Structural Breaks and Consumer Credit: Is Consumption Smoothing Finally a Reality?

April 2006

Abstract

Has structural change in consumer credit made consumption smoother? Given recent empirical analysis the consumer's inability to smooth consumption appears as prevalent as ever. In this paper, however, I show that structural change in consumer credit appears to have made consumption smoothing a reality. First, using the statistical methods of Bai and Perron (1998, 2003), I find structural breaks in the series for consumer credit and consumption at various points from 1959 through 2005. Most notably, structural breaks occur in total consumer credit and revolving consumer credit in the 1990s. Based on the break date estimates, I estimate a structural equation of consumption growth in line with previous empirical tests of the permanent income hypothesis. Consumption smoothing is evident in the data after the mid-1980s and into the 2000s. The findings of this paper have important implications for a variety of economic research. The evidence for consumption smoothing bears directly on the efficacy of monetary policy and fiscal policy, as well as on the recent discussion of the decline in macroeconomic volatility since the 1980s.

JEL Classification Codes: E21, E44, E50, C32
Keywords: Consumption, Consumer Credit, Structural Breaks, Deregulation

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1 Introduction

Has structural change in consumer credit markets made consumption smoother? Or has the expansion of consumer credit markets only served to make consumers more vulnerable to shocks? Given recent research a good argument can be made that the latter appears to be the case. The consumer's inability to smooth consumption appears as prevalent as ever. Gross and Souleles (2002) examine micro data on credit cards to explain the lack of smoothing apparent in consumption data, while Attanasio *et al* (2004) look at auto loans to make this point. Similarly, Wakabayashi and Horioka (2005) do so with Japanese household data. On the aggregate level, Ludvigson (1999) shows that consumer credit is a significant predictor of consumption in the United States—consistent with a lack of smoothing—while Bacchetta and Gerlach (1997) document this abroad. All told these studies are the latest generation of a significant body of research emphasizing the importance of credit market, or "liquidity," constraints in explaining the empirical failure of the Life Cycle-Permanent Income Hypotheses as espoused in Hall (1978).[1]

In this paper, however, I show that in the midst of structural change in consumer credit markets, consumption smoothing now appears to be a reality. I find structural breaks in the series for consumer credit and consumption consistent with regulatory and structural change in credit markets. To estimate the breaks, I use the methods of Bai and Perron (1998, 2003) for estimating deterministic breaks. Most notably, structural breaks occur in total consumer credit and revolving consumer credit in approximately 1995 for the former and 1983 and 1998 for the latter. Then, motivated by the break date estimates, I estimate a structural equation of consumption growth in line with previous empirical tests of the permanent income hypothesis. The structural estimation first serves to confirm previous findings, both income growth and consumer credit predict consumption growth in samples up through approximately the mid-1980s. However, the structural

[1] While Hall (1978) showed that intertemporal consumption follows a random walk, evidence has showed that lagged income, and for Ludvigson (1999) and Baccheta and Gerlach (1997), consumer credit, have predictive power for current consumption. For additional research on liquidity constraints—as well as additional possible reasons for the lack of consumption smoothing, such as rule of thumb behavior and precautionary motives—see Zeldes (1989), Jappelli (1990), Cambell and Mankiw (1989) Hayashi (1982, 1985), Chah, Ramey and Starr (1995), and Carroll (2001)).

estimation reveals that the prediction power of either income growth and consumer credit growth generally fails after the mid-1980s, and the model completely "breaks down" after 1995. While the data suggests that consumption smoothing does not hold in earlier eras, consumption smoothing is evident after the mid-1980s and into the 2000s.

With this two-pronged empirical strategy, this paper makes an important connection. First, this paper shows that, indeed, consumer credit has changed over the last thirty years, with structural change apparent in the statistical behavior of the series. And second, this proves to be notable as the structural change is consistent with consumption smoothing that is shown to be evident in the data. The structural estimation reveals that unlike the previous research on consumption behavior—particularly the recent emphasis on credit card borrowing and other micro data used to support a lack of consumption smoothing—consumption smoothing is a feature of consumption data and liquidity constraints, in particular, are no longer important for consumer behavior.

The findings of this paper have important implications for a variety of economic research. First, consumption smoothing and liquidity constraints bear directly on the efficacy of monetary policy and fiscal policy. Liquidity constraints, *ceteris paribus*, make households more sensitive to policy or general macroeconomic shocks. Consistent with this notion, household balance sheets are cited as an important source for the propagation of monetary shocks and the amplification of their effects (see Bernanke and Gertler (1995), and Bernanke et al (1996), and Mishkin (1977, 1978)). This may be especially relevant today given recent concerns that households are over-indebted; rely too much on credit card borrowing (see the Gross and Souleles (2002) paper reference above); and as a result are leaving themselves exposed to such shocks. Relatedly, for fiscal policy, the existence of liquidity constraints implies that households should spend a significant portion of a tax rebate (see Coronado et al (2005), and Johnson et al (2004), for analysis of recent fiscal stimuli), or reduce consumption in the opposite scenario.

However, if households smooth consumption, as the data here suggest, then aggregate demand management should have little effect on short run spending. In this view, greater access to credit is a positive tool for consumption smoothing and responding to changes in policy or economic shocks in general. In a complementary paper, I examine time series data on credit card balances and available liquidity to find support for the positive benefits the growth in credit card borrowing, including the ability to smooth consumption (Brady (2005)). Since deregulation of the credit card industry in 1978 and of commercial banking in the early 1980s, the supply of consumer credit has increased to all households, especially to the subset of borrowers previously considered to be liquidity-constrained (see Athreya (2002); Evans and Schmalensee (1999); and Brady (2004)).

Note, too, at issue is not merely how consumers may or may not respond to policy changes, but that consumption smoothing suggests appropriate policy strategies. The results in this paper speak directly to the debate—gaining much attention with the recent appointment of Ben Bernanke to replace Alan Greenspan as Federal Reserve chairman—regarding discretionary monetary management versus a less-discretionary inflation-targeting "framework."[2] Consumption smoothing implies that discretionary demand management is ineffective. More liquid consumers are able to smooth in the anticipation of policy changes or even better absorb unanticipated changes.

Further still, the results of this paper support the view that structural changes are behind the "Great Moderation" of the macroeconomy. McConnell and Perez-Quiros (1999), and others have documented the decline in macroeconomic volatility since the mid-1980s.[3] In line with this decline has been an interest in discovering the underlying sources—with explanations ranging from the "structural," to "good policy," to it's just been a matter of "good luck."[4] The structural change in consumer credit markets and coincident consumption smoothing documented in this paper provide corroborative evidence that the consumer sector, in particular, is an important source of the decline in volatility (McConnell and Perez-Quiros (1999) emphasize the decline in the volatility of consumer durables, while Ramey and Vine (2004) focus on changes in the automobile industry[5]).

The section that follows discusses the literature on consumption smoothing and also puts into

[2] See Bernanke and Blinder (1997).

[3] See Kim and Nelson (1999) and Stock and Watson (2002) for additional documentation. See also, Cambell (2005), Cecchetti *et al* (2004) and Ramey and Vine (2005) for further discussion and analysis of the "Great Moderation."

[4] See Ahmed et al (2002) for a summary.

[5] Though interestingly, Ramey and Vine (2004) make the argument that the structural change they find in the automobile industry is borne of a change in the policy function of the Federal Reserve.

context developments in consumer credit markets that bear directly on the issue. To substantiate the claims set forth thus far, that discussion is followed by the empirical analysis, including the structural break techniques and the estimation of a structural consumption equation over various sub-samples.

2 Consumption Smoothing with Structural and Regulatory Change

Since Hall's (1978) formulation of the Life-Cycle-Permanent Income Hypothesis, much has been written on consumption smoothing, and in particular, the apparent lack of consumption smoothing in the data. Hall (1978) showed that if rational consumers maximize intertemporal utility (meaning that marginal utility, and hence, consumption, follow a random walk), then policies that change short-run income, such as temporary tax rebates or expansionary monetary policy, will have no affect on consumption.[6] Consumption will only change in so far as the policies affect permanent income and for Hall's consumer, the level of consumption today should embody all predictable changes in income from the past. Empirically, no variable except past consumption should help predict the behavior of consumption.

