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Abstract

This paper explains non-mortgage borrowing by U.S. households with demand-side factors, viz. disposable income, wealth and interest rate. The life cycle hypothesis and a standard two period consumption model are the basis of our theoretical model. We find with the cointegration techniques that current disposable income, past wealth, and interest rate explain consumer borrowing over 50 years.

Keywords: consumer borrowing, disposable income, wealth, interest rates, US economy

JEL Classification: D12, C22, O51

1. Introduction

The aim of this paper is to explain the determinants of the non-mortgage consumer borrowing (consumer borrowing hereafter) by the US personal sector during the last 50 years with demand-side factors viz., disposable income, wealth and real interest rate.[1] Our specification and approach are consistent with the Life Cycle Hypothesis (LCH) of Modigliani and Brumberg (1955) and the demand-side approach of Hartropp (1992). Long-run relationships between consumer credit, income, wealth and real interest rate are estimated with alternative specifications and methods of estimating cointegrating equations.

2. The theory of consumer credit demand

A classical explanation of why some households borrow to finance consumer spending comes from the LCH. According to 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.[2] Our model is a standard two period model and follows Hartropp (1992). As shown by Fama (1970), a multi-period problem can be reduced to a two-period problem using dynamic recursive programming. Let the individual maximize the utility (1) subject to the constraint (2):

(1) $$U = f(C_t, C_{t+1}^e)$$

(2) $$C_t + C_{t+1}^e = Y_t + B_t + Y_{t+1}^e - \ 1 + r \ \ B_t$$

where C is the consumer expenditure, Y the disposable income, B the increase in net financial liabilities ($B = C - Y$), and r the real interest rate on borrowing and saving (assumed equal). The

[1] Consumer credit includes revolving and non-revolving credit. Revolving credit is credit debt, and non-revolving credit includes loans for items such as vacations, autos and boats.

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

superscript *e* indicates the expected value. The usual first and second order conditions for a maximum are:

(3) $$(\partial U / \partial C_t) > 0; (\partial U / \partial C_{t+1}^e) > 0;\ (\partial^2 U / \partial C_t^2) < 0;\ (\partial^2 U / \partial (C_{t+1}^e)^2) < 0$$

We assume that Y_{t+1}^e depends on income at time *t*: $Y_{t+1}^e = w_t Y_t$, 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_{t+1}^e equals *1+r*. Hence, C_t and C_{t+1}^e will each be determined by Y_t, Y_{t+1}^e, *r* and the household's relative preference given in (1) for C_t against C_{t+1}^e. Since $B_t = C_t - Y_t$, we can write:

(4) $$B_t = f\ Y_t, w_t \cdot Y_t, r\ - Y_t$$

For the borrowers the following conditions are satisfied:

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

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) a one dollar increase in Y_t directly reduces new borrowing of 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_{t+1}^e. (b) and (c) effects tend to offset the effect of (a). Hence, the overall effect on B_t is ambiguous. We leave to the data say which effect prevails.

Another important variable, in the new borrowing decisions, is the net wealth *NW*. An increase in wealth may induce new borrowing. In fact, a positive MPC out of wealth (as suggested by consumption theory), for a given Y_t, induces a higher B_t. As explained by Hartropp (1992), it may be strange that households with financial assets should take new unsecured loans, since the interest on latter is typically greater than on former. But if we consider the transactions costs and inconvenience of liquidating financial assets, the decision to incur new borrowing is not so strange.

The supply of consumer credit is modeled as being essentially demand determined. In particular, the supply of consumer credit may on the whole adjust directly to meet the demand, with or without the price (interest rate) changing 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. Empirical results

As we said above, our empirical assessment is equivalent to examining what factors determine the demand alone. Our empirical model is the following equation:

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

Our above model predicts that $r < 0, NW > 0$, whereas the sign of Y is determined empirically.

