Financial Crisis and Sticky Expectations

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Abstract

We utilize the Kalman filter and instrumental variable methods to estimate consumption growth persistence for the U.S. Results show that prior to the financial crisis, the stickiness parameter β was around 0.7. However, when the sample is extended until 2009.Q1, the estimates of β declined to around 0.5. Extending the sample beyond 2009.Q1 show mild increase in β. Our findings imply that during the crisis consumers' attentiveness to aggregate information has slightly increased, thereby reducing the persistence of aggregate consumption growth.

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1. Introduction

Empirical evidence on the behavior of excess smoothness during the recent financial crisis has not emerged. It is well known that aggregate consumption is 'too smooth' and hence consumption dynamics can be well explained by habit formation or sticky expectations. Recently, Carroll, Sommer and Slacalek (2011) find that the sticky consumption growth model outperforms the random walk model of Hall (1978) and typically fits the data better than the popular Campbell and Mankiw (1989) model in most advanced countries. Using quarterly data over the period 1962.Q3-2004.Q4, they find the stickiness parameter is around 0.7 for the U.S. This implies that around 70 percent of the households do not have full updated information about the latest macroeconomic developments. But it is not clear whether the recent empirical data, especially covering the periods of financial crisis, also yield analogous levels of excess smoothness.

To address this issue, we estimate the degree of stickiness in aggregate consumption growth for the U.S. considering the effects of the recent financial crisis. In doing so, we utilize the Kalman filter and single equation instrumental variable (IV) techniques. However, one should be cautious about using recent data because the data tend to be revised fairly heavily within a window of about 3 years after their initial release. So whatever results one attains now may not be consistent when the Bureau of Economic Analysis (BEA) releases its next version of the data. To this end, it is pragmatic to utilize a component of consumption expenditure that does not change much in the data construction process, for example retail sales. This series reflect retail spending and is the main source of true well-measured data that does not involve judgmental guesstimates in real time. Therefore, our analysis considers retail sales as the main measure of consumption spending. For the purpose of robustness, we also use nondurable goods spending series.

2. Sticky Expectations Model

Our specification of the sticky expectations model is adapted from Carroll and Slacalek (2007) and Carroll et al. (2011). Instead of habits, this model utilizes a modest informational friction, i.e. not every household is instantaneously aware of all macroeconomic developments. It is always that a household observes his own personal circumstances frictionlessly, however information about the macroeconomy is attained only occasionally. According to Carroll and Slacalek (2007) and Carroll et al. (2011), consumption growth is well approximated by:

$$\Delta \ln C_t = \alpha + \beta \Delta \ln C_{t-1} + \varepsilon_t \tag{1}$$

where α is the intercept, C is the consumption and ε is the error term. This model follows an AR(1) process, whose autocorrelation estimate approximates the share of households (β) who do not have up-to-date information about macroeconomics developments. (1 - β) is the proportion of households who update the information on their permanent income in each period. For each household, this update (1 - β) is assumed to be independent of not only their income, wealth and other characteristics, but also the date when they last updated their information set.

3. Empirical Results
Data

We use quarterly data over the period 1995.Q1-2012.Q2 for the U.S. Our main measure of consumer spending is real retail sales and is extracted from BEA. Other variables used in our analysis include real nondurable goods expenditure (BEA), real personal disposable income (BEA) and ratio of household assets to income (NiGEM of the NIESR Institute). The data sources are indicated in parentheses. Figure 1 illustrates the growth rates of consumption (retail spending = $\Delta \ln C$ and nondurable goods spending = $\Delta \ln C1$). The

