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# Abstract

This paper examines the relationship between aggregate consumer spending and credit availability in the United States. The author finds that consumer spending falls (rises) in response to a reduction (increase) in credit availability. Moreover, she provides a formal assessment of the possibility that credit availability is particularly important for consumer spending when it undergoes large changes. In this respect, she estimates a consumption function in which only large expansions and contractions in credit affect spending. She concludes that large changes in credit availability are particularly important for consumers' spending decisions. As should be expected, these periods tend to be associated with periods of high economic uncertainty. These results show that credit availability should be taken into account when modeling and forecasting consumer spending.



*JEL classification: E21, E27, E44, E51, E58*
*Bank classification: Credit and credit aggregates; Domestic demand and components; Recent economic and financial developments*



# Résumé

L'étude porte sur la relation entre les dépenses de consommation globales et la disponibilité du crédit aux États-Unis. L'auteure constate que les dépenses de consommation diminuent (augmentent) lorsque la disponibilité du crédit décroît (s'accroît). En outre, elle analyse de façon formelle la possibilité que la disponibilité du crédit, lorsque celle-ci varie fortement, soit particulièrement importante pour les dépenses de consommation. À cet égard, elle estime une fonction de consommation dans laquelle seuls les mouvements prononcés d'expansion ou de contraction du crédit agissent sur les dépenses. Elle conclut que les variations marquées de la disponibilité du crédit ont une importance particulière pour les décisions de dépense des consommateurs. Comme il était à prévoir, de telles variations sont généralement associées aux périodes de grande incertitude économique. Ces résultats montrent que la disponibilité du crédit devrait être prise en compte dans la modélisation des dépenses de consommation et l'établissement des prévisions connexes.



*Classification JEL : E21, E27, E44, E51, E58*
*Classification de la Banque : Crédit et agrégats du crédit; Demande intérieure et composantes; Évolution économique et financière récente*

## 1 Introduction

The global economy is facing the worst economic and financial crisis since the Great Depression. In response to weak macroeconomic fundamentals, concerns about counterparty risk, credit risk, and the value of assets underlying financial derivatives, as well as sharp declines in liquidity in key financial markets, interest rate spreads for virtually all risk-bearing asset classes increased substantially in late 2008. Also, banks started to restrict access to credit for consumers and businesses. This tightening of financial conditions has restrained aggregate demand and economic activity across the globe. Consumer spending in particular has suffered as households have not been able to gain access to credit in order to finance their expenditures. In response to the global financial turmoil and economic weakness, central banks have taken unprecedented actions in their conduct of monetary policy. Most notably in the United States, where the financial crisis began, the Federal Reserve has reduced the federal funds rate to zero and has made credit available to institutions and markets in which it had not previously intervened. Similar actions have also been undertaken by other central banks, including the European Central Bank, the Bank of England, and the Bank of Japan.

The fact that central banks did not only rely on "traditional" monetary policy actions – that is, lowering monetary policy rates – but also took "unconventional" credit easing measures suggests a belief that the behaviour of aggregate demand is affected by the cost and availability of credit. Specifically, the efforts to un-freeze credit markets suggest that central banks believe that the credit conditions facing households, whose spending accounts for the largest share of aggregate demand, have important effects on economic activity. This view is not necessarily at odds with the life cycle hypothesis (the building block of a large share of the theoretical research on consumer spending), provided that consumers spending patterns can be constrained in the short term if access to credit is suddenly restricted.

Various studies have linked credit constraints to consumer behaviour, but the most common approach is to proxy credit constraints by macroeconomic variables such as the unemployment rate and consumer and mortgage credit growth (e.g. Bachetta and Gerlach 1997 and Ludvigson 1999). We argue that these measures may not be ideal proxies for the credit constraints that consumers face. Essentially, macroeconomic aggregates proxy a combination of the demand for credit by consumers and bank's ability to supply credit within a given economic situation. Consider, however, a situation in which banks suffer substantial losses due to foreign exposures (for instance U.S. banks' losses during the Latin American debt crisis). In response to balance sheet constraints, banks might restrict availability to credit not in *response* to an anticipated macroeconomic slowdown, but *prompting* a fall in credit availability.

To better assess the relationship between credit constraints and consumer spending, this paper measures credit constraints using credit availability, as reported by banks. More specifically, we use the net per cent of lenders indicating a tightening of loan standards for consumer instalment loans in the Federal Reserve's Senior Loan Officer Survey (SLOS). This credit availability measure is a concept closely related to credit supply and is relatively independent of the factors underlying credit demand. Using this measure, this paper examines the relationship between aggregate consumer spending and credit constraints. Past research has not established a clear relationship between consumer spending and shifts in credit supply. For policymakers, confirming this relationship is particularly important. Indeed, the pullback in credit growth in the current financial crisis seems to have originated mainly as a supply shock as banks began tightening their lending activities in efforts to shore up their balance sheets after suffering large losses on their subprime mortgage portfolios. In response, policymakers have engaged in alternative policies including credit easing, but there is little empirical evidence to suggest that these actions will succeed in stimulating consumer spending as no clear empirical relationship between credit supply and consumer spending has been established in the literature.

The results in this paper establish a relationship between credit availability and consumer spending. In particular, a 10 percentage point reduction in credit availability is shown to be associated with a 0.4 percentage point reduction in the growth rate of consumer spending. This relationship suggests that, to the extent that policy may influence the credit constraints facing households, that central banks may be able to undertake credit easing policies geared towards affecting credit supply and successfully affect the path of consumer spending. Moreover, a key contribution of this study is to provide a formal assessment of the possibility that credit constraints are particularly important for consumer spending when they reach a certain threshold. In this respect, we estimate a consumption function in which only large expansions and contractions in credit affect spending. We conclude that credit constraints are particularly important for consumer spending when the changes in credit availability are large. When greater than 19 per cent of lenders are tightening loan standards, a further 10 percentage point decrease in credit availability is shown to lead to a 0.6 percentage point fall in the growth rate of consumer spending. Moreover, the response of consumption growth to credit availability is even higher in periods of high economic uncertainty, with a 10 percentage point decrease in credit availability associated with a 1.3 percentage point fall in consumption growth. Finally, our results suggest that including credit availability in consumption functions can significantly improve their forecasting power.

The remainder of this paper is organized as follows. Section 2 reviews the theory of consumer behaviour and the role credit conditions play in consumption decisions. Section 3 reviews the relevant empirical literature. Section 4 introduces the data used in the analysis

with a particular focus on the measure of credit availability analyzed. Section 5 presents the empirical framework, while Section 6 summarizes the estimation and forecasting results. Finally, Section 7 concludes.

## 2 Theory

This section provides a brief overview of the theory of consumer behaviour under the permanent income hypothesis and discusses the role of credit constraints in consumer spending. The permanent income hypothesis postulates that households consume in order to maximize their lifetime utility function subject only to their lifetime budget constraint (Friedman 1957). Therefore, consumers' expenditures depend on their permanent income ($Y_{Pt}$), which is the present value of their wealth:

$$Y_{Pt} = A_t + E_t\left[\sum_{i=0}^{\infty} \beta^i Y_{Lt+i}\right] \quad (1)$$

where $A_t$ is the real value of an individual's nonhuman wealth at the beginning of period $t$, $\beta$ is the discount factor, $Y_{Lt}$ is real disposable labor income, and $E_t$ is the expectations operator conditional on information available to the individual at time $t$.