However, Flavin (1981,1985), Hayashi (1982,1985), Cambell and Mankiw (1989), Bacchetta and Gerlach (1997), Ludvigson (1999), and others have provided a variety of evidence that lagged values of income and even consumer credit do have predictive content for consumption. In the parlance of the research, consumption is "excessively" sensitive to a change in current income. Specifically, following Hall (1978), Flavin (1981) and Hayashi (1982) show that when regressing consumption growth on lagged values of income reveals consumption is not entirely determined by lagged consumption.[7] Similarly, Ludvigson (1999) and Bacchetta and Gerlach (1997) show

[6] Hall (1978) refers to the "Life-Cycle-Permanent Income Hypothesis." For brevity of exposition, we focus on the permanent income hypothesis. Though very similar to the permanent income hypothesis, the life cycle hypothesis differs with a greater emphasis on the underlying utility function and that consumption out of a transitory change in income is a function of a household's lifespan, to name two examples (Mayer (1972)). The two theories are closely linked, however, by their mutual emphasis on the relationship between consumption and permanent income (Hall (1978)).

[7] In a rejoinder, Hall and Mishkin (1982) test this possibility using panel data and argue that the fraction of consumers that are "sensitive"—about 20 percent—is probably not enough to have an appreciable effect on aggregate

with both U.S. data and international data, respectively, that consumer credit is also a significant predictor of current consumption. In other words, the data suggests that consumer do not smooth consumption.

This apparent lack of consumption smoothing has engendered some popular culprits. Cambell and Mankiw (1989) argue that approximately half of all consumers follow a "rule-of-thumb" while the remaining portion abide by the permanent income hypothesis. Alternatively, consumers may suffer from myopia (see Shea (1995a, b) for discussions). A more often discussed reason for the lack of consumption smoothing are borrowing or "liquidity" constraints in credit markets. Such papers include Chah, Ramey and Starr (1995), Jappelli *et al* (1998), Ludvigson (1999), Bacchetta and Gerlach (1997), Gross and Souleles (2002), Zinman (2003), Attanasio *et al* (2004) as well as earlier papers by Flavin (1985), Hayashi (1985), and Zeldes (1989). Ludvigson (1999), for example, shows that consumer credit growth is a significant predictor of consumption growth, independent of income growth, while Bacchetta and Gerlach (1997) provide similar evidence for countries other than the United States. And Gross and Souleles (2002) use a panel of credit card data for the years 1995 to 1998 to argue that household credit card use is indicative of liquidity-constraints.

Though the issue is far from settled. While empirically evident, the economic significance of liquidity constraints for aggregate consumption may be minimal. Hayashi (1985) notes the decline in consumption he documents is small. Also, Zeldes (1989) finds that liquidity constraints are most important for younger households, which may not affect aggregate consumption to a significant degree (which is consistent with Jappelli (1990)).[8] In general, Runkle (1990), Altonji and Siow (1987), and recently Dejuan *et al* (2004) provide evidence in support of the permanent income hypothesis and consumption smoothing. Also, in work that complements the current study, I find that data on credit card balances and credit card limits suggests that consumers in

consumption in the short-run.

[8] Cox and Jappelli (1993), however, argue that even if the "effect of liquidity constraints on consumption is small . . . the effect on household balance sheets could conceivably be much larger. Credit constraints could affect leveraged purchases of durables and housing"(p198). Cox and Jappelli (1993) conclude that constrained households would increase debt by 75 percent given they became unconstrained. Also, Mayfield (1989) shows that constrained households consume fewer durable goods relative to nondurable goods than do unconstrained agents.

the aggregate use credit cards to smooth consumption, disavowing, in particular, the relevance of liquidity constraints (Brady (2005)).

Even if one feels the statistical evidence provided *against* the Life Cycle-Permanent Income Hypotheses is compelling, after two and half decades of structural and regulatory change, the support against the hypotheses may actually be out-dated. In the brief section that follows, I discuss how the deregulation of the credit card industry and of commercial banking eased access to, and expanded the supply of, consumer credit. With easier access to credit, therefore, economic theory suggests that households will smooth consumption (Hall (1978)).

2.1 Regulatory and Structural change in Consumer Lending

Various strands of economic research suggest that factors such as the deregulation, commercial bank consolidation, and other aspects of structural change in financial markets are beneficial to small borrowers in particular. This appears to be especially true for households. Traditionally, households are characterized as bank dependent, whose access to credit is restricted during recessions or other periods of financial distress, with the effects of economic recessions and credit crunches falling disproportionately on households (see Mishkin (1977,1978), and Peek and Rosengren (1995)). However, with a more integrated national market households can likely access credit more readily even during periods of distress. These changes have been predominately wrought by the removal of credit card interest rate ceilings in 1978 and the deregulation of commercial banking in the early 1980s.[9]

The Supreme Court ruling in the 1978 case, *Marquette National Bank of Minneapolis v. First of Omaha Service Corporation*, 439 US 299, deregulated credit card interest rates. This initiated an

[9] Additional important components to this story include the increased use of securitization in credit markets and the importance of credit scoring for consumer lending. While the latter was developed in 1958 and became widespread in the 1960s and 1970s (McCorkell, 2002), in conjunction with the regulatory change, credit scoring has enabled the expansion of consumer credit by lowering the cost of provision and making it easier to identify quality borrowers (Bostic, 2002). As a result, credit is not only allocated to high quality borrowers more efficiently, but makes lending to lower quality borrowers more profitable, expanding the supply of credit to them as well (Athreya (2002), Evans and Schmalens (1999)). Also, securitization (first done with credit card receivables in 1986, following in the footsteps of mortgages in 1970) lowers costs and encourages an increase in supply overall and to more marginal borrowers (Johnson (2002), Ryding (1990)).

expansion of consumer credit, as lenders could compete over a geographically broader market (Evans and Schmalensee (1999), Ellis (1998)). Before the ruling, 36 of 38 states surveyed in the Federal Reserve Board's Survey of Consumer Finances restricted credit card interest rates (Zinman, 2003). The Supreme Court ruling effectively eliminated state usury laws by allowing First of Omaha the right to offer credit card services to residents of Minnesota. The provision of credit cards has since been dominated by a few large banks operating across state lines.

In addition, the 1980 Depository Institutions Deregulation and Monetary Control Act (DIDMCA) and the 1982 Garn-St Germain Depository Institutions Act, helped make consumer lending more profitable (hence, increasing the supply). DIDMCA was passed to allow banks to offer competitive interest rates on deposits (such as NOW accounts). The legislation also scheduled the end of regulation Q interest rate ceilings by 1986. The Garn-St Germain Act allowed banks to offer money market deposit accounts, which were free of reserve requirements and were not subject to regulation Q interest rate restrictions (Berger, 1995). While many decry the consolidation of commercial banking that has followed deregulation, consumer lending has, in fact, increased.

Tables 2.1 and 2.2 display a snapshot of commercial banking at different points from 1972 to 2002. Consistent with consolidation, the number of banks has declined, asset concentration has increased, and the share of consumer lending for banks in the lower end of the asset distribution has declined. The real amount of consumer lending has increased while the share of consumer lending by the bottom 95 percent of banks has fallen from just over 40 percent in 1972 to 10 percent in 2002. However, consumer lending as a share of total lending for the top five percent of banks has increased slightly from 1972 to 2002, from approximately 16 percent of the loan portfolio to approximately 18 percent.[10]

These numbers support the proposition that a large bank is likely to offer more services than a small independent bank, service a larger base of customers, and as result, manage risk more efficiently (Berger et al (1995)). For example, credit card lending, associated with a lack of collateral and lack of monitoring, requires the economies of scale best handled by a large organization (Peak

[10] These last two numbers are not shown explicitly in Tables 1 and 2, but are easily calculated from Table 2.

and Rosengren (1998)). Second, after deregulation, large banks can now serve customers who were previously the exclusive province of local banks. In this light, relationship lending and the comparative advantage of the local lender, so often viewed through rose-colored glasses, has really been a product of restrictions on interstate banking (more on this shortly). Consistent with this perspective, empirical evidences suggests that small business lending, for example, has not suffered following the deregulation of commercial banking in the early 1980s or from the merger activity of the 1980s and 1990s (see Peak and Rosengren (1998), Strahan and Weston (1998), and Jayaratne and Wolken (1999) substantiating this view).

