Risto Herrala

Credit constraints and durable consumption A new empirical approach

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Credit constraints and durable consumption
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Abstract

I find quantitative evidence of a significant effect for credit constraints on durable consumption during a post-deregulation consumer spending spree. The effect varied markedly across age and educational groups. Young households with low levels of education displayed high sensitivity to credit conditions. In contrast, older highly educated households were relatively immune to credit market developments.

Keywords: durable consumption, credit constraints, stochastic frontier analysis

JEL classification numbers: D12, D91, E21

Luottorajoitteet ja kuluttaminen
Uusi empiirinen lähestymistapa

Suomen Pankin keskustelualoitteita 15/2010

Risto Herrala
Rahapolitiikka- ja tutkimusosasto

Tiivistelmä

Luottarajoitteilla oli merkittävä vaikutus kestokulutukseen luotonsäännöstelyn purkamista seuranneen ”kulutusjuhlan” aikana. Tämä vaikutus vaihteli voimakkaasti väestöryhmittäin. Se oli erityisen suuri nuorten, vähän koulutettujen kotitalouksissa. Vanhempien, hyvin koulutettujen kotitalouksissa kestokulutus ei sen sijaan ollut herkkää luoton saatavuudelle.

Avainsanat: kestokulutus, luottorajoitteet, rintama-analyysi

JEL-luokittelu: D12, D91, E21

Contents

1 Introduction

Econometric findings indicate that credit constraints may significantly affect consumer behaviour. These include excess sensitivity of consumption to current income, non-classical consumption dynamics, and sensitivity of consumer borrowing to credit conditions (Attanasio and Weber, 2010; Attanasio et al, 2008; Gross and Souleles, 2002; Attanasio and Jappelli, 2001; Carroll, 2001; and Zeldes, 1989, among others). Unfortunately, until late no satisfactory method has been presented for quantifying credit constraints. This has hindered standard regression analysis of their effect on consumer behaviour.

The present study is, to my knowledge, the first regression analysis of this problem. The recent insight that credit constraints can be estimated by stochastic frontier analysis (Herrala 2010) opens the problem to this approach. The credit constraint estimates produced by stochastic frontier analysis can be used in a standard regression to estimate their effect on consumer behaviour.

The data is of particular interest for a study of the effect of credit constraints on durable consumption. It contains information about a relatively broad range of durables among a large number of households. The survey methodology supports aggregation of the results to the macroeconomic level. The data covers two consecutive years, so that the effect of credit constraints on durable consumption can be tested against classical dynamics. The estimation period encompasses a 'consumer spending spree' in the aftermath of credit market deregulation in the late 1980's in Finland. The estimation results shed light on the first phase of a boom-bust cycle that ended in a systemic banking crisis.

The econometric analysis indicates that, indeed, credit conditions significantly contributed to a consumer spending spree during the boom-phase of the cycle. This effect was not uniform across the population. Credit conditions affected consumption most among households that experienced the largest change in credit availability. Furthermore, the effect of credit conditions on consumption was highest among young households with a relatively low level of education. In contrast, older and highly educated households appeared almost immune to credit conditions.

The estimation results reinforce the view that non-negligible real effects may arise from financial regulation and other factors that affect loan supply. Disregard for credit conditions can lead to error in the study and prediction of consumer behaviour. The findings also indicate that changes in consumer dynamics may significantly contribute to boom-bust cycles.

The paper is organized as follows. The next section formalises the methodology. The econometric estimation of the constraints and their behavioural effect follows. The analysis is completed by a robustness assessment. A short summary and views on the future agenda conclude.

2 Data and methodology

The estimation sample is a complex household survey by Statistics Finland, covering years 1987–1988.[1] In estimations, year 1988 is treated as the present and year 1987 as the past. The stock of durable wealth in the survey includes real estate (own house, secondary house, and other real estate) and vehicles (cars, caravans, boats, motorcycles, and snowmobiles). Table 1 shows the variable means.