Under rational expectations, Hall (1978) shows that consumption can be approximated by a random walk. In practice, several studies have found that the rational expectations permanent income hypothesis does not hold empirically (e.g. Campbell and Mankiw 1989, 1990, 1991, Deaton 1992, Attanasio and Weber 1993, Flavin 1981). These studies find that consumption is partially explained by current disposable income. Notably, Campbell and Mankiw (1990) estimate:

$$\Delta C_t = \alpha + \beta E_{t-1} \Delta Y_t + \varepsilon_t \quad (2)$$

and conclude that the permanent income hypothesis holds for a portion of the population who they deem as "life cycle consumers" who consume their permanent income, and does not hold for another fraction of the population, the "rule of thumb" consumers who consume their current income. The share of "rule of thumb" consumers in the population, or the excess sensitivity of consumption ($C_t$) to income ($Y_t$) is captured by the coefficient on disposable income ($\beta$) in Equation 2 which Campbell and Mankiw (1990) estimate to be around 0.5.

The most commonly cited explanation for the empirical failure of the permanent income hypothesis is the presence of binding liquidity or credit constraints.[1] Importantly, the permanent income hypothesis assumes that capital markets are perfect and, as such, households can borrow or lend as much as they desire at a constant interest rate. In actuality, however some consumers may be unable to borrow and lend at the same interest rate or to borrow the desired quantity. As a consequence, they may be unable to smooth their spending and consumption may be determined by current rather than permanent income.

If the liquidity constraint hypothesis holds, then aggregate consumption should be sensitive to credit conditions as well as to income. Ludvigson (1999) provides a theoretical framework for thinking about the relationship between credit constraints and consumer spending. She proposes a model of consumer spending where consumers' access to credit varies stochastically with income and is subject to economy-wide variation in the credit ceiling.[2] In this framework, there are two channels through which variation in the credit limit affects consumption. First, variation in the credit ceiling affects consumption through its influence on current resources. Second, even when consumers are currently unconstrained, the current credit ceiling can still affect current consumption because it influences the likelihood of being constrained tomorrow. Empirically, Ludvigson (1999) shows that her model can be estimated by incorporating credit into equation 2. She puts forward the following specification of equation 2:

$$\Delta C_t = a + \beta E_{t-1} \Delta X_t + \varepsilon_t \qquad (3)$$

Where $X_t$ is a column vector including disposable income as well as credit market indicators.[3]

### 3 Literature Review

As rejections of the permanent income hypothesis are often attributed to liquidity constraints, several studies have empirically examined the link between liquidity constraints and consumer spending (e.g. Flavin 1985, Jappelli and Pagano 1989, Vaidyanathan 1993, Wilcox 1989).[4] The results from these studies suggest that the observed excess sensitivity of

[1] Campbell and Mankiw (1990) for example, justify the existence of rule of thumb consumers as a reflection of credit market imperfections. Credit constrained consumers, particularly when desired consumption is greater than their current income, are often forced to consume their current income.
[2] Economy-wide variation in the credit ceiling is introduced by allowing for aggregate shocks to the ceiling that are independent of income. This is consistent with empirical evidence from Ludvigson (1998) that economy-wide variation exists in the supply of consumer credit.
[3] In similar research, Bachetta and Gerlach (1997) also suggest incorporating credit into the analysis with a version of Equation 2. However, while Ludvigson (1999) proposes a theoretical model to motivate equation 2, Bachetta and Gerlach (1997) do not.
[4] Although not examined here, there is also a large body of literature that examines the relationship between credit constraints and consumer spending using micro data. Gross and Souleles (2002) for example, use a unique set of credit card accounts to analyze consumers' responses to increases in credit supply. Contrary to the permanent income

consumption to disposable income can be explained, to some extent, by credit constraints which prevent some consumers from borrowing against their expected lifetime income. Among the variables that have been used as proxies for credit constraints by these studies are: the rate of unemployment (Flavin 1985; Wilcox 1989), the total consumer credit to consumption ratio (Japelli and Pagano 1989; Vaidyanathan 1993), the ratio of current disposable income to previous consumption (Muellbauer 1983), and nominal interest rates (Wilcox 1989). As Madsen and McAleer (2000) rightly point out though, there is no guarantee that these proxies are adequate approximations of credit constraints. Indeed, they may be detecting movements other than credit constraints. For example, the unemployment rate may instead capture consumers' assessment of uncertainty surrounding expected future income or movements in consumers' lifetime income.

More recent studies have tried to capture the role of credit constraints in consumer spending by including variables that capture price and/or quantity restrictions on credit in consumption functions. Price restrictions on credit are generally captured by the wedge between interest rates applied to lenders and to borrowers, which represents the premium charged to borrowers. This premium fluctuates over time, rising as credit conditions tighten and falling during credit expansions. Empirically, Bachetta and Gerlach (1997) have shown that consumer spending is significantly negatively related to this borrowing/lending wedge.

In addition to restricting credit by raising loan rates, lenders may also decrease the supply of credit available by tightening standards. Empirically, quantity restrictions on credit are generally captured with credit growth. Credit growth for both consumer and mortgage credit has been shown to play an important role in consumer spending (e.g. Bachetta and Gerlach 1997; Ludvigson 1999; Smith and Song 2005). Furthermore, the presence of credit in the consumption function has been shown to reduce the estimated sensitivity of consumption to income, suggesting that the perfect capital market assumption of the permanent income hypothesis may be a key reason behind why it does not hold empirically.

Despite the perceived importance of credit growth for consumer spending, it may not be an ideal proxy for household's credit constraints. Although the correlation between credit growth and consumer spending may arise from shifts in the availability of credit that relaxes credit constraints, it may also arise from changes in expectations of future income that affect consumption and therefore the demand for credit. Slow credit growth, for example, may signify either that borrowers are unwilling to assume additional debt, or, alternatively that lenders are unwilling to extend additional credit to borrowers. Therefore, to accurately assess the role of credit constraints in consumer spending it is important to distinguish between

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hypothesis, they concluded that increases in credit limits generate an immediate and significant rise in consumer debt. See also Zeldes(1989), Runkle(1991), and Filer and Fisher (2007) among others.

credit growth due to borrowing by households in advance of expected income increases or shifts in credit availability.

To better distinguish between the role of credit demand and supply factors in consumer spending, Madsen and McAleer (2000) include, in a consumption function, results from the Reuters/University of Michigan Surveys of Consumers. Specifically, they utilize the survey responses on buying conditions in the auto sector to proxy for overall credit conditions facing households.[5] They conclude that when credit constraints are accommodated in a consumption function, consumption is not sensitive to current income, but that the significance of their credit constraint variable is sensitive to the model's specification.

We build on Madsen and McAleer's (2000) approach by also augmenting a consumption function with a measure of credit availability. In contrast, however, our credit availability measure provides a gauge of the tightness of credit conditions facing households across all spending decisions, instead of one that is reflective only of credit conditions in the automotive sector. In particular, we focus on the concept of credit availability as observed through the willingness of lenders to provide funds at market interest rates. This measure captures movements in credit availability related to non-interest fees, maturity of credit extended, maximum credit size, loan covenants, credit score requirements, and collateralization requirements (Swiston 2008). In fact, Lown, Morgan and Rohatgi (2000) find that changes in lending standards provide information that cannot be inferred from other measures of credit availability including loan rates, loan growth, or the mix of bank loans and other sources of credit. Moreover, these lending standards reported by banks are closely related to credit supply and can be seen as relatively independent of the factors underlying credit demand.

