Precautionary Saving, Borrowing Constraints, and Fiscal Policy*

Thomas Bishop
Department of Economics
University of Michigan

Cheolbeom Park
Department of Economics
National University of Singapore

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Abstract: Recent empirical studies suggest that the average marginal propensity to consume (MPC) has declined. This paper explains the declining trend of the MPC with a standard representative consumer model where borrowing constraints become more relaxed as suggested by data. With an increase in available credit, the consumer can easily spread out negative income shocks by credit card borrowing or consumer loans. As a result, consumers under relaxed borrowing constraints have lower MPCs than they had a generation ago. This result suggests that policy makers should now account for the less responsiveness of consumers to fiscal stimulus plans aiming at boosting consumption.

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Key Words: Marginal Propensity to Consume, Borrowing Constraints, Precautionary Saving, Consumption Function, Effectiveness of Fiscal Policy

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* Author address: Bishop: Department of Economics, University of Michigan, 611 S. Tappan Street, Ann Arbor, MI, 48109, USA. Park: Department of Economics, National University of Singapore, 1 Arts Link, Singapore 117570, Republic of Singapore. E-mail: Bishop: twbishop@umich.edu. Park: ecscp@nus.edu.sg.

I. Introduction

The issue of the marginal propensity to consume (MPC) has attracted attention from economists and policy makers because it is considered to determine the effectiveness of fiscal policy aimed at boosting consumption. However, rigorous theoretical studies of the MPC, when consumers face uncertainty, have been recently undertaken. Carroll and Kimball (1996) compare a model where consumers face uncertainty and borrowing constraints to one where consumers have perfect foresight and can borrow as much as they like, as is typically assumed in the traditional permanent/life-cycle income hypothesis. The authors show that the introduction of uncertainty and borrowing constraints into the model causes the MPC to rise relative to the perfect foresight and unconstrained case and that the MPC rises more for consumers with low wealth than those with high wealth because the consumption is concave over wealth. Carroll (2001) argues that a high growth rate in income and/or a high rate of discounting the future (or more accurately the "impatience" of consumers) determine the MPC, rather than borrowing constraints per se.

Along with these theoretical studies, recent empirical studies suggest that the MPC may have declined during the last one or two decades. Shapiro and Slemrod (1995) found that 43% of surveyed consumers were willing to spend the temporary increase in their take-home income in response to the changes in income tax withholding in 1992, even though the temporary increase in income was likely to be offset by the approximately equally sized decrease in tax refund or increase in tax within a year due to the roughly constant overall annual tax liability. However, Shapiro and Slemrod (2003) reported that only 22% of respondents were willing to spend the tax rebate resulted from the ten-year tax cut policy in 2001 in another similar survey. Their findings in two surveys are surprising for two reasons. First, although the authors use the same survey methodology and very similar questionnaires, the responses are noticeably different. Second, while the change in life-time income due to the 1992 tax withholding change was negligible, the life-time income change due to the 2001 tax cuts was substantial if the tax cuts were to be completely implemented.[1] However, consumers' responses from the1992 policy change are far greater than those from the 2001 tax cut policy, which contradicts a prediction of the permanent/life-cycle income hypothesis. Furthermore, different responses in 1992 and 2001 suggest different MPCs in both years. Assuming a specific distribution on the MPC across consumers as described in Shapiro and Slemrod (2002), these figures imply that the average MPC is approximately 0.47 in 1992 and 0.33 in 2001[2]

Other evidence is consistent with the hypothesis that the average MPC has declined over time. A New York Times/CBS News poll in May 1982 found that approximately 50% of consumers in a survey said that they would spend the increase in take-home income due to the tax cuts proposed by the Reagan administration (Souleles (2002)), while Gallup Poll in July 2001 reported that only 17% of respondents said that they would spend the 2001 tax rebate from the tax cut (Shapiro and Slemrod (2002)). In addition, Souleles (2002) estimates the average MPC in response to the 1982 tax cut to lie between 0.6 and 0.9, while Johnson, Parker and Souleles (2004) estimate the average MPC in response to the 2001 tax cut to lie between 0.2 and 0.4. Although standard errors

[1] In the 2001 survey that Shapiro and Slemrod (2003) examined, many consumers did not believe the government's tax cut policy as literally as the policy said. Most respondents were pessimistic about the size of future tax cuts.
[2] Refer to the Appendix Table for the range of the average the MPC when distribution parameters change.

