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Testing hyperbolic discounting in consumer decisions: Evidence for Argentina ☆

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Abstract

The paper focuses on deep parameter estimates following the GMM-approach applied to a modified Euler-Equation which nests the case of a quasi-hyperbolic discount function. Parameter estimates for Argentina match with a discount function in which procrastination is a key feature.

Keywords: Euler-Equation; GMM; Hyperbolic discounting; Procrastination

JEL classification: D91; E21

1. Introduction

People could behave differently when they decide about short-run and long-run tradeoffs. This fact has been suggested in the literature since long time ago (Strotz, 1956) and reconsidered again in the nineties (Loewenstein and Prelec, 1992; Sozou, 1998; Laibson, 1997; Harris and Laibson, 2001; Frederick et al.,

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Table 1
GMM estimates of deep parameters

GMM estimates HEE-CRRA 1980:1-2005:3	Weighting Matrix Estimator		
	Newey–West (nw) fixed (3)*	Andrews (3.81)*	Newey–West variable (6)*
β	1.022	1.019	1.028
Std. error	0.064	0.065	0.067
γ	0.340	0.312	0.366
Std. Error	0.120	0.132	0.115
δ	0.984	0.986	0.980
Std. Error	0.043	0.044	0.046
J-statistic	0.100	0.104	0.070

*Lag truncations are in brackets.

2002, among others). Strotz (1956) first suggested that people are more impatient in the short-run decisions than in the long-run ones. The contrast between long-run patience and short-run impatience is captured with discount functions that take the hyperbolic form.

Sozou (1998) recognizes the systematic preference for an immediate reward and adds that a plausible reason for this behaviour is the risk that a future reward will not be realized. Recently, Dasgupta and Maskin (2005) showed that "…if the 'average' situation entails some uncertainty about when payoffs are realized, the corresponding preferences may well entail hyperbolic discounting, giving rise to preference reversals" (Dasgupta and Maskin, 2005, p. 1290).

In the empirical field, most of the research has consisted in numerical simulations to compare the outcomes of the models relative to a set of stylized facts. In this paper, instead, structural parameters of consumer decisions are estimated applying Generalised Method of Moments (GMM) to an Euler-Equation that takes into account the possibility of different discounting rates. Exponential and hyperbolic discounting can be tested performing an empirical approximation of the Euler-Equation obtained in Harris and Laibson (2001).

Short-run and long-run discount rates along with the risk aversion coefficient are estimated for the aggregate consumer expenditure of Argentina using quarterly data 1980–2005. In a previous work (Ahumada and Garegnani, 2004) an exponential model was found for the period 1980–2001. However, when the sample is extended to include the 2002–2005, the new macroeconomic environment, which follows the sovereign debt default and the abandonment of a 10-year-old convertibility regime, suggested that a different perception about the realization of future rewards would be revealed from consumer behaviour.

The next section discusses some methodology issues and presents econometric results. Section 3 concludes.

2. Exponential vs. hyperbolic discounting in the Euler-Equation

Laibson (1997) and Harris and Laibson (2001) used the hyperbolic discounting for modelling consuming vs. saving behaviour. In order to reflect this pattern of discount rates, they adopted a discrete-time discount function, $\{1, \beta\delta, \beta\delta^2, \beta\delta^3, \beta\delta^4,\ldots\}$. This "quasi-hyperbolic function" reflects a faster rate of decline in the short-run over that in the long-run. The short-run discount factor is $\beta\delta$ and the long-run discount factor is δ. The hyperbolic discounting function nests the standard case of exponential

Table 2
GMM estimates of deep parameters (weighting with dummies for period 2002:1-2005:3)

GMM estimates HEE-CRRA 1980:1-2005:3	Weighting matrix estimator		
	Newey–West (nw) fixed (3)*	Andrews (3.41)*	Newey–West variable (7)*
β	0.9773	0.9780	0.9747
Std. Error	0.0023	0.0024	0.0018
γ	0.1225	0.1093	0.1819
Std. Error	0.0539	0.0584	0.0441
δ	1.0009	1.0008	1.0010
Std. Error	0.0009	0.0010	0.0007
J-statistic	0.1401	0.1449	0.0998

*Lag truncations are in brackets.

discounting when $\beta=1$. In their model a Hyperbolic Euler-Equation (HEE) when the utility function is of a constant relative risk aversion form (CRRA)[1] is,

$$C_t^{-\gamma} = E_t[R(C'_{t+1}\beta\delta + (1-C'_{t+1})\delta)C_{t+1}^{-\gamma}] \tag{1}$$

where C is the per capita private consumer's expenditure, R is the gross return on savings, C' is the derivative of C with respect to cash-on-hand, β and δ are the discount factors, $\beta\delta$ is the short-run discount factor, δ is the long-run discount factor, and, finally γ is the (absolute value of) the risk aversion parameter.

Table 1 presents the GMM estimates for Argentina of these deep parameters[2]. In this empirical application, C' was approximated by the actual ratio of current consumption to current cash-on-hand (current income plus cash holding)[3]. Besides, as in Ahumada and Garegnani (2004), returns were approximated by the real deposit interest rates and the rate of growth of the real exchange rate.[4]

Estimation of a HEE for the whole period (1980:1 to 2005:3) showed that the β parameter is not different from 1[5], which means that the standard Exponential Euler-Equation represents Argentine consumers' behaviour. This finding coincides with the results in Ahumada and Garegnani (2004). When $\beta=1$, the term $(C'_{t+1}\beta\delta+(1-C'_{t+1})\delta)$ in (3) is equal to δ and the exponential discounting case is obtained.