Table 1. **Variable means**

	1987	1988
Durable wealth	3.60	3.74
Loans	2.24	2.33
Wealth	3.77	3.91
Income	2.86	2.89

Note: Calculated with the svy: mean command in Stata.
All variables in natural logarithms of 1000 euros.'
Data source: Statistics Finland

The estimation period covers a boom phase in the Finnish economy after the deregulation of credit markets in 1986. Both years 1987 and 1988 were characterized by record real consumption growth of over 5% per annum, not surpassed since then and more than double the average of the period 1975–2010. The speedboat, ill fitted for the idyllic Finnish archipelago, became a symbol of excess consumption during the time. A hypothesis often presented when discussing the events is that loose credit conditions, brought about by credit market deregulation, contributed to a consumer spending spree.[2]

Estimation of credit conditions follows closely the methodology outlined in Herrala (2010). A stochastic, log-linear credit constraint π, the maximum amount a consumer can borrow, is assumed

$$\pi_{it} = \beta_W \text{Wealth}_{it} + \beta_I \text{Income}_{it} + \nu_{it} \tag{2.1}$$

where i denotes households, t time, ν a standard normal random variable, and β credit policy parameters. The credit policy parameter estimates $\hat{\beta}$ are obtained by stochastic frontier analysis.

Application of stochastic frontier analysis is based on the insight that borrowing (L) may be decomposed into two elements, a credit constraint and its

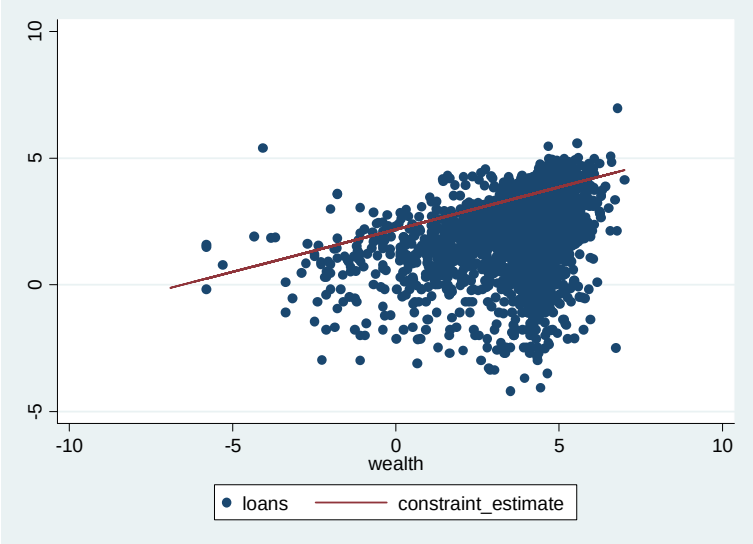
[1] The survey of saving and indebtedness.
[2] See Nyberg and Vihriälä (1994) and Herrala (1999) for discussion and references.

utilization rate (-u). This decomposition presents an analogy with efficiency analysis, the standard field of application of stochastic frontier models, where production is decomposed into the production possibility frontier and efficiency. In stochastic frontier analysis, u is treated as a random variable with positive domain (usually half-normal or exponential). The parameters of interest are estimated from the equation

$$L_{it} = \beta_W \text{Wealth}_{it} + \beta_I \text{Income}_{it} + \nu_{it} - u_{it} \quad (2.2)$$

In estimations below, fixed and variable effects with age and education level are allowed. To guarantee that the credit policy parameter estimates $\hat{\beta}$ reflect credit conditions during the main period of interest, here 1988, the stochastic frontier analysis is performed on the (sub) sample of households that increased borrowing at that time. Figure 1 illustrates the method graphically in a simplified case.

Figure 1 **A scatter plot of loans and wealth, and a credit constraint estimate**



Note: The constraint estimate has been estimated by the Frontier -command in Stata. The exogenous variable was loans in 1988 and the exogenous variables were wealth in 1988 and a constant. All variables in natural logarithms of 1000 euros. Data source: Statistics Finland.

The credit policy parameter estimates $\hat{\beta}$, reflecting credit conditions in 1988, are used to calculate, for all 4766 households in the survey that had a well defined value of wealth and income, a constraint estimate

$$\hat{\pi}_{i,1988} = \hat{\beta}_W \text{Wealth}_{i,1987} + \hat{\beta}_I \text{Income}_{i,1988} \quad (2.3)$$

Notice from (2.3) that the constraint estimate is calculated with lagged wealth. It is, therefore, an estimate of credit market status at the beginning of the period of interest, before durables purchases in 1988 influenced credit market position. The estimate may, then, be used to study the causal effect of household credit constraints on durable goods purchases.