of the estimates and different identification assumptions[3] in the two studies make direct comparisons of the two sets of estimates difficult, the declining tendency in the MPC certainly appears to exist.[4]

A possible explanation for the above findings could be the mental accounting hypothesis by Thaler (1990) who postulates that different sources of income result in different MPCs. With the 1982 tax cut and the 1992 change in tax withholding, the take-home income was increased, while the 2001 tax rebate was delivered to each household as a separate check. Hence, Thaler's (1990) ad hoc assumption that the MPC from a separate check is lower than the MPC from increased income from regularly-timed paycheck could explain the findings. However, this paper attempts to explain the declining trend of the MPC with a standard representative consumer model rather than relying on the behavioral assumption by Thaler (1990). We simulate a model that predicts a declining average MPC when forward-looking consumers optimally respond to an increase in available credit.

While the MPC is declining, the widespread use of credit cards has made borrowing accessible for most US households. The 2001 Survey of Consumer Finances reports that 76.2% of the US households have at least one credit card and two thirds of them hold positive amounts of credit card debt (Aizcorbe, Kennickell and Moore (2003) and Laibson, Repetto and Tobacman (2003)). At the same time, the credit card debt has grown over 10% per year since credit cards were introduced in mid 1970s, implying

[3] While the 1982 tax cuts proposed by Reagan administration is identified as the change in tax withholding in Souleles (2002), the 2001 tax cuts proposed by Bush administration is identified as the mailing of tax rebate checks.

[4] Among related studies, Parker (1999) and Souleles (1999) obtain low MPC estimates during the 1980s. However, these low estimates are probably due to the fact that the temporary increases in income, identified as the change in Social Security tax withholding or tax refund, are similar to the regular annual payments in Hsieh (2003) in the sense that those increases are repeated every year. Hsieh (2003) finds that consumption does not respond to well-anticipated regular payments.

approximately a 250% growth rate per decade (Yoo (1998) and Manning (2000)). Furthermore, Gross and Souleles (2002) report that the average credit limit (i.e., borrowing potential) per credit card account is 2.5 times the average US monthly individual income.[5]

Thus, this paper tries to explain the apparent decline in the average MPC by using a partial equilibrium model in which borrowing constraints on consumers are relaxed. After solving the representative consumer problem, this paper shows that Carroll's (2001) argument that the consumer's impatience is the key factor to determine the MPC is approximately true when the change in borrowing constraints is small. However, if the change in borrowing constraints is significantly large as suggested by data, this paper shows through simulations that the MPC declines as the borrowing constraints become relaxed. Since consumers can spread negative income shocks out more freely, consumers under relaxed borrowing constraints have lower MPCs. That is, while a large negative income shock such as a temporary lay-off forced a consumer to reduce her consumption drastically and to have a high MPC in the past time, such a shock can be spread out over periods by the credit card borrowing and the consumer does not need to reduce her consumption drastically these days. As a result, the MPC of a consumer with relaxed borrowing constraints can continue to be low and additional income is used to pay off debt rather than spent on additional consumption. This result suggests that both borrowing constraints and the consumer's impatience are important factors to determine the MPC.

[5] Ludvigson (1999) shows that the ratio of consumer loan to personal income has also grown by more than 200% since World War II.

The structure of this paper is as follows. Section II presents the optimization problem for a representative consumer when he faces uncertainty about labor income. Section III provides simulation results and their interpretation for the consumer model. Section IV offers concluding remarks.

II. The Model

The representative consumer considers optimizing a time-separable expected utility model:

$$\max E_0\left[\sum_{t=0}^{\infty}\beta^t u(C_t)\right] \tag{1}$$

subject to

$$X_{t+1} = R(X_t - C_t) + Y_{t+1} \tag{2}$$

$$Y_{t+1} = P_{t+1}\varepsilon_{t+1} \tag{3}$$

$$P_{t+1} = GP_t N_{t+1} \tag{4}$$

$$X_t + kP_t \geq C_t \tag{5}$$

where E_0 denotes the conditional expectation given information at time 0, $\beta \in (0,1)$ denotes the time discount rate, R denotes the risk-free gross interest rate, C_t denotes consumption at time t, Y_t denotes labor income at time t, and X_t denotes the resource available for consumption (cash-on-hand). P_t is the permanent component of the labor income, and ε_t and N_t are temporary and permanent shocks in the labor income, respectively. ε_t can be interpreted as temporary bonuses, lay-offs or illnesses, while N_t

can be interpreted as promotions or demotions in the career of the consumer. G, the gross growth rate of P_t, is assumed to be constant.