Interestingly, the increase in consumer lending runs counter to the typical objection of bank consolidation—that bank-dependent borrowers, such as small firms and households, might lose access to credit as large banks absorb small, local lenders (Berger et al (1995), Berger et al (1999)). Some research indicates that traditionally the relationship between the local bank and the small borrower has been special. The local bank is thought to have a comparative advantage over larger, non-local institutions, where the ability to monitor locally makes the loan profitable at the margin (Peek and Rosengren (1998), Strahan and Weston (1999)). In contrast, the larger institution may suffer from diseconomies of scale, where the cost of monitoring is too high for a complex institution engaged in offering a variety of services. Berger et al (2004) document that large institutions tend to lend to more geographically distant customers, have shorter and less exclusive relationships with their customers, and overall interact impersonally with their customers. Alternatively, others have shown that small firms benefit from the local relationship, gaining easier access to credit and receiving lower rates versus similar firms without an established relationship (Peterson and Rajan (1994), Berger and Udell (1996)). Therefore, if local banks are enveloped by larger institutions, the relationship-dependent borrower may suffer. However, again, research and data suggest that neither small business lending nor consumer lending has suffered from these developments.

These developments are important for consumers because with more integrated markets and large banking organizations, the brunt of recessions should fall less disproportionately on “small” borrowers such as households (Berger et al (1999); Houston and James (1998); Strahan and Weston

(1998)). Moreover, with easier access to credit we might see a more tempered business cycle as households smooth consumption. This interpretation is consistent with research that has documented an apparent decline in the volatility of the business cycles since the middle of the 1980s (see McConnell and Quiros-Perez (1999), and Stock and Watson (2002)). And, with respect to research on consumption behavior, one might expect that consumption smoothing is more likely a reality recently than found for data from the 1980s and before. Hence, in the remainder of this study, I do two things: 1) I consider the presence of breaks in the time series for consumption and consumer credit using statistical techniques; and 2) I use the structural breaks to estimate a structural equation for consumption growth over time. Details of the latter step are provided later, while I discuss the former step in the next section.

3 Structural Break Search

In this section I use the statistical techniques of Bai and Perron (1998, 2003) to search for breaks in the time series behavior of consumption and consumer credit. Consistent with McConnell and Perez-Quiros (1999), one might expect a break in consumption growth or volatility at some point in the sample in the mid-1980s (at least). With respect to consumer credit, there could be a number of breaks in the mean growth rate or in the volatility of the series consistent with regulatory changes in the late 1970s and early 1980s; with commercial bank consolidation in the late 1980s and early 1990s (and beyond); and with further regulatory changes in commercial banking in the mid-to-late 1990s.

Specifically, I search for a break in the means of the log difference of total consumption expenditures and its components, durables and nondurables plus services; and total consumer credit and its components, nonrevolving consumer credit and revolving consumer credit. Estimation is performed on monthly data from January 1959 through September 2005.[11] Though for revolving credit, the sample runs from January 1978 through September 2005. I begin the sample in 1978

[11] Each series is expressed in seasonally adjusted 2000 dollars.

to avoid jumps in the revolving series prior to that date (the series actually begins in 1968).

The Bai and Perron (1998) method for estimating multiple unknown breakpoints is based on the minimization of the objective function,

$$SSR_T(T_1, ..., T_m), \tag{1}$$

where T_j denotes the break dates ($j = 1, ..., m$) and SSR_T is the sum of squared residuals after each m-partition $(T_1, ..., T_m)$ has been estimated using least squares. The objective function $SSR_T(T_1, ..., T_m)$ is constructed with the regression estimates from each m-partition, e.g., $\hat{\beta}(\{T_j\})$. Formally, the break point estimates are

$$\left(\hat{T}_1, ..., \hat{T}_m\right) = \arg \min_{T_1, ..., T_m} SSR_T(T_1, ..., T_m). \tag{2}$$

Multiple test statistics are provided by Bai and Perron (1998) to test the hypothesis of $m = 0$ breaks versus the alternative of $m = k$ breaks. For brevity, we restrict our attention to two of these statistics. The first generalizes the *supF* test detailed in Andrews (1993) in order to test for multiple break points. The *supF* test is motivated by the fact that in a hypothesis test of structural change, the break point, T_j, appears as a parameter under the alternative hypothesis but not the null. Therefore, the usual Wald, LM, or LR-statistics fail to have standard asymptotic properties (*see* Andrews (1993) and Andrews, Lee and Ploberger (1996) for discussion on this point). For the case when $k = 1$, the F-statistic, $F(T_1, ..., T_m)$ is constructed for all possible break dates and the T_j that maximizes $supF(T_1..., T_j)$ will be the estimated break date.

A variant of the *supF* tests for the presence of $m+1$ breaks given that m breaks are present. Given the model with m breaks, the strategy then tests each $m+1$ additional partition. In practice, one is performing $m+1$ tests of $m = 0$ breaks versus the alternative of $m = 1$ breaks. The test amounts to choosing the model with $m+1$ breaks if the sum of the squared residuals is smaller than the model with m breaks (*i.e.*, rejecting the null that the latter case is true). In the application of the tests, each series is modeled with the growth rate modeled as an AR(1) process.[12] The maximum number of breaks for consumption and nonrevolving consumer credit is set to 5, while for revolving consumer credit and its shorter sample the maximum number of breaks is set to 3.[13]

Tables 3.1 through 3.10 display the results of the various tests I use to choose the number of deterministic breaks in each series, for both the mean growth rate and the volatility of each series (explained below). The tables combine to display the *supF(m|0)* and *supF(m+1|m)* statistics for the mean growth rate of each series; the estimated break dates (obtained from the global optimization) associated with the maximum of the *supF* statistics; and the parameter estimates of each series modeled as an AR(1), with the number of break dates inferred from the *supF* tests supported by Bai and Perron's (1998) sequential method (which in these results support the choice of breaks found by the *supF(m|0)* and *supF(m+1|m)* statistics).

3.0.1 The Mean Growth Rate of Consumer Credit

Tables 3.1 and 3.2 display the results for total consumer credit and its components, revolving and nonrevolving consumer credit. Panel A of Table 3.1 displays the results for total consumer credit. The *supF* test of zero versus m breaks is maximized when $m = 2$ (21.95). The *supF* test of $m+1$ breaks versus m breaks also is maximized when $m = 2$ (13.67). The estimated break dates from the global optimization for $m = 2$ are February 1966 and September 1995. Panel B displays the results for revolving consumer credit. The *supF* test of zero versus m breaks is maximized when $m = 1$ (44.73), while the *supF* test of $m + 1$ breaks versus m breaks is maximized when $m = 2$ (13.67). The estimated break dates from the global optimization for $m = 2$ are December 1983

[12] Mathematically, if x is the series being tested,
$\Delta x_t = \mu + \Delta x_{t-1}$.
Estimating in this manner follows a recent literature that has used structual break techniques to analyze macroeconomic stability in the post-War era. References include McConnell and Perez-Quiros (1999), Stock and Watson (2002), and Ahmed et al (2002). Also, considering alternatives, such as modeling the series as AR(0), AR(2) and higher, do not lead to significant differences in the estimated break dates. Note that for Bai and Peron's (1998) tests, including a lag of the dependent variable requires the assumption that serial correlation is not present in the errors.