Three base regressions are run with different interest rates: r^{ff} (real federal funds rate; model 1), r^{3Y} (real 3-years constant maturity rate; model 2), r^{10Y} (real 10-year constant to maturity rate; model 3). This is done to examine whether the borrowers respond more to shorter or longer interest rates since consumer credit includes non-revolving credit i.e., loans for vacations, autos, boats, etc.

Data are used in natural log form, except for the three real interest rates. All the variables are found to be I(1) in our sample.[3] The long run relationships are estimated with three single-equation cointegration techniques, namely, Fully Modified Ordinary Least Squares (FMOLS), Canonical Cointegrating Regression (CCR) and Dynamic Ordinary Least Squares (DOLS), for the period 1960q1 – 2011q1. These estimators are asymptotically equivalent and efficient. Results are in Tables 1-3.

[3] All the variables are I(1) in levels and I(0) in first differences according to the ADF and KPSS tests. To conserve space these are not reported but they are available upon request.

Table 1: Results of Model 1: 1960Q1-2011Q1			
$$B_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 NW_{t-1} + \alpha_3 r_t^{ff}$$			
	FMOLS	DOLS	CCR
Intercept	-7.826 (0.919) [8.515]	-7.489 (0.687) [10.904]	-7.802 (0.907) [8.598]
$\alpha_1 Y_t$	0.472 (0.131) [3.607]	0.527 (0.112) [4.704]	0.473 (0.129) [3.663]
$\alpha_2 NW_{t-1}$	0.678 (0.111) [6.114]	0.635 (0.087) [7.308]	0.676 (0.109) [6.175]
$\alpha_3 r_t^{ff}$	-0.008 (0.005) [1.593]	-0.006 (0.005) [1.195]	-0.008 (0.005) [1.523]
EG residual test		-4.399**	
Error Correction Estimation			
λ	-0.025*** (0.008)		
$\bar{R}^2$	0.789		
LM(1) test (p-value)	0.661		
LM(2) test (p-value)	0.903		
LM(4) test (p-value)	0.323		
LM(6) test (p-value)	0.111		
JB test (p-value)	0.079		
BPG test (p-value)	0.720		

Notes: All variables (excluding interest rate) are expressed in natural log. Standard errors are reported in ( ) brackets, whereas in [ ] are reported *t*-statistics.. *, **, *** denotes significance at 10%, 5%, and 1%, respectively. EG = Engle-Granger *t*-test for cointegration. λ , factor loading in the ECM. BPG, Breusch-Pagan-Godfrey heteroskedasticiy test; JB, Jarque-Bera normality test, LM, Bresuch-Godfrey serial correlation LM test. FMOLS uses Newey-West automatic bandwidth selection in computing the long-run variance matrix. In the DOLS leads and lags are selected according to SIC criteria. The standard errors for the DOLS estimation are calculated using the Newey-West correction. A dummy for 2009 financial crisis (first three quarters of 2009) is added to the cointegrating relationship. Four dummies are added in ECM formulation: an impulse dummy for 2008Q4 (peak of financial institution crisis (Lehmann Brothers, Merrill Lynch, Fannie Mae, Freddie Mac)); a dummy for 1980Q1-1980Q3 (US recession); an impulse dummy for 1987Q1 (period where federal reserve is considered starting to react to variations in inflation rates and unemployment (see Curtis (2005)); an impulse dummy for 1989Q1 (slowdown of economy and consumptions as a result of restrictive monetary policy enacted by the Federal Reserve). In ECM the optimal lag length (from a maximum of 4 lags) of short-run dynamics is identified to ensure that the error term is white noise.