While equations (1) through (4) are conventional, Equation (5) states that the consumer is allowed to borrow up to a fraction of permanent component in the labor income (kP_t), where $k \geq 0$ and k is known to consumers. When $k = 0$, the consumer is not allowed to borrow at all. As k increases, the borrowing constraint becomes more relaxed and the consumer is allowed to borrow more. Thus, borrowing constraints are introduced as quantity constraints rather than price constraints, i.e., rather than a gap between borrowing and lending rates. Ludvigson (1999) presents evidence that actual lenders usually want to put the limit of borrowing as a fraction of permanent income. A change in the consumer's borrowing constraints due to the increase of credit limit in the credit card account or fluctuations in consumer loan condition can be reflected by the change in k.

As is well known, the above problem has no analytic solution due to the presence of the uncertainty in the future labor income. Hence, we apply numerical methods to solve the problem and obtain numerical solutions. Like other studies in consumption literature, we first take advantage of the recursive nature of the problem and then normalize all variables by P_t to reduce the number of state variables. Thus, the consumer's problem can be rewritten in the following form:

$$v_t(x_t) = \max\ u(c_t) + \beta E_t[v_{t+1}(x_{t+1})] \tag{6}$$

subject to

$$x_{t+1} = \frac{R}{GN_{t+1}}(x_t - c_t) + \varepsilon_{t+1} \tag{7}$$

$$x_t + k \geq c_t . \quad (8)$$

Lower-case letters are defined as $x_t = X_t / P_t$, $c_t = C_t / P_t$, and so on. To allow the normalization by P_t, the consumer is assumed to have the constant relative risk aversion (CRRA) utility function such as $u(C_t) = \frac{C_t^{1-\gamma}}{1-\gamma}$ when $\gamma > 0$; if $\gamma = 1$, $u(C_t) = \ln C_t$.[6]

To obtain numerical solutions, we set $\beta = 1/1.05$, R = 1.02, and G = 1.02. The log values of labor income shocks, $\ln \varepsilon_t$ and $\ln N_t$, are assumed to be independently, identically, and normally distributed with mean zero and variances σ_ε^2 and σ_N^2, respectively. Using empirical estimates from Carroll (1992), σ_ε and σ_N are both set equal to be 0.10. We also use discrete approximations of the distributions of shocks, ε_t and N_t in numerical methods. Under these parameter values, the following condition holds:

$$R\beta E_t[(GN_{t+1})^{-\gamma}] < 1 . \quad (9)$$

This condition is often known as "impatience condition" which ensures that the optimal consumption policy function converges to the unique infinite horizon solution and that the consumer wants to borrow when there is no borrowing constraint.

Denoting the end of life as T = 100, we compute the optimal consumption function recursively and consider the first period consumption function $(c_1(x))$ as the converged consumption function $(c(x))$, since $c_1 - c_2 < 0.0001$. We use a definition of the converged function from period 1 to define the MPC and evaluate its properties when the CRRA coefficient (γ) and borrowing constraint parameter (k) change. The maximum

[6] The assumption of CRRA utility function will be relaxed by the use of Kreps-Porteus preferences in the next section.

bound of k (2.5) is chosen considering the average credit limit per credit card and per capita GDP in the US. Gross and Souleles (2002) report that the average credit limit per credit card account is \$6,207 from January 1995 through January 1998, while the average per capita annual GDP in the US from 1995 through 1997 is \$29,296, which implies a monthly income of \$2,441.[7] Since the billing cycle of credit cards is usually one month, these numbers suggest that the average consumer can borrow up to $2.5(\approx 6207/2441)$ times of their income. Certainly, this is a conservative estimate about the limit of borrowing because a consumer is implicitly assumed to hold only one credit card and have no other personal loans.[8] Under this set-up, we perform simulations to investigate the effect of borrowing constraints changes on the MPC.