[13] Five is the recommended number by Bai and Perron (1998) for a sample of this size. Intuitively, this implies that the test allows for the possiblility that there have been five events or points at which the mean of consumption growth has changed over the last forty-five years.

and April 1998. For nonrevolving credit in panel B, the *supF(m|0)* and *supF(m+1|m)* tests are maximized when $m = 3$ (31.03 and 41.62, respectively). The estimated break dates from the global optimization for $m = 3$ are October 1961, August 1976 and October 1992.

To provide a sense of the difference between the time periods suggested from the results in Table 3.1, Table 3.2 displays the parameter estimates for estimating the AR(1) model in the different time periods.[14] The point to note is the noticeable difference in the estimated parameters across the samples. Using the estimated break dates in a Chow test confirms that there is a statistically significance difference between these periods (displayed in Table 3.3). Only the October 1961 date for nonrevolving consumer credit is *not* statistically significant at the five percent level.

3.0.2 The Mean Growth Rate of Consumption

Tables 3.4 and 3.5 display the results for consumption, consumer durables, and for consumer nondurables plus services. For the consumption series, the value of *supF(m|0)* is maximized when $m = 1$ and is statistically significant at the five percent level. The *supF(m+1|m)* test suggests that any additional breaks are statistically insignificant. The date corresponding to the single break is January 1984. For consumer durables, the value of *supF(m|0)* is maximized when $m = 1$ and is statistically significant at the five percent level. Similar to the overall consumption series, the *supF(m+1|m)* suggests that any additional breaks are not statistically significant. The date corresponding to the break is April 1982. The outcome for the nondurables plus services component is nearly identical to the other consumption series. However, the date corresponding to the $m = 1$ comes much earlier in the sample, in February 1973. The parameter estimates from each series estimated over these split samples are reported in Table 3.5. The accompanying Chow test results are displayed with the results for consumer credit in Table 3.3. The Chow tests reveal that the difference between the periods is statistically significant.

[14] Note that at this stage, I refrain from comparing the parameter estimates in detail. Here, I seek to simply document whether changes have occured in the process generating the series. This will serve to motivate the next section, where I compare and discuss structural estimates across time.

3.0.3 The Volatility of Consumer Credit

Tables 3.6 and 3.7 display the results for structural break tests on the volatility of the consumer credit series. For lack of a method for consistently estimating the structural break in the variance of a series, I look for a break in the absolute value of the growth rate of each series (see Timmerman (2001) for an example of this method). Panel A of Table 3.6 displays the results for total consumer credit. The *supF* test of zero versus m breaks is maximized when $m = 1$, while the *supF* test shows that any additional breaks are statistically insignificant. The estimated break date from the global optimization for $m = 1$ is January 1966. The estimated parameters before and after this date are reported in Table 3.7. The Chow tests associated with these dates are reported in Table 3.8. Panel B of Table 3.6 displays the results for revolving consumer credit. Similar to the total series, the *supF* test of zero versus m breaks is maximized when $m = 1$, while the *supF* test shows that any additional breaks are statistically insignificant. The estimated break date from the global optimization for $m = 1$ is April 1998. The parameter estimates and Chow tests are reported in Tables 3.7 and 3.8, respectively. For nonrevolving credit in panel B, the $supF(m|0)$ and $supF(m+1|m)$ tests suggest there is not a statistically significant break in the volatility.

3.0.4 The Volatility of Consumption

Tables 3.9 and 3.10 displays the results for consumption, consumer durables, and for consumer nondurables plus services. For the consumption series, the value of $supF(m|0)$ is maximized when $m = 1$ and is statistically significant at the five percent level. The $supF(m+1|m)$ test suggests that any additional breaks are statistically insignificant. The date corresponding to the single break is February 1987. For consumer durables, the value of $supF(m|0)$ is maximized when $m = 1$ and is statistically significant at the five percent level. Similar to the overall consumption series, the $supF(m+1|m)$ suggests that any additional breaks are not statistically significant. The date corresponding to the break is December 1984. For nondurables plus services, the $supF(m|0)$ is maximized when $m = 1$ and is statistically significant at the five percent level. However, the date corresponding to the $m = 1$ comes much earlier in the sample, in October 1988. The parameter estimates for each series estimated over the split samples are reported in Table 3.10, and the difference between the between the periods is statistically significant at the one percent level (Table 3.8).

3.0.5 Interpretation of Break Test Results

Overall, the plethora of information provided by the break tests is help understand the evolution of deregulation and structural change in credit markets. The dates are not exact. But given that the effects of structural changes or regulatory change unfold over time, finding dates in the data that accord *exactly* with specific events might be unlikely. For revolving credit, for example, the breaks in the mean growth rates are consistent with two general periods in the evolution of revolving credit. The 1983 date may signal the shift in the growth rate of the series as the effects were beginning to take hold–on the heels of the deregulation of credit card interest rates in 1978, and the DIDMCA legislation and Garn-St. Germain Act and of 1980 and 1982, respectively.[15]

In addition, the 1998 date for revolving credit, and the 1995 date for the total credit series may represent a similar shift with respect to legislation and structural change (moreover, the break in the volatility of revolving credit is found in 1998). These mid-to-late 1990s dates may reflect the effects of the Riegle-Neal Act of 1994 (if not the effects of deregulation put in motion in the early 1980s). The 1994 Act, which deregulated interstate banking, arguably served as something of an official recognition to the process of structural change that had been under way since the deregulation of the early 1980s.[16] The estimated break dates for the total series in 1966 is less clear, as is the 1976 date for nonrevolving consumer credit. For the former, the 1966 break may be capturing the beginning of the revolving series in 1968 (obviously contained within the total series),

[15] In particular, it did not take long for credit card markets to show the transforming effects of the 1978 Supreme Court Ruling that removed credit card interest rate ceilings (Evans and Schmalens (1998)).

[16] The Riegle-Neal Act of 1994 had two important provisions. The first repealed the Douglass Amendment to the Bank Holding Company Act of 1956, thereby allowing, beggining on September 29, 1995, full nationwide banking regardless of state law. The second provision allowed for interstate branching, where a national bank, beginning on June 1, 1997, can operate branches in more than one state without a seperate corporate structure for each state.

while the 1976 date for nonrevolving credit may be indicative of the macroeconomic volatility of the period, the rise of credit scoring, or perhaps other possible factors. However, the 1992 date for the nonrevolving series, and even the 1995 date for the total series, are indicative of the consolidation of commercial banking. As shown in Table 2.1, the number of commercial banks was relatively stable up through the 1990s, but from 1992 to 2002 fell by almost half.

For consumption and its components a change in both the mean growth rate and the volatility appears to have occurred over the course of the 1980s. The break dates in the early 1980s for the mean growth rates of consumption and durables, and the dates found in the late 1980s for the volatility of all three consumption series are consistent with a growing body of research that has noted that *something* has changed in the macroeconomy since approximately the mid-1980s. Though the emphasis is typically on the volatility of the macroeconomy (see McConnell and Perez-Quiros (1999), Stock and Watson (2002), and Ahmed et al (2002)). Interestingly, a break date is not found in the consumption series in the mid-1970s—an approximate date evocative of the much-discussed productivity slowdown. Though for the sub-component, nondurables and services, a break in the mean growth rate is found in1973.

The purpose of this section has been to investigate statistically whether structural breaks in consumer credit and consumption have occurred. The results suggest that the processes underlying the series—processes described with the mean growth rate and volatility of each series—are, in fact, characterized by structural breaks. This appears to be particularly important for consumer credit. Or, structural change appears to be ongoing (or is certainly more recent) in consumer credit. The implications of these results are important. Simply put, any discussion of the relationship between consumer credit—the use of credit cards, to be of a particular concern—and consumption behavior must take note of these changes. Moreover, these breaks indicate one must take care in making predictions or proclamations about consumer behavior. The next step, therefore, is to re-consider consumption smoothing in light of this statistical evidence.