average growth in $\Delta \ln C$ and $\Delta \ln C1$ is around 0.3% and 0.6% for the entire period. Overall, $\Delta \ln C1$ has been relatively more volatile than $\Delta \ln C$. Further, the growth rate of both series became negative during the recent financial crisis.
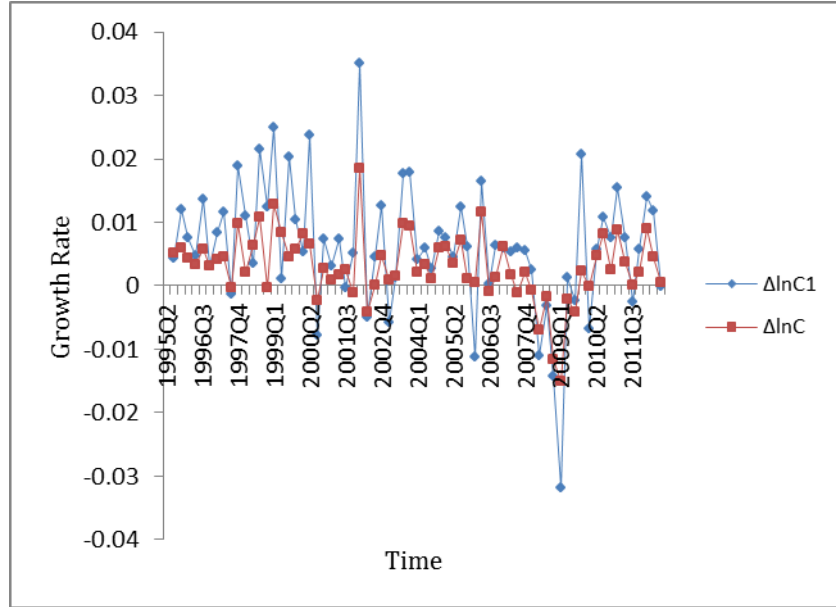

Figure 1: Growth of Consumption Expenditure 1995.Q1-2012.Q2

Kalman Filter Estimates

Following the work of Sommer (2007) and Carroll et al. (2011), we estimate the excess smoothness using the Kalman filter method. As pointed out in these studies, quarterly consumption data may suffer from substantial measurement error. Therefore, it is vital to utilize an estimation method that handles errors efficiently. To this end, application of the Kalman filter method seems feasible. This procedure separates the true consumption growth from its transitory components and measurement error. We assume that measurement error appears in an MA(1) form (see Sommer, 2007). The Kalman filter specification of consumption growth is as follows:

$$\Delta \ln C_t = \Delta \ln C_t^* + e_t + (\varpi - 1)e_{t-1} - \varpi e_{t-2} \qquad (2)$$

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$$\Delta \ln C_t^* = \alpha + \beta \Delta \ln C_{t-1}^* + u_t + \phi_1(\beta)u_{t-1} + \phi_2(\beta)u_{t-2} \tag{3}$$

The state-space versions of equations (2) and (3) are as follows:

$$\Delta \ln C_t = \alpha + [1\ 0\ 0\ 1\ 0\ 0] \begin{bmatrix} \Delta \ln C_t^* \\ e_t \\ -e_t + \varpi \Delta e_t \\ \Delta e_t + \varpi \Delta e_{t-1} \\ u_t \\ u_{t-1} \end{bmatrix} + 0 \tag{4}$$

$$\begin{bmatrix} \Delta \ln C_t^* \\ e_t \\ -e_t + \varpi \Delta e_t \\ \Delta e_t + \varpi \Delta e_{t-1} \\ u_t \\ u_{t-1} \end{bmatrix} = \begin{bmatrix} \beta & 0 & 0 & 0 & \phi_1 & \phi_2 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & -\varpi & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \end{bmatrix} \begin{bmatrix} \Delta \ln C_{t-1}^* \\ e_{t-1} \\ -e_{t-1} + \varpi \Delta e_{t-1} \\ \Delta e_{t-1} + \varpi \Delta e_{t-2} \\ u_{t-1} \\ u_{t-2} \end{bmatrix} + \begin{bmatrix} u_t \\ e_t \\ (\varpi - 1)e_t \\ e_t \\ u_t \\ 0 \end{bmatrix} \tag{5}$$

$$Q = \begin{bmatrix} \sigma_u^2 & 0 & 0 & 0 & \sigma_u^2 & 0 \\ 0 & \sigma_e^2 & (\varpi\text{-}1)\sigma_e^2 & \sigma_e^2 & 0 & 0 \\ 0 & (\varpi\text{-}1)\sigma_e^2 & (\varpi\text{-}1)^2\sigma_e^2 & (\varpi\text{-}1)\sigma_e^2 & 0 & 0 \\ 0 & \sigma_e^2 & (\varpi\text{-}1)\sigma_e^2 & \sigma_e^2 & 0 & 0 \\ \sigma_u^2 & 0 & 0 & 0 & \sigma_u^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \tag{6}$$

where $\Delta \ln C_t^*$ is the true consumption growth of retail spending, e_t is the measurement error and ϖ is the first autocorrelation in the errors. As suggested in Carroll et al. (2011, p.1145), the estimates of ϕ_1 and ϕ_2 depend on β and hence our Kalman filter estimation includes these coefficients. Equations (4) and (5) are the state-space versions of measurement and state-evolution, respectively. Equation (6) is the state-space related

