if this explanation is true then the US economy should have witnessed a decline in

[2] They also use Flow of Funds Data from 1952-2001. They define financial wealth = net worth- net real estate wealth.

consumption in the last recession as the net worth of households declined from $42,371 billion in 1999 to $41,071 billion in 2001. The explanation of this puzzle lies in the different wealth effect arising out of housing wealth and financial wealth[3]. The difference in the wealth effect arises from the nature of shocks affecting these two types of wealth. Using the long run equilibrium relationship between consumption, labor income, housing wealth and financial wealth we have shown that consumption and financial wealth adjust to correct for the long run disequilibrium. This is in contrast with the Lettau-Ludvigson result where only stock market wealth does the adjustment. The difference arises in the adjustment property of consumption because of the disaggregation of the wealth as the nature of variation in the housing wealth is totally different from the nature of variation in financial wealth. Using the method proposed by Gonzalo and Ng, we find that housing wealth is dominated by permanent shocks whereas financial wealth is dominated by transitory shocks over different forecast horizons. Since consumption should be affected by permanent movements in wealth according to the life cycle hypothesis, we have shown that the net effect of housing wealth on consumption is higher than the net effect of financial wealth. The other way to look at the same problem is to perform multivariate Beveridge-Nelson decomposition of the variables of interest. Using the Granger Representation Theorem we have decomposed consumption, labor income, housing wealth and financial wealth into a multivariate Beveridge-Nelson trend and cycle. We find significant cyclical component for consumption and financial wealth. The consumption cycle and the financial wealth cycle capture the dynamics of consumption and stock market in the US really well over different time periods. Our results show that consumption was above its trend in the last recession which is consistent with a very strong consumption growth in the last two years. The consumption cycle also explains different episode of recessions in the US economy. Financial wealth cycle follows the broad pattern as shown in Lettau-Ludvigson. It tracks the bull and bear market of the 70's and 80's and post 1997.

The major changes in the housing market over three decades lead us to believe that the effect of housing wealth on consumption is not stable over time. In this paper, using a time varying parameter model we have shown that the effect of the growth of housing market wealth on consumption growth

[3]To be consistent with the model we use financial wealth as a measure of non housing wealth in our paper. The results do not change if we use stock market wealth instead. See the Data Appendix for the definition of financial wealth and stock market wealth.

has been increasing since 1970's. The error correction coefficient in vector error correction model provides us information about the importance of the transitory shocks at different forecast horizons of a variable. Using time varying parameter model we have shown that the importance of transitory shocks in housing wealth has been changing overtime. The importance of transitory shocks at different forecast horizons increased during the 1970's for housing wealth, whereas it decreased during the 80's and 90's. This implies that the impact of a dollar increase in house wealth today will have a bigger impact on consumption than a dollar increase in housing wealth in 1970's. The change in the relative importance of transitory shocks is also consistent with the run up in house prices in the 1970's and decline in the house prices in the 1980's. This has implication for the efficiency of housing market in US. Since the importance of random walk component has increased overtime for housing wealth, our results show that the housing market has become more efficient over time. However, for consumption and financial wealth our model shows that the importance of transitory shocks has been stable for most of the time period.

2 Theoretical Background

We present an overview of the theoretical background of our empirical work in this section. It follows closely the model presented in Campbell and Mankiw (1989) and Lettau-Ludvigson (2003). We assume that housing enters into the agent's budget constraint only[4]. If W_t is the total wealth at time t, then the budget constraint can be written as

$$W_{t+1} = (1 + R_{t+1})(W_t + Y_t - C_t) \tag{1}$$

R_t is the real interest rate, Y_t is the after tax labor income and C_t is the consumption on non durable goods and services. The total wealth can be thought of as the sum of financial wealth, human wealth and housing wealth

$$W_t = F_t + L_t + H_t \tag{2}$$

[4] Case, Quigley and Shiller (2000), Benjamin, Chenloy and Jud (2004) and Ludvig and Slok (2002) have the same framework.

where F_t is financial wealth, L_t is human wealth and H_t is housing wealth. Since human wealth is unobservable, the assumption made in literature is that permanent human wealth is proportional to current labor income[5]. Thus, we can write the logarithm of wealth as

$$w_t \approx \omega f_t + \theta y_t + (1 - \omega - \theta) h_t \tag{3}$$

Small case letters are logarithms of variables and y_t is the current labor income. ω represents the share of financial wealth in total wealth, θ is the share of labor income in total wealth.

The return to aggregate wealth can be decomposed as

$$(1 + R_{w,t}) = \omega(1 + R_{f,t}) + \theta(1 + R_{y,t}) + (1 - \omega - \theta)(1 + R_{h,t}) \tag{4}$$

Campbell and Mankiw have shown that the consumption-wealth ratio has the following property

$$c_t - w_t = E_t \sum_{i=1}^{\infty} \rho_w^i (r_{w,t+1} - \triangle c_{t+i}) \tag{5}$$

After substituting for w_t from equation 3 we get,

$$c_t - \theta y_t - \omega f_t - (1 - \omega - \theta) h_t$$

$$= E_t \sum_{i=1}^{\infty} \rho_w^i \{[\theta r_{y,t+i} + \omega r_{f,t+i} + (1 - \omega - \theta) r_{h,t+i}] - \triangle c_{t+i}\} + \eta_t \tag{6}$$

The right hand side of equation 6 is stationary, therefore, the linear combination of consumption, labor income , financial wealth and housing wealth is stationary and hence they are cointegrated.

3 Comparison of Wealth Effect

Lettau-Ludvigson (2003) have shown that consumption, labor income and wealth are cointegrated in the long run. In this paper, we have disaggregated total wealth into housing wealth and financial

[5] There are three ways to rationalize this assumption. First, without imposing any restriction on the functional form of expected or realized returns on human wealth we can get this relationship between current labor income and permanent human wealth if we characterize labor income as annuity value of human wealth. Second, we can specify a Gordon growth model for human capital where expected returns to human capital are constant and labor income follows a random walk. Finally, labor income can be thought of as the dividend on human capital, as in Campbell (1996) and Jagannathan and Wang (1996). See Lettau-Ludvigson (2001) for details.

market wealth. In a perfect world when these two assets are perfect substitutes the marginal propensity to consume out of these two different types of wealth will be equal but because of issues like volatility, illiquidity and institutional structure, these propensities might be different. Therefore, equation 6 can be written as

$$c_t = \beta_0 + \beta_1 y_t + \beta_2 h_t + \beta_3 f_t + \varepsilon_t \tag{7}$$

Where y_t is labor income, f_t represents financial market wealth and h represents house wealth. Here c_t is the expenditure on nondurable goods and services. We have excluded the expenditure on housing services as housing wealth enters the budget constraint only. Let's define $z_t = (1, c_t, y_t, h_t, f_t)'$. Let z_{1t} be the subset of z_t except c_t. Equation 7 represents the long run relationship between consumption, labor income, financial wealth and housing wealth. The theory implies that the residual should be stationary and consumption,labor income, housing wealth and financial wealth should share a common trend. Here β_2 and β_3 represent the elasticity of consumption with respect to financial wealth and housing wealth. We can convert these elasticities into marginal propensity to consume out of financial wealth and housing wealth by using the consumption and respective wealth ratios.

We first test for cointegration and the number of cointegrating vectors in equation 7. The range of data set spans the period from the first quarter of 1952 to the third quarter of 2002[6]. We perform the cointegration test by testing the stationarity of cointegrated residual and performing the Johansen cointegration test. The cointegrating vector has been estimated using Stock-Watson dynamic OLS (DOLS) and Newey-West heteroscedastic autocorrelation consistent standard errors as there is a significant degree of serial correlation in the residuals if just OLS is used. DOLS adds leads and lags of the differenced explanatory variables to account for the serial correlation. Six leads and lags have been chosen for the estimation of the cointegrating vector. The DOLS equation specification is

$$c_t = \beta' z_{1t} + \sum_{j=-6}^{+6} \gamma' \triangle z_{1t-j} + u_t \tag{8}$$

[6]See Data Appendix for description of the data set used in the paper

As table 2 shows the coefficient on financial wealth is almost three times bigger than the corresponding coefficient on housing wealth. These coefficients are consistent with overall literature in this area. The standard errors are Newey-West HAC errors. After estimating the equation by dynamic OLS we test for the stationarity of the cointegrating residual and the test results are shown in table 3. In all the cases we reject the null of non stationarity of the residual at 5% and 10% significance level. Hence, using econometric methodology we have established the existence of a cointegrating relationship.