4 Structural Estimation of Consumption

In this section I estimate a structural equation in the spirit of Ludvigson (1999) and Bacchetta and Gerlach (1997). I ask if the predictive power of consumer credit and income growth is different across periods in a structural equation for consumption. This approach is useful for at least a couple of reasons. First, it provides an established method to test the permanent-income hypothesis that allows for easy comparison with previous findings. That is, estimating with an "off the shelf" consumption equation provides a ready comparison and contrast to the previous research on consumption smoothing discussed in Section 2. Second, the equation emphasizes the importance of consumer credit in explaining consumption behavior. Indeed, Ludvigson (1999) and Bacchetta and Gerlach (1997) have found that consumer credit is a significant predictor of consumption growth, providing support not only for the failure of the hypotheses, but also suggesting that credit markets are crucial in the story of that failure. This provides a useful vehicle for discerning the effects of structural and regulatory change in credit markets on the relationship between consumption growth and consumer credit, in particular.

4.1 Single equation estimation

Again, to consider the time-varying relationship between consumer credit and consumption, I estimate an "off the shelf" consumption equation. Specifically, Ludvigson (1999) estimates a structural equation of the form,

$$\Delta c_t = \mu + \lambda E_{t-1}\Delta y_t + \pi E_{t-1} r_t + \alpha E_{t-1}\Delta d_t + \varepsilon_t \ , \tag{3}$$

where y is income, r is the real interest rate, d is credit growth, E is the expectations operator, and ε_t is the error term orthogonal to the other regressors in period $t-1$ and before. Where y is real disposable income, c is real nondurable consumption expenditures plus real consumption service expenditures, and the interest rate is the three month treasury bill rate less the inflation rate defined by the consumer price index.[17, 18] Using a sample of quarterly data over the years 1953 to 1993 for total consumer credit, and 1978 to 1993 for revolving consumer credit, Ludvigson (1999) shows that both series are significant predictors of consumption growth.

4.2 Samples

I estimate the structural equation using monthly data over a series of samples. First, I estimate over the entire sample, January 1959 (1978 for revolving) to September 2005, and then compare a split-sample—January 1959 to December 1983, and January 1984 to September 2005.[19] This sample split is motivated by research on the "Great Moderation" (see McConnell and Perez-Quiros (1999), and others mentioned above).

Second, I estimate over sub-samples dictated by the break results from the previous section. For revolving consumer credit, I compare the samples, January 1978 to December 1983; January 1984 to March 1998; and April 1998 to September 2005. For total consumer credit, I compare the samples, January 1959 to January 1966; February 1966 to September 1995; and October 1995 to September 2005. This allows me to consider how consumption behavior has changed over time with statistical support to the sample divisions (as opposed to estimating over the split sample—which simply provides a general picture of this potential change). Overall, these two steps provide a picture of how consumption behavior may have evolved over time.

[17] Real disposable income (2000 dollars) is made availabe by the Department of commerce.
The real rate is calculated using the Fisher relationship, real = nominal - inflation rate.

[18] Consumer durables are ignored by Hall (1978) and the papers that followed (see references above). This is to avoid computing the "use" value of consumption durables as opposed to the actual purchase. The "first" generation of tests of the permanent income hypothesis calculated consumption as the purchase of nondurables plus the depreciation of the stock of durables (Mayer (1972)). Hall (1978) drops the durable component to "avoid the suspicion that the findings are an artifact of the procedure for imputing a service flow to the stock of durables"(p979). The literature has followed this practice since.

[19] To replicate and compare with the previous research, an earlier version of this paper also estimated using quarterly data (when possible given the sample lengths). However, the monthly estimation proved to be sufficient for comparison, and served my particular need for sample length, so I report only the monthly results here.

4.3 Results

In practice equation (3) is estimated using two-stage least squares, with the period $t-2$ lags and beyond of the variables used as instruments. This strategy is followed for a number of reasons. First, since consumption and the regressors are jointly determined, ordinary least squares is inappropriate and instrumental variable estimation is necessary. Since the period $t-1$ expected values of income growth and the other variables are not observable, it is necessary to find variables to use in their place. The period t variables are inappropriate instruments since under the null that the permanent income hypothesis is true these variables are correlated with the error term. Second, as is typical in previous research on estimation of consumption equations, due to serial correlation associated with time averaged quarterly data, the actual $t-1$ values of the regressors are also inappropriate (this is obviously relevant when quarterly data is used; however, the instrument list proved to be appropriate for the monthly data as well).[20] Therefore, the instrument list includes the $t-2$ through $t-4$ lags of consumption growth, income growth, credit growth credit, and the interest rate.[21] All variables are in expressed in logarithms except for the interest rate, which is in percent.

Tables 4.1 through 4.4 display the results for equation (3). Each table reports the second stage results showing the instrumental variable estimates for each regressor, as well as the first stage F-test and probability value for the regression of income and credit growth regressed on the instrument set. In addition, I report the Sargan statistic for testing the overidentifying restrictions—*i.e.*, that

[20] If the permanent income hypothesis is true, then measured consumption is the time average of a random walk. However, Working (1960) showed that the time average of a continuous-time random walk is uncorrelated with all variables lagged more than one period (Cambell and Mankiw (1989) and Christiano, Eichenbaum and Marshall (1991)).

[21] The $t-2$ value of an error correction term, the ratio of consumption to income, is also included as an instrument. Note that the same instrument set was used for all sub-samples. This decision was made to make the comparison across sub-samples as deviod of researcher interference as possible—that is, to avoid the temptation to data "mine" or adjust the instrument set until the results "came out right." Perhaps more detailed analysis is warranted on the sub-periods analyzed here, *e.g.*, finding if different structural equations are necessary for different periods—but this level of detail I leave to extenstions of this paper. Here the purpose is to assume the received conclusions on consumption estimation and then see how those conclusions may have changed over time. However, despite these qualifications, in only one model out of the 23 reported here is the instrument set statistically questionable (based on the Sargan Test).

the instrument set is appropriate. Each table reports the results for three variants of (3). Model 1 contains only income growth as a regressor; model 2 adds the real interest rate; and model 3 adds credit growth. The latter version is run twice, once for total consumer credit and once for revolving consumer credit.

4.3.1 Consumption and Total Consumer Credit

Table 4.1 displays the results for the consumption equation estimating with total consumer credit. For the entire sample, expected income growth is statistically significant at the five percent level in the first two models (columns 1 and 2) and comes close to statistical significance at the ten percent level in model 3 (column 3). In model 3, however, total consumer credit growth is a significant predictor of consumption growth at the five percent level. Overall, these results are consistent with previous research on consumption behavior—that consumption growth is "excessively sensitive" to income growth and consumer credit (the latter result found more recently by Ludvigson (1999) and Bacchetta and Gerlach (1997)). That the real interest rate is typically not a statistically significant predictor is also consistent with the literature.

However, comparing the pre-"Great Moderation" era with period thereafter reveals a noticeable difference the in consumption data. The early period, from 1962 up through 1983 confirms the conclusions of the full sample estimation, consumption is "excessively sensitive" to income growth and consumer credit. Expected income growth and consumer credit growth are at least statistically significant at the ten percent level. However, the results from 1984 up through September of 2005 tell a different story. The predictive power for consumption is not present in the second half of the sample. In fact, none of the coefficients across the three models are statistically significant. This split-sample comparison suggests that in the latter period the data is consistent with the permanent income hypothesis—that is, consistent with consumption smoothing.

