Great Recession and Persistence: Evidence from Sticky Expectations Consumption Growth Model

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Abstract

We estimate the degree of stickiness in aggregate consumption growth for the U.S. considering the effects of the Great Recession. The behavior of stickiness estimate in the crisis is somewhat as the U-shaped pattern. Our findings imply that during the crisis consumers' attentiveness to aggregate information has slightly increased, thereby reducing the persistence of aggregate consumption growth. However, the reduction in persistence is transitory. Since 1980, the U.S. faced five recessions and in most of them the degree of stickiness declined, albeit temporarily.

Keywords: Financial crisis; consumption growth; Sticky expectations; persistence

JEL: C5; E2

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1. Introduction

The U.S. consumption declined sharply during the 2007-08 Great Recession. The annual consumption growth rate became -0.5 percent in 2008 (World Bank, 2013), thus reflecting the surge in uncertainty, weaker economic prospects and tighter credit availability. In addition, the rate of household consumption (as a percentage of disposable income) fell to 92 percent in 2009 from the pre-crisis high that exceeded 95 percent (Lee, Rabanal and Sandri, 2010). If consumption smoothing is limited and households reduce consumption markedly, this response will contribute to contractions in the overall economy. In times of a recession, this may lead to a further downward spiral in economic activity. There has always been high persistence or excess smoothness in aggregate consumption (Fuhrer, 2000; Gruber, 2004; Carroll and Slacalek, 2007; Carroll, Slacalek, Sommer, 2011).

Several empirical studies have examined the behavior of consumption stickiness by estimating the two popular theoretical frameworks: habit formation or sticky expectations.[1] Habit formation model, originally proposed by Muellbauer (1988), assumes that a representative consumer maximizes his momentary utility function subject to the usual transversality condition and the dynamic budget constraint. Sticky expectations model (Carroll and Slacalek, 2007), however, does not depart the standard time separable utility function but with a key assumption that consumers do not immediately and fully take into account information contained in macroeconomic indicators. Put simply, the household macroeconomic

[1] Other theoretical explanations of persistence in aggregate consumption growth exists in the literature, for example see Sims (2003), Reis (2006), Deaton (1991), Carroll (1992), Ludvigson and Michaelides (2005) and Pischke (1995), among others. Sims (2003) and Reis (2006) examined the economic agents' imperfect attentiveness to exogenous macroeconomic shocks. Deaton (1991), Carroll (1992) and Ludvigson and Michaelides (2005) considered the buffer-stock models which allow for precautionary saving motives, impatience and restrictions on borrowing. Pischke (1995) examined consumers' incomplete information on economy wide variables. Moreover, there is a vast amount of literature on habit persistence and the equity premium puzzle (for example, Christiano, Eichenbaum and Evans, 2005; Smets and Wouters, 2004) and the business cycle (for example, Sundaresan, 1989; Abel, 1990; Constantinides, 1990).

expectations are sticky. This underlying framework is analogous to the one presented in Mankiw and Reis (2002) and Carroll (2003). Almost all studies in the literature support the strong existence of serial correlation in aggregate consumption growth. However, the estimates of the size of habit persistence or stickiness parameter β are mixed, which may partially result from different econometric techniques utilized.

Tests of the empirical performance of the habit formation model are available only for the OECD countries, for instance see Ferson and Constantinides (1991), Braun, Constantinides and Ferson (1993), Fuhrer (2000), Gruber (2004) and Sommer (2007). Ferson and Constantinides (1991) investigated the habit formation and durability of consumption goods for the U.S. Utilizing the generalized method of moments (GMM) technique, they find evidence supporting the habit formation and durability, although habit persistence dominate durability in their data. Following Ferson and Constantinides (1991), Braun, Constantinides and Ferson (1993) estimated the habit formation model using aggregate consumption data for six OECD countries.[2] Their estimates of the habit persistence range from 0.57 to 0.93 and they asserted that time-nonseparable preferences improved the fit of the consumption model.