The second step is to test the number of cointegrating vectors. For this, we perform the Johansen test for the number of cointegrating relations. Both the trace statistic and the maximum eigenvalue statistic indicates the presence of one cointegrating relationship. As table 4 shows we reject the null of no cointegration at all levels of significance whereas we don't reject the null of one cointegrating relationship for the maximum eigenvalue statistic as well as the trace statistic. In our subsequent analysis we will assume one cointegrating vector which is consistent with the theory as well as the Johansen test for number of cointegrating vectors.

The estimates of β in equation 8 implies that the long-run elasticity of consumption with respect to financial wealth is three times bigger than the housing wealth. Lettau and Ludvigson have argued that these coefficients might give a wrong picture of the overall impact of the explanatory variables if there is a long run relationship between the dependent variable and the explanatory variables. Here, the interpretation of coefficient β becomes really important to analyze the difference in the impact of housing wealth and financial wealth on consumption. If consumption and wealth are cointegrated then they share a common trend. Therefore, the $\beta's$ imply the correlation between the permanent movements in wealth and consumption, not every movement in wealth. They reveal nothing about the relation between consumption and transitory movements in wealth. If most of the movements in stock market wealth are transitory and if transitory movements in stock market wealth have negligible impact on consumption then the final impact of these two measures of wealth will be different than what is implied by these coefficients. Therefore, it's very important to find out whether the movements in financial wealth and housing wealth are dominated by permanent shocks or transitory shocks.

The tools provided by Gonzalo-Granger and Gonzalo-Ng enable us to find out the relative importance of permanent and transitory shocks at different forecast horizons using variance decomposition for a cointegrated system[7]. For this decomposition we first need to estimate the VECM model associated with our cointegrated model as the error correction coefficient in VECM provides information about the relative importance of permanent and transitory shocks. The Engle and Granger representation theorem provides a VECM representation of the cointegrated system.

The VECM model has the following representation

$$\Gamma(L)\triangle z_t = \Gamma_0 + \Pi z_{t-1} + u_t \tag{9}$$

Where $\Gamma(L) = I_n - \sum_{k=1}^{p-1} \Gamma_k$ and $\Pi = \alpha\beta'$ where $\alpha = (\alpha_c, \alpha_y, \alpha_h, \alpha_f)'$.

The lag length criteria implies that p=2. Therefore, in the VECM representation our model has one lag. The following VECM has been estimated

$$\triangle c_t = \gamma_{10} + \gamma_{11}\triangle c_{t-1} + \gamma_{12}\triangle y_{t-1} + \gamma_{13}\triangle h_{t-1} + \gamma_{14}\triangle f_{t-1} + \alpha_c\beta' z_{t-1} + u_{ct}$$

$$\triangle y_t = \gamma_{20} + \gamma_{21}\triangle c_{t-1} + \gamma_{22}\triangle y_{t-1} + \gamma_{23}\triangle h_{t-1} + \gamma_{24}\triangle f_{t-1} + \alpha_y\beta' z_{t-1} + u_{yt}$$

$$\triangle h_t = \gamma_{30} + \gamma_{31}\triangle c_{t-1} + \gamma_{32}\triangle y_{t-1} + \gamma_{33}\triangle h_{t-1} + \gamma_{34}\triangle f_{t-1} + \alpha_h\beta' z_{t-1} + u_{ht}$$

$$\triangle s_t = \gamma_{40} + \gamma_{41}\triangle c_{t-1} + \gamma_{42}\triangle y_{t-1} + \gamma_{43}\triangle h_{t-1} + \gamma_{44}\triangle f_{t-1} + \alpha_s\beta' z_{t-1} + u_{ft}$$

Where $\beta' z_{t-1}$ is the disequilibrium error from the last period. If the $\alpha' s$ are significant then the current period value of the variables move to correct an error left over from the last period. $\alpha_y, \alpha_h, \alpha_f$ are the corresponding speed of correction for the labor income growth, housing wealth growth and financial market wealth. According to the Engle-Granger theorem, if there exists a cointegrating relationship then at least one of these $\alpha' s$ must be significant.

The above system of equations has been estimated using OLS as they have the same explanatory variables and hence SUR method is equivalent to OLS. The estimation results are shown in table 5. It shows that the error correction coefficient is significant for financial wealth at all significance levels and for consumption at 10% significance level. Therefore, it's the financial wealth which does

[7]See King, Plosser, Stock and Watson (1991) for details.

most of the error correction. For the rate of growth of financial wealth only the error correction term is significant whereas for other variables the other explanatory variables are also significant. Therefore, labor income and housing wealth doesn't move to correct for the disequilibrium error.

3.1 Variance Decomposition and Wealth Effect

The error correction property of the model can be used to get insight about the importance of permanent and transitory shocks at different forecast horizons for consumption, labor income, housing wealth and financial wealth using Gonzalo-Ng methodology. We need to trace out the structural innovations from the reduced form Wold moving average representation of the VECM model for the variance decomposition. The Granger Representation Theorem (GRT) provides an explicit link between the VECM form of a cointegrated VAR and the Wold moving average representation. Let y_t be cointegrated with r cointegrating vectors captured in the r$\times n$ matrix β', so that $\beta' y_t$ is I(0). Suppose $\triangle z_t$ has the following Wold representation

$$\triangle z_t = \mu + \Psi(L) u_t \tag{10}$$

Where $\Psi(L) = \sum_{k=0}^{\infty} \Psi_k L^k$ and $\Psi_0 = I_n$. Here u_t is n$\times$1 vector. The Wold representation presented above is like a reduced form equation. We want to identify innovations distinguished by whether they have permanent or transitory effect. In the model presented above there is one cointegrating vector, so, we have 4-1=3 permanent innovations and one transitory innovation. Let's denote the structural innovations as $\eta_t = (\eta_{1t}, \eta_{2t}, \eta_{3t}, \eta_{4t})'$ where we assume the first three innovations are permanent and the last one is transitory.

The permanent and transitory innovations may be identified using the estimated parameters $\hat{\beta}$ and $\hat{\alpha}$ from the error correction representation. GRT provides us the following conditions

$\alpha' \Psi(1) = 0$ and $\Psi(1)\beta = 0$

Let

$$G = \begin{bmatrix} \alpha'_{\perp} \\ \beta' \end{bmatrix} \tag{11}$$

Let's assume that

$$D(L) = \Psi(L)G^{-1}$$

Gonzalo and Ng have shown that the structural innovations can be represented as

$$\eta_t = G u_t$$

and the structural residuals are related to $\triangle z_t$ as

$$\triangle z_t = \mu + \Psi(L)G^{-1}G u_t$$

$$= \mu + D(L)\eta_t$$

The error term η_t is correlated across equations. To get the impulse responses and the variance decomposition we need to orthogonalize these structural innovations. Gonzalo and Ng have shown that this can be done by using the Choleski decomposition of the covariance matrix of the structural innovations. If $\mathrm{E}[\eta_t \eta_t'] = \Sigma_\eta$ and if we have a matrix H satisfying HH'=Σ_η then $\mathrm{H}^{-1}\eta_t = \tilde{\eta_t}$ achieves the permanent and transitory decomposition and the resulting innovations are orthogonalized.

The complete P-T decomposition can be written as

$$\triangle z_t = \mu + D(L)HH^{-1}\eta_t = \tilde{D(L)}\tilde{\eta_t} \tag{12}$$

Here each element of $\triangle z_t$ has been decomposed into a function of three permanent shocks and one temporary shock. We can see that more weight is given to the permanent shock if α is lower implying that the variable participates little in error correction. According to this decomposition, intuitively it makes sense that financial wealth and consumption have large transitory component as both of them participate in error correction.