One limit on this split-sample comparison is the perhaps arbitrary split (supported by research on the "Great Moderation" though it may be). Hence, drawing conclusions on consumption smoothing based on this sample comparison may be premature. However, the statistical tests of section 3 provide some guidance on where structural change may have occurred, and hence, provide a more statistically rigorous comparison across samples. Table 4.2 displays the results for samples dictated by the statistical break tests above. For the two samples spanning 1959 through September of 1995, the results are generally consistent with the full sample estimation. Income growth is a significant predictor of consumption at the ten percent level for the majority of the sample period. However, consumer credit is not statistically significant. Moreover, the late sample, 1995 through 2005, shows that the failure of the model to predict consumption behavior—particularly during the years of the "Great Moderation"—appears to be concentrated in the years after the structural break in total consumer credit found in late 1995.[22]

4.3.2 Consumption and Revolving Consumer Credit

In addition to testing the sensitivity of consumption to total consumer credit, I also test the revolving component in the consumption equation.[23] The results show that for most of the sample, like total consumer credit, revolving credit does not predict consumption growth. Table 4.3 displays the results in a similar manner as above, comparing the full sample to a split sample, and to samples based on the structural break results from Section 3. Given the only regressor altered is the consumer credit variable, Table 4.3 only displays the regression results for model 3.[24]

Columns 1 and 2 of Table 4.3 compare the full sample for revolving credit, 1978 to 2005, to the "Great Moderation" sample, 1984 to 2005 (note that as in Section 3, estimation with revolving consumer credit begins in 1978). Estimation over both samples reveals very little explanatory power for both income growth and revolving consumer credit. Given the lack of explanatory power for income growth shown in Table 4.1 for the "Great Moderation" sample, this is not surprising. In

[22] Additional estimation on samples split according to decade (not reported in this version of the paper) reveals that total consumer credit is a significant predictor of consumption in the 1980s, but fails to be so for the 1990s sample.

[23] Ultimately, the information for the nonrevolving component proved to be redundant. For the sake of brevity, I look at only the revolving component.

[24] The results for models 1 and 2 estimated over these different sample periods did not change that much from comparable samples displayed in Tables 4.1 and 4.2. For example, the results for model 2 estimated from 1995 to 2005 were not substantially different than the results for 1998 to 2005, and hence it would have been redundant to display the results.

column 3 of Table 4.3, the coefficient on revolving credit is not statistically significant at the 10 percent level (though not far from it).

Only for the short sample, 1978 through 1983—which is dictated by the structural break results above, but also serves, perhaps not coincidentally, as a brief pre-"Great Moderation" sample—is revolving consumer credit a statistically significant predictor of consumption growth. For the remaining two sub-samples determined by the structural breaks found for revolving consumer credit, 1984 to April of 1998, and April 1998 through September 2005, the model proves inadequate for predicting consumption growth (not only are the coefficients not statistically significant, but the sign of the coefficient on revolving credit runs counter to expectation).

4.4 Remarks

On balance, the results displayed in Tables 4.1 through 4.3 reveal that the predictability of consumption growth is not apparent in the data over the period of time structural and regulatory change evolved in credit markets. While estimation over earlier time periods—in particular, prior to the mid-1980s—supports the much cited conclusion that consumption growth is "excessively sensitive" to both income growth and consumer credit growth, this conclusion breaks down more or less after the mid-1980s. Based on the split-sample estimation, split according to both research consensus on the "Great Moderation," and on the structural break search in Section 3, the data suggests that consumption growth is no longer predicted by either income growth or consumer credit growth. The are no longer statistical failures. Much of the statistical support for liquidity constraints—or any other factor that might prevent consumption smoothing—deteriorates in the era of deregulated credit markets.

5 Conclusion

On balance, the various statistical techniques in this paper reveal that the case for rejecting the Life Cycle-Permanent Income hypotheses is weak once information on the structural and regulatory change in credit markets is applied in testing the hypotheses. First, the statistical break estimation in section 3 showed that structural change has occurred in the processes generating both consumption growth, and in particular, consumer credit growth. These findings support the notion discussed in Section 2 that regulatory and structural change in consumer credit markets has made it easier for consumer to access credit, and are more likely to smooth consumption as a result. Moreover, the estimation of a structural equation for consumption growth similarly supports that hypothesis.

The motivation for this paper is the popular emphasis on liquidity constraints in helping explain the empirical failure of the permanent income hypothesis. Considering so much attention has been paid to constraints in credit markets, the structural and regulatory change in consumer credit markets suggests important implications for consumer behavior. If structural change in consumer credit markets has liberated the consumer, then statistical rejection of the permanent hypothesis should be less likely as consumers become less liquidity constrained. The econometric experiments in this paper support that proposition.

In other words, consumer behavior is able to come closer to the conception of the permanent income hypothesis. As Hall (1978) argues, aggregate demand policy that only has an effect on transitory income will have little to no effect on consumption when households are able to borrow in anticipation of the change in income. The results here suggest consumers are able to do this more in line with Hall's expectation. Though Ludvigson (1999) and others have shown evidence that the data once rejected the predictions of the permanent income hypothesis, in the era of liberalized consumer credit markets, this appears to be no longer the case.

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Table 2.1 Asset Characteristics of Commercial Banks

	Number of Banks	Total Assets	Mean Assets	Median Assets	Fraction of Total Assets
Fourth Quarter 2002	*constant 2000 dollars (millions)*				
All Banks	7,887	6,765,941	858	88	
95th percentile	395	5,722,674	14,488	2,532	0.85
Below 95th percentile	7,492	1,043,267	139	83	0.15
Fourth Quarter 1992	*constant 2000 dollars (millions)*				
All Banks	11,462	4,027,554	351	61	
95th percentile	574	3,016,403	5,255	1,749	0.75
Below 95th percentile	10,888	1,011,151	93	57	0.25
Fourth Quarter 1982	*constant 2000 dollars (millions)*				
All Banks	14,406	3,425,680	238	47	
95th percentile	721	2,511,164	3,483	904	0.73
Below 95th percentile	13,685	914,516	67	44	0.27
Fourth Quarter 1972	*constant 2000 dollars (millions)*				
All Banks	13,728	2,629,548	192	38	
95th percentile	687	1,875,072	2,729	818	0.71
Below 95th percentile	13,041	754,476	58	36	0.29

Notes: Numbers calculated for all FDIC-insured commercial banks. Data obtained from the FDIC. Dollar values are deflated using the GDP Deflator. Fraction of total assets calculated as ratio of total assets for each percentile group to total assets for all banks. *95th percentile* includes all banks at and above the 95th percentile in total assets. *Below 95th percentile* includes all banks below the 95th percentile in total assets.

Table 2.2 Loan Characteristics of Commercial Banks

	Number of Banks	Total Loans	Mortgages	C&I	Consumer	Credit Cards
Fourth Quarter 2002			*constant 2000 dollars (millions)*			
All Banks	7,887	3,978,160	1,147,720	872,156	672,821	300,500
95th percentile	395	3,308,222	857,106	758,614	605,504	292,137
Below 95th percentile	7,492	669,938	290,614	113,542	67,318	8,363
Ratio						
95th percentile		0.83	0.75	0.87	0.90	0.97
Below 95th percentile		0.17	0.25	0.13	0.10	0.03
Fourth Quarter 1992			*constant 2000 dollars (millions)*			
All Banks	11,462	2,334,475	532,467	615,947	442,664	156,132
95th percentile	574	1,784,098	362,838	517,646	344,107	143,077
Below 95th percentile	10,888	550,377	169,629	98,301	98,557	13,055
Ratio						
95th and above		0.76	0.68	0.84	0.78	0.92
Below 95th		0.24	0.32	0.16	0.22	0.08
Fourth Quarter 1982			*constant 2000 dollars (millions)*			
All Banks	14,406	1,597,191	247,955	787,340	310,246	56,513
95th percentile	721	1,130,642	150,606	655,519	194,455	52,681
Below 95th percentile	13,685	466,549	97,349	131,821	115,791	3,832
Ratio						
95th percentile		0.71	0.61	0.83	0.63	0.93
Below 95th percentile		0.29	0.39	0.17	0.37	0.07
Fourth Quarter 1972			*constant 2000 dollars (millions)*			
All Banks	13,728	1,392,471	184,723	429,875	284,921	23,467
95th percentile	687	1,013,123	111,501	342,206	166,377	21,366
Below 95th percentile	13,041	379,348	73,222	87,669	118,543	2,101
Ratio						
95th percentile		0.73	0.60	0.80	0.58	0.91
Below 95th percentile		0.27	0.40	0.20	0.42	0.09

Note: See comments for Table 2.1. Ratio indicates the share of each loan category for each bank class. *95th percentile* includes all banks at and above the 95th percentile in total assets. *Below 95th percentile* includes all banks below the 95th percentile in total assets.