Fuhrer (2000) argued that the standard consumption models generally fail to match the volatility of actual consumption data. The maximum likelihood technique (similar to Fuhrer and Moore, 1995) revealed that the real variables could have a 'hump-shaped' response to shocks under habit formation hypothesis. The coefficient of habit persistence was 0.8 for the U.S., consistent with other studies (Ferson and Constantinides, 1991; Gruber, 2004; Carroll and Slacalek; 2007; Sommer, 2007; and Carroll et al., 2011). Gruber (2004) derived a solution for the 'excess volatility' problem that exists in the standard consumption models. In doing

[2] They used the GMM technique.

so, he found that habits play an important role in explaining the dynamics of consumption behavior. The GMM technique yield estimates of habit persistence around 0.55 to 0.92 for 8 OECD countries. Sommer (2007) employed the Kalman filter and instrumental variable (IV) techniques to ascertain the degree of habit persistence in the U.S. The coefficient of habit persistence was around 0.7. Thus, these studies (Ferson and Constantinides, 1991; Braun, Constantinides and Ferson, 1993; Fuhrer, 2000; Gruber, 2004) favor the habit formation model in understanding the dynamics of consumption growth.

The performance of sticky expectations model has not received much attention in the literature. Using the Kalman filter technique, Carroll and Slacalek (2007) attained a stickiness estimate of 0.75 for the U.S., which indicates excess smoothness in consumption growth. Carroll, Slacalek and Sommer (2011) employed the Kalman filter and IV techniques to investigate the degree of excess smoothness for 13 OECD countries. They found the sticky-consumption model outperform the random walk model of Hall (1978) and typically fits the data better than the popular Campbell and Mankiw (1989) model. The stickiness estimate is around 0.7 on average across the selected countries.

According to Sommer (2007), at least half of the variation in quarterly consumption growth can be interpreted as measurement error or truly transitory disturbances unrelated to the consumption model. Consequently, the widely used GMM technique is not robust to the presence of substantial measurement error in consumption data (see Carroll, Slacalek and Sommer, 2011). However, the IV techniques are efficient in controlling the measurement errors. To this end, there is no need to make prior assumptions about the stochastic structure of measurement errors and transitory fluctuations. Sommer (2007) and Carroll, Slacalek and Sommer (2011) utilized the IV techniques and found satisfactory results. Another efficient estimator in controlling measurement errors is the Kalman filter (see Carroll and Slacalek, 2007; Sommer, 2007; Carroll, Slacalek and Sommer, 2011).

Still, there remain issues uninvestigated in the literature. One of it is whether the recent empirical data, especially covering the periods of Great recession, yield analogous levels of excess smoothness as in Carroll, Sommer and Slacalek (2011). The objective of this paper is to investigate the behavior of consumption growth persistence during the Great Recession. In doing so, we estimate the degree of stickiness in aggregate consumption growth for the U.S. considering the effects of the Great Recession. Using the instrumental variable techniques, we provide evidence of persistence in consumption, with the stickiness parameter β around 0.7; such result is consistent with several studies (Fuhrer, 2000; Carroll and Slacalek, 2007; Sommer, 2007; Carroll, Slacalek and Sommer, 2011). Our sequential estimations yield some interesting evidence about the behaviour of β in the Great Recession period. However, such behaviour of β is transitory. We find that the estimate of β decreased to around 0.4 when the sample is extended up to 2009.Q4. Samples beyond 2010.Q1 reveal that β started to increase. These results show that β values appeared in a somewhat U-shaped pattern during the Great recession. This implies that during the crisis consumers' attentiveness to aggregate information has slightly increased, thereby reducing the persistence of aggregate consumption growth.

2. Sticky Expectations Model

Our specification of the sticky expectations model is adapted from Carroll and Slacalek (2007) and Carroll, Slacalek and Sommer (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, Slacalek and Sommer (2011), consumption growth is well approximated by:

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

where α is the intercept, C is the real 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 1947.Q1-2018.Q1 for the U.S. Our main measure of consumer spending is real personal consumption expenditure. This series is extracted from the Federal Reserve Economic Data (Federal Reserve Bank of St. Louis). Figure 1 illustrates the growth rate of real consumption. The growth of consumption is around 0.3 percent on average. Further, the growth rate of consumption became negative during the Great Recession.