The importance of the permanent shock and the transitory shock can be analyzed quantitatively by taking a look at the variance decomposition of consumption, labor income, housing wealth and financial wealth at different forecast horizons. Table 6 shows the variance decomposition at different horizons for the case where the coefficient of the error correction has been restricted to zero when it is insignificant. We have also estimated the decomposition for the unrestricted case which is shown in table 6. We restrict the coefficient to zero when they are insignificant because as discussed in Podivinsky (1992) these coefficients have poor finite sample properties. We might get different results for the restricted and unrestricted case because the orthogonal complement of a matrix, say, z, is not continuous in small perturbations in z. As shown in table 6 at all forecasting horizon, the forecast errors for consumption, labor income and housing wealth are dominated by permanent shocks. Transitory shocks constitute almost half of the forecast error of financial wealth and one fourth of the forecast error of consumption at all horizons. This proves our intuitive explanation of large coefficient α for the financial wealth. Around 50% of variations in financial wealth is accounted for by the transitory shocks in both the restricted and the unrestricted case whereas for consumption the corresponding number is around 25%.

Here, we call the variance decomposition without any restriction on the coefficient of error correction as the unrestricted variance decomposition. The variance decomposition with restriction on the coefficient is called the restricted variance decomposition. Looking at table 6, unrestricted variance decomposition has the same pattern of permanent shocks and transitory shocks across variables. Financial wealth forecast error at infinite horizon is dominated by transitory shocks whereas consumption,labor income and housing wealth are dominated by permanent shocks.

What implication does this finding have on the wealth effect? As Lettau-Ludvigson have pointed out, that the coefficient β in the wealth equation regression explains the relationship between consumption and permanent movements in wealth, since they share a common trend in the long run. The impact of housing wealth and financial wealth on consumption will be different from β if some of the movements are not permanent. Both restricted and unrestricted variance decomposition show us that most of the movements in housing wealth is permanent whereas half of the movements in financial wealth is transitory. Even the most conservative estimate of the transitory component for the financial wealth implies that 46% of the variation in financial wealth is due to transitory shocks.

Since our dependent and explanatory variables are in logarithms, the interpretation of the coefficient β is in terms of elasticities. To convert them into the usual wealth effect we need to multiply the coefficients by the consumption-wealth ratio. This turns out to be 7 cents for housing wealth and 6 cents for financial wealth as the consumption-housing wealth ratio is three times bigger than the consumption-financial wealth ratio[8]. This is in agreement with the typical estimates of wealth effect in the literature[9]. But a dollar increase in financial wealth will increase the consumption by 6 cents only if all the increase in financial wealth is permanent. But we have shown earlier that even in the unrestricted variance decomposition case only 54% of movements in financial wealth are permanent. Therefore, only 54% of the 6 cents increase will effectively take place. On the other hand 99% of the movements in housing wealth is permanent therefore, most of the 7 cents increase in consumption will be effective. Hence, the net long-run effect of a dollar increase in housing wealth on consumption is much higher than the effect of an increase in financial wealth. This is one of the explanations of the puzzle of robust consumption growth during the last recession. Even though the stock market went down, the housing market was really strong and people refinanced their mortgages, took loans on home equity lines of credit and maintained a strong consumption growth.

3.2 Multivariate Beveridge-Nelson Trend and Cycle

The other way to look at the relative importance of permanent and transitory components is to perform multivariate Beveridge-Nelson(BN) decomposition of the non stationary variables of interest using Engle-Granger theorem. We want to find out whether multivariate BN decomposition reinforces our result that only consumption and financial wealth tend to have significant deviations away from trend. BN methodology decomposes a non stationary series into a random walk component and a stationary component which is the cycle of the nonstationary series. According to the Engle-Granger theorem the BN decomposition of z_t has the following representation

$$z_t = y_0 + \mu t + \Psi(1) \sum_{k=1}^{t} u_t + \tilde{u}_t - \tilde{u}_0 \tag{13}$$

where

$$\Psi(1) = \beta_\perp(\alpha'_\perp \Gamma(1)\beta_\perp)^{-1}\alpha'_\perp \tag{14}$$

and $\tilde{u}_t = \tilde{\Psi}(L)u_t$. Where $\Psi(L) = \Psi(1)+(1\text{-}L)\tilde{\Psi}(L)$.

[8]The wealth effects for housing wealth and financial wealth are statistically indifferent. Therefore, marginal propensities to consume out of permanent movements in housing and financial wealth are not statistically different from each other.

[9]Some studies like Juster, Lupton, Smith and Stafford (1999) and Engelhardt (1996) estimate the wealth effect to be even larger than 15 cents but the consensus lies around 2-10 cents.

The common trend in x_t is extracted using $TS_t = \Psi(1)\sum_{k=1}^{t} u_t$

Using this methodology we have decomposed consumption, labor income, house wealth and financial wealth into a BN trend and cycle. The practical implementation of this trend-cycle decomposition has been done by using Morley's (2002) state space technique. Appendix 1 shows how to represent the above model into state space format and then how to decompose the variables into trend and cycle. Figures 1 to 6 show the log of consumption, labor income, housing wealth, financial wealth with their respective trend and cycles of consumption and financial wealth. As shown in the figure only financial market wealth tends to have large deviations from its trend. Figure 5 shows the cyclical component of financial market wealth. The cycle of financial wealth follows broadly the pattern as documented in Lettau-Ludvigson. This gives us interesting insight into the bulls and bear market of US stock market. As the figure shows, the US financial wealth was above its trend in the 60's, from the mid 70's to the mid 80's it was below the trend and again we had a bull market in post 1997 period.

The cycle of consumption has been shown in figure 2. The importance of the cyclical component in consumption is smaller than the importance of cyclical component in financial wealth but it shows some interesting patterns. It shows that consumption at the end of sample period i.e. at the end of 2002 was above its trend. During the 1991 recession it was below trend and our result reinforces the conventional wisdom that the fall in consumption was one of the most important factors behind that recession. The cyclical component of consumption also captures the recession of 1969-70 and 1973-1975. The uniqueness of the 2001 recession can also be seen from the fact that the cyclical component of consumption has remained above trend since 1999.This reinforces the argument that consumption led to the moderation of the recession in 2001. For housing wealth, most of the variations is due to trend as there are very small deviations away from trend. This reinforces the argument that most of the changes in housing wealth are permanent whereas for financial wealth a big portion of the changes is transitory and hence the net effect of housing wealth on consumption is higher.

3.3 A Time Varying Model of Housing Market Deregulation

The US economy has witnessed rapid financial liberalization over the last four decades. The housing market has especially undergone big changes over the last three decades. Increased competition in the primary mortgage market along with improvements in information processing technology have lowered the explicit, financial transactions costs associated with obtaining a mortgage, as reflected in the secular decline in average points and fees on conventional loans. Mortgage refinancing has become easier because of a big decline in mortgage refinancing cost. Mortgage refinancing has been at its record high in the last two years because of the institutional changes and lower mortgage rates and this had a big impact on consumer spending in the US. There have also been episodes of housing market boom and bust in the last thirty years. Because of the deregulation in the housing market we would expect housing market to become more efficient and less frequency of booms and busts in the housing market overtime. This has implications for the error correction coefficient as it tells us about the importance of transitory innovations at different forecast horizons for the housing wealth. Our model shows that the error correction parameter is insignificant for the whole sample but this estimate is an average of all the estimates at different points of time. If the parameter is unstable over time the average of the estimate will not give us the proper information about that parameter especially when there have been big changes in the housing market over time. It's intuitive to think that the impact of housing wealth on consumption should be time varying as the degree of efficiency of housing wealth has increased over time. Ideally, we would like to allow the $\beta' s$ in equation 7 to vary overtime, but, we do not have the econometric tool to analyze the time variation in a non stationary framework[10]. Therefore, we assume that the long run relationship between consumption, labor income, housing wealth and financial wealth has remained constant. We assume that short run relationship might have changed due to the deregulation in the housing market. In this section we allow the parameters of the VECM to vary over time.