Although the information content of credit availability has not been investigated in detail in the literature on consumer spending, other studies have used this measure to capture the effect of movements in credit supply on the overall economy and on other components of demand. For example, Lown and Morgan (2006) use vector autoregressions to study the effect of credit availability on bank loans and output. They find that credit availability is significant in explaining variation in business loans and output. Moreover, they find a statistically significant negative relationship between credit availability and some categories of inventory investment in structural equations of inventory investment. Bayoumi and Melander (2008) also consider this variable in their analysis of macro-financial linkages in the United States. They estimate the effects of a negative shock to banks' capital to asset ratios on credit availability which in turn affect consumer, mortgage, and corporate loans and

[5] In particular, they proxy the degree to which consumers find themselves credit constrained by multiplying the percentage of consumers who believe it is a bad time to buy a car with the percentage of consumers that believe it is a bad time to buy a car because interest rates are high and credit is tight.

the corresponding components of private spending. They conclude that an exogenous 1 percentage point fall in the bank capital to asset ratio, through its effects on credit availability, reduces the level of real GDP by about 1.5 per cent.

## 4 Data

Credit availability is captured by responses to the Federal Reserve's Senior Loan Officer Survey (SLOS) which began asking banks about the supply and demand for credit in 1966.[6] The survey asks loan officers at major banking institutions whether their standards for approving credit have tightened or eased since the prior quarter. The questions have changed somewhat over time however; we are able to obtain a unique series from 1966 forward by combining two series. Prior to 1996, the data available indicates the net per cent of domestic banks more willing to make consumer instalment loans, while after 1996, the data indicates the net percentage of domestic banks reporting a tightening of loan standards for consumer loans. Therefore, for the sample period 1966Q3 to 1996Q1 we use one minus the net per cent of domestic banks more willing to make instalment loans and combine it with the post 1996 series to obtain one unique series. See Appendix 1 for more detail on the series construction.

Credit standards may be linked to consumer spending for two key reasons. First, to the extent that standards accurately capture movements in credit availability, a tightening of standards should result in a decline in spending by those consumers that depend on banks for credit. Second, tighter credit standards may also provide a signal about other disturbances that cause the economy to slow. For example, lenders may proactively tighten standards in response to a deterioration in credit quality. Both explanations suggest that lending standards should be negatively correlated with consumer spending.

As expected, consumer spending slows during periods in which bankers tighten credit standards (Figure 1).[7] This relationship is particularly evident during recessions where consumer spending tends to moderate, or in some cases decline, alongside a contraction in credit availability. In the current cycle in particular, consumer spending fell by the largest amount in the post-War period as lending standards increased sharply. Overall, the contemporaneous correlation between lending standards and consumer spending is fairly high at negative 0.44. This suggests that by omitting credit constraints from models of consumer spending, we may be omitting a key factor driving consumer behaviour. For those who are interested in forecasting developments in the economy, this suggests that forecasts

[6] For a complete overview of the history of the survey, see Loan, Morgan and Rohatgi (2000).
[7] In order to highlight the correlation between the two series, we have inverted the lending standards series in Figure 1.

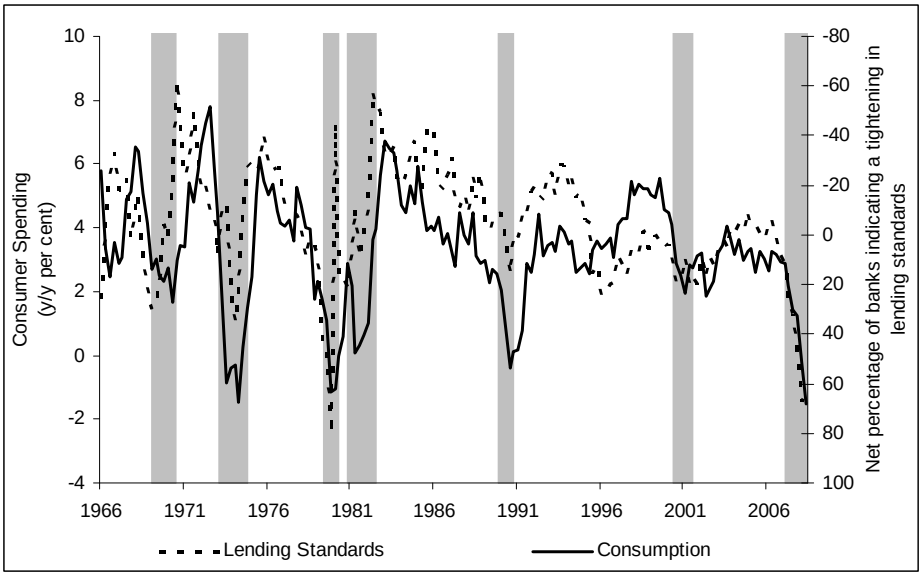
of consumer spending can be improved by including credit availability in consumption models.

As mentioned previously, credit availability should better capture the effect of credit constraints on consumer spending than growth in consumer credit because it captures factors affecting the supply of credit, while credit growth may capture factors affecting both the supply and demand for credit. Although a major consideration for banks when deciding whether to extend or restrict credit is the perceived ability of the borrower to repay (based on for example, their expected future income), which would also affect credit demand, Figure 1 provides some reassurance that the credit availability series mainly captures credit supply shocks. For example, it is well known that 1969 was characterized by a negative credit supply shock when regulators coerced banks into imposing severe non-price rationing in order to directly restrict bank lending, this negative credit supply shock is clearly captured by a decrease in credit availability over that period. Moreover, two important financial innovations over the 1980s 1) the development of a market for mortgage-backed securities, and 2) the development of a market for high-risk (junk) bonds expanded the supply of credit significantly. This credit supply shock is captured in Figure 1 by the continual expansion of credit availability over the 1980s. Finally, the current financial crisis has been associated with a negative supply shock as the pullback in credit availability seems to have originated mainly as a result of banks tightening their lending activities in efforts to shore up their balance sheets after suffering large losses on their subprime mortgage portfolios. As suspected, growth in consumer spending is less highly correlated with consumer credit than with credit availability (Figure 2). The contemporaneous correlation between consumer credit and consumer spending is 0.16. Moreover, consumer spending appears to lead consumer credit rather than the inverse.

While the correlation between consumer spending and consumer credit growth is quite weak, it is higher between spending and mortgage credit at 0.51. This suggests that empirically, there may be some support for the hypothesis that mortgage credit can significantly affect consumer spending (see Figure 3). This is likely related to the tax deductibility of mortgage interest in the United States, which makes mortgage credit a popular way to finance consumer spending. Previous studies (e.g. Bachetta and Gerlach 2007) have indeed found that movements in mortgage credit have a significant effect on U.S. consumption.[8]

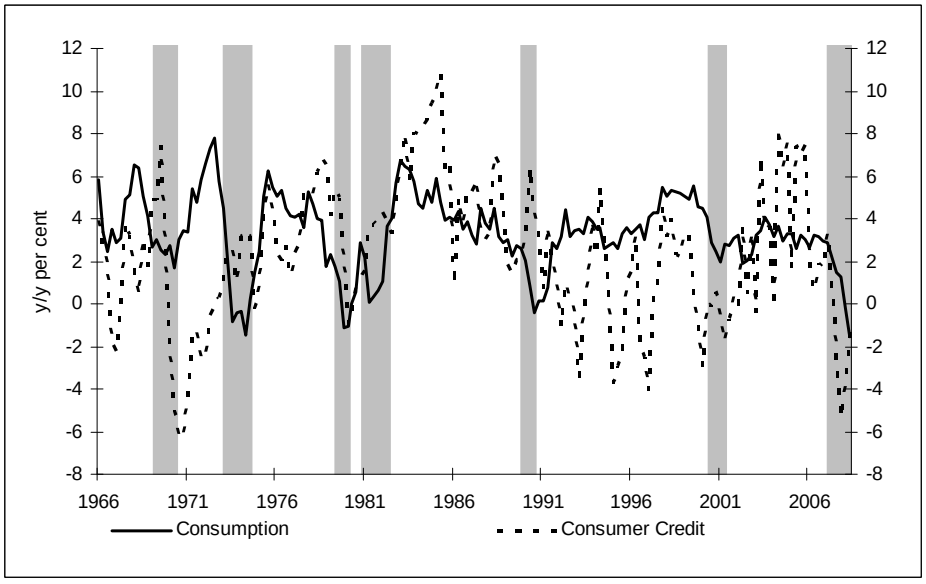
[8] Note that the stock of mortgage credit was about 260 times larger than the stock of consumer credit at the end of 2008.