{Insert Figure 1 about here}

Baseline Estimates

Following the work of Sommer (2007) and Carroll, Slacalek and Sommer (2011), we estimate excess smoothness in equation (1) using the two stage least squares

(TSLS) and full information maximum likelihood (FIML) instrumental variable methods. Table 1 display the β estimates. Results show that β coefficients are statistically significant at the 1 percent level. Prior to the Great Recession, β was around 0.73. However, when the sample is extended to include the Great Recession period, the estimates of β marginally decreased to around 0.69. Application of the Wald test reveals that $\beta_{1947.Q1-2007.Q3}$ is not statistically different from $\beta_{1947.Q1-2018.Q1}$. For example, when we tested the restriction that $\beta_{1947.Q1-2007.Q3}$ = 0.734 is equal to $\beta_{1947.Q1-2018.Q1}$ = 0.690, the Wald test computed $\chi^2(1)$ test statistic with p-value in the parenthesis is 2.736 (0.204). The restriction cannot be rejected because the p-value is statistically insignificant. Similar finding is achieved for the restriction of β in the FIML method. These results imply that during the crisis consumers' attentiveness to aggregate information has not changed significantly.

For each estimated equation, the diagnostic tests (χ^2 summary statistics) indicate the absence of serial correlation ($\chi^2 sc$), functional form misspecification ($\chi^2 ff$), non-normality ($\chi^2 n$) and heteroscedasticity ($\chi^2 h$) in the residuals. The instruments used in the TSLS and FIML estimation include unemployment rate (4 lags), long-term interest rate (4 lags) and price volatility (3 lags).[3] The F statistics exceed 10 (rule of thumb, see Stock and Watson, 2003) and therefore the selected instruments are valid.

Our estimate of β close to 0.7 (prior to the crisis) is very consistent with the findings of other studies that used the sticky expectations model (Carroll and Slacalek, 2007; Carroll, Slacalek and Sommer, 2011). Furthermore, our estimate is also consistent with the studies that used habit formation model (Ferson and

[3] We derive price volatility using the CPI. GARCH model is used to attain the series.

Constantinides, 1991; Fuhrer, 2000; Gruber, 2004; Sommer, 2007). These studies suggest that the estimates of β is between 0.65 to 0.80.

{Insert Table 1 about here}

Sequential Estimations

The results in the preceding section revealed that when sample is extended to include the Great Recession period, the estimate of β did not change significantly from the pre-crisis estimate. In our view, it is difficult to argue that the estimates of β is homogenous over time. To precisely determine the behaviour of β, we estimate equation (1) by adding quarters sequentially from 2007.Q4 to 2018.Q1. The NBER dates the start of the Great Recession from 2007.Q4; to this end we follow the NBER dates to estimate β sequentially. Our sequential estimations reveal that there were possible changes in β over the crisis period. We construct 42 samples such as 1947.Q1-2007.Q4, 1947.Q1-2008.Q1,…,1947.Q1-2017.Q4 and 1947.Q1-2018.Q1.

Figure 2 illustrate the TSLS estimates of β for 42 samples.[4] We also include $\beta_{1947.Q1-2007.Q1}$, $\beta_{1947.Q1-2007.Q2}$, and $\beta_{1947.Q1-2007.Q3}$ for comparability. We find that the β coefficients are statistically significant at the conventional levels in all samples.

{Insert Figure 2 about here}

[4] These estimates are fairly consistent with the FIML; we do not report the FIML results to conserve space.