We have the following time varying parameter model

$$\triangle c_t = \gamma_{10t} + \gamma_{11t}\triangle c_{t-1} + \gamma_{12t}\triangle y_{t-1} + \gamma_{13t}\triangle h_{t-1} + \gamma_{14t}\triangle s_{t-1} + \alpha_{ct}\beta' x_{t-1} + u_{ct} \tag{15}$$

[10]Hansen (1992) test allows for a single break in the cointegrating relationship. But, we are interested in changes overtime, therefore, one break in the cointegrating relationship will not serve our purpose.

Here we are analyzing the consumption growth equation. The labor income, housing wealth and financial wealth equation will have the same structure.

The measurement equation for the state space model is

$$\triangle c_t = \begin{bmatrix} 1 & \triangle c_{t-1} & \triangle y_{t-1} & \triangle h_{t-1} & \triangle s_{t-1} & \beta' x_{t-1} \end{bmatrix} \begin{bmatrix} \gamma_{10t} \\ \gamma_{11t} \\ \gamma_{12t} \\ \gamma_{13t} \\ \gamma_{14t} \\ \alpha_{ct} \end{bmatrix} \tag{16}$$

We assume that the coefficients follow a random walk process. Therefore, the transition equation is

$$\begin{bmatrix} \gamma_{10t} \\ \gamma_{11t} \\ \gamma_{12t} \\ \gamma_{13t} \\ \gamma_{14t} \\ \alpha_{ct} \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \gamma_{10t-1} \\ \gamma_{11t-1} \\ \gamma_{12t-1} \\ \gamma_{13t-1} \\ \gamma_{14t-1} \\ \alpha_{ct-1} \end{bmatrix} + \begin{bmatrix} \omega_{11t} \\ \omega_{12t} \\ \omega_{13t} \\ \omega_{14t} \\ \omega_{15t} \\ \omega_{16t} \end{bmatrix} \tag{17}$$

In matrix notation, we have

$$\triangle c_t = x_{t-1}\Gamma_t + u_{ct} \tag{18}$$

$$\Gamma_t = F\Gamma_{t-1} + \omega_{1t} \tag{19}$$

$$u_{ct}\tilde{}\, i.i.d.N(0, \sigma_c^2) \tag{20}$$

$$\omega_{1t}\tilde{}\, i.i.d.N(0, \sigma_{\omega 1}^2) \tag{21}$$

The Kalman Filter is applied to the above model to make inference on the changing regression coefficients[11]. Figure 7 shows the filtered estimate of the response of consumption growth to lagged housing growth. From our VECM estimation under the assumption of constant parameter we found that it was insignificant. But the time varying parameter model provides some interesting insights about the evolution of this parameter over time. We can see an increasing trend in this coefficient.

[11]The MLE estimation procedure was adopted. See Kim and Nelson (1999) for details.

This coefficient is not capturing the full effect of liberalization because it is related to lagged housing wealth growth.

The magnitude of error correction coefficient tells us the importance of transitory innovation in the forecast error variance decomposition . The higher the magnitude of the error correction coefficient, the higher will be the relative importance of transitory innovations in the forecast error variance decomposition. The error correction coefficient for consumption growth and financial wealth growth is stable over time as can be seen from figures 8 and 10, except for some volatility in the financial wealth error correction in the 1970's.

The error correction coefficient of the housing wealth gives us some interesting results. From 1973 to 1981, the error correction coefficient witnessed a big increase. This was also the time when housing wealth increased by 30%. Our model indicates that this increase in housing wealth was not permanent and this was supported by the downfall of the market in the 1980's. Except for an increase during 1985-86 (abolition of Regulation Q), the error correction term has a declining trend till 1993. The coefficient has become relatively stable and almost insignificant since 1994. This may reflect the increased information processing in the mortgage market and better functioning of the housing market. This argument is consistent with Sellon(2002) who has argued that pass through of monetary policy actions to mortgage market has increased substantially since 1994 and the market has become more efficient in processing the information. To quantify this effect we perform forecast error variance decomposition using the time varying parameter coefficients at four different time period in our sample. As shown in table 7, 35% of the variation in housing wealth was accounted by transitory shocks in 1970, whereas it was 57% in 1990, 30% in 1995 and 2% in 2002. This implies that the relative importance of permanent shock in housing wealth has been increasing over the whole sample period.

The time variation in the error correction coefficient has interesting implications for the housing wealth effect. The higher magnitude of error correction coefficient tells us that the relative importance of permanent shocks affecting the housing wealth was lower before 1994. We have already discussed that the magnitude of the wealth effect is determined by the type of shocks affecting it at different forecast horizons. Since the absolute value of error correction coefficient has witnessed a decline overtime, therefore, the magnitude of wealth effect arising out of housing wealth should be increasing. This reinforces the argument that the liberalization in the housing market led to an increase in the housing wealth effect.

The conditional forecast errors of consumption growth, housing wealth growth and financial wealth growth are plotted in figures 11-13. By looking at the plots we do not see any evidence of heteroscedasticity. Therefore, the state space model without heteroscedasticity in the measurement equation error use here is appropriate.

The results above warrant a discussion about the efficiency of housing market in US. Case and Shiller (1989) showed that the market for single family homes prior to 1990 was not efficient. Our results support their hypothesis but as we have shown the housing market seemed to have become more efficient in 90's as the relative importance of random walk component has increased significantly. The explanation of this phenomenon again lies in the deregulation of housing market. It has become easier to trade in houses as the transaction cost associated with selling and buying of houses has decreased significantly in recent years.

3.4 Robustness Analysis

Our results are robust to different specification of the model and the use of different data sets. Our results show the same broad pattern if we include durable goods flow expenditure in non durable goods and services expenditure as a measure of consumption in our model. Our results have the same qualitative properties if we replace financial wealth with stock market wealth which is defined as corporate equities+mutual fund shares+pension fund reserves+life insurance reserves. The pattern of shocks affecting different variables doesn't change if we change the ordering of variables in Choleski decomposition. In the time varying model, the results are robust to AR specification of the transition equation. The results in the time varying model also don't change if we restrict coefficients other than α to remain constant.

4 Concluding Remarks and Limitations

The motivation of this paper comes from the strong consumption growth in the last recession. In this paper we have shown that the explanation of strong consumption growth lies in the different marginal propensity to consume out of housing wealth and the financial wealth. Using Gonzalo-Ng methodology we have shown that the difference in the wealth effect arises from the difference in the relative importance of permanent and transitory innovations at different forecast horizons for both types of wealth. Transitory shocks dominate the forecast error of financial wealth at all horizons whereas permanent shocks dominate housing wealth. Using this property we have shown that the marginal propensity to consume out of housing wealth is higher than the marginal propensity to consume out of financial wealth. Therefore, even though the net worth of US households declined the consumption was very strong because of a very strong housing market. Using the same framework we have also shown that Beveridge-Nelson cycles of consumption and financial wealth follow the broad pattern of the business cycle. Because of big structural changes in the housing market in last three decades we would not expect the impact of housing wealth on consumption to be constant over time. Using a time varying parameter model we have shown that the housing wealth effect has increased as permanent shocks have become more important in the forecast error of housing wealth. This implies that increase in housing wealth today will have a bigger impact on consumption than the increase in housing wealth twenty years ago.

One of the limitations of this paper is that durable goods expenditure has not been modeled explicitly. We have included flow of durable goods services in our model but that does not capture the dynamics of durable goods expenditure. The initial evidence shows that recent surge in housing wealth has supported the durable goods expenditure. It will be interesting to develop a model which includes durable goods expenditure explicitly as movements in the durable goods expenditure are very important for the business cycle.

The other limitation is that cointegrating vector is not allowed to vary overtime. We still do not have the tools to analyze a time varying coefficient model in a non stationary framework. It will be ideal to deal with the issue of housing market deregulation in a case where we allow the coefficient in the cointegrating relationship to vary overtime.

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Data Appendix

1. Consumption- The data on consumption has been taken from NIPA accounts of BEA. It includes expenditure on non durable goods and services. Expenditure on housing services has been excluded. It is seasonally adjusted and deflated by chained weighted deflator. The data is in terms of real per capita. Flow of durable goods and services are taken from Federal Reserve Board.

2. Labor Income- Labor income in my study is the same as Lettau-Ludvigson's . After tax labor income has been defined as Wages and Salaries+Transfer Payments+Other labor income-personal contributions for social insurance-taxes. Taxes are defined as [Wages and Salaries/(Wages and Salaries+Proprietor's income +rental income+personal dividends+personal income)] times personal tax and non tax payments. The quarterly data are in per capita terms.