Figure 1: Credit Availability and Consumer Spending




Note: Shaded periods depict NBER recessions.

Figure 2: Consumer Spending and Consumer Credit




The SLOS credit availability measure can also be compared to the measure of credit constraints for automotive purchases utilized in Madsen and McAleer (2000) (Figure 4). Although the two credit measures seem to move together over time, the correlation between them is actually quite weak at 0.16. Given that the SLOS measure represents the total amount of credit tightening faced by consumers rather than credit constraints on automotive purchases, we prefer the SLOS measure.

Figure 3: Consumer Spending and Mortgage Credit

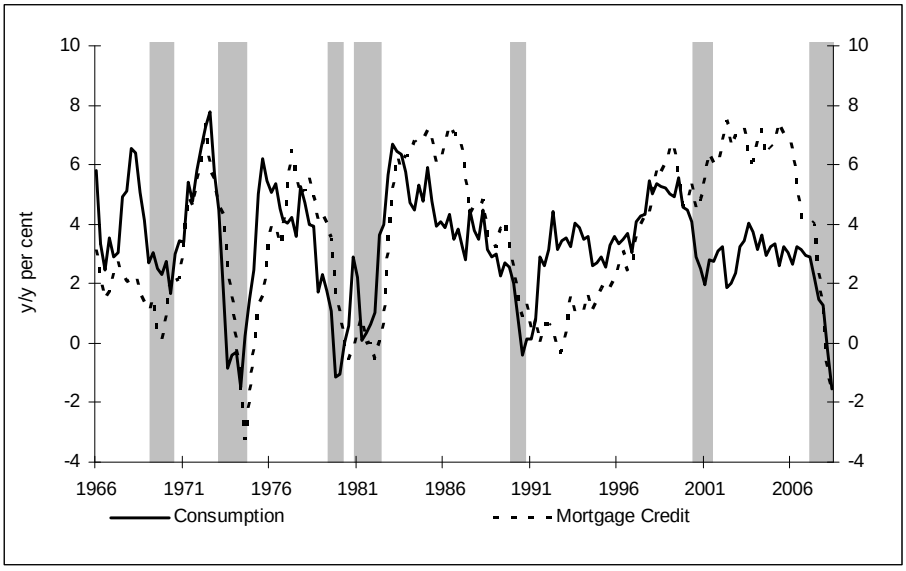
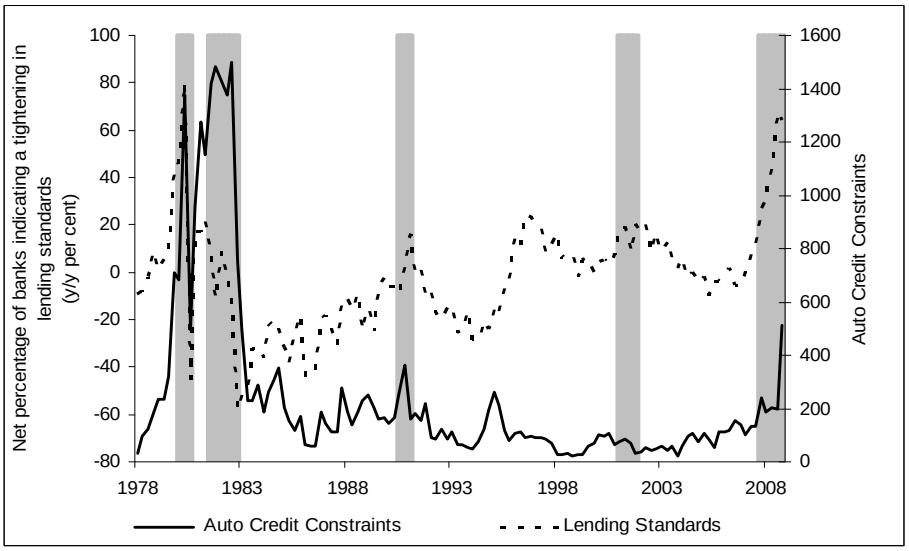
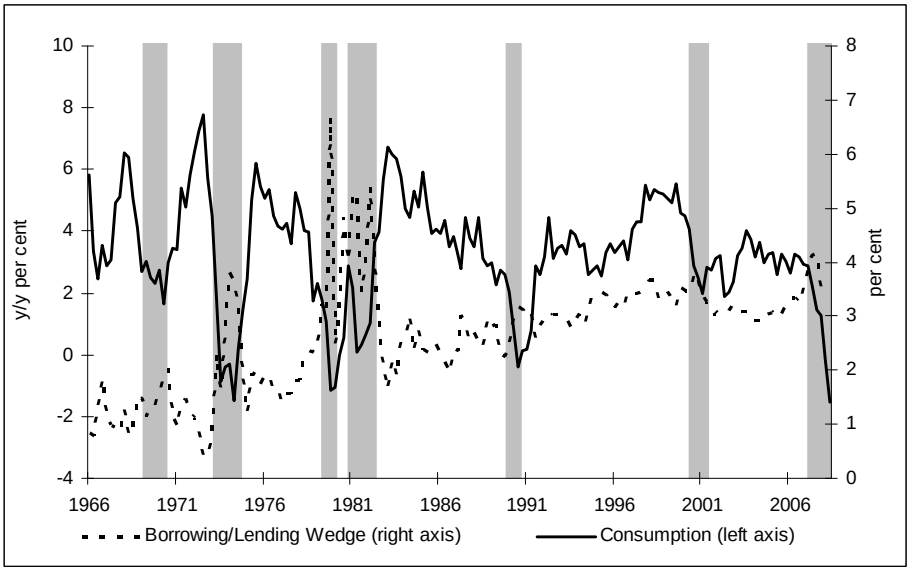



Figure 4: Credit Availability and Auto Credit Constraints




Of course, price restrictions on credit may also affect consumer spending. Therefore, we also examine the role of the wedge between interest rates applied to lenders and to borrowers (the borrowing/lending wedge). As seen in Figure 5, increases in the borrowing/lending wedge do appear to be highly negatively correlated with movements in consumer spending (contemporaneous correlation: 0.42).

Figure 5: Consumer Spending and the Borrowing/Lending Wedge




## 5 Empirical Framework

In our examination of the relationship between consumer spending and the tightness of credit conditions, we follow Bacchetta and Gerlach (1997) and test two simple implications of the hypothesis of liquidity constrained consumers. First, we test whether the tightness of credit conditions can help predict changes in consumption. We argue that even if a consumers' financial position is unchanged, reduced access to credit can lead to a drop in consumption as it restricts the consumers' ability to smooth consumption. Second, we test whether the excess sensitivity of consumption to income falls when credit constraints are included in the consumption function. We postulate that the non-zero weight on disposable income may reflect the omission of factors such as credit constraints that prevent consumers from optimally allocating their intertemporal consumption and therefore from conforming to the permanent income hypothesis. Finally, we further build on previous work by examining whether only large changes in credit availability affect consumer spending using a threshold model.