These results show that β values appeared in a somewhat U-shaped pattern. The lowest values of β is around 0.4 in the sample 1947.Q1-2009.Q4. To this end, the Wald test indicates that $\beta_{1947.Q1-2007.Q3} = 0.73$ is not equivalent to $\beta_{1947.Q1-2009.Q4} = 0.40$ (Wald $\chi^2(1)$ test statistic with p-value in the parenthesis is 9.256 (0.00)). The Wald test restriction that $\beta_{1947.Q1-2007.Q3} = 0.73$ is equal to $\beta_{1947.Q1-2009.Q4} = 0.40$ is rejected at the 1% level.[5] The significant decrease in β is attributed to the Great Recession, however this is transitory because β estimates start to rise after 2010. In all samples, there is a strong rejection of the Hall's (1978) random walk proposition (excess smoothness = 0).

Other Recessions

Does consumption persistence always change in a crisis? We answer this question by estimating β for the four recessions prior to the Great Recession, i.e. 1980 recession (January-July 1980), early 1980s recession (July 1981-November 1982), early 1990s recession (July 1990-March 1991), and early 2000s recession (March-November 2001). Figures 3-5 illustrate the TSLS estimates of β for the four earlier recessions.[6] In all cases, β appeared in a somewhat U-shaped pattern, thereby strongly supporting the evidence achieved in the sample including the Great Recession. The estimates of β in the 1980 and early 1980s recessions are low (around 0.2 to 0.3, see Figure 3). However, after the early 1980s recession β starts to increase. The Wald test indicates that $\beta_{1947.Q1-1979.Q1}$ estimate of 0.65 is not

[5] The Wald test results for other β s are not reported to conserve space, however they are available from the authors upon request.

[6] Analogous results are obtained using the FIML and these are not reported for brevity. The estimates of β are statistically significant at the conventional levels in all samples.

equivalent to the β estimates achieved in the early 1980s, see Table 2. Similarly, the β estimates decreased significantly in the early 1990s recession; the Wald test indicates that $\beta_{1947.Q1-1990.Q1} = 0.76$ is not equivalent to $\beta_{1947.Q1-1990.Q4} = 0.54$ (see Table 2 for details). Moreover, the estimates of β in the early 2000s recession declined only marginally, i.e. $\beta_{1947.Q1-2001.Q1} = 0.65$ declines to $\beta_{1947.Q1-2001.Q3} = 0.55$. The Wald test indicated that the there are no significant changes in β in the early 2000s recession. This is probably because the early 2000s recession was relatively short in duration and mild (see Kliesen, 2003).

{Insert Figures 3-5 about here}

{Insert Table 2 about here}

Robustness

To assess robustness of our results, we sequentially estimate two additional versions of the consumption growth model, namely (i) consumption growth model of real final sales of domestic product ($\Delta \ln C1$) (model 1 below) and (ii) consumption growth model of real personal consumption expenditure ($\Delta \ln C$) augmented with disposable income growth ($\Delta \ln Y$) and wealth-income-ratio (W) (model 2 below). The specifications of (i) and (ii) are as follows:

Model 1: $\Delta \ln C1_t = \alpha + \beta \Delta \ln C1_{t-1} + \varepsilon_t$ (2)

Model 2: $\Delta \ln C_t = \alpha + \beta \Delta \ln C_{t-1} + \delta \Delta \ln Y_t + \theta W_t + \varepsilon_t$ (3)

Equation (3) 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, Slacalek and Sommer (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. In most equations, instruments lagged up to 4 periods were used; we do not report the exact instruments for each estimated equation for brevity.

Figure 6 illustrate the estimates of β for models 1 and 2 as well as for our baseline model. The temporarily decline in β is observed in all the three cases. The estimates in model 1 and 2 are consistent with our baseline estimates. For model 2, the estimates of disposable income growth (wealth) are plausible and (but) statistically significant (insignificant) at the conventional levels.[7] 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 decline when the samples are extended to include the Great Recession period, but then increases in the post 2010 period. In the light of these results, we infer that our baseline estimates of β are robust.