III. Simulation Results

To investigate whether the declining trend of the MPC can be explained by a standard representative consumer model, we calculate the average MPC across an economy of 4,000 consumers who follow the converged optimal consumption rule in the previous section, but who are subject to different realizations of income shocks randomly drawn from the corresponding distributions. Each consumer is endowed with a level of resources at the beginning of his working life. This initial endowment is randomly drawn from the estimated distribution of initial liquid wealth in Gourinchas and Parker (2002). To calculate a stable distribution of cash-on-hand across consumers, we use the level of normalized cash-on-hand in the current period to calculate current optimal consumption and the level of resources carried to the next period. We perform this exercise for 100

[7] The US per capita GDPs are taken from Penn World Table 6.1.
[8] Manning (2000, page 6) reports that "the typical American adult has about four retail, three bank, nearly one gasoline, and a travel and entertainment or a miscellaneous credit card."

periods to obtain the economy's distribution of cash-on-hand. It is from this stable distribution that we calculate the MPC for each consumer:

$$MPC = \frac{dC_t}{P_t d\varepsilon_t} = \frac{P_t dc((R/GN_t)(x_{t-1} - c_{t-1}) + \varepsilon_t)}{P_t d\varepsilon_t} = c'(x_t). \qquad (10)$$

Thus, equation (10) measures the MPC from temporary income changes, such as those from temporary tax cuts. Finally, we calculate the average of (10) across consumers.

Figures 1, 2 and 3 represent changes in optimal consumption as borrowing constraints change, when the CRRA coefficient $\gamma = 1$, 2, and 3, respectively. Consistently with previous studies, the consumption functions are concave and that optimal consumption is lower at all levels of cash-on-hand when γ is higher, holding k constant. As k increases for a fixed γ, the consumption function shifts to the left, implying greater borrowing to achieve a fixed level of consumption, or more intuitively, greater consumption at a fixed level of resources. This finding suggests that even consumers who are not currently constrained in their ability to borrow also increase consumption slightly as k increases, which is consistent with the findings in Gross and Souleles (2002). Those authors find that consumers who are not currently borrowing constrained increase their consumption slightly in response to an increase in borrowing capacity. As argued by the authors, consumers with non-binding constraints raise their consumption due to the weakened precautionary saving motive resulting from the relaxation of borrowing constraints. This interpretation is presented visually in Figures 1, 2, and 3.

When the change in borrowing constraints is small, the consumption function appears to shift by a similar amount of additional feasible borrowing regardless of the level of normalized cash-on-hand, as observed in Carroll (2001). However, for large changes in k, the consumption function shifts to the left by a relatively large amount for those consumers with low cash-on-hand relative to permanent income—that is, for consumers who were previously borrowing constrained. As a result, the consumption function becomes flatter and the cases where consumers would be constrained are fewer. The point at which the borrowing constraint begins to bind (represented by the kinks in the consumption functions) also falls as k becomes larger.

Consistent with these figures, Table 1 clearly shows that the average MPC falls as k increases. Specifically, when $\gamma = 1$, the MPC falls from 0.44 to 0.35 as k rises from 0 to 2.5. These values roughly coincide with the values found in Shapiro and Slemrod (1995, 2002, 2003). If the average consumer could borrow 250% of his income when the 2001 tax cut was implemented and if this borrowing ability had been increasing 10% per year as the credit card borrowings did in the past two decades, then the borrowing capacity (k) would have been approximately equal to permanent income in 1992 (k=1), when the tax withholding law was changed. These estimates also suggest that the MPC has fallen from 0.41 to 0.35 between 1992 and 2001 when $\gamma = 1$, which implies that a substantial portion of the decrease in the MPC can be explained by the rapid relaxation of the borrowing constraints due to the widespread credit cards. However, note that this prediction is robust for other values of CRRA coefficient γ.

When $k < 0.5$, changes in the average MPC are not very large. However, for $k > 0.5$, the decline in the average MPC is substantial. In this case, the consumer is able to better smooth temporary income shocks over time. In other words, the effect of negative temporary income shocks on consumption can be more easily offset by borrowing money as k increases. As a result, fewer and fewer consumers have binding borrowing constraints, given the labor income process, although consumers are impatient. This reasoning is presented in Table 2. As k increases, the cash-on-hand is distributed at a wider range (higher standard deviation of the cash-on-hand) and less and less consumers have binding borrowing constraints.[9]

Another noteworthy point in Table 1 is that when k is held constant, the average MPC becomes higher as γ decreases. Intuitively, as γ falls, the representative consumer becomes less risk-averse and has a higher elasticity of intertemporal substitution. Hence, the consumer with low γ is less concerned about income shocks and is more willing to spread out small negative temporary shocks over time. As a result, the borrowing constraints are more likely to be binding to the consumer with lower γ, which implies higher MPC when γ is low and k is held constant.