Before turning to the importance of credit constraints, we introduce our benchmark model. We estimate a benchmark consumption function in the spirit of Equation 3. All estimation is over the period 1966:IV-2008:III. Given that we are interested in not only deviations from the permanent income hypothesis but also the forecasting power of our consumption function, we estimate an error correction specification of Equation 3. This framework allows for richer dynamics in consumption behaviour in that it can capture differences in behaviour in the short and long-run.

Based on the deviations of consumer spending from the permanent income hypothesis, the benchmark consumption function models consumer spending using the permanent income hypothesis in the long-run and allows for deviations from the permanent income hypothesis along the dynamic path.[9] Our consumption function contains a long-run anchor determined by a cointegrating vector between the level of consumption, income, and net worth (all in real per capita terms), and the real federal funds rate.[10] We then allow for deviations from the permanent income hypothesis in the short-run by allowing other variables to affect consumption within the business cycle. Over the course of the business cycle, we allow stock prices, unemployment, real oil prices, and the variables included in the cointegrating vector to affect the path of consumer spending. The dynamic consumption function is given by:

$$\Delta C_t = \alpha + \pi \Delta L^j (C_t) + \sum_{i=1}^{n} \beta_i \Delta L^j \left( X_{it} \right) + \gamma \left[ C_{t-1} - \psi_1 Y_{t-1} - \psi_2 W_{t-1} - \psi_3 \, R_{t-1} \right] + \varepsilon_t \qquad j = 0,...,m \tag{4}$$

where $C_t$ is aggregate consumer spending, $Y_t$ *i*s disposable income, $W_t$ is households' net worth, $R_t$ is the real federal funds rate, and $X_{it}$ is a vector containing the *n* short-run dynamic variables.[11] The general-to-specific method is used to determine the variables and their lag lengths included in the final specification.

We then augment the dynamic consumption function (4) to include a role for credit availability. We thus estimate (4) allowing credit availability to affect the path of consumer spending over the business cycle and measure the improvement to the in and out-of-sample performance of the model.

Next, we postulate that credit availability matters for consumer spending only when it reaches a particular threshold. In this context, we estimate a threshold model in which only large changes in credit availability can affect consumption. If our hypothesis holds, then the explanatory and forecasting power of the model should be maintained by including only large changes in credit availability. Moreover, if the in and out-of-sample properties of our model (4) are improved by including only large changes in credit availability, we can conclude that only large variations in credit availability affect consumption.

We estimate a threshold that conditions the inclusion of credit availability in the consumption function. Credit availability enters the regression at time *t* only if its absolute value exceeds the estimated threshold. The threshold, $\theta$, is estimated from the following equality:

[9] Our approach is closely related to that followed by Desroches and Gosselin (2004).
[10] We include the federal funds rate as we consider aggregate consumption rather than the consumption of non-durables and services. Its inclusion follows Gosselin and Lalonde (2003) and reflects the importance of the cost of capital for durables consumption. Moreover, its inclusion allows for a transmission channel of monetary policy.
[11] Consumption, disposable income, and households' net worth are expressed in real, per capita terms.

$$CA_{tr} = \begin{cases} CA & if \ |CA| \geq \theta \\ 0 & otherwise \end{cases} \quad (5)$$

We obtain the threshold value by completing a grid search that minimizes the sum of squared errors of Equation 4 augmented with the threshold variable, $CA_{tr}$. The estimated threshold indicates at which level of credit availability its inclusion in the consumption function improves the model's fit.

Given that we allow short-run dynamic variables as well as credit availability at time *t* to affect consumption in time *t*, our consumption function (4) may suffer from simultaneity problems. All versions of the dynamic consumption path are thus estimated using instrumental variables (IV).

## 6 Results

In this section, we provide empirical evidence on the relationship between aggregate consumer spending and credit constraints. In doing so, we also test the hypothesis that the omission of credit constraints is a key factor contributing to the empirical breakdown of the permanent income hypothesis.

### 6.1 Benchmark Model

To estimate the benchmark model we first estimate the long-run relationship between the level of consumption, income, net worth, and the real federal funds rate. We test for cointegration using the Johansen-Juselius (1990) approach as well as a modified ADF test (Dickey and Fuller 1979) on the residuals of the estimated long-run relationship. Results from both approaches indicate cointegration at the 5% significance level (Table 1). The cointegrating vector was then estimated using Stock and Watson's (1988) method. The results indicate that the sum of the coefficients on households' net worth and disposable income is not statistically different than one, suggesting that consumption conforms to the permanent income hypothesis in the long-run. The final specification of our benchmark consumption function was then obtained using the general-to-specific approach.[12,13] Appendix 1 provides further detail on all data used in estimation.

[12] Among other variables included in the short-run dynamics, the unemployment rate, the real interest rates, and real oil prices were insignificant and did not improve the model fit.
[13] Prior to estimating our benchmark consumption function, we verified that the time series used in the model are nonstationary in level and stationary in first differences using ADF tests. This is done to ensure that the levels of variables included in the cointegrating relationship are I(1) and to verify that the first differences of variables used in both the ECM and dynamic models are I(0).The results of the ADF tests are not reported, however, all variables

The benchmark consumption function performs well in explaining variation in consumer spending, with the explanatory variables explaining about 61 per cent of the movements in consumer spending over the sample period (Table 2).[14] Importantly, the error-correction term depicts a negative coefficient, indicating that consumption conforms to the permanent income hypothesis in the long-run. The remainder of the short-run coefficients are also statistically significant with the expected signs. Most notably, in line with previous literature (e.g. Campbell and Mankiw 1990), consumption displays excess sensitivity to current income. The coefficient on disposable income suggests that about 34 per cent of consumers are rule of thumb consumers, which is a substantial departure from the permanent income hypothesis. Thus, despite the fact that consumer spending appears to be well approximated by the permanent income hypothesis in the long-run; it deviates from it in the short-run.

Table 1: Cointegration Tests (1966:IV-2008:III)

| | Unit Root Tests[b] | | Johansen Test[c] |
|---|---|---|---|
| Long-Run Parameter Estimates[a] | ADF | Lags | λ-Trace |
| -0.5056 - 0.4090(Interest rate)$_t$ + 0.8994(Income)$_t$ +0.1530(Wealth)$_t$ | -5.03 | 1 | 63.55 |
| ( 33.63) (-7.54) (43.24) (11.43) | | | Ho: r=1 |

a) The figures in parentheses are t-statistics.
b) the ADF statistic tests the null hypothesis of no cointegration (Ho: unit root in the residuals). Critical values for the 1, 5 and 10% levels are -4.3, -3.99, and -3.74 (Hamilton 1994). The optimal lag length for the ADF regression is given by the Bayesian information criteria.
c) The critical values for the 5% level is 47.71 for r=1 (where *r* is the number of cointegrating vectors).