3. Housing Wealth- Housing wealth is net house wealth of households after adjusting for mortgages. This has also been deflated by chained weighted index. The data source is Flow of Funds Account of Federal Reserve Board.

4. Financial Wealth- Financial wealth is defined as total financial asset-liabilities of households excluding mortgages. This has also been deflated and in real per capita terms. The data source is Flow of Funds Account of Federal Reserve Board. Financial Asset is line 8 of the table B.100 of the Flow of Funds Account and liabilities are line 32. We define stock market wealth as Corporate Equities+Mutual Fund Shares+Pension Fund Reserves+Life Insurance Reserves.

5. Population- Population data for the US economy has been taken from Bureau of Labor Statistics.

6. Price Deflator- This is chained weighted price deflator. The data source is Federal Reserve St. Louis.

Appendix 1
State Space Representation of Multivariate Beveridge-Nelson Trend and Cycle

Here we provide a state-space representation of the multivariate Beveridge-Nelson trend and cycle based on Cochrane (1994) and Morley (2002). We have the following VECM equations

$$\triangle c_t = \gamma_{10} + \gamma_{11}\triangle c_{t-1} + \gamma_{12}\triangle y_{t-1} + \gamma_{13}\triangle h_{t-1} + \gamma_{14}\triangle f_{t-1} + \alpha_c\beta' z_{t-1} + u_{ct}$$

$$\triangle y_t = \gamma_{20} + \gamma_{21}\triangle c_{t-1} + \gamma_{22}\triangle y_{t-1} + \gamma_{23}\triangle h_{t-1} + \gamma_{24}\triangle f_{t-1} + \alpha_y\beta' z_{t-1} + u_{yt}$$

$$\triangle h_t = \gamma_{30} + \gamma_{31}\triangle c_{t-1} + \gamma_{32}\triangle y_{t-1} + \gamma_{33}\triangle h_{t-1} + \gamma_{34}\triangle f_{t-1} + \alpha_h\beta' z_{t-1} + u_{ht}$$

$$\triangle s_t = \gamma_{40} + \gamma_{41}\triangle c_{t-1} + \gamma_{42}\triangle y_{t-1} + \gamma_{43}\triangle h_{t-1} + \gamma_{44}\triangle f_{t-1} + \alpha_f\beta' z_{t-1} + u_{ft}$$

We know that the Beveridge-Nelson cycle is defined as

$$z_t^{*c} = -[E(\triangle z_{t+1}^*|I_t) + E(\triangle z_{t+2}^*|I_t) + E(\triangle z_{t+3}^*|I_t) + ----+E(\triangle z_{t+k}^*|I_t) + ----]$$

where I_t is the information available at time t. Casting the above model in state space form we have

$$\begin{bmatrix} \triangle c_t^* \\ \triangle y_t^* \\ \triangle h_t^* \\ \triangle f_t^* \\ \beta' z_t \end{bmatrix} = \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} & \gamma_{14} & \alpha_c \\ \gamma_{21} & \gamma_{22} & \gamma_{23} & \gamma_{24} & \alpha_y \\ \gamma_{31} & \gamma_{32} & \gamma_{33} & \gamma_{34} & \alpha_h \\ \gamma_{41} & \gamma_{42} & \gamma_{43} & \gamma_{44} & \alpha_f \\ \gamma_{51} & \gamma_{52} & \gamma_{53} & \gamma_{54} & \alpha_c - \beta_1\alpha_y - \beta_2\alpha_h - \beta_3\alpha_f + 1 \end{bmatrix} \begin{bmatrix} \triangle c_{t-1}^* \\ \triangle y_{t-1}^* \\ \triangle h_{t-1}^* \\ \triangle f_{t-1}^* \\ \beta' z_{t-1} \end{bmatrix} + \begin{bmatrix} u_{ct} \\ u_{yt} \\ u_{ht} \\ u_{ft} \\ u_{zt} \end{bmatrix}$$

where $\gamma_{5i} = \gamma_{1i} - \beta_1\gamma_{2i} - \beta_2\gamma_{3i} - \beta_3\gamma_{4i}$ and $u_{zt} = u_{ct} - \beta_1 u_{yt} - \beta_2 u_{ht} - \beta_3 u_{ft}$ and starred letter represents the mean adjusted variable.

In matrix form the state space form can be written as

$$\triangle z_t^* = F \triangle z_{t-1}^* + u_t^*$$

where $u_t^* \tilde{} N(0, -\ )$ and eigenvalues of the matrix F are less than unity in modulus. Then the cycle of the ith component of vector z_t^* can be written as

(i,i)th element of the matrix -$(F + F^2 + F^3 + - - - - -) * \triangle z_t^*$ which is equivalent of (i,i)th element of matrix -$F(I - F)^{-1} * \triangle z_t^*$.

The trend component can be calculated by substracting the cyclical component from the corresponding variable.

Table 1

Mean Growth Rate of the Variables During Different NBER Recessions

	Time-Period	Consumption	Financial Wealth	Housing Wealth
First Recession	1960-61	-0.07	3.8	-0.48
Second Recession	1969-70	0.35	-1.1	-0.11
Third Recession	1973-75	-0.25	-6.5	-1.1
Fourth Recession	1980-80	-1.3	0.015	0.97
Fifth Recession	1981-82	0.35	0.60	-0.006
Sixth Recession	1990-91	-0.41	0.88	-0.04
Seventh Recession	2001-01	0.63	-0.34	1.6

Table 2[12]

DOLS Estimate of Cointegrating Vector

$Coefficient$	$Value$	$Std.Error$	$P-Value$
β_1	0.620	0.0384	0.000
β_2	0.135	0.0268	0.000
β_3	0.372	0.0206	0.000

Table 3

Stationarity Test for Cointegrating Residual

$Test$	$P-Value$	$Null$
ADF	0.0371	$Nonstationary$
$Phillips-Perron$	0.0287	$Nonstationary$

[12]Standard errors are Newey-West HAC errors.

Table 4

Johansen Cointegration Test

Hypothesized no of CE(S)	Eigenvalue	Trace Stat	5% CriticalValue	1% Critical Value
None	0.287895	99.84652	53.12	60.16
At most1	0.082683	31.60090	34.19	41.07
At most2	0.047009	14.25426	19.96	24.60
At most3	0.022509	4.576055	9.24	12.97

Hypothesized no of CE(S)	Eigenvalue	Max Eigen Stat	5% CriticalValue	1% Critical Value
None	0.287895	68.24562	28.14	33.24
At most1	0.082683	17.34663	22.00	26.81
At most2	0.047009	9.678209	15.67	20.20
At most3	0.022509	4.576055	9.24	12.97

Table 5[13]

VECM Estimation

Explanatory Variables	$\triangle c_t$	$\triangle y_t$	$\triangle h_t$	$\triangle s_t$
$\triangle c_{t-1}$	**0.177**	*0.237*	0.209	-0.170
	(0.01)	(*0.05*)	(0.33)	(0.65)
$\triangle y_{t-1}$	0.057	-0.076	-0.209	-0.211
	(0.22)	(0.34)	(0.13)	(0.39)
$\triangle h_{t-1}$	0.018	0.053	**0.278**	0.119
	(0.47)	(0.20)	**(0.00)**	(0.35)
$\triangle s_{t-1}$	**0.035**	**0.058**	0.0469	0.088
	(0.02)	**(0.02)**	(0.26)	(0.22)
$\beta' z_{t-1}$	*-0.030*	-0.017	-0.014	**0.215**
	(0.08)	(0.57)	(0.76)	**(0.00)**

[13] P-Values are in parentheses. The bold numbers are significant at 5% significance level. The italicised numbers are significant at 10% significance level.