{Insert Figure 6 about here}

4. Conclusion

This paper utilized the framework presented in Carroll and Slacalek (2007) and Carroll, Slacalek and Sommer (2011) to estimate the consumption growth

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

stickiness (β) for the U.S. The objective is to investigate the behavior of β in the Great Recession. We use the instrumental variable techniques to estimate β. Initially, we estimate β over two sample periods: prior to the Great Recession (1947.Q1-2007.Q3) and including the Great Recession (1947.Q1-2018.Q1). In addition, we estimate β by adding quarters sequentially from 2007.Q4 to 2018.Q1 to precisely determine when this parameter starts to change in the Great Recession period. We find that prior to the Great Recession, β was around 0.73. However, when the sample is extended to include the Great Recession period, β decreased only marginally to around 0.69. Our baseline results show that β did not change significantly during the Great Recession.

The sequential estimations yield some interesting evidence about the behaviour of β in the Great Recession. However, such behaviour of β is transitory. We find that the estimate of β decreased to around 0.4 when the sample is extended up to 2009.Q4. Samples beyond 2010 reveal that β started to increase. These results show that β values appeared in a somewhat U-shaped pattern during the Great Recession. Furthermore, we investigate whether consumption persistence also decreased in previous recessions (1980, early 1980s, early 1990s and early 2000s). To this end, we find overwhelming evidence of β being significantly reduced in all previous recessions, except the early 2000s recession.

Our findings imply that existing consumption persistence based frameworks (for example, asset pricing models, business cycle macroeconomic models, etc) must be applied cautiously. Consumption persistence features prominently in the literature devoted to the estimation of medium-scale macroeconomic models (for example, Christiano, Eichenbaum and Evans 2005; Smets and Wouters, 2004). Further, consumption persistence has been widely used to resolve the equity premium puzzle (Sundaresan, 1989; Abel, 1990; Constantinides, 1990). Such

models may yield misleading results if consumption persistence is limited. Therefore, models that use empirical data covering the financial crises periods may be difficult to analyze.

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Table 1: Stickiness Estimates of TSLS and FIML

	Stickiness Parameter β : Include Great Recession		Stickiness Parameter β : Exclude Great Recession		Wald Test χ^2 Statistic
	TSLS	***FIML***	***TSLS***	***FIML***	
β	***0.734***	***0.728***	***0.690***	***0.687***	***0.734 (β) = 0.690 (β)***
	(3.65)*	***(4.17)****	***(5.59)****	***(4.28)****	***Wald test 2.736 (0.204)***
					0.728 (β) = 0.687 (β)
					Wald test 3.201 (0.182)
$\chi^2 sc$	0.608	0.056	0.859	1.425	
	(0.44)	(0.81)	(0.68)	(0.20)	
$\chi^2 ff$	1.405	0.385	1.684	1.337	
	(0.25)	(0.57)	(0.25)	(0.19)	
$\chi^2 n$	0.735	0.567	0.742	0.430	
	(0.70)	(0.75)	(0.58)	(0.23)	
$\chi^2 h$	1.549	2.207	0.227	0.605	
	(0.22)	(0.15)	(0.54)	(0.42)	
$Adj\ R^2$	0.72	0.75	0.77	0.79	
Time Period	1947.Q1-2007.Q3		1947.Q1-2018.Q1		

Notes: t-statistics are reported in parentheses. *p*-values are also in parentheses below the χ^2 test statistics ($\chi^2 sc$ = serial correlation, $\chi^2 ff$ = functional form, $\chi^2 n$ = normality and $\chi^2 h$ = heteroscedasticity). * denotes statistical significance at the 1% level.

Table 2: Wald Test on Equality of β

	β	Wald Test χ^2 Statistic
Recession: January-July 1980	$\beta_{1947.Q1–1979.Q1} = 0.65$ $\beta_{1947.Q1–1980.Q2} = 0.26$	***0.65 (β) = 0.26 (β)*** ***Wald test 13.885 (0.00)******
Recession: July 1981-November 1982	$\beta_{1947.Q1–1979.Q1} = 0.65$ $\beta_{1947.Q1–1981.Q3} = 0.25$	***0.65 (β) = 0.25 (β)*** ***Wald test 13.920 (0.00)******
Recession: July 1990-March 1991	$\beta_{1947.Q1–1990.Q1} = 0.76$ $\beta_{1947.Q1–1990.Q4} = 0.54$	***0.76 (β) = 0.54 (β)*** ***Wald test 11.695 (0.00)******
Recession: March-November 2001	$\beta_{1947.Q1–2001.Q1} = 0.65$ $\beta_{1947.Q1–2001.Q3} = 0.55$	***0.65 (β) = 0.55 (β)*** ***Wald test 1.539 (0.42)***

Notes: 1% statistical significance is denoted by *.