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covariance matrices. The Kalman filter estimation is performed as follows: i. excluding the financial crisis period (1995.Q1-2006.Q4) and ii. adding a quarter sequentially from 2007.Q1 to 2012.Q2. For the latter, we construct 22 samples, such as 1995.Q1-2007.Q1, 1995.Q1-2007.Q2,...,1995.Q1-2012.Q1 and 1995.Q1-2012.Q2. This sequential estimation reveals the exact time when the estimate of β starts to change during the crisis. Figure 2 illustrate the first stage Kalman filter estimates of β. For brevity, we did not report the results of ϖ, σ_u^2, σ_e^2 and the variance of relative consumption growth $(\text{var}(\Delta \ln C_t^*)/\text{var}(\Delta \ln C_t))$. Further, the statistical significance of β estimates is also not reported, nevertheless β is statistically significant at the conventional levels in all samples.
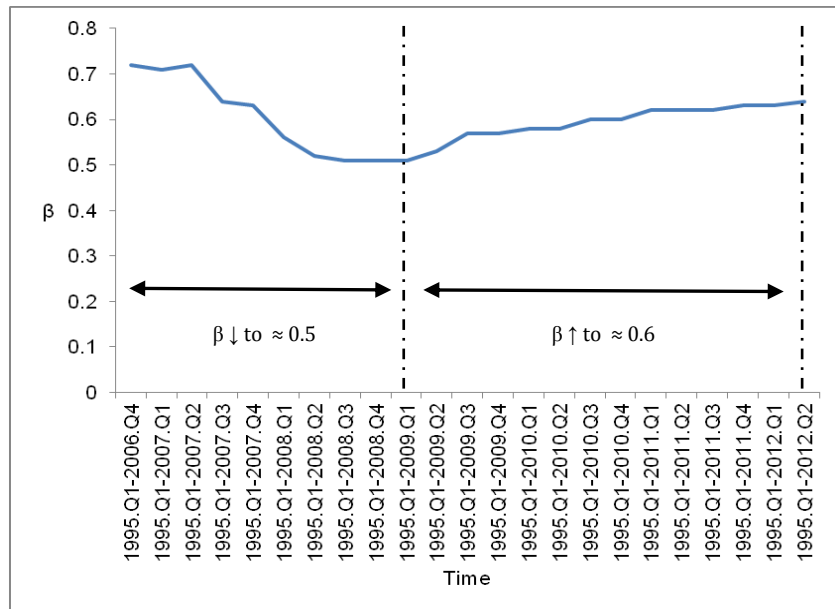

Figure 2: First-Stage Kalman Filter Estimates of β

We find that prior to the financial crisis (1995.Q1-2006.Q4), β was around 0.7. However, when the sample is extended to include the financial crisis period (1995.Q1-2012.Q2), the estimates of β has declined to around 0.6. The sequential estimation results indicate that when samples are extended until 2009.Q1, the estimates of β declined to around 0.5. This implies that during the crisis consumers' attentiveness to aggregate information has slightly increased, thereby reducing the persistence of aggregate consumption growth. To

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this end, consumers become more forward looking and efficient. Beyond the sample 1995.Q1-2009.Q1, β began to increase, albeit very mildly. Perhaps this is because the crisis was a bit relaxed after 2009. In all samples, there is a strong rejection of the Hall's (1978) random walk proposition (excess smoothness = 0).

Robustness

To assess robustness in our results, we estimate β using the IV method.[1] We estimate three versions of the consumption growth model, namely (i) consumption growth model of retail spending ($\Delta \ln C$),[2] (ii) consumption growth model of nondurable goods spending ($\Delta \ln C1$) (model 1) and (iii) consumption growth model of retail spending augmented with disposable income growth ($\Delta \ln Y$) and wealth-income-ratio (W) (model 2). The specification of (ii) and (iii) is as follows:

Model 1: $\Delta \ln C1_t = \alpha + \beta \Delta \ln C1_{t-1} + \varepsilon_t$ $\quad\quad\quad\quad\quad\quad\quad\quad$ (7)

Model 2: $\Delta \ln C_t = \alpha + \beta \Delta \ln C_{t-1} + \delta \Delta \ln Y_t + \theta W_t + \varepsilon_t$ $\quad\quad\quad\quad$ (8)

Equation (8) presents a general model that corresponds to consumption growth persistence, rule of thumb consumers (Campbell and Mankiw (1989, 1991)) and random walk model (Hall, 1978). The wealth variable captures the impacts of asset holdings on consumption growth. According to Carroll et al. (2011), θ should capture the rate of interest effects as wealth is a proxy for expected interest rates. The instruments used are unemployment rate, long-term interest rates, consumer sentiment and price volatility.[3] In most equations, instruments lagged up to 3 periods were used; we do not report the exact instruments for each estimated equation for brevity.