Table 3.1 Structural Break Tests on the Mean Growth Rate of Consumer Credit

A. Total Consumer Credit: January 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =2
1	20.48	11.47	23.61	11.47	February 1966
2	21.95	9.75	7.67	12.95	September 1995
3	16.84	8.36	4.7	14.03	-
4	13.71	7.19	-		
5	11.39	5.85	-		

B. Revolving Consumer Credit: January 1978 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =2
1	44.73	10.98	13.67	10.98	December 1983
2	29.66	8.98	3.77	12.55	April 1998
3	21.096	7.13	-	-	-

C. NonRevolving Consumer Credit: January 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =3
1	21.27	11.47	41.62	11.47	October 1961
2	25.60	9.75	41.62	12.95	August 1976
3	31.03	8.36	8.36	14.03	October 1992
4	26.22	7.19	-	-	-
5	19.02	5.85	-	-	-

Notes: *SupF* statistics estimated using Bai and Perron (1998) methods, with Gauss code made available by Bai and Perron. Critical values from Table 1, Bai and Perron (1998). The estimated break dates are for *m* are chosen for the value that maximizes the *SupF* statistics. The dates are chosen by global optimization (see Bai and Perron (1998)).

Table 3.2 Estimation of model selected by Bai and Peron (1998) Sequential Method

A. Total Consumer Credit January 1959 to September 2005

Regime		*Coefficients*	*Standard Errors*
1959:3 - 1966:01	α	0.508	0.086
	ρ	0.270	0.105
1966:02 - 1995:08	α	0.085	0.024
	ρ	0.705	0.037
1995:09 - 2005:09	α	0.292	0.051
	ρ	0.232	0.090

B. Revolving Consumer Credit January 1978 to September 2005

1978:1 - 1983:11	α	0.158	0.092
	ρ	0.694	0.092
1984:1 - 1998:4	α	0.594	0.0817
	ρ	0.339	0.073
1998:5 - 2005:9	α	0.209	0.058
	ρ	0.045	0.088

C. NonRevolving Consumer Credit January 1959 to September 2005

1959:3 - 1961:10	α	0.508	0.086
	ρ	0.270	0.105
1961:10 - 1976:7	α	0.093	0.074
	ρ	0.120	0.086
1976:8 - 1992:10	α	0.020	0.033
	ρ	0.734	0.050
1993:11 - 2005:9	α	0.361	0.051
	ρ	0.185	0.080

Notes: Table shows coefficients of AR(1) model across sub-samples chosen by Bai and Perron's (1998) sequential method.

Table 3.3 Chow Stability Tests

Series	Dates	*F-Test*	*Probability Value*
Total Consumer Credit	February 1966	9.86	0.000
	September 1995	8.52	0.000
Revolving Consumer Credit	December 1983	3.54	0.029
	April 1998	12.33	0.000
Nonrevolving Consumer Credit	October 1961	1.31	0.272
	August 1976	5.02	0.006
	October 1992	4.32	0.013
Consumption	January 1984	7.54	0.000
Durables	April 1982	12.59	0.000
Nondurables and Services	December 1973	6.14	0.002

Notes: The Chow test is for each series modeled as an AR(1). The dates chosen correspond to the structural break estimates in Tables 3.1 and 3.4.

Table 3.4 Structural Break Tests on the Mean Growth Rate of Consumption

A. Consumption: March 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	16.81	11.47	4.77	11.47	January 1984
2	10.97	9.75	5.39	12.95	
3	8.07	8.36	6.84	14.03	
4	7.89	7.19	0.75	14.85	
5	6.54	5.85	-	-	

B. Durables: March 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	25.67	11.47	6.52	11.47	April 1982
2	15.98	9.75	3.001	12.95	
3	10.89	8.36	1.39	14.03	
4	8.002	7.19	1.31	14.85	
5	6.801	5.85	-	-	

C. Nondurables and Services: March 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	14.28	11.47	4.9	11.47	December 1973
2	8.98	9.75	8.59	12.95	
3	8.98	8.36	5.43	14.03	
4	8.05	7.19	0.26	14.85	
5	6.45	5.85	-	-	

Notes: *See* comments to Table 3.1.

Table 3.5 Estimation of model selected by Bai and Peron (1998) Sequential Method

A. Consumption Expenditures: March 1959 to September 2005

Regime		*Coefficients*	*Standard Errors*
1959:03 - 1983:12	α	0.320	0.038
	ρ	-0.053	0.058
1984:01 - 2005:09	α	0.380	0.035
	ρ	-0.380	0.058

B. Durables Expenditures: March 1959 to September 2005

Regime		*Coefficients*	*Standard Errors*
1959:03 - 1982:04	α	0.330	0.173
	ρ	0.078	0.062
1982:05 - 2005:09	α	0.706	0.17
	ρ	-0.330	0.054

C. Nondurables and Services: March 1959 to September 2005

Regime		*Coefficients*	*Standard Errors*
1959:03 - 1973:12	α	0.430	0.035
	ρ	-0.240	0.067
1974:01 - 2005:09	α	0.310	0.021
	ρ	-0.260	0.051

Notes: *See* notes to Table 3.2.

Table 3.6 Structural Break Tests on the Volatility of Consumer Credit

A. Total Consumer Credit January 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	13.9	11.47	12.09	11.47	January 1966
2	12.98	9.75	11.83	9.75	-
3	12.57	8.36	3.9	8.36	-
4	17.7	7.19	-	-	-
5	13.81	5.85	-	-	-

B. Revolving Consumer Credit January 1978 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	49.8	10.98	9.64	10.98	April 1998
2	29.2	8.98	4.87	12.55	
3	17.85	7.13	-	-	-

C. NonRevolving Consumer Credit January 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =3
1	9.47	11.47	6.59	11.47	-
2	5.52	9.75	14.49	12.95	-
3	8.41	8.36	5.91	14.03	-
4	7.34	7.19	-	-	-
5	8.76	5.85	-	-	-

Notes: *SupF* statistics estimated using Bai and Perron (1998) methods, with Gauss code made available by Bai and Perron. Critical values from Table 1, Bai and Perron (1998). The volatility is captured by the absolute value of the growth rate of each series.

Table 3.7 Estimation of model selected by Bai and Peron (1998) Sequential Method: Volatility

A. Total Consumer Credit January 1959 to September 2005

Regime		*Coefficients*	*Standard Errors*
1959:3 - 1965:12	α	0.562	0.086
	ρ	0.232	0.106
1966:01 - 2005:09	α	0.282	0.025
	ρ	0.432	0.041

B. Revolving Consumer Credit January 1978 to September 2005

1978:1 - 1998:4	α	0.519	0.065
	ρ	0.431	0.060
1998:5 - 2005:9	α	0.380	0.049
	ρ	0.100	0.076

Notes: Table shows coefficients of AR(1) model across sub-samples chosen by Bai and Perron's (1998) sequential method. The volatility is captured by the absolute value of the growth rate of each series. No breaks in the volatility of nonrevolving consumer credit were found.

Table 3.8 Chow Stability Tests: Volatility

Series	Dates	*F-Test*	*Probability Value*
Total Consumer Credit	January 1966	6.06	0.002
Revolving Consumer Credit	April 1998	10.5	0.000
Nonrevolving Consumer Credit	--	--	--
Consumption	Februrary 1987	10.09	0.000
Durables	December 1984	7.31	0.000
Nondurables and Services	October 1988	13.50	0.000

Notes: The Chow test is for each series modeled as an AR(1). The dates chosen correspond to the structural break estimates in Tables 3.6 and 3.9.

