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Direct Measures of Time Preference

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Abstract: This work constitutes an attempt to estimate time preference factors in a direct way from survey data, without relying on consumption data and on particular estimation techniques. By using microeconomic data obtained from the Bank of Italy Survey of Household Income and Wealth (for the year 2000) and a simple second order Taylor expansion of a generic utility function we will compute, for each agent, a utility discount factor. The interesting features of the dataset will also enable us to relate discount factors to a large number of social, economic, and demographic variables. Agents do appear to discount future utility flows at rates which vary across age, education, civil status, income and wealth situations; more importantly, it is suggested that risk and market incompleteness should be considered as important determinants of time preference parameters.

I INTRODUCTION

Why do people discount utility of future consumption? Or, why are people impatient? This is a question which has been raised several times in the literature and in policy debates, and which remains fundamentally unanswered.

Of course, we are not wondering about the reasons why an agent with an uneven distribution of endowments across time periods should try to make

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that distribution even, as the mechanisms of intertemporal allocation of consumption have largely been explored, at least since the work of Böhm-Bawerk (1959), and still constitute the focus of interesting theoretical and empirical work.

The problem which is addressed in this paper is, rather, the following: why should people with a *smooth* distribution of resources and with time independent preferences prefer to anticipate consumption, that is, be impatient. This attitude, known as *pure* time preference, since the work of Irving Fisher (1930) is, in a sense, a more fundamental one, and is the focus of this research.

There have been many attempts, in the literature, to assess the magnitude of time preference parameters, but these have been mostly based on the estimation of Euler equations for rates of growth of consumption (as, for example, in Lawrance (1991) and in Dynan (1993)) or experimental data (see, for a recent example, Anderhub *et al.* (2001)).

The estimation procedure presents some limitations and drawbacks: first of all, it relies on specific functional forms for utility functions, and on hypotheses about separability, additivity, etc. Second, it postulates a correct assessment of interest rates, which enter in a non trivial way in the Euler equations. Using one measure of interest rate rather than another is very likely to strongly affect the results of the estimation. Last but not least, estimating Euler equations assumes that first order conditions for optimal consumption hold, which is not the case if there are frictions in the markets for capital (and/or goods).

On a distinct ground of criticism, recent research papers (Ludvigson and Paxon (2001) and Carroll (2001)), have shown that linear approximations to Euler equations (which is implied by linear regressions of Euler equations) might be affected by a potentially important approximation bias.

In this work a new, more direct approach to the assessment of time preference parameters will be introduced, which is based upon the use of recently released data from the Bank of Italy Survey on Households Income and Wealth (SHIW) for the year 2000.

In the framework of Samuelson (1937) discounted utility model and under somewhat milder assumptions on the structure of preferences (in particular, without imposing any restriction on the shape of individuals' instantaneous utility function) it will be possible to derive intertemporal preference factors by using a simple quadratic Taylor series expansion.

As this will be done on a very large group of (2,228) individuals, it will also be possible to split the sample according to age and other social and demographic dimensions and check the dynamics of time preference. Moreover, in an effort to better assess the relevance of various factors which might be thought to determine pure time preference, we will perform a Tobit estimation and derive interesting conclusions, that will suggest avenues for future research.

A novel feature of the analysis consists in the fact that our data also allow us to compute, at least locally, the curvature of utility functions, which will make it possible both to account for concavity of utility in the computation of time preference parameters, and to establish some interesting links between those parameters and others, governing agents' attitudes towards risk (in particular the coefficient of absolute risk aversion).

The rest of the work is organised as follows: Section II contains a brief review of literature; Section III introduces the model used to compute time preference parameters. Section IV illustrates the results obtained for various groups of agents; Section V presents the results of a Tobit estimation, relating time preference to some variables of interest. Section VI concludes, with some final remarks.

II LITERATURE

That agents may display *pure* time preference might seem irrational, as it was suggested by various distinguished theorists (Jevons, 1965; Marshall, 1920; Pigou, 1932; Ramsey, 1928; just to cite a few), but even casual empiricism or personal experience suggest this is indeed the case. Most people are impatient, to a smaller or larger degree, and most evaluate differently the benefits derived from consumption at different stages of life. Why this is so, is still an open question.

A certain number of alternative theories have recently been put forward to provide tentative answers to the existence of positive rates of time preference, of which a very comprehensive and detailed survey can be found in the recent work by Frederick *et al*. (2002). Some authors (like Hansson and Stuart, 1990 and Rogers, 1994) impute discounting to some sort of evolutionary dynamics, in the sense that agents discounting little or much could be the winners in some kind of "evolutionary contexts".

Others, as in Posner (1995), argue that a single economic agent contains, in some sense, many "selves", corresponding to different periods or situations in lifetime, and that the weight attached to some (typically the ones corresponding to situations in the more distant future) of these "selves" will normally be smaller than the one attached to others. Others still, (as is the case in Becker and Mulligan (1997)) invoke a rational "defective recognition of future utilities" to explain this phenomenon.