Table 6

Variance Decomposition for the Case Where $\alpha_y = \alpha_h = 0 (Restricted)$

Period	c		y		h		f	
	P	T	P	T	P	T	P	T
1	0.75	0.25	1	0	1	0	0.53	0.47
2	0.78	0.22	0.998	0.002	0.996	0.004	0.53	0.47
5	0.78	0.22	0.998	0.002	0.995	0.005	0.53	0.47
10	0.78	0.22	0.998	0.003	0.995	0.005	0.53	0.47
∞	0.78	0.22	0.998	0.003	0.995	0.005	0.54	0.46

Variance Decomposition for the Case Where $\alpha_y = \alpha_h \neq 0 (Unrestricted)$

Period	c		y		h		f	
	P	T	P	T	P	T	P	T
1	0.74	0.26	0.97	0.03	0.994	0.006	0.52	0.48
2	0.77	0.23	0.97	0.03	0.994	0.006	0.52	0.48
5	0.77	0.23	0.97	0.03	0.994	0.006	0.52	0.48
10	0.77	0.23	0.968	0.032	0.994	0.006	0.51	0.49
∞	0.77	0.23	0.968	0.032	0.994	0.006	0.51	0.49

Table 7

Variance Decomposition for the Time Varying Coefficients in 1970

Period	c		y		h		f	
	P	T	P	T	P	T	P	T
1	0.81	0.19	0.985	0.015	0.658	0.342	0.76	0.24
2	0.83	0.17	0.985	0.015	0.667	0.333	0.763	0.237
5	0.831	0.169	0.986	0.014	0.668	0.332	0.764	0.236
10	0.83	0.17	0.986	0.014	0.668	0.332	0.764	0.236
∞	0.83	0.17	0.986	0.014	0.67	0.33	0.764	0.236

Variance Decomposition for the Time Varying Coefficients in 1990

Period	c		y		h		f	
	P	T	P	T	P	T	P	T
1	0.86	0.14	0.99	0.01	0.44	0.56	0.82	0.18
2	0.88	0.12	0.98	0.02	0.435	0.565	0.81	0.19
5	0.875	0.125	0.975	0.025	0.43	0.57	0.808	0.192
10	0.875	0.125	0.975	0.025	0.43	0.57	0.805	0.195
∞	0.87	0.13	0.975	0.025	0.43	0.57	0.80	0.20

Variance Decomposition for the Time Varying Coefficients in 1995

Period	c		y		h		f	
	P	T	P	T	P	T	P	T
1	0.79	0.21	0.981	0.019	0.70	0.30	0.735	0.265
2	0.81	0.19	0.982	0.018	0.713	0.287	0.738	0.262
5	0.815	0.185	0.983	0.017	0.714	0.286	0.739	0.261
10	0.815	0.185	0.986	0.014	0.715	0.285	0.74	0.26
∞	0.82	0.18	0.987	0.013	0.715	0.285	0.74	0.26

Variance Decomposition for the Time Varying Coefficients in 2003

Period	c		y		h		f	
	P	T	P	T	P	T	P	T
1	0.788	0.212	0.975	0.025	0.99	0.01	0.45	0.55
2	0.805	0.195	0.97	0.03	0.985	0.015	0.447	0.553
5	0.81	0.19	0.97	0.03	0.982	0.018	0.456	0.554
10	0.81	0.19	0.97	0.03	0.981	0.019	0.45	0.55
∞	0.81	0.19	0.965	0.035	0.98	0.02	0.45	0.55