To verify this line of logic, we solve the same representative consumer's problem under the assumption of Kreps-Porteus preferences, which break down the tight relation between the risk aversion coefficient and elasticity of intertemporal substitution in the CRRA utility function. With the optimal consumption function under Kreps-Porteus preferences, we also compute the average MPC from simulations of an economy based on 4,000 consumers. As shown in Table 3, when the risk aversion coefficient is held constant at 3, the average MPC increases as the elasticity of intertemporal substitution becomes higher. As consumers become more eager to spread out negative temporary shocks over time, consumers are more likely to have binding borrowing constraints and

[9] The negative average cash-on-hand, however, is not an accurate description of wealth for the average or median household. This result occurs because young consumers choose to borrow heavily when income is low, expecting that they can repay the debt sometime in the future.

higher MPC. Also, when elasticity of intertemporal substitution is held constant at 0.1, the average MPC increases as the risk aversion coefficient becomes lower. As consumers become less concerned about income shocks, consumers have a weaker motive of precautionary saving and higher MPC. All these results also suggest that the average MPC falls as k increases when the risk aversion coefficient and elasticity of intertemporal substitution are held constant because borrowing constraints are less and less likely to be binding with higher values of k.

IV. Conclusion

This paper shows that the two seemingly unrelated phenomena, the declining MPC and rapid and widespread of credit cards, may be related to each other through consumers' borrowing constraints. The current widespread use of credit cards is predicted to make consumers less responsive to temporary changes in income than they were a generation ago. Because of this increased ability to borrow, consumers are better able to smooth temporary income shocks and maintain a smooth level of consumption over time.

Although the underlying intuition is straightforward, the relation between the MPC and the change of borrowing constraints resulting from the use of credit card has important implications in macroeconomics. First, policy makers should now account for the possibility that consumers will be less responsive to temporary changes in taxes than they were in the past due to the fact that they have greater access to credit card borrowing. Instead of using tax rebates to purchase additional consumption goods, consumers with the ability to borrow may use the temporary windfall to pay down debt or to save for future consumption. In most countries where credit card use is growing, the responsiveness of consumers to fiscal stimulus plans may also decrease over time.

Secondly, by giving consumers easy access to credit, the widespread use of credit cards may also have important implications for the propagation of shocks in business cycle shocks. The existence and nature of borrowing constraints can play a crucial role in the prediction of such models.

Finally, the model predicts that all consumers, not just those who are currently borrowing constrained, respond to an increase in borrowing capacity. This prediction is consistent with buffer stock models, where consumers maintain a stable stock of wealth to protect themselves against possible financial emergencies. In this model, even consumers with a large level of cash-on-hand relative to permanent income are still predicted to increase consumption when borrowing constraints are relaxed, although not nearly as much as those consumers who hold a low level of cash-on-hand relative to permanent income.

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Table 1. Borrowing Constraints and the Average MPC under CRRA Utility Function

Constraints	$\gamma = 1$	$\gamma = 2$	$\gamma = 3$
	$\overline{m}$	$\overline{m}$	$\overline{m}$
0%	0.4419	0.3728	0.3184
10%	0.4424	0.3715	0.3148
20%	0.4414	0.3691	0.3103
50%	0.4344	0.3567	0.2912
100%	0.4132	0.3268	0.2539
250%	0.3479	0.2475	0.1751

Notes. Binding point is the level of cash-on-hand where the borrowing constraints begin to be binding. $\overline{m}$ is the average MPC across 4,000 consumers.

Table 2. Borrowing Constraints and the Distribution of Cash-on-hand under CRRA Utility Function

k	$\gamma = 1$			$\gamma = 2$			$\gamma = 3$		
	$\bar{x}$	$\sigma(x)$	Binding fraction	$\bar{x}$	$\sigma(x)$	Binding fraction	$\bar{x}$	$\sigma(x)$	Binding fraction
0%	1.034	0.108	0.486	1.059	0.117	0.309	1.087	0.128	0.197
10%	0.934	0.109	0.479	0.961	0.118	0.294	0.991	0.129	0.179
20%	0.835	0.110	0.469	0.863	0.120	0.273	0.896	0.131	0.162
50%	0.542	0.121	0.416	0.579	0.132	0.220	0.626	0.145	0.108
100%	0.069	0.155	0.309	0.132	0.170	0.124	0.213	0.186	0.044
250%	-1.24	0.310	0.098	-1.05	0.290	0.012	-0.79	0.358	0.006

Notes. $\bar{x}$ denotes the average normalized cash-on-hand across 4,000 consumers. $\sigma(x)$ denotes the standard deviation of the normalized cash-on-hand. 'Binding fraction' represents the fraction of consumers whose borrowing constraints are binding.