In the empirical durable consumption equation

$$C_{i,1988} = \alpha_C C_{i,1987} + \alpha_\pi \hat{\pi}_{i,1988} + \varepsilon_i \tag{2.4}$$

C denotes the stock of durable wealth, α parameters, and ε a standard normal random variable. The stock of durable wealth is the source of durable consumption for the households. In estimations, fixed and variable effects across different population groups are allowed. The empirical model (2.4) also extends to the study of the effects of changes in credit conditions on durable consumption dynamics.

The empirical model (2.4) encompasses Mankiw's (1982) theoretical model of durable consumption as a special case ($\alpha_C = 1$ and $\alpha_\pi = 0$). Extensions of the theory to the case of a non-zero constant term and a below unit own elasticity have been extensively discussed by various (See eg Attanasio and Weber, 2010; Attanasio and Jappelli, 2001, and references). The parameter α_π reflects deviations from classical dynamics due to the influence of credit conditions in 1988.

3 The credit constraints

The stochastic frontier models 1 and 2 (Table 2) of credit conditions in 1988 include fixed and variable effects of wealth and income across age and educational groups. In Model 2, second order effects of wealth and income, their cross term, and an inverse Mill's ratio from a Probit model of credit market entry is also included. The inverse Mill's ratio controls for possible selection bias caused by the exclusion of households that did not increase borrowing in 1988 from the estimation sample.[3] Model 1 is normal/half normal, and model 2 normal/exponential.

[3] In the Probit model, credit market entry was regressed by lagged wealth, income, family size, age, educational level, socioeconomic status, and area as well as a survey based indicator for borrowing intentions.

Table 2. **Stochastic frontier models of credit constraints**

	model 1	model 2	model 3
β parameters			
Inverse Mill's ratio		-0.87***	
		(0.15)	
A0	1.83***	2.17***	1.64***
	(0.2)	(0.39)	(0.18)
A1	1.06***	1.87***	1.07***
	(0.29)	(0.58)	(0.21)
A2	1.17***	2.56***	-0.14
	(0.23)	(0.51)	(0.18)
EU	0.75*	0.94*	0.84***
	(0.4)	(0.5)	(0.28)
Wealth*A0	0.28***	0.22***	0.32***
	(0.02)	(0.08)	(0.02)
Income*A0	0.37***	0.25	0.2***
	(0.08)	(0.27)	(0.07)
Wealth*A1	0.35***	0.23**	0.34***
	(0.03)	(0.1)	(0.02)
Income*A1	0.51***	0.32	0.36***
	(0.1)	(0.33)	(0.07)
Wealth*A2	0.17***	0.14*	0.28***
	(0.04)	(0.09)	(0.02)
Income*A2	0.54***	0.09	0.62***
	(0.08)	(0.28)	(0.06)
Wealth*EU	-0.25***	-0.15**	-0.21***
	(0.05)	(0.07)	(0.04)
Income*EU	0.17	-0.03	0.09
	(0.14)	(0.19)	(0.11)
Wealth^2		0.03***	
		(0.01)	
Income^2		-0.01	
		(0.06)	
Wealth*Income		0.02	
		(0.03)	
variance of v	0.24	0.34	0.4
variance of u	1.8	0.5	1.3
Sample size	1435	1426	3582
Iterations completed	22	30	22
log-likelihood	-1901	-1847	-5645
AIC	2.67	2.62	3.16
distribution of u	half normal	exponential	exponential

Note: Estimated by the Frontier-command with weights in LIMDEP. The endogenous variable in models 1 and 2 is the loan stock in 1988, and in model 3 the loan stock in 1987. In models 1 and 2, wealth is measured in 1988, and in model 3 in 1987. Income is measured in 1988. Group indicators A0=age below 31 years; A1=age 31–45 years, A2=age over 45 years; EU= university level. All variables in natural logarithms of 1000 euros. Data source: Statistics Finland.