Quite recently, a new intriguing theory presented by Trostel and Taylor

(2001) has argued that the instantaneous utility function (the “felicity” function, as it is often called) varies with age, as the ability of individuals to enjoy consumption is very likely to vary during the course of life. Therefore, while ruling out the existence of an intrinsic preference for present consumption, this theory would allow for positive rates of time preference on the grounds that people tend to rationally devalue consumption in periods of low expected felicity.

More recently some contributions (Prelec and Loewenstein, 1991 and Keren and Roelofsma, 1995) have in some way linked time preference to uncertainty, suggesting that impatience might be linked to uncertainty of future prospects. Recent empirical work by Anderhub *et al*. (2001), based on experimental data, offers some support to this view.

The issue of uncertainty is also obviously related to market incompleteness, under which individuals are prevented from redistributing resources across states of the world and periods of time, or both. The relationship between utility discounting and uncertainty, or attitudes towards risk, should therefore carry over to market incompleteness or incomplete market participation.

A related, though distinct, question concerns the dynamics of time preference. It is certainly interesting and policy relevant to assess the variability of impatience across age and other social and demographic dimensions. Many of the theories of intertemporal preference (including the above mentioned) bear some implication about the dynamics of utility discounting, especially for what concerns variability across age. Once again, however, the implications and the relative empirical tests (when available) are far from unambiguous. Some studies (Cropper *et al*., 1994; Yaari, 1965; Attanasio *et al*., 1995; Trostel and Taylor, 2001) suggest that the rate of time preference falls and then rises (sometimes dramatically) with age. Others (Rogers, 1994; Posner, 1995; Becker and Mulligan, 1997) indicate that a somewhat inverse pattern might also emerge.

The analysis that follows will also shed some additional light onto these matters, and show interesting dynamics of time preference parameters across age, risk, education, and other important variables.

III THE MODEL

To get a quantitative idea of time preference parameters we are going to use the answers to two questions which were asked of family heads in the most recent (year 2000) wave of the Bank of Italy Survey on Household Income and Wealth (SHIW) run every two years on a very large number of households.

The first question, number E12, asks the following: "Suppose you have been told you won 10 million lire, that you will be able to cash, for sure, in a year. What is the most you are prepared to pay to immediately get the 10 million lire?"

The second question we are going to use, number E13, asks the following: "And if the 10 million lire were only available in two years, what is the most you would be prepared to pay to get them immediately?"

The respondents can either specify a monetary amount, or declare they do not know, or simply refuse to answer.

To understand the way we can use the answers to those questions to estimate discount factors, let us suppose we are dealing with agents having preferences represented, at a time t, by a time additive, but otherwise generic intertemporal utility function of the kind $U_t(w) = \sum_{s=t}^{t} u(w_s)$, where w_s is a given level of wealth enjoyed in year s.

Having defined instantaneous utility $u(w)$ over wealth we are implicitly assuming a sort of derived (or indirect) utility function, which accounts for immediate consumption as well as for the share of wealth which will generate consumption in all the subsequent periods. However, as will become clear in the sequel, we will not explicitly consider the level of wealth w in our calculations, which means that we might as well have defined instantaneous utility over income or total consumption without substantially affecting the results of the analysis.

More importantly, we suppose that agents discount the utility derived from consumption at a date s > t using a factor β^{s-t}, which will be contained within the unit interval.

By interpreting the answers to question E12 and E13 as reservation prices (which we will denote, in the sequel, by x_1 and x_2) over which agents would turn down the offer of anticipating the delivery of the ten million lire, and assuming agents own (or, rather, that they think they will own) the same level of income, w, for two or, respectively, three consecutive periods, we can set the following equalities (where the time index has been omitted, for simplicity):

$$u(w + 10 - x_1) + \beta\, u(w) = u(w) + \beta\, u(w + 10) \qquad (1)$$

for the first question and

$$u(w + 10 - x_2) + \beta\, u(w) + \beta^2\, u(w) = u(w) + \beta\, u(w) + \beta^2\, u(w + 10) \qquad (2)$$

for the second (notice that we have expressed all monetary amounts in million lire).

We may immediately notice that all the other terms in the summation of instantaneous utilities have been eliminated (as they are irrelevant to the choice under analysis) and that expression (2) can be further simplified into:

$$u(w + 10 - x_2) + \beta^2 u(w) = u(w) + \beta^2 u(w + 10) \tag{3}$$

In writing expressions (1) and (2) it is apparent that we are implicitly assuming that the discount factor remains constant for at least two years, which seems a relatively mild assumption.