### 6.2 Augmented Model Results

The short-run deviations from the permanent income hypothesis may be caused by credit constraints; therefore, we augment our benchmark model with credit variables. In order to facilitate comparison with the literature, we first examine the explanatory power of credit variables analyzed by previous studies in the consumption function. We include the borrowing/lending wedge as a measure of price restrictions on credit, and growth in consumer and mortgage credit as measures of quantity restrictions on credit. Results for the borrowing/lending wedge are seen in column 2 of Table 2, while results for consumer and mortgage credit are seen in columns 3 and 4 of Table 2.[15]

In contrast to past studies (e.g. Bacchetta and Gerlach 1997, Ludvigson 1999), we find that neither the borrowing/lending wedge nor growth in consumer or mortgage credit are significant determinants of consumer spending.[16,17] Our results also differ from previous

included in cointegrating relationships, with the exception of the real federal funds rate, were found to be I(1) and all variables included in the ECM and dynamic models were found to be I(0).
[14] The benchmark model results do not change materially with small changes in the sample period.
[15] We allowed for up to four lags of each of these variables in our dynamic consumption equation. As there were no significant lags, we report only results for the contemporaneous values of the credit variables to facilitate comparison with the literature.
[16] Sensitivity analysis suggests that the difference in our results is not related to differences in the sample period.
[17] The difference in results may also be related to the fact that these studies use consumption of non-durables and services as their measure of consumer spending while we examine aggregate consumption. However, given that our measure of consumer spending includes spending on durables goods, we would expect it to be more, not less, sensitive

studies in another important respect, the addition of the credit variables to the consumption function increases, rather than decreases, the coefficient on disposable income, suggesting that either the observed excess sensitivity of consumption to income is not accounted for by credit constraints, or that these variables do not accurately capture the credit constraints affecting consumers.[18]

Given these results, we build on previous studies by evaluating the explanatory power of credit availability for consumer spending. First, we augment our benchmark model with credit availability and measure the improvement to the goodness of fit and forecasts relative to our benchmark model. Second, we estimate the threshold model as in (5) and complete the same model comparison relative to both the benchmark and augmented models of consumer spending.

As a first step, we include credit availability in the consumption function.[19] Credit availability enters the regression in level as lending standards are implicitly expressed as a change, measuring the proportion of banks either tightening or easing lending standards. Unit root tests confirmed that the variable is stationary in level.[20] Column 5 of table 2 provides the results of the estimation.

The results confirm that credit availability is an important determinant of consumer spending (Table 2). As expected, there is a statistically significant negative relationship between credit availability and consumer spending with a 10 percentage point reduction in credit availability typically associated with a 0.4 percentage point decline in the growth rate of consumer spending. This finding provides some validation for the view that the financial system is an important source of and propagation mechanism of cyclical fluctuations.[21,22]

Unexpectedly, the coefficient on disposable income remains relatively constant when lending standards are included in the model and is not statistically different than in the benchmark model. These results imply therefore, that although credit constraints are an important determinant of consumer spending, they alone can not explain the observed excess sensitivity of consumption to current income.[23]

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to credit than a measure of consumer spending that excludes this component. Results of sensitivity analysis confirmed that these results hold if we consider instead consumption of non-durables and services as is common in the literature.

[18] These findings were confirmed using the Campbell-Mankiw framework augmented by Ludvigson (1999) to include credit variables outlined in Section 2.

[19] We allowed for up to four lags of this variable in our consumption function. Our preferred specification is shown in Table 2.

[20] Results are not reported, but are available from the author.

[21] Results from adding the unemployment rate, which may capture credit demand, into the equation augmented with credit availability suggest that the unemployment rate is insignificant.

[22] These findings were confirmed using the Campbell-Mankiw-Ludvigson framework.

[23] It may also be the case that the coefficient on disposable income depends on credit constraints.

In-sample performance of the augmented consumption model relative to the benchmark model is assessed by comparing the $R^2$s, while out-of-sample performance is examined by comparing the RMSE from one-step-ahead out-of-sample forecasts over the last ten years of the sample period (1998:IV-2008III). The results suggest that incorporating credit constraints into models of consumer spending can improve in-sample explanatory power, although the improvement is relatively small. Indeed, the addition of credit availability into the model increases the $R^2$ by about 1.5 percentage points relative to the benchmark model.

Table 2: Error-Correction Model Results (1966:IV-2008:III)[24]

| | Benchmark | Wedge | Consumer Credit | Mortgage Credit | Credit Availability | Threshold | GARCH(1,1) |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| $ec_{t-1}$ | -0.2543*** | -0.2612*** | -0.2608*** | -0.2676*** | -0.2243*** | -0.2087*** | -0.2189*** |
| | (-5.19) | (-5.63) | (-5.24) | (-5.62) | (-4.72) | (-4.22) | (-4.59) |
| $Consumption_{t-2}$ | 0.1886*** | 0.1892*** | 0.1942*** | 0.1874*** | 0.1690** | 0.1607** | 0.1657** |
| | (2.87) | (2.85) | (2.84) | (2.67) | (2.42) | (2.27) | (2.34) |
| $Consumption_{t-3}$ | 0.1727** | 0.1618** | 0.1750** | 0.1491* | 0.1385* | 0.1481* | 0.1550** |
| | (2.15) | (2.09) | (2.14) | (1.79) | (1.77) | (1.92) | (2.00) |
| Stock $Market_{t-1}$ | 0.0157* | 0.0149* | 0.0152* | 0.0139 | 0.0126 | 0.0128 | 0.0104 |
| | (1.82) | (1.78) | (1.73) | (1.61) | (1.50) | (1.48) | (1.30) |
| $Income_t$ | 0.3420** | 0.3732*** | 0.3742*** | 0.3993*** | 0.3497*** | 0.3104** | 0.3000** |
| | (2.39) | (2.77) | (2.57) | (2.99) | (2.71) | (2.30) | (2.19) |
| $Wedge_t$ | | -0.0063 | | | | | |
| | | (-0.13) | | | | | |
| Consumer $Credit_t$ | | | -0.0430 | | | | |
| | | | (-1.02) | | | | |
| Mortgage $Credit_t$ | | | | 0.0124 | | | |
| | | | | (0.21) | | | |
| Credit $Availability_t$ | | | | | -0.0044* | -0.0064* | -0.0128** |
| | | | | | (-1.77) | (-1.95) | (-2.10) |
| $R^2$ | 0.614 | 0.611 | 0.604 | 0.607 | 0.629 | 0.649 | 0.657 |
| LM ARCH(4) | 0.972 | 0.935 | 0.980 | 0.868 | 0.968 | 0.940 | 0.986 |
| Jarque-Bera | 0.001 | 0.014 | 0.001 | 0.051 | 0.031 | 0.009 | 0.001 |
| Breusch-Godfrey | 0.433 | 0.021 | 0.172 | 0.004 | 0.085 | 0.240 | 0.010 |
| White heteroskedasticity | 0.000 | 0.000 | 0.002 | 0.016 | 0.034 | 0.012 | 0.083 |

Note: The instruments are lags one to four of changes in the error-correction term, consumption, disposable income, the stock market, mortgage credit, consumer credit, the wedge, and credit availability depending on the variables included in the regression. t-statistics are reported in parentheses. Significance at the 1, 5, and 10 per cent levels is represented by ***, **, and *, respectively.

The improvement in the model's out-of-sample forecast performance is more apparent than the in-sample improvement (Table 3). The RMSEs shown in parentheses are expressed relative to the benchmark model's RMSE and suggest that the inclusion of credit availability in the consumption model increases its out-of-sample forecast performance by about five per cent relative to the benchmark model.[25] Excluding credit availability in consumption models may thus result in an over-prediction of consumer spending when credit availability is tightening and an under-prediction of consumer spending when credit availability is becoming more accommodative. This omission is likely to be particularly important in periods of extreme volatility of financial conditions; therefore, we also examine whether the large

[24] The parameter estimates and significance of the credit variables are robust to different instrument lists.
[25] This difference is not statistically significant according to results from a Diebold-Mariano test.

changes in the credit constraints facing households are particularly important for their consumption decisions using the threshold specification in equation 5.