Table 2: Results of Model 2: 1960Q1-2011Q1			
$B_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 NW_{t-1} + \alpha_3 r_t^{3Y}$			
	FMOLS	DOLS	CCR
Intercept	-7.587 (0.704) [10.771]	-7.470 (0.637) [11.730]	-7.576 (0.700) [10.844]
$\alpha_1 Y_t$	0.509 (0.100) [5.079]	0.530 (0.103) [5.131]	0.509 (0.099) [5.133]
$\alpha_2 NW_{t-1}$	0.649 (0.085) [7.641]	0.633 (0.080) [7.883]	0.648 (0.084) [7.694]
$\alpha_3 r_t^{3Y}$	-0.009 (0.004) [2.457]	-0.009 (0.004) [2.401]	-0.009 (0.004) [2.458]
EG residual test		-4.354**	
Error Correction Estimation			
λ	-0.028*** (0.009)		
$\bar{R}^2$	0.797		
LM(1) test (p-value)	0.632		
LM(2) test (p-value)	0.889		
LM(4) test (p-value)	0.280		
LM(6) test (p-value)	0.094		
JB test (p-value)	0.059		
BPG test (p-value)	0.784		
See notes in Table 1.			

Table 3: Results of Model 3: 1960Q1-2011Q1			
$B_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 NW_{t-1} + \alpha_3 r_t^{10Y}$			
	FMOLS	DOLS	CCR
Intercept	-7.520 (0.501) [15.000]	-7.454 (0.593) [12.574]	-7.518 (0.499) [15.050]
$\alpha_1 Y_t$	0.558 (0.073) [7.669]	0.574 (0.096) [6.001]	0.558 (0.072) [7.710]
$\alpha_2 NW_{t-1}$	0.639 (0.060) [10.602]	0.629 (0.073) [8.577]	0.639 (0.060) [10.642]
$\alpha_3 r_t^{10Y}$	-0.008 (0.003) [3.156]	-0.009 (0.003) [2.561]	-0.008 (0.003) [3.180]
EG residual test		-4.374**	
Error Correction Estimation			
λ	-0.028*** (0.008)		
$\bar{R}^2$	0.797		
LM(1) test (p-value)	0.670		
LM(2) test (p-value)	0.912		
LM(4) test (p-value)	0.266		
LM(6) test (p-value)	0.092		
JB test (p-value)	0.062		
BPG test (p-value)	0.769		
See notes in Table 1.			

In all models the coefficient of disposable income (α_1) is positive. The results are very similar except for the fed funds rate version (model 1) where the coefficient of interest rate is not statistically significant. Other two versions (model 2 and 3) exhibit remarkably similar results. All the coefficients are statistically significant, the Engle-Granger test confirms the presence of a long-run relationship and ECMs are satisfactory. These results imply:

1) The Fed funds rate is not statistically significant in explaining the consumer credit pattern. This is because consumer credit includes non-revolving credit (items such as vacations, automobiles, boats, etc.) which are more linked to longer interest rates. Hence, our preferred versions are model 2 and 3.

2) Disposable income has a positive effect on consumer credit.

3) Factor loading parameter is very low in all formulations. This suggests that error correction mechanism is very slow: consumer credit reverts toward the equilibrium level very slowly.

4. Conclusions

This work estimates the long-run determinants of the flow of non-mortgage borrowing in the US economy during the last 50 years. Demand for these borrowings depends positively on disposable income, past wealth, and negatively on the real longer (3-years and 10-years) interest rates. The semi-log elasticity (the percentage change in consumer demand in terms of a unit change in interest rate) of the non-mortgage borrowing, for a 100 basis point increase in the long run interest rates, is between -0.8 to -0.9.

Data Appendix

Consumer credit outstanding, federal funds rate, 3-year and 10-year Treasury constant maturity rates, PCE price index, and CPI all items are taken from Federal Reserve Economic Data (FRED). Disposable (labor) income is reconstructed from BEA's (Bureau of Economic Analysis) National Income and Product Account (NIPA) as did by Ludvigson and Steindel (1999). Total net wealth is obtained by Flow-of-Funds Accounts of the Board of Governors of the Federal Reserve System. All variables are deflated by PCE chained type price index.

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