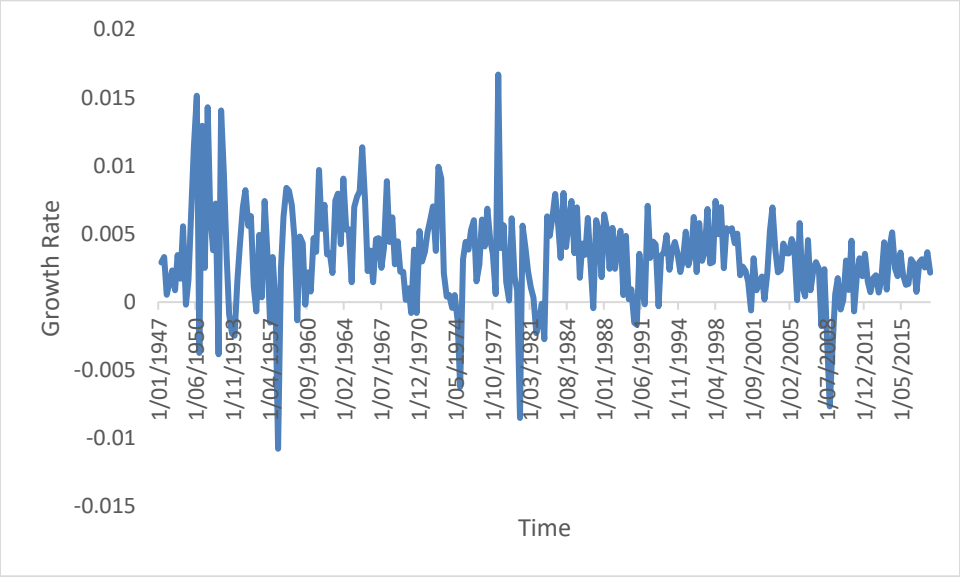

Figure 1: Growth of Consumption Expenditure 1947.Q1-2018.Q1

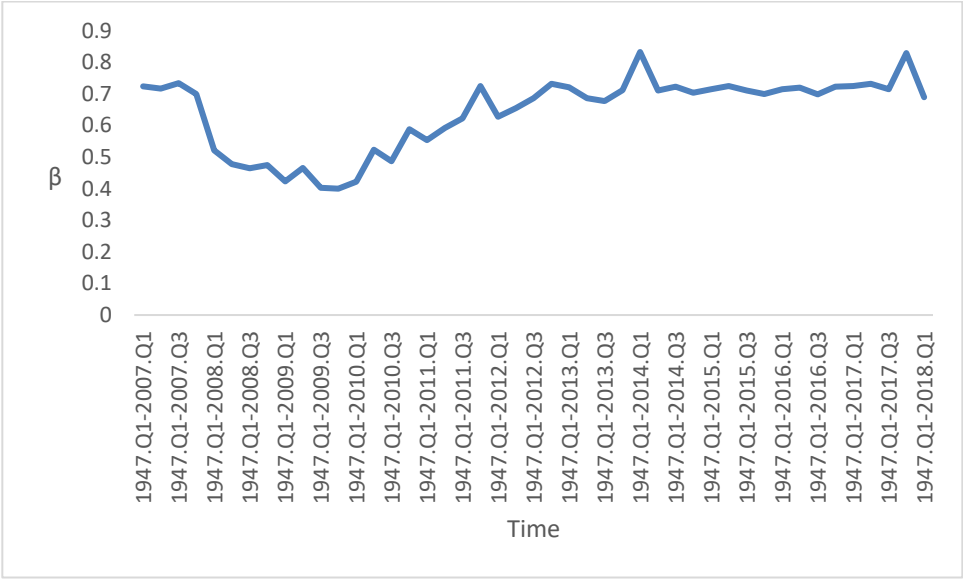

Figure 2: TSLS Estimates of β

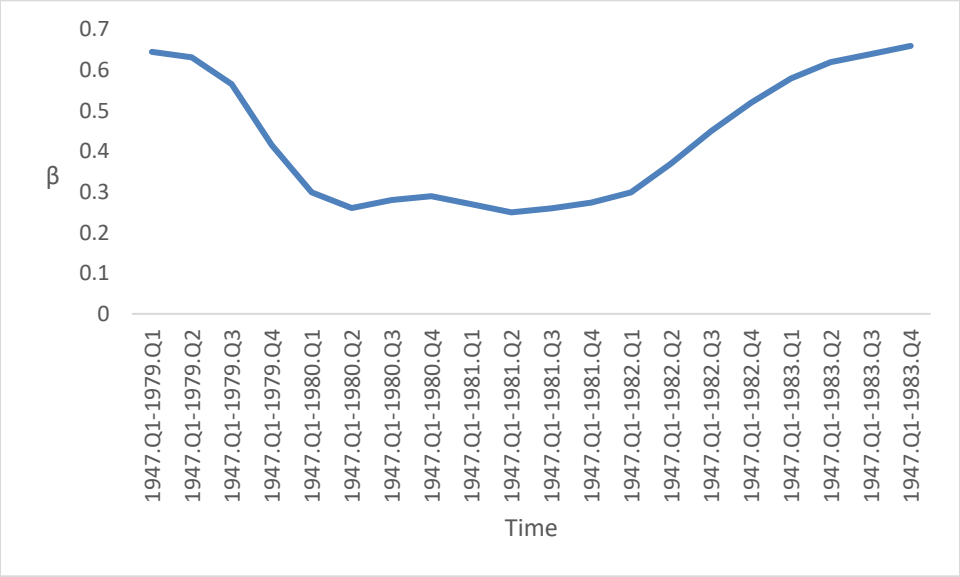

