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Investigating the US consumer credit determinants using linear and non-linear cointegration techniques[☆],[☆☆]

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ABSTRACT

This paper has investigated the determinants of total consumer credit for the USA over the period 1968:Q1 to 2011:Q3. Using Breitung's (2001) non-parametric rank tests, we find the existence of linear cointegrating relationships in the consumer credit models. Enders and Siklos' (2001) threshold adjustment tests revealed that non-linearity is present slightly (with a statistical significance of 10% level) in the consumer credit model with a short-term interest rate (federal funds rate), while there exists a linear and symmetric cointegrating relationship in the models with medium (3 years) and long (10 years) term interest rates. Application of the linear cointegrating techniques (fully modified OLS, canonical cointegrating regression and general to specific) show that consumer credit responds more significantly to the medium and long-term interest rates than the short-term interest rate. We use these results to assess the popular belief that abnormality in the consumer credit set the stage for the 2007–08 crisis and severe recession.

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1. Introduction

Research on the US consumer credit determinants and in particular evidence that credit is influenced by federal funds rate is very trivial. The monetary policy to have desirable impacts on consumer borrowing, the relationship between consumer credit and federal funds rate is expected to be statistically significant. It is well known that the Federal Reserve Bank (Fed henceforth) cannot control inflation or stimulate output and employment directly; instead, it affects them indirectly, primarily by altering the federal funds rate. This often in the first instance induces investment and consumption spending and then output and employment. In this process, consumer credit does play an important role. Furthermore, investigating the consumer credit demand allows us to assess the popular belief that American consumers 'over-borrowed' during the 1990s and 2000s and that this behavior set the stage for the crisis and severe recession that followed, beginning in 2007–08. To this end, there might be unstable or lack of a well-defined cointegrating relationship for demand for consumer credit.

A number of studies that have modeled consumer credit and examined its determinants for the USA or other countries, made use of the linear cointegration techniques (Hartropp, 1992; Calza et al., 2001, 2003; De Nederlandsche Bank, 2000; Hofmann, 2001; Schadler et al., 2004). There is a risk that theoretical foundations and policy insights that have been formulated based on these studies may be flawed, if indeed, the true cointegration relationship of consumer credit is non-linear. In this paper we explore the total consumer credit — defined as the sum of revolving and non-revolving credit — for the USA considering the demand-side factors viz., real disposable income, real wealth and real interest rates (federal funds rate, 3-year constant maturity rate and 10-year constant maturity rate). Our specification and approach are consistent with the Life Cycle Hypothesis (LCH) of Modigliani and Brumberg (1955). The long-run relationships between consumer credit, income, wealth and interest rates are investigated using alternative specifications and different techniques. In particular, classical linear cointegrating techniques (canonical cointegrating regression, general to specific and fully modified ordinary least squares), Breitung's (2001) non-parametric rank tests, and Enders and Siklos (2001) threshold equilibrium adjustment are applied.

The contribution of this paper is as follows. We examine the consumer credit relationships using two non-linear cointegration techniques (Breitung, 2001; Enders and Siklos, 2001). Breitung's technique is different from testing for non-linear error correction, or testing for non-linear equilibrium correction towards a linear long-run cointegrating relation as suggested by Enders and Siklos (2001). The relationship between the economic variables can be highly non-linear; see Fan et al. (2004). For example, market frictions, heterogeneous agents and official intervention

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could shift the demand for credit; so a constant behavior of consumer credit may not be observed. Our results based on Breitung's (2001) non-parametric rank tests revealed the existence of linear cointegrating relationships in the consumer credit models. Enders and Siklos' (2001) threshold adjustment tests show instead that non-linearity is present slightly (with a statistical significance of 10% level) in the consumer credit model with short-term interest rate (federal funds rate). We use these results to assess the popular belief that abnormality in the consumer credit sets the stage for the 2007–08 crisis and severe recession.

The structure of this paper is as follows. Section 2 presents the theoretical framework and discusses recent empirical studies on consumer credit demand. Empirical results are discussed and presented in Section 3. Finally, Section 4 concludes.

2. Theoretical framework and empirical studies

2.1. Theoretical framework

The LCH offers a classical explanation of why some households borrow to finance consumer spending. According to the LCH, households in the first few years borrow to maintain a desired level of consumption exceeding current income. The gap between consumption and income is financed by borrowing which the households repay with future savings.[1] Our model is a standard two period model and follows the work of Hartropp (1992). Fama (1970) showed that the multi-period problem can be reduced to a two-period problem using dynamic recursive programming. Let the individual maximize utility (Eq. (1)) subject to the constraint (Eq. (2)):

$$U = f\left(C_t, C^e_{t+1}\right) \tag{1}$$

$$C_t + C^e_{t+1} = Y_t + B_t + Y^e_{t+1} + (1+r)B_t \tag{2}$$

where C is the consumer expenditure, Y is the disposable income, B is the increase in net financial liabilities ($B = C - Y$), and r is the real interest rate on borrowing and saving (assumed equal). The superscript e indicates the expected value. The usual first and second order conditions for the maximum are as follows:

$$(\partial U/\partial C_t) > 0;\ (\partial U/\partial C^e_{t+1}) > 0;\ \left(\partial^2 U/\partial C_t^2\right) < 0;\ \left(\partial^2 U/\partial (C^e_{t+1})^2\right) < 0. \tag{3}$$