Table 3.9 Structural Break Tests on the Volatility of Consumption

A. Consumption: March 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	28.0483	11.47	8.16	11.47	Februrary 1987
2	17.9739	9.75	7.86	12.95	
3	13.7876	8.36	7.86	14.03	
4	13.3064	7.19	-	-	
5	10.6066	5.85	-	-	

B. Durables: March 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	15.7357	11.47	4.99	11.47	December 1984
2	9.0046	9.75	4.65	12.95	
3	7.8939	8.36	4.36	14.03	
4	7.0506	7.19	-	-	
5	9.8198	5.85	-	-	

C. Nondurables and Services: March 1959 to September 2005

Number of Breaks *m*	*SupF(m|0)*	5% Critical Value	*SupF(m+1|m)*	5% Critical Value	Estimated Break Dates for model with *m* =1
1	32.876	11.47	4.5099	11.47	October 1988
2	17.614	9.75	4.5099	12.95	
3	16.875	8.36	4.1804	14.03	
4	11.8163	7.19	1.381	14.85	
5	9.6829	5.85	-	-	

Notes: *See* comments to Table 3.1. The volatility is captured by the absolute value of the growth rate of each series.

Table 3.10 Estimation of model selected by Bai and Peron (1998) Sequential Method: Volatility

A. Consumption Expenditures: March 1959 to September 2005

Regime		*Coefficients*	*Standard Errors*
1959:03 - 1987:02	α	0.561	0.035
	ρ	0.116	0.049
1987:03 - 2005:09	α	0.390	0.041
	ρ	0.009	0.080

B. Durables Expenditures: March 1959 to September 2005

1959:03 - 1984:12	α	1.871	0.170
	ρ	0.130	0.061
1985:01 - 2005:09	α	1.262	0.167
	ρ	0.445	0.052

C. Nondurables and Services: March 1959 to September 2005

1959:03 - 1988:10	α	0.465	0.024
	ρ	-0.013	0.048
1988:11 - 2005:09	α	0.327	0.031
	ρ	-0.091	0.086

Notes: *See* notes to Table 3.7.

Table 4.1 Instrumental Variables Estimation of Monthly Consumption Growth: Before and During the "Great Moderation"

Total Consumer Credit									
	1959.02 to 2005.09 (*n=556*)			**1962.04 to 1983:12 (*n=261*)**			**1984.01 to 2005:09 (*n=261*)**		
Income growth	0.21	0.19	0.12	0.322	0.318	0.261	0.075	0.092	0.078
	(2.33)*	(2.25)*	(1.62)	(2.55)*	(2.43)*	(1.84)**	(0.75)	(1.02)	(0.94)
Interest Rate	-	-0.003	-0.006	-	0.001	-0.0005	-	0.0002	-0.0019
		(-0.43)	(-0.86)		(0.07)	(-0.04)	-	(0.02)	(-0.17)
Credit Growth	-	-	0.064	-	-	0.08	-	-	0.02
	-	-	(1.99)*	-	-	(1.89)**	-	-	(0.45)
First Stage Results									
F-test (Income)	3.19	2.31	1.96	3.19	2.29	1.85	2.15	1.86	1.61
p-value	0.00	0.01	0.02	0.00	0.01	0.14	0.04	0.05	0.08
F-test (Credit)	-	-	37.49	-	-	22.02	-	-	15.54
p-value	-	-	0.00	-	-	0.00	-	-	0.00
Test of Restrictions	11.27	12.76	*20.54*	8.26	10.65	16.81	8.54	9.36	9.69

Notes: Results displayed for instrumental variables estimation of consumption growth on the regressors income growth, the interest rate and credit growth. T-statistics are in parentheses, calculated with standard errors corrected for heteroskedasticity and serial correlation. The *indicates statistical significance at the 5 percent level and **indicates statistical significance at the 10 percent level.

The instrument set includes lags two through four of each regressor (when appropriate for each specification), lags two through four of consumption growth, and an error correction term, the lag two log difference of consumption and income. All variables expect for the interest rate are expressed in seasonally adjusted 2000 dollars, and transformed into logarithms. The first stage results report the F-statistic and associated probability value of a regression of income growth and credit growth regressed on the instruments, respectively. The last row reports the Sargan statistic for testing overidentifying restrictions (distributed as chi-square in the number of restrictions). The *italics* in this row indicate that the null hypothesis is rejected at the 5 percent level. This is only the case for column three; in all other cases the test fails to reject the hull hypothesis.

Table 4.2 Instrumental Variables Estimation of Monthly Consumption Growth: Sub-Samples across 1959 to 2005

Total Consumer Credit									
	1959.01 to 1966.01 (*n=80*)			**1966.02 to 1995:09 (*n=355*)**			**1995.10 to 2005:09 (*n=121*)**		
Income growth	0.331	0.232	0.620	0.247	0.205	0.192	-0.015	-0.044	-0.045
	(1.12)	(0.57)	(1.88)**	(2.09)*	(1.91)**	(1.77)**	(-0.12)	(-0.35)	(-0.36)
Interest Rate	-	0.03	-0.05	-	-0.01	-0.01	-	0.002	0.02
		(0.29)	(-0.55)		(-0.61)	(-0.76)	-	(0.18)	(0.89)
Credit Growth	-	-	0.15	-	-	0.05	-	-	-0.19
	-	-	(0.742)	-	-	(1.40)	-	-	(-0.98)
First Stage Results									
F-test (Income)	0.38	0.43	0.43	2.27	1.71	1.43	0.92	0.97	0.95
p-value	0.91	0.93	0.95	0.03	0.08	0.14	0.49	0.47	0.50
F-test (Credit)	-	-	3.51	-	-	28.68	-	-	1.96
p-value	-	-	0.00	-	-	0.00	-	-	0.03
Test of Restrictions	4.19	4.39	11.08	10.73	13.54	16.45	1.09	1.62	2.41

Notes: See comments to Table 4.1.

Table 4.3 Instrumental Variables Estimation of Monthly Consumption Growth from 1978 to 2005: Before and During the "Great Moderation"

Revolving Consumer Credit	**1978.01 to 2005.09 (*Full Sample*)**			**1984.01 to 2005:09 (*n=261*)**	**1978.01 to 1983.11 (*n=71*)** ***See also Table 4.4***
Income growth	0.094	0.071	0.032	0.085	0.155
	(0.94)	(0.78)	(0.34)	(1.03)	(0.89)
Interest Rate	-	-0.006	-0.015	-0.003	-0.010
	-	(-0.62)	(-1.59)	(-0.12)	(-0.55)
Credit Growth	-	-	0.085	-0.001	0.146
	-	-	(1.61)	(-0.01)	(1.87)**
First Stage Results					
F-test (Income)	1.91	1.71	1.52	1.63	1.67
p-value	0.07	0.08	0.11	0.08	0.09
F-test (Credit)	-	-	8.67	9.06	1.44
p-value	-	-	0.00	0.00	0.17
Test of Restrictions	11.27	12.83	11.57	10.52	11.40

Notes: See comments to Table 4.1.

Table 4.4 Instrumental Variables Estimation of Monthly Consumption Growth: Sub-Samples across 1978 to 2005

B. Revolving Consumer Credit			
	1978.01 to 1983.11 (*n=71*)	**1983.12 to 1998:03 (*n=172*)**	**1998.04 to 2005:09 (*n=90*)**
Income growth	0.155	0.125	0.003
	(0.89)	(1.14)	(0.03)
Interest Rate	-0.010	0.011	0.015
	(-0.55)	(0.44)	(0.51)
Credit Growth	0.146	-0.003	-0.074
	(1.87)**	(-0.03)	(-0.40)
First Stage Results			
F-test (Income)	1.67	1.25	0.85
p-value	0.09	0.25	0.60
F-test (Credit)	1.44	5.03	1.35
p-value	0.17	0.00	0.20
Test of Restrictions	11.40	13.28	3.07

Notes: See comments to Table 4.1.