From (1) and (3) it is easy to realise that $\beta = 1$ when $x_1 = x_2 = 0$. Let us now concentrate on the interesting case in which we have: $x_2 > x_1 > 0$.

A second order Taylor series expansion around the point w of (1) and (3) yields, respectively:

$$u(w) - u'(w)(10 - x_1) + 0.5u''(w)(10 - x_1)^2 + \beta u(w) = u(w) + \beta\,[u(w) + 10u'(w) + 50u''(w)] \tag{4}$$

and

$$u(w) - u'(w)(10 - x_1) + 0.5u''(w)(10 - x_1)^2 + \beta^2 u(w) = u(w) + \beta^2\,[u(w) + 10u'(w) + 50u''(w)] \tag{5}$$

which can be further simplified and rearranged, with some algebraic manipulations, into:

$$[10u'(w) + 50u''(w)](1 - \beta) = u'(w)x_1 + u''(w)(10x_1 - 0.5x_1^2) \tag{6}$$

and

$$[10u'(w) + 50u''(w)](1 - \beta^2) = u'(w)x_2 + u''(w)(10x_2 - 0.5x_2^2). \tag{7}$$

The interpretation of Equations (6) and (7) is quite immediate: the left hand side represents the net utility gain from getting in advance the proposed amount of money (10 million lire). The right hand side, on the other hand, represents the cost that one has to bear to get the money in advance (i.e. x_1 or x_2). The net gain must be at least as great as the net benefit, to induce an agent into offering x_1 or x_2, in order to immediately obtain the money.

It is also clear that given our assumption about the constancy of β for the two periods, we have to consider expressions (6) and (7) as two equations in two unknowns, β and $u(w)$, in order to get a unique solution.

Computing the ratio of (7) to (6) we obtain:

$$\frac{(1-\beta^2)}{(1-\beta)} = \frac{u'(w)x_2 + u''(w)(10x_2 - 0.5x_2^2)}{u'(w)x_2 + u''(w)(10x_1 - 0.5x_2^2)} \tag{8}$$

which can be further simplified as:

$$\beta = \frac{u'(w)x_2 + u''(w)(10x_2 - 0.5x_2^2)}{u'(w)x_2 + u''(w)(10x_1 - 0.5x_2^2)} - 1 \tag{9}$$

Expression (9) is very close to our final result, as it expresses the factor of time preference as a function of first and second derivatives of the utility function and of the monetary quantities x_1 and x_2.

It is worth noticing the importance of considering the curvature of the utility function in correctly assessing agents' degree of (pure) time preference. As marginal utility increases as income decreases, we have total utility going down at an increasing rate as x_1 (or x_2) increases. Disregarding the curvature of utility functions, therefore, could lead to a serious underestimation of time preference.

If we possessed information about the curvature of agents' utility, it would be very easy to recover (9) in terms of observables.

In fact, let us denote by $A(w)$ the coefficient of absolute risk aversion, and by $k = -A(w)$ the opposite of this coefficient. Therefore, the following holds:

$k = \dfrac{u''(w)}{u'(w)}$, which implies: $u''(w) = ku'(w)$,

Substituting the latter expression into expression (9) we obtain:

$$\beta = \frac{u'(w)x_2 + u''(w)(10 - 0.5x_2^2)}{u'(w)x_2 + u''(w)(10 - 0.5x_2^2)} - 1 = \frac{[x_2 + k(10x_2 - 0.5x_2^2)]}{[x_1 + k(10x_1 - 0.5x_1^2)]} - 1 \tag{10}$$

which is an expression we can use to compute β out of our data.

Of course, we will not be allowed to apply expression (10) to all (x_1, x_2) pairs, as a cursory examination of the formula reveals. In particular, expression (10) is not defined for $x_1 = x_2 = 0$ (though the limit is clearly seen to be 1, using De l'Hospital's rule). In this case, however, we already know that $\beta = 1$. Moreover, expression (10) cannot be applied when $x_2 \leq x_1$. In such a case our formula would either yield a negative number, or zero, which could not be interpreted as a signal of very low, or negative, time preference factors, but rather as a signal of the occurrence of what is called "hyperbolic discounting" (see also, for a comprehensive survey, the work by Frederick *et al*. (2002)). Expression (10) cannot be applied, as well, when x_2 is much larger than x_1, in a way which is not compatible with fixed (across one or two periods) discount factors and exponential discounting. In this case our formula would return a value of β larger than one, which of course should not be interpreted in the sense of assigning more weight to the future than to the present (in such a case we should observe negative values for x_1 or x_2, which we never do in our data-set).

With these caveats in mind, we may now turn to the computation of individuals' coefficients of absolute risk aversion, which is possible using our micro data. To do so, we use the answers to the following hypothetical question posed by the Central Bank in its 2000 survey (question E14): "You are offered the opportunity of acquiring a security permitting you, with equal probabilities, either to gain 10 million