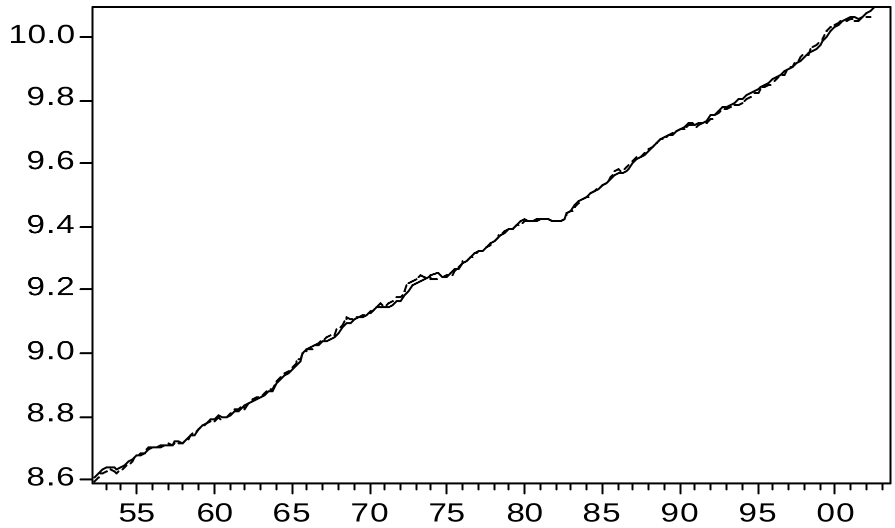

Figure 1: Consumption and its Trend

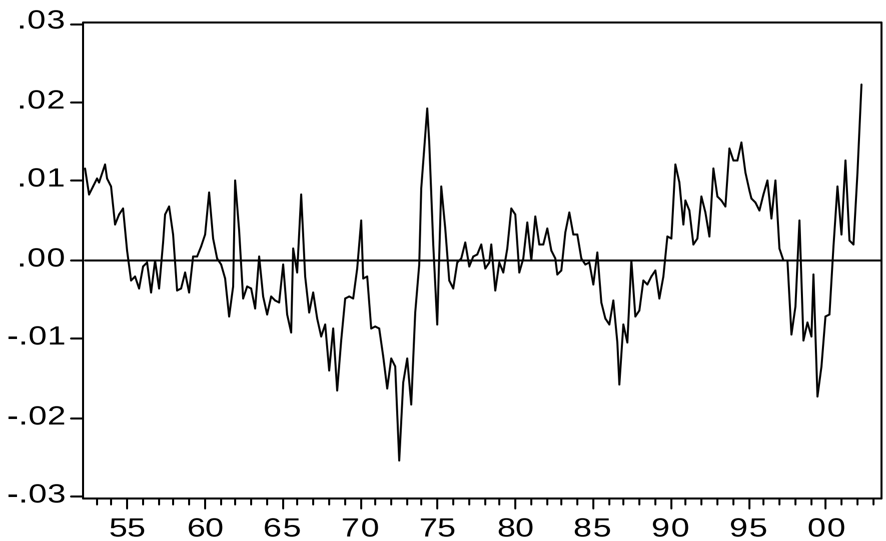

Figure 2: Consumption Cycle

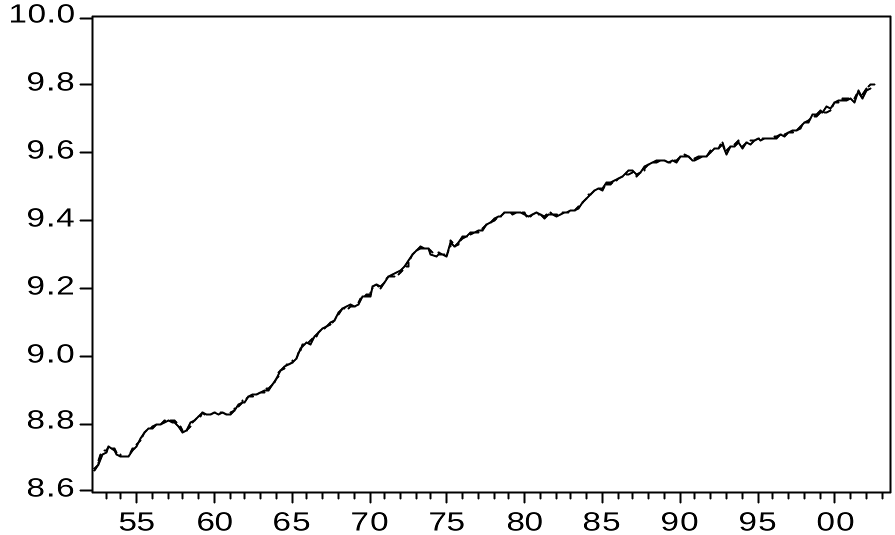

Figure 3: Labor Income and its Trend

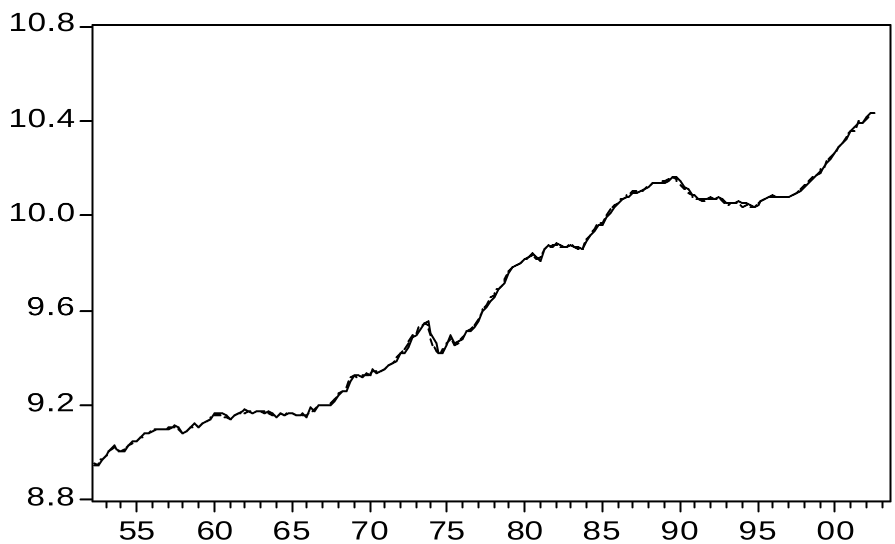

Figure 4: Housing Wealth and its Trend

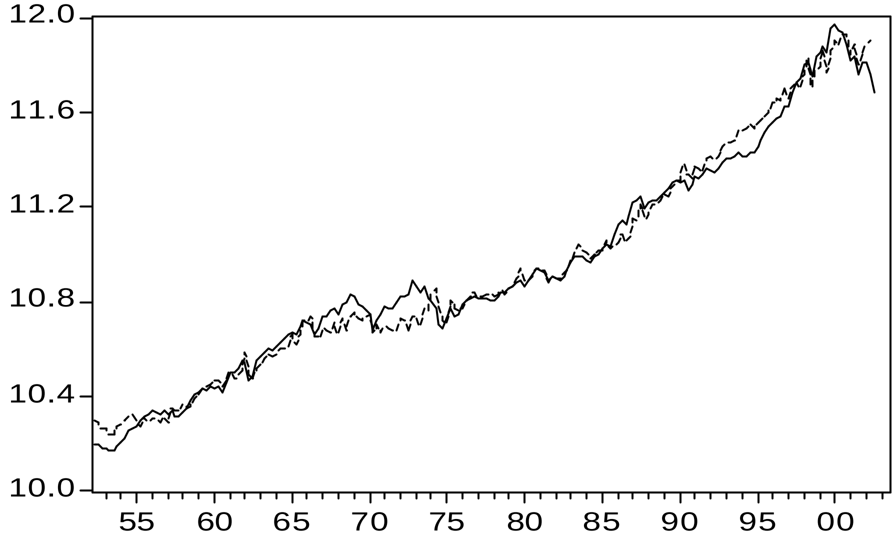

Figure 5: Financial Wealth and its Trend

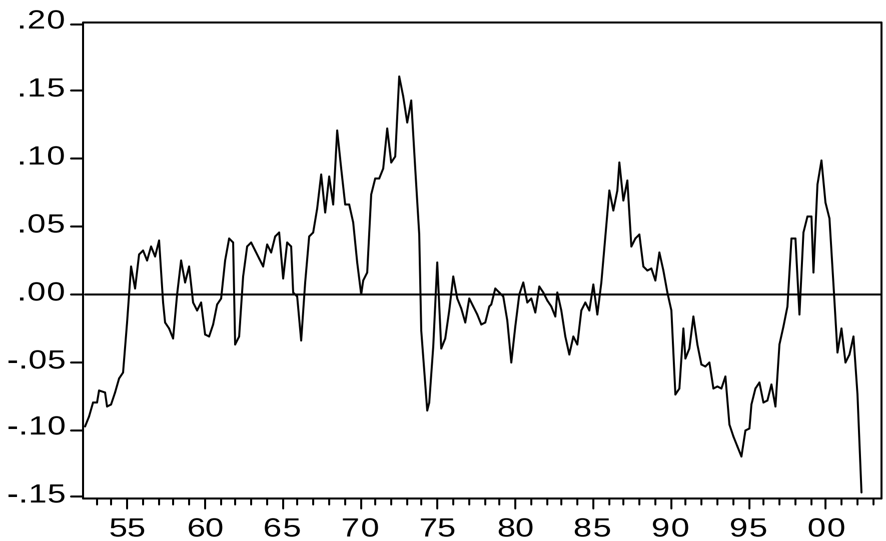

Figure 6: Financial Wealth Cycle

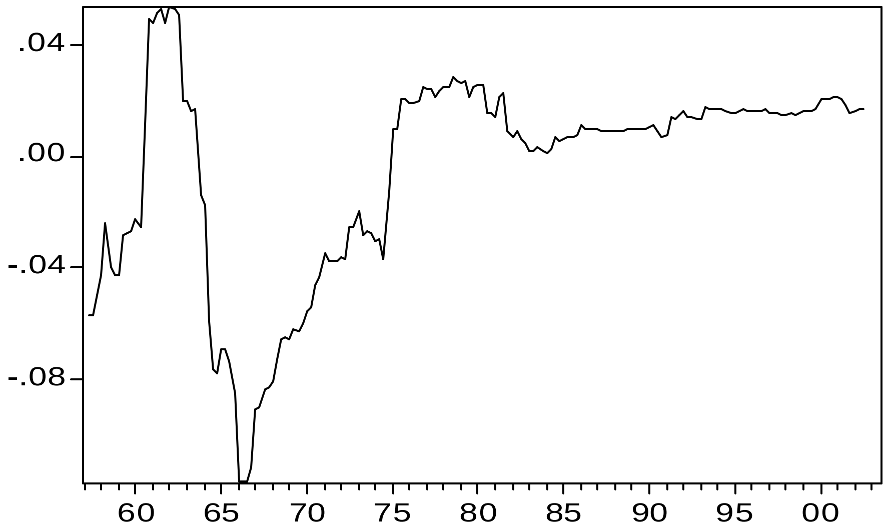

Figure 7: Response of Consumption Growth to Lagged Housing Wealth Growth

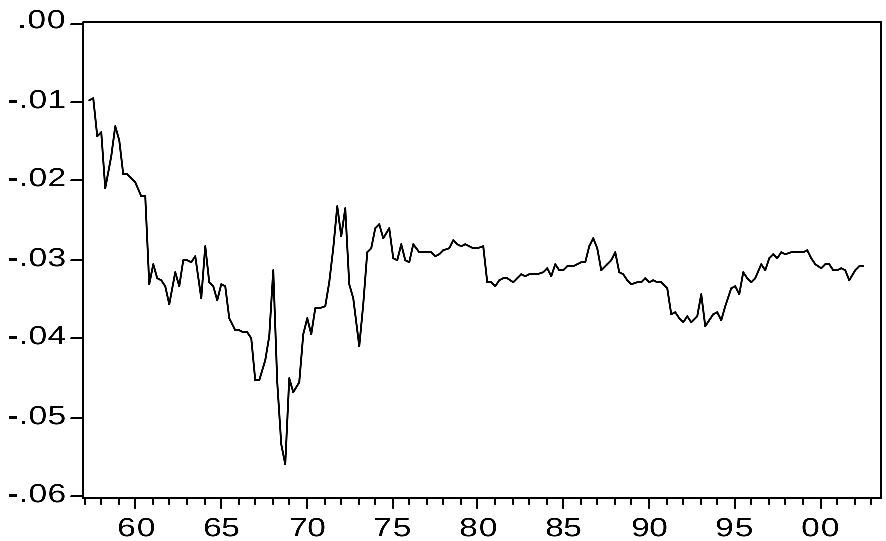