Table 3: Out-of-Sample Forecast Performance (1998:IV-2008III)

| | |
|---|---|
| Random Walk | 0.00617 (1.41070) |
| Benchmark Model | 0.00438 (1.00000) |
| Augmented Model | 0.00417 (0.95233) |
| Threshold Model | 0.00405 (0.92596) |
| GARCH(1,1) | 0.00381 (0.87065) |

Note: Numbers in parentheses represent relative RMSEs (i.e divided by the benchmark consumption model's RMSE). Out-of-sample performance estimation period is 1966:IV-1998:III, forecasting period is 1998:IV-2008:III.

### 6.3 Threshold Model

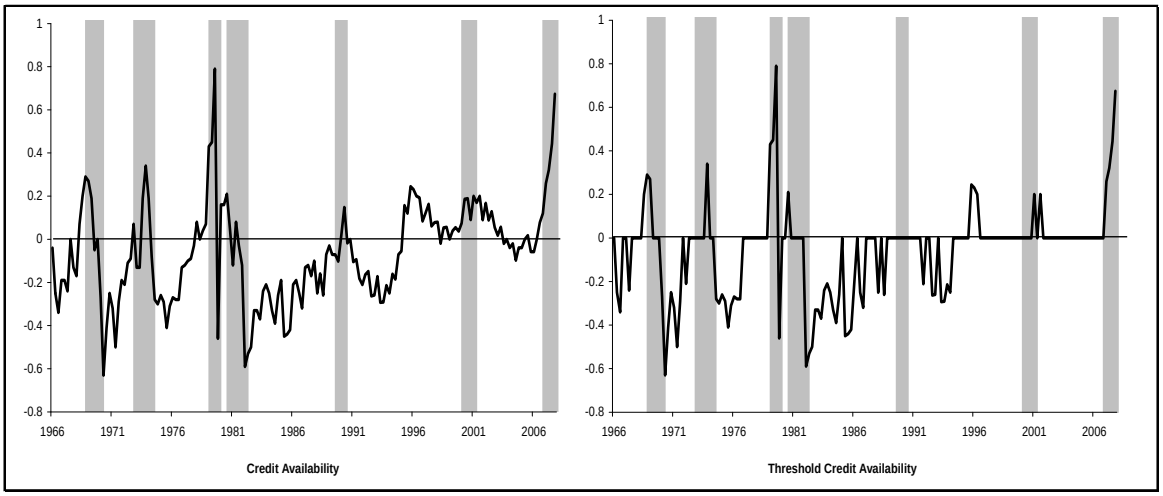
In the threshold consumption model the level of credit availability affects consumption only when its absolute value exceeds the estimated threshold. In this context, we postulate that the explanatory value of credit standards for consumer spending is from when credit constraints are binding. If this hypothesis holds, replacing credit availability with the transformed credit availability series, $CA_{tr}$, in the consumption model should result in an improvement to the model's in- and out-of-sample performance. To obtain the threshold and $CA_{tr}$, equations 4 and 5 are estimated simultaneously, yielding a threshold value of 0.1931.[26] This result implies that credit availability affects consumer spending only when greater than 19.3 per cent of lenders are tightening or easing lending standards.

Before turning to the results of the estimation, it is useful to compare the credit availability series with $CA_{tr}$. In Figure 6, the graph on the left depicts the credit availability series entering the augmented model, while the graph on the right shows the credit availability measure entering the threshold model. Cyclical deviations in credit availability appear to be an important driver of business cycles with the threshold model suggesting that a tightening of lending standards was a useful indicator for explaining the moderation of consumer spending in six of the last seven recessions. Likewise, the threshold model suggests that post recession expansions in lending activity were useful in explaining rebounds in consumer spending during most economic recoveries. Notably, the "Great Moderation" in macroeconomic volatility since the mid-1980s also appears to be reflected in credit availability. Since the decline in volatility began, the threshold variable suggests that credit availability played a small role in consumer behaviour until the current financial crisis in which it has contributed to the largest drop in consumer spending observed in the post-War period.

[26] Our results are not sensitive to small changes in θ or to a change in the sample period for the estimation of the threshold. We also define a smoother criterion for the determination of the threshold. In this specification, the threshold is conditioned on the average absolute level of the credit availability variable over the current and previous quarter. The estimated threshold under this criterion is marginally different at 0.1561 and does not have a material effect on the results from the estimation of the consumption function.

The threshold model results (Table 2) suggest that the importance of credit availability for consumer spending increases when there are large changes in credit availability. The coefficient on the credit standards variable in the threshold model suggests that a further 10 percentage point reduction in credit availability when greater than 19 per cent of lenders are restricting credit access is associated with a 0.6 percentage point decline in the growth rate of consumer spending (Table 2).[27] Although the coefficient on disposable income falls relative to the benchmark model it is not statistically different than in the benchmark model. Therefore, it remains unlikely that credit constraints are the only contributor to the observed excess sensitivity of consumption to current income.

Figure 6: Credit Availability




Note: Shaded periods depict NBER recessions.

The in-sample performance of the threshold model compares favourably to that of both the benchmark and augmented models. The increment to the $R^2$ is about 3.5 and 2 percentage points relative to the benchmark and augmented consumption models, respectively. Thus we conclude that small fluctuations in the availability of credit do not have a large effect on the credit constraints facing households and are thus relatively unimportant when making consumption decisions. On the other hand, large fluctuations in credit availability can severely restrict the ability of consumers to smooth their consumption. Moreover, these results suggest that the severe tightening of credit availability throughout the financial crisis of 2007-2009 contributed to the sharp drop-off in consumer spending.

In terms of out-of-sample forecast performance, we also observe an improvement relative to the benchmark and augmented models (Table 3). The RMSE decreases by about seven per cent relative to the benchmark model and about three per cent compared to the augmented

[27] The difference is not statistically significant however.

model. Moreover, the difference between the loss functions associated with the forecasting errors of the threshold model relative to the benchmark and augmented models are found to be statistically significant using a Diebold-Mariano test.

### 6.4 Alternative Threshold Models

The results above confirm that large changes in credit availability are particularly important for the spending decisions made by consumers; however, credit availability may also be particularly important for spending decisions when there is a high degree of uncertainty surrounding the tightness of credit constraints. This hypothesis is examined in an alternative threshold model in which the criterion depends on the variance of credit availability:

$$CA_{tr} = \begin{cases} CA & if\ \sigma(CA_t) \geq \theta \\ 0 & otherwise \end{cases} \qquad (6)$$

where σ is an estimate of the volatility of credit availability given by the conditional variance of a GARCH(1,1) model. Figure 7 shows the maximum-likelihood estimates of $\theta$ from the GARCH(1,1) model.[28]

As seen in Figure 7, the estimated threshold, $\theta$, at 0.12 captures periods of high volatility in credit availability. Moreover, periods of high volatility in credit availability often coincide with recessions. In Figure 7, points above the horizontal line (the threshold) depict values where σ meets the criterion, indicating where credit availability is useful in explaining consumption. This can perhaps be better observed in Figure 8, which graphs the transformed credit availability series from the GARCH(1,1) threshold model.