Table 3. Borrowing Constraints and the Average MPC under Kreps-Porteus Preferences

Constraints	Risk aversion coefficient = 3		
	EIS = 0.01	EIS = 0.1	EIS = 1.0
	$\overline{m}$	$\overline{m}$	$\overline{m}$
0%	0.250	0.281	0.499
10%	0.236	0.265	0.467
20%	0.227	0.251	0.451
100%	0.156	0.168	0.358
250%	0.045	0.088	0.075

Constraints	Elasticity of intertemporal substitution = 0.1		
	RA = 1	RA = 2	RA = 3
	$\overline{m}$	$\overline{m}$	$\overline{m}$
0%	0.435	0.358	0.281
10%	0.424	0.352	0.265
20%	0.440	0.337	0.251
100%	0.993	0.263	0.168
250%	0.039	0.183	0.088

Notes. Binding point is the level of normalized cash-on-hand where the borrowing constraints begin to be binding. $\overline{m}$ is the average MPC across 4,000 consumers. EIS denotes the elasticity of intertemporal substitution and RA denotes the risk aversion coefficient in Kreps-Porteus preferences.

Figure 1. Consumption Policy Function and Borrowing Constraints under CRRA Utility Function ($\gamma = 1$)

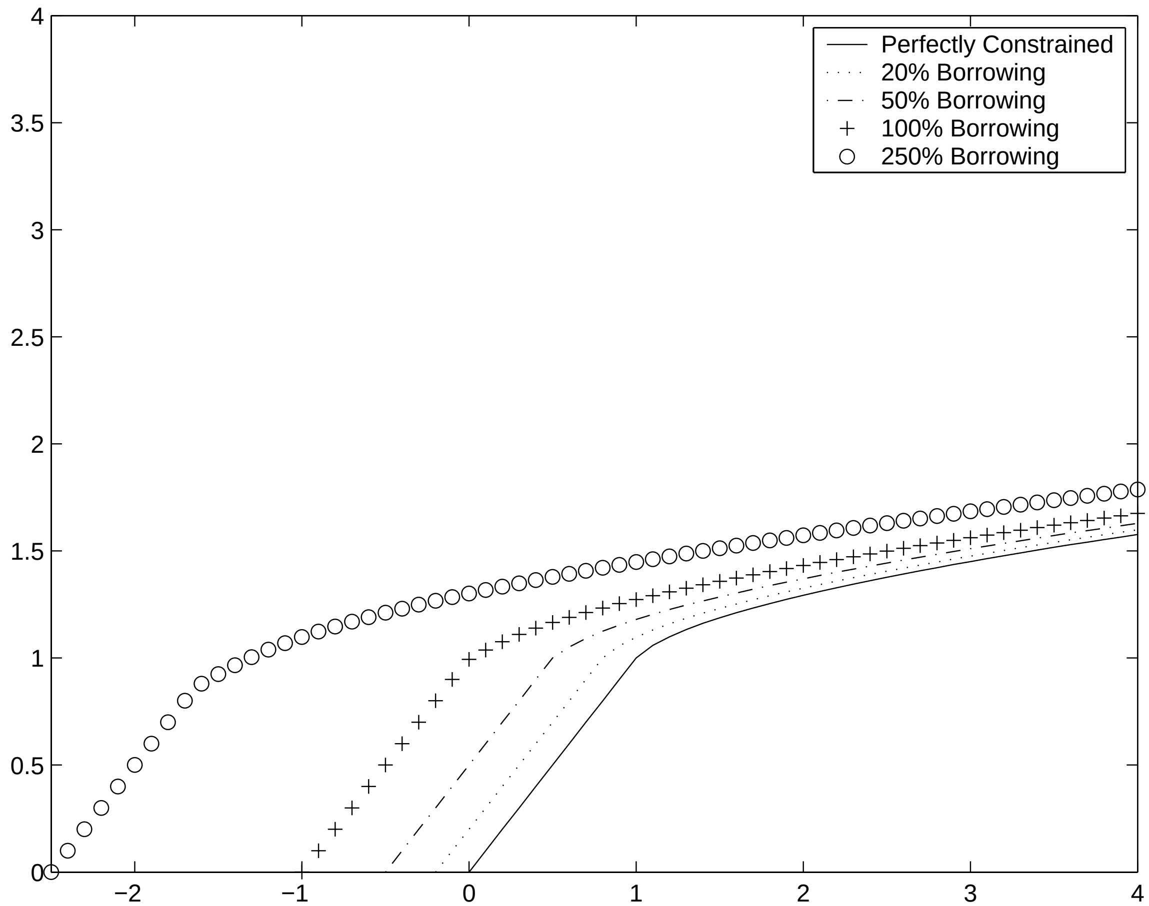


Figure 2. Consumption Policy Function and Borrowing Constraints under CRRA Utility Function ($\gamma = 2$)