Figure 8: Error Correction Coefficient for Consumption Growth

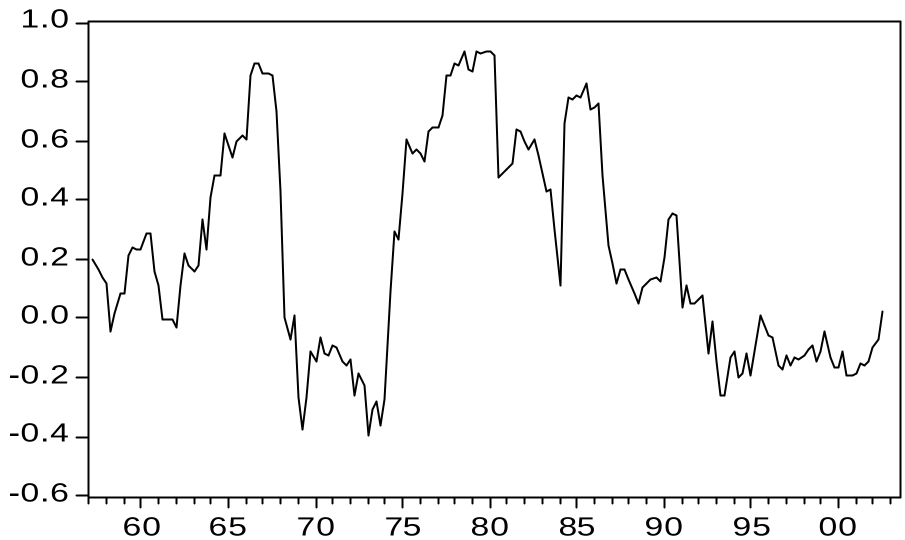

Figure 9: Error Correction Coefficient for Housing Wealth Growth

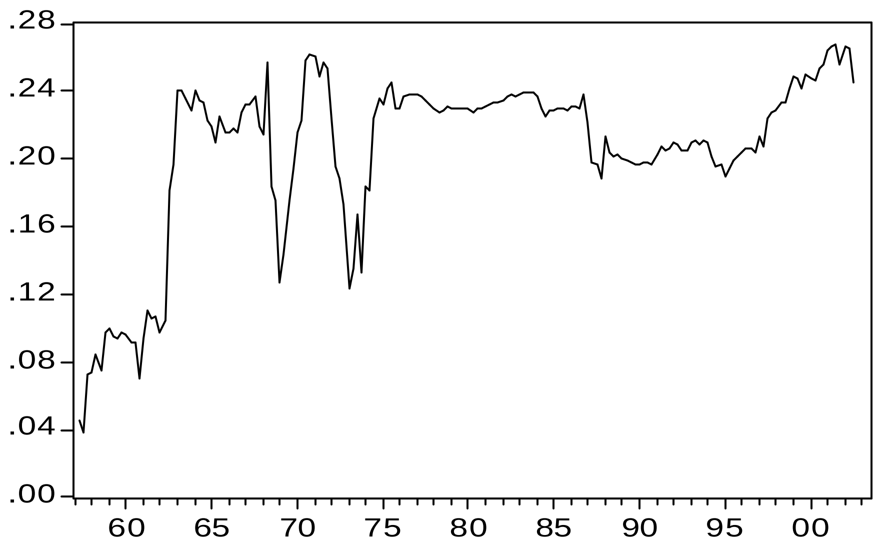

Figure 10: Error Correction Coefficient for Financial Wealth Growth

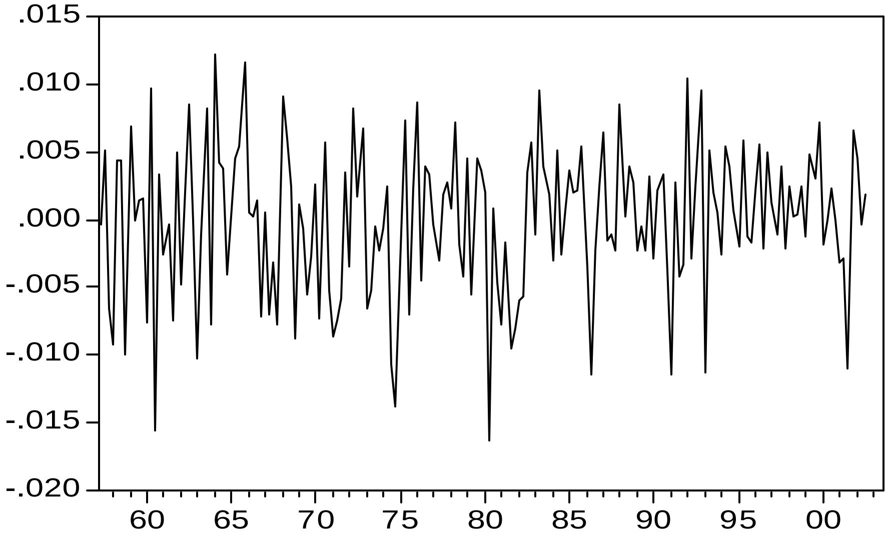

Figure 11: Conditional Forecast Error of Consumption Growth

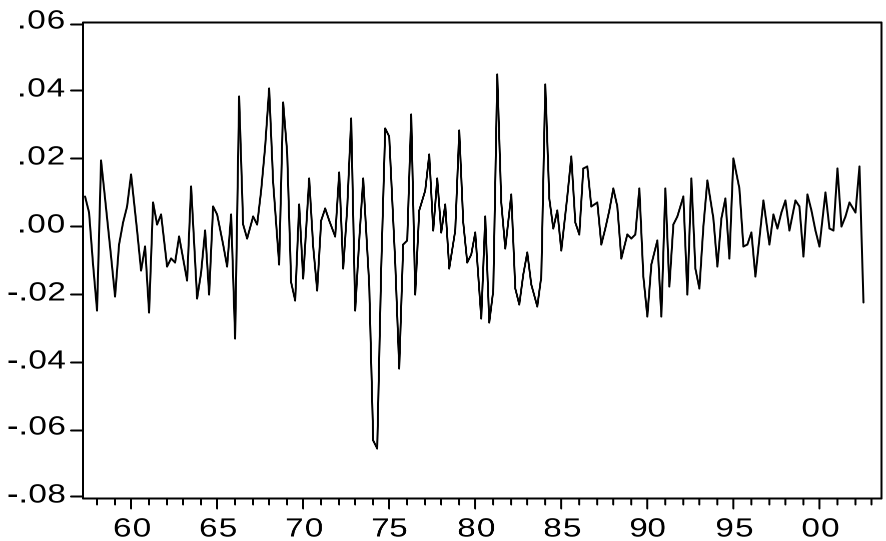

Figure 12: Conditional Forecast Error of Housing Wealth Growth

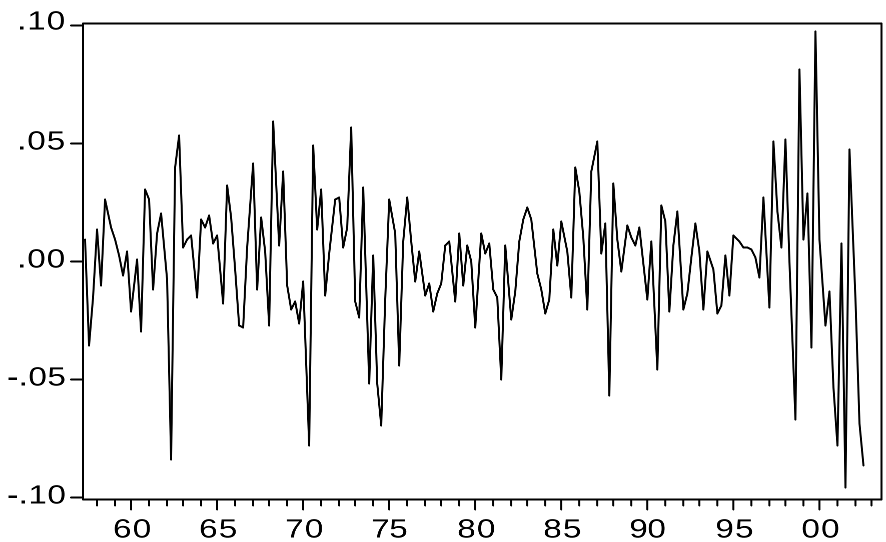

Figure 13: Conditional Forecast Error of Financial Wealth Growth