Table 3. **Dynamic models of durable consumption in 1988**

	model A	model B	model C	model D
A0	-2.66***	-2.48***	-2.64	-2.13***
	(0.45)	(0.74)	(2.33)	(0.52)
A1	-1.99***	-1.97***	-2.75*	-0.88***
	(0.32)	(0.53)	(1.53)	(0.26)
A2	-0.3***	-0.68**	-0.68	-0.27**
	(0.07)	(0.29)	(0.43)	(0.11)
EU	0.48**	1.28**	-1.87	0.58***
	(0.2)	(0.53)	(1.38)	(0.2)
Durable wealth in 1987*A0	0.62***	0.64***	0.61***	0.69***
	(0.05)	(0.07)	(0.05)	(0.07)
Durable wealth in 1987*A1	0.53***	0.54***	0.52***	0.74***
	(0.05)	(0.07)	(0.05)	(0.05)
Durable wealth in 1987*A2	0.86***	0.81***	0.85***	0.87***
	(0.04)	(0.06)	(0.04)	(0.04)
Durable wealth in 1987*EU	0.1**	0.1*	0.12**	-0.01
	(0.05)	(0.06)	(0.05)	(0.05)
Credit constraint*A0	1.05***	0.99***	1.09	0.85***
	(0.15)	(0.24)	(1.24)	(0.2)
Credit constraint*A1	0.98***	0.97***	1.52*	0.41***
	(0.12)	(0.19)	(0.82)	(0.12)
Credit constraint*A2	0.27***	0.44***	0.63**	0.29***
	(0.06)	(0.16)	(0.3)	(0.07)
Credit constraint*EU	-0.26***	-0.46***	0.85	-0.07
	(0.07)	(0.15)	(0.73)	(0.06)
Credit constraint change *A0				0.35
				(0.26)
Credit constraint change*A1				1.19***
				(0.2)
Credit constraint change*A2				0.1**
				(0.04)
Credit constraint change*EU				-0.64***
				(0.22)
Credit constraint^2*A0			0	
			(0.16)	
Credit constraint^2*A1			-0.07	
			(0.1)	
Credit constraint^2*A2			-0.05	
			(0.04)	
Credit constraint^2*EU			-0.14	
			(0.09)	
SL			-0.25***	-0.24***
			(0.08)	(0.08)
SE			-0.23***	-0.22***
			(0.07)	(0.08)
SS			0.06	0.1
			(0.13)	(0.14)
SP			-0.2***	-0.2***
			(0.07)	(0.07)
TA			-0.01	-0.01
			(0.02)	(0.02)
Sample size	4766	4766	4766	4766
R squared	99%		99%	99%
F	119275	93872	68544	125646
Estimation method	regress	ivreg	regress	regress

Note: Estimated with Stata with svy: regress and svy: ivreg commands. The endogenous variable is the stock of durable wealth in 1988. In model B, the credit constraint estimate from model 2 is used as an instrument for the credit constraint estimate from model 1. In model D, credit constraint change is the arithmetical difference between the constraint estimates produced by models 1 and 3. Groups: A0 = age below 3 years, A1 = 31–45 years, A2 = over 45 years, EU = University level, SL = Labour, SE = Entrepreneur, SS = Student, SP = Pensioner, TA = Town like community. All variables in natural logarithms of 1000 euros. Standard error in parenthesis. */**/*** = 10%/5%/1% significance. Data source: Statistics Finland.

The credit policy parameter estimates of year 1988 are broadly in line with those reported in Herrala (2010). Here, as in the earlier study, the effect of wealth on household credit constraints is highly significant in all estimated models. The income effect is significant in model 1 and insignificant in model 2. The estimated credit constraint levels appear realistic. In model 1, for example, the mean credit constraint estimate in the sample of households that increased borrowing is 3.9 (49 300 euro), approximately 10% above mean wealth, and 3.4 in the whole sample of households. In model 2, the corresponding whole sample estimate is 4.

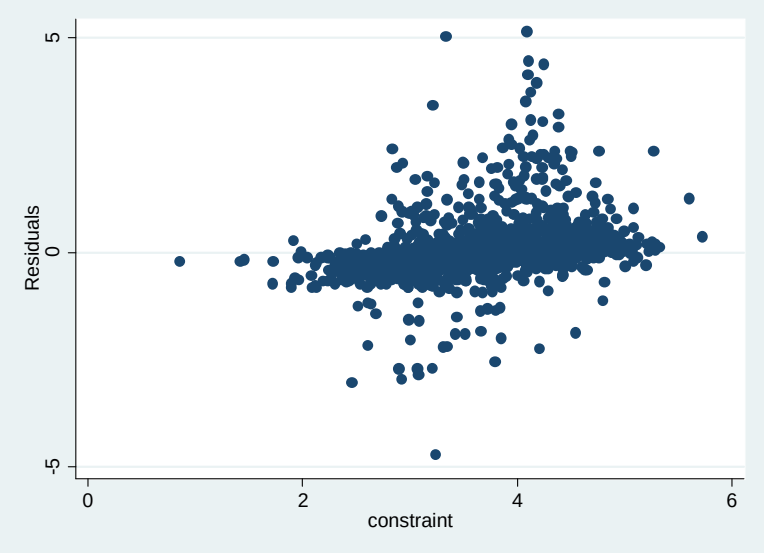
Model 3 generates estimates of past credit policy parameters. These are used in some regressions of durable consumption dynamics to study the effect of changes in credit conditions. The past constraint is estimated from the whole sample (instead of the sample of households that increased borrowing) with 1987 debt levels because the data does not allow identification of households that were active at the credit market in 1987. Arguably, the stochastic frontier parameters obtained from the whole sample reflect credit conditions in 1987 with reasonable accuracy, since credit market deregulation 1986 shifted credit constraints significantly upwards.