Figure 3: TSLS Estimates of β in the 1980 and early 1980s recessions

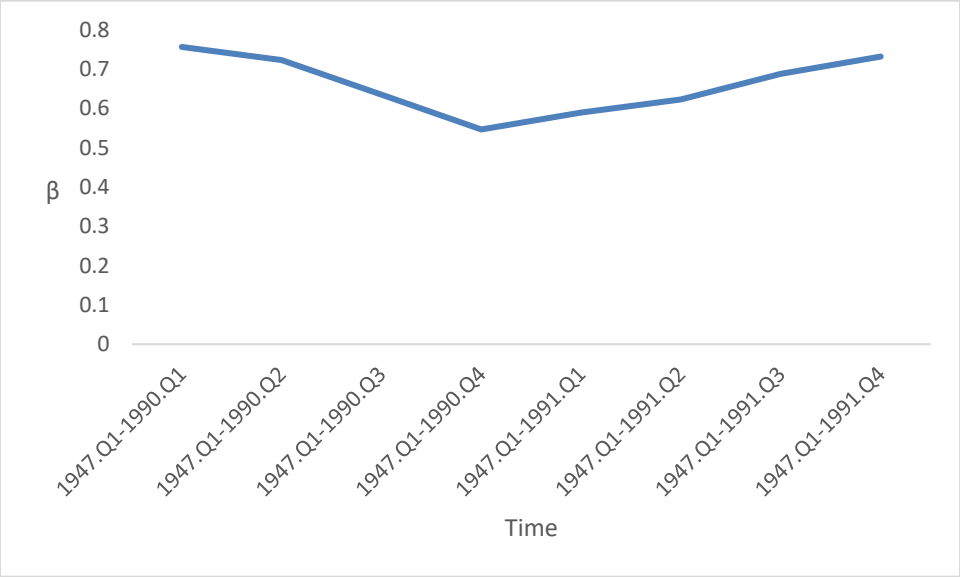

Figure 4: TSLS Estimates of β in the early 1990s recession