We assume that Y^e_{t+1} depends on income at time t: $Y^e_{t+1} = w_t Y_t$, where w_t is the weight on income in period t. From the first order conditions we know that the ratio of the marginal utility of C_t to the marginal utility of C^e_{t+1} equals $1 + r$. Hence, both C_t and C^e_{t+1} will be determined by Y_t, Y^e_{t+1}, r and the household's relative preference given in Eq. (1) for C_t against C^e_{t+1}. Since $B_t = C_t - Y_t$, we can write:

$$B_t = f\left(Y_t, w_t \cdot Y_t, r\right) - Y_t. \tag{4}$$

From the borrowers' perspective the following conditions must be satisfied:

$$f'(Y_t) > 0, f'(w_t \cdot Y_t) > 0, f'(r) < 0. \tag{5}$$

The function f includes the household's preference for consumption today as opposed to consumption tomorrow. While the new borrowing is clearly related negatively to the real interest rate, the overall effect of Y_t on new borrowing is ambiguous. Y_t influences B_t in three ways: (a) one dollar increase in Y_t directly reduces new borrowing by one dollar (assuming no change in C_t); (b) an increase in Y_t of dY_t directly shifts the budget constraint to the right by an amount of dY_t, and therefore tends to increase C_t; and (c) an increase in Y_t shifts the budget constraint up and to the right (by an amount of $w_t \cdot Y_t$) indirectly through its effect on Y^e_{t+1}. Note that (b) and (c) effects tend to offset the effect of (a) and hence the overall effect on B_t is ambiguous; however we leave this data to depict which effect prevails.

Moreover, another important variable in the new borrowing decisions is net wealth (NW) defined as total assets minus total liabilities. An increase in wealth may induce new borrowing. In theory, a positive marginal propensity to consume (MPC) out of wealth, for a given Y_t, induces a higher B_t. The estimated equation therefore becomes:

$$B_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 NW_{t-1} + \alpha_3 r_t. \tag{6}$$

The above model predicts that $r\langle 0, NW\rangle 0$, whereas the sign of Y is empirically determined. We use Eq. (6) for our analysis. We are following a demand-side approach assuming that the demand for consumer credit mainly influences the credit market dynamics.[2] We recognize that the supply factors may play an important role, however the role of demand should not be undermined. For example, consumer finance sector in the U.S. since 1950s was largely driven by the increase in demand for many products and services (Ryan et al., 2011). In the presence of this increasing trend, firms responded with innovations offering consumers more choices and products. The available data on consumer credit demand and supply collected in the Senior Loan Officer Opinion Survey conducted by the Fed seems to confirm this point. Fig. A (see Appendix A) shows that the demand changes were clearly leading the supply changes of credit over the last 20 years. This gives us the intuition that the dynamics of consumer demand are more important with respect to the supply.[3] Nevertheless, credit supply was higher than demand in the Great Recession period. Regrettably we are unable to analyze this aspect of the market due to the data limitations.

2.2. Recent empirical evidence

Tests of the empirical determination of consumer credit are limited. Most studies have utilized the survey data to explore the structure of consumer credits, for instance Jappelli (1990), Cox and Jappelli (1993), Crook (2001), Magri (2002), Crook and Hochguertel (2005), Del-Rio and Yong (2005) and Benito and Mumtaz (2006). Benito and Mumtaz (2006) provide a comprehensive review of this literature. There are a few studies on consumer credit that used aggregated time series data, for example Hartropp (1992), Calza et al. (2001, 2003), De Nederlandsche Bank (2000), Hofmann (2001) and Schadler et al. (2004).

Using the UK data, Hartropp (1992) found that current income and current and past wealth have a positive influence on consumer borrowing, and that the interest rate has a negative effect. Calza et al. (2001) estimated the credit demand for the Euro Area. They found a long-run relationship between credit demand, real weighted short-term and long-term interest rates, and real GDP.[4] Similar analyses on credit demand have been performed in De Nederlandsche Bank (2000) for several EU countries, including Japan and the USA. Using the cointegrating vector autoregression (VAR) model, Hofmann (2001) attained a long-run relationship linking real credit positively to real GDP and real

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[1] Other theories may also be relevant. The Permanent Income hypothesis (PIH) theory of consumption suggests that consumer spending depends on permanent income, which gives a low weight in its estimation to current income. In this situation, a rise in income would result in increased saving and not debt. Partly due to this reason, the PIH is unable to explain the facts of consumer credit.

[2] The supply of consumer credit is modeled as being essentially demand determined. To this end, the supply of consumer credit may on the whole adjust directly to meet the demand, with or without the price (interest rate) changes in proportion to excess demand. This theory implies that the quantity of consumer credit traded for a given interest rate is that shown by the demand curve.

[3] A Granger causality test (not reported for brevity but available from the authors upon request) confirms our intuition.

[4] In another study, Calza et al. (2003) considered a new measure of the cost of borrowing, obtained as a weighted average of bank lending rates and extracted information content of the loan overhang/shortfall of the future inflation.

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