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[1] We follow the procedure used in Carroll et al. (2011).
[2] This is the retail spending model we used in the preceding section.
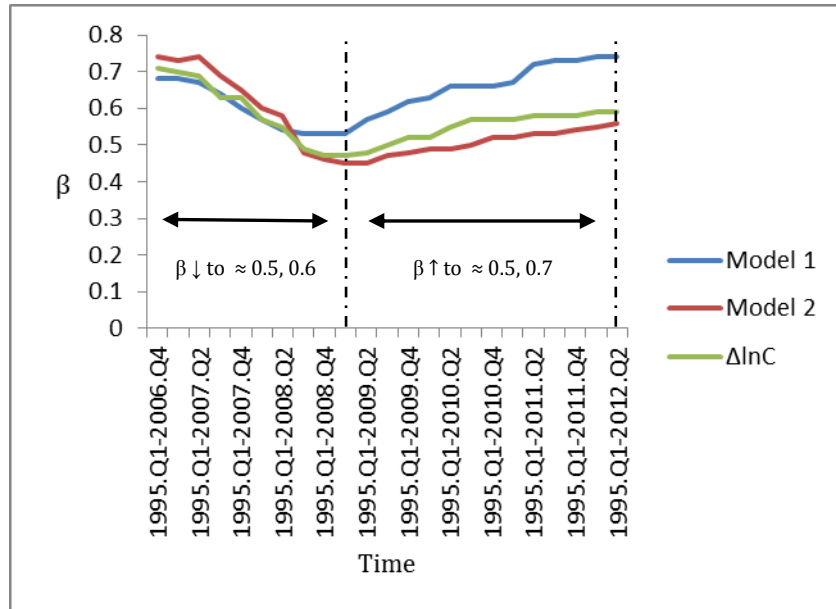[3] We derived price volatility using the GDP deflator. GARCH model was used to attain the series.

Figure 3: IV Estimates of β for alternative consumption growth models

Figure 3 illustrate the estimates of β for models 1 and 2 and $\Delta \ln C$. The results are consistent with the Kalman filter estimates. For model 2, the estimates of disposable income growth (wealth) are plausible and (but) statistically significant (insignificant) at the conventional levels.[4] This implies that our consumption data not only depicts consumption persistence but also reflect rule-of-thumb consumers as suggested by Campbell and Mankiw (1991). The presence of positive excess smoothness signifies the invalidity of Hall's (1978) random walk model. All the three models reveal that the estimates of β declined when the samples are extended until 2009.Q1, but then increased slightly in the post 2009.Q1 period. Model 2 and $\Delta \ln C$ yield quite consistent estimates of β; model 1 estimates are slightly higher after 2009.Q1. With these results, we infer that our Kalman filter estimates of β are robust.

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[4] These results are not reported to conserve space.

A Comparison with Other Studies

Prior to the financial crisis, the estimate of β was close to 0.7. This is very consistent with the findings of other studies that use the sticky expectations model (Carroll and Slacalek, 2007; Carroll et al., 2011). Another group of studies (Ferson and Constantinides, 1991; Fuhrer, 2000; Gruber, 2004; Sommer, 2007) used the habit formation model to explain the persistence in aggregate consumption growth. Findings of these studies suggest that the estimates of β is between 0.65 to 0.80. According to Carroll et al. (2011) and Gruber (2004), the β coefficients do not differ vastly across the advanced economies. None of the above studies examine the behavior of β during the recent financial crisis.

4. Conclusion

Using the Kalman filter and instrumental variable methods, we estimated the consumption growth persistence for the U.S. We find that prior to the financial crisis, the stickiness parameter β was around 0.7. However, when the sample is extended until 2009.Q1, the estimates of β declined to around 0.5. This implies that during the crisis consumers' attentiveness to aggregate information has slightly increased, thereby reducing the persistence of aggregate consumption growth. Beyond the sample 1995.Q1-2009.Q1, β increased mildly, possibly because the crisis was a bit relaxed after 2009. Both measures of consumption (retail spending and nondurable goods spending) exhibit fairly consistent estimates of β. Analogous results are also attained when the consumption growth persistence model is extended to include the rule of thumb consumers (Campbell and Mankiw, 1991) and wealth effects (Carroll et al., 2011).

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