The mean constraint estimate in the whole sample of households for 1987 given by this model is 2.8, ie significantly lower than the estimates of year 1988. Credit constraints were still moving upwards in 1988 as competition for loan clients was increasing at the post-deregulation credit market.

4 Consumption dynamics

Graphical analysis gives support to the hypothesis that, indeed, credit conditions did contribute to consumption dynamics in 1988. A scatter plot of standard Euler equation residuals and the constraint estimates from model 1 shows a positive and possibly linear correlation.

Figure 2. **Scatter plot of Euler residuals and the constraint estimates of model 1**



Note: The Euler residuals are from a linear regression of durable wealth in 1988 on a constant term and durable wealth in 1987. See table 2 for information on model 1. All variables in natural logarithms of 1000 euros. Data source: Statistics Finland.

The econometric analysis of consumption dynamics reinforces this finding. In the benchmark model A (Table 3), the stock of durable wealth in 1988 is regressed by durable wealth in 1987, and the constraint estimates obtained from model 1.

In model A, the marginal effects of lagged durable wealth and the credit constraints are significant in all age and educational groups. Large variation in marginal effects across groups is observed. The marginal effect of lagged durables is highest and that of credit constraints is lowest among the oldest, highly educated households. Behaviour in this group accords closely with the standard Euler equation. In contrast, the marginal effect of lagged durable wealth is lowest and the marginal effect of credit constraints highest among the young households with a low level of education. The marginal effect of the constraint is high, near unity, as if the households in this group were all constrained.[4]

Additional insight may be obtained with the help of models B, C and D (Table 3). Model B has been estimated by IV regression to assess the effect of constraint misspecification on the estimation results. The constraint estimate from model 2 has been used as an instrument for the constraint estimate of model 1. Model C includes second order variable effects of the constraint, and controls for

[4] The method does not directly reveal which households are constrained and which ones are not.

socioeconomic groups and area type. In model D, the change in credit conditions is included as an additional explanatory variable. The change in credit conditions has been calculated by subtracting from credit constraint estimates (2.3) calculated with model 1 parameters the corresponding credit constraint estimates calculated with model 3 parameters.

Comparison reveals both similarities and differences across the different models. In all estimated models, the marginal effects of lagged durable wealth and the credit constraints of year 1988 are highly significant. All models show marked differences in marginal effects across groups. The effects of credit constraints on durable consumption dynamics are consistently most pronounced among the youngest with the lowest education level.

Addition of second order variable effects of the constraints in model C results in some diminution of the statistical significance of the individual marginal effects of the constraint in some groups. The estimates of the marginal effects of credit constraints also vary from model to model.

Perhaps the most interesting finding arises from model D. It shows that credit conditions in 1988, and the change is credit conditions between 1987 and 1988 were jointly significant in the empirical model. This result implies that credit conditions affected consumer behaviour most among households that had experienced the biggest change in credit availability.

I have furthermore explored a number of alternative constraint specifications with socioeconomic and area related group variables, and alternative distributional assumptions of the residuals of the stochastic frontier model. The finding that credit constraints significantly affect the dynamics of consumption appears very robust to such changes. The results are also robust to addition of a lagged loan stock variable in the dynamic consumption model. This variable had only an insignificant influence on the estimation results.

5 Concluding remarks

I estimate the quantitative effect of credit constraints on durable consumption. The study covers a period of rapid consumption growth in the aftermath of credit market deregulation. It yields evidence that credit conditions significantly affected durable consumption growth at that time.

The link between durable consumption dynamics and credit conditions during the period of study is probably pronounced by the credit market deregulation. More research is obviously needed in order to assess the effects of credit conditions on consumption more generally.

Hopefully this study promotes further investigation of other countries and time periods. The method used here is also well suited for analysis of the effects of credit constraints on other types of behaviour, such as investment.

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