Nevertheless, a remarkable property of the HEE is that it allows for liquidity constraints. As Harris and Laibson (2001) suggest, when low levels of cash-on-hand are expected, C' will be close to one and the effective discount factor will be $\beta\delta$, while when high levels of cash-on-hand are expected, C' will

[1] This equation corresponds to Eq. (11) in Harris and Laibson (2001).

[2] The instruments used are the second and third lagged values of growth rate of consumption, the growth rate of the real exchange rate and the real interest rate separated into both components, the nominal interest rate and inflation. EViews was used. See the user's guide for a description of each weighting matrix estimator, and see Favero (2001) for a description of GMM.

[3] In this case the marginal propensity to consume is assumed to be equal to the mean propensity to consume. Cash-on-hand was approximated by national income at current prices plus end-of-last-period money holding for transaction purposes (currency, current account and saving accounts). In order to evaluate the sensitivity of results to these weights, ad-hoc weights between 0.5 and 0.9 were also tried in the GMM estimation, but the main findings remained.

[4] The rate of growth of real exchange rate has been considered one of the main variables explaining the variation of "perceived wealth" in Argentina. Since the exchange rate was nominally fixed under the convertibility regime, this rate was approximated in real terms by the ratio of wholesale to consumer prices. Thus, returns are included in I(0) form.

[5] According to a Wald test, the β parameter was not different from 1 for the whole period (with probability 0.6758, using the Variable Newey–West weighting matrix estimator).

Table 3
Wald coefficient restrictions

Wald test: null hypothesis = β = 1	
Test statistic	Probability
Chi-square	0.0000
Wald test: null hypothesis = δ = 1	
Test statistic	Probability
Chi-square	0.1597

be close to zero and the discount factor will be δ. In general, the effective discount factor will be a weighted average of these factors, with the weights determined by the marginal propensity to consume out of liquid wealth. As low levels of cash-on-hand imply that agents are liquidity constrained, the HEE appears appropriate to describe consumer decisions when these constraints are binding. Garegnani (2005) and Ahumada and Garegnani (2005) have shown that Argentine consumers can be considered as facing liquidity constraints but only after 2002, when a new monetary, exchange rate and financial regimes started. These results have been obtained applying different tests to an equilibrium-correction model of the consumption function. Given these findings, the estimations were performed with the weights C'_{t+1} entering the equation only in 2002:1 to 2005:3, through a multiplicative dummy for this period. If the coefficient β were less than one, consumer behaviour would be represented by HEE since the beginning of the new regime. Results are presented in Table 2, which also shows the robustness of the estimations to the choice of the method to estimate the weighting matrix.[6]

As can be observed, the (absolute) value of the relative risk aversion coefficient (g) is positive, representing concave preferences.

It is worth noting that in this case the estimate of β is 0.97, which is different from 1 when HEE is assumed since 2002. Table 3 shows that the Wald statistic rejects this hypothesis. Tables 2 and 3 also show that the discount factor δ is not different from 1, at traditional levels[7]. This value of the discount factor matches with a discount function of the form $\{1, \beta, \beta, \beta, \beta, \ldots\}$, a form which is used by Akerlof (1991). Such a function represents decision makers who weigh today's rewards more than any greater rewards in the future. Procrastination is a key feature of this kind of behaviour. Procrastination occurs when "present costs are unduly salient in comparison with future costs, leading individuals to postpone tasks until tomorrow without foreseeing that when tomorrow comes, the required action will be delayed yet again" (Akerlof, 1991, p.1; see also Harris and Laibson, 2001, p. 7.). This type of behaviour would be revealed for the representative Argentine consumer after the 2002 break.

3. Conclusions

In this paper an empirical approximation of a Hyperbolic Euler-Equation is performed to obtain deep parameters describing consumer decisions. This equation, which also nests the standard exponential case,

[6] Issler and Scotto Piqueira (2000) used seasonal dummy variables in the GMM estimation of Euler-Equations for Brazilian consumers.

[7] The validity of instruments is not rejected using the J statistic suggested by Hansen (1982).

implies that people could have a higher discount rate between the present and the next period than between any subsequent periods.

The results for Argentina show that while for 1980–2001 period an exponential discount function is obtained, for 2002–2005 period a hyperbolic discount functio n appears behind Argentine consumption-saving decisions. The new macroeconomic environment started in 2002 may imply a different perception about the realization of future rewards. This behaviour can be reflected by the hyperbolic discount factor that allow for distinguishing short-run from long-run impatience and could be observed when consumers faced liquidity constraints. Moreover parameter estimates are compatible with the case in which consumers procrastinate.

Appendix A. Data sources

Private Consumption and *Gross National Disposable Income*: ECLAC, Buenos Aires and Dirección Nacional de Cuentas Nacionales (INDEC).

Real Exchange Rate (ratio of wholesale to consumer prices) and *Inflation* ($p_t - p_{t-1}$, where p_t is the log of the general level of consumer prices): INDEC.

Interest Rate (30–59 days deposit interest rate) and *Currency*, *Current account and Saving account deposits*: Banco Central de la República Argentina (BCRA).

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