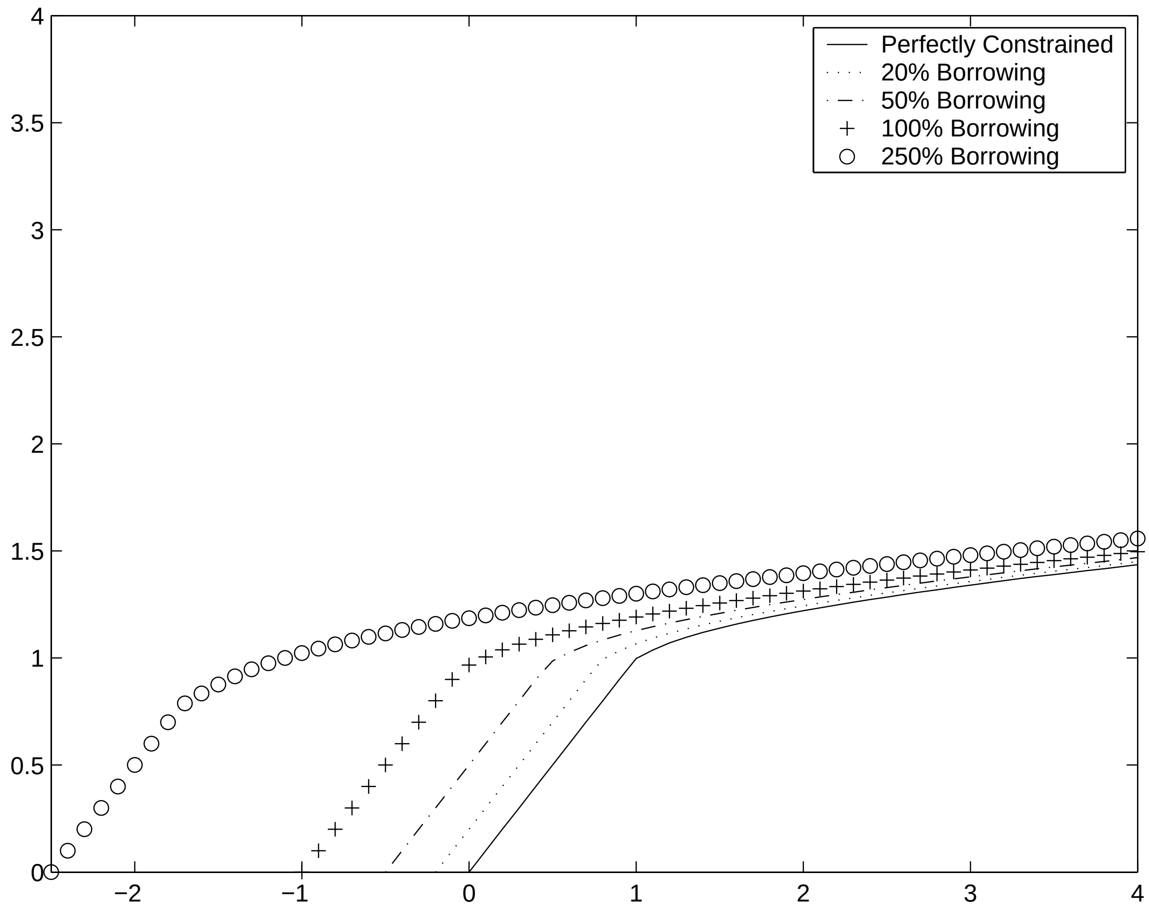
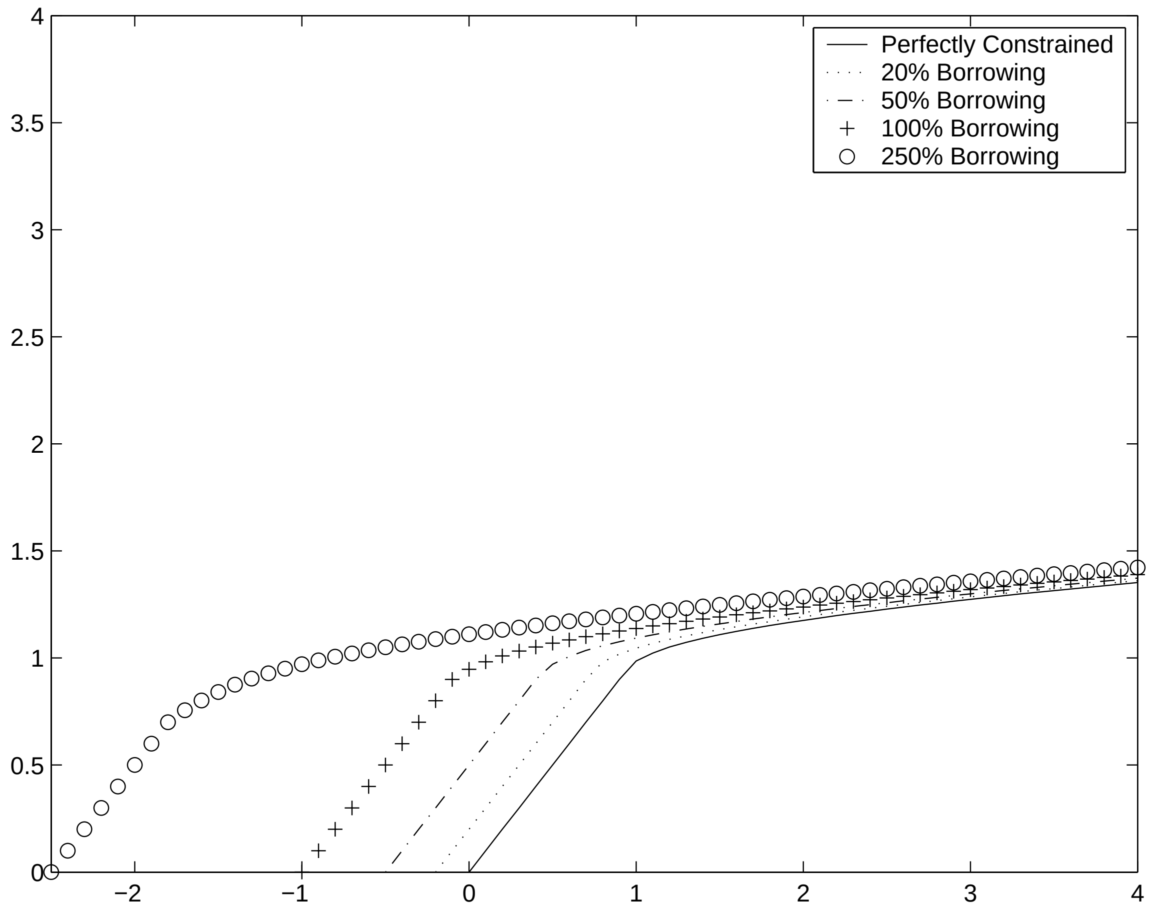


Figure 3. Consumption Policy Function and Borrowing Constraints under CRRA Utility Function ($\gamma = 3$)



Appendix

Table A-1. Implied Values of the Average MPC for Alternative Distributions of the Individual MPC

a	b	c	$\overline{m}$
0.0031	2.0291	0.9850	0.4715
0.0331	2.0058	0.9900	0.4710
0.0624	1.9831	0.9950	0.4705
0.0912	1.9680	1.0000	0.4701

See Shapiro and Slemrod (2002) for the parameterization of the distribution of individual MPCs. $\overline{m}$ is the average MPC. To maintain non-negative a, c must be equal to or greater than 0.9850. This table computes $\overline{m}$ based on survey results in Shapiro and Slemrod (1995).