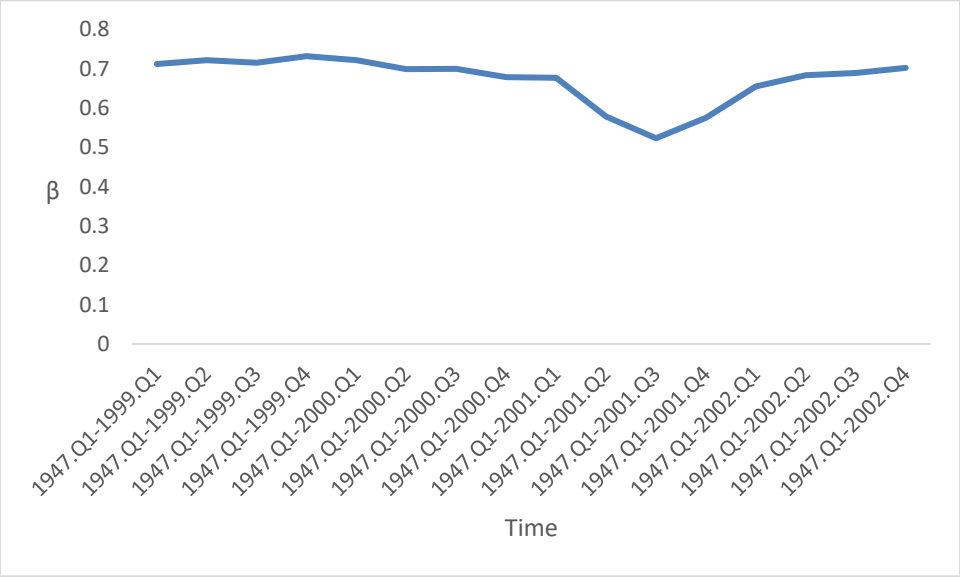

Figure 5: TSLS Estimates of β in the early 2000s recession

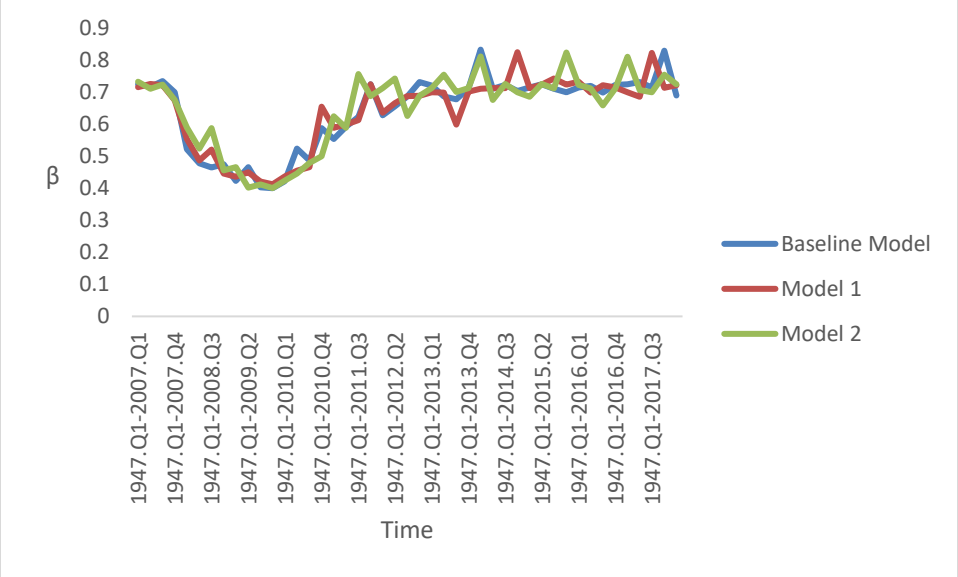

Figure 6: TSLS Estimates of β for alternative consumption growth models