In Figure 8, it can be seen that the estimated threshold suggests that credit availability matters for consumption only in relatively extreme periods where the volatility of credit availability is elevated. Compared to the original threshold model (5) credit availability enters into the consumption function fewer times. On the other hand, the periods of high volatility suggested by model 6 do correspond with the periods of tight/loose credit conditions estimated by model 5. These results suggest that it may not only be the level of credit availability that matters for consumer spending, but also the uncertainty surrounding the availability of credit.

[28] Results using an estimate of the volatility of credit availability given by the conditional variance of an ARCH(1) model were also examined. The results were very similar to the GARCH(1,1) model. Upon request, results are available from the author.

Figure 7: Conditional Variance Estimates

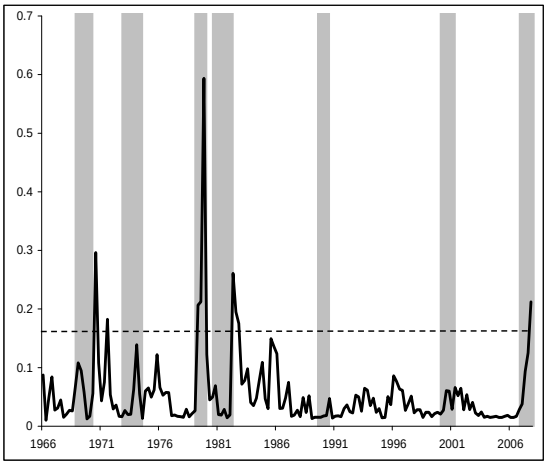
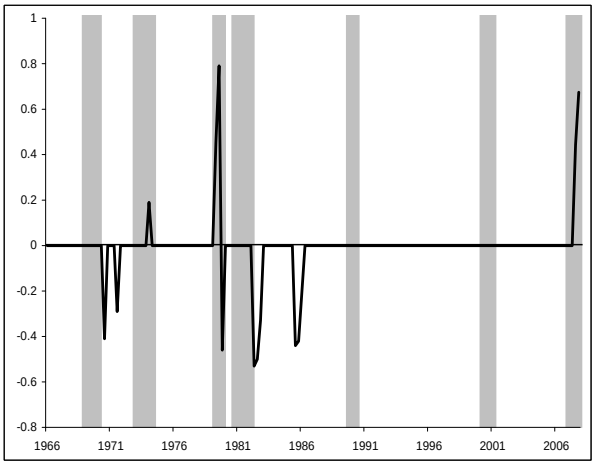



Figure 8: Credit Availability




The inclusion of $CA_{tr}$ from Equation 6 with GARCH (1,1) conditional volatility in Equation 4 improves the in-sample model fit vis-à-vis the benchmark model as well as the model augmented with credit availability and a threshold in the level of credit availability (Table 2). Moreover, the coefficient on $CA_{tr}$ suggests that a 10 percentage point reduction in credit availability during periods of extreme economic volatility is typically associated with a 1.3 percentage point reduction in the growth rate of consumer spending in contrast to the 0.4 percentage point reduction suggested by the augmented model.[29] Out-of-sample performance can also be compared. As seen in Table 3, the forecasts from the GARCH(1,1) threshold model have a lower RMSE than from the benchmark, augmented and level threshold models. The RMSE of the GARCH (1,1) forecasts is about 13, 7, and 4 per cent lower than from the benchmark, augmented and level threshold models, respectively. Using the Diebold-Mariano test, we find a statistically significant difference between the loss functions associated with the forecasting errors of the GARCH(1,1) model vis-à-vis the benchmark model and augmented models; however, we do not find a statistically significant difference between the loss function associated with the GARCH(1,1) model compared to the level threshold model.

**7 Conclusion**

Credit constraints have emerged as a key factor linking the financial crisis of 2007-2009 to real economic activity and subsequently to the worst U.S. recession since the Great Depression. The spill-over from financial conditions to real economic activity appears to have been particularly predominant in the consumer sector as a severe tightening of consumer credit conditions over the financial crisis has been associated with a sharp drop-off in consumer spending. This observation is however, at odds with the theory of consumer

[29] This difference is not statistically significant.

behaviour under the permanent income hypothesis which dictates that consumers' expenditures depend only on the value of their permanent income.

Previous research has shown that the permanent income hypothesis does not hold empirically. In particular, several researchers have found that consumer spending displays excess sensitivity to current income (e.g. Campbell and Mankiw 1990). We build on previous research and show that consumer spending also displays excess sensitivity to credit constraints, notably credit availability as measured by the net percentage of lenders indicating a tightening of loan standards for consumer spending in the Federal Reserve's Senior Loan Officer Survey. Moreover, we show that large changes in credit availability are particularly important for consumer spending. Lastly, the results suggest that the forecast performance of consumption models can be improved by including data on credit availability. These findings suggest that the omission of borrowing constraints in the permanent income hypothesis is an important factor behind its empirical violation. Nevertheless, borrowing constraints alone cannot account for the empirical deviation of consumer spending from the permanent income hypothesis as consumption continues to display excess sensitivity to current income even when we include a role for borrowing constraints.

For policymakers, our results have important implications. Although the permanent income hypothesis suggests that policy can affect consumer spending only through its effect on permanent income (Hall 1978), our results suggest that this view is incorrect. In particular, to the extent that policy may influence the credit constraints facing households, it may have another mechanism to affect consumer spending. This finding supports the extraordinary steps that policymakers across the globe have taken in the current cycle to influence the cost and availability of credit to stimulate domestic demand. Most notably, the Federal Reserve has made credit available to institutions and markets in which it had never previously intervened in the belief that it could achieve its dual mandate to promote maximum sustainable employment and stable prices over time by influencing financial conditions through the cost and availability of credit as well as through its traditional asset price channel. The success of these policies, as evidenced by the decline in borrowing spreads and increase in credit access since their implementation, combined with our conclusion that consumers respond significantly to changes in the borrowing constraints that they face when making consumption decisions suggest that these policies may help to stimulate domestic demand.

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Appendix 1: Sources and Definitions of Variables

- Consumption: Change in the log of real consumption (U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts) per capita (U.S. Department of Labor, Bureau of Labor Statistics Household Data).
- Real Dispobsable Income: Change in the log of real disposable personal income (U.S. Department of Commerce, Bureau of Economic Analysis, Personal Income & Outlays) per capita.
- Change in the log of net worth per capita (Balance Sheets for the U.S. Economy, Flow of Funds data (C.9)), divided by the GDP deflator (U.S. Department of Commerce, Bureau of Economic Analysis, National Income and Product Accounts).
- Real federal funds rate – Federal funds rate (Federal Reserve Board) deflated by core PCE.
- Credit Availability: Lending standards for consumer spending – Prior to 1996Q1 - One minus the share of domestic banks more willing to make consumer instalment loans (Federal Reserve Board, Senior Loan Officer Survey on Bank Lending Practices). Post 1996Q1 - Change in the net percentage of respondents indicating tightening loan standards for consumer credit (Federal Reserve Board, Senior Loan Officer Survey on Bank Lending Practices).

- Standard & Poors 500 Composite Index (Standard & Poor's Corporation).
- Consumer Credit: Credit market debt outstanding owed by private domestic non-financial sectors (Federal Reserve Board, Flow of Funds) deflated by the GDP deflator.
- Mortgage Credit: Mortgage credit market debt outstanding owed by private domestic non-financial sectors (Federal Reserve Board, Flow of Funds) deflated by the GDP deflator.
- Borrowing/Lending Wedge: Prime rate charged by banks (Conference Board) minus the 3-month Treasury Bill Rate (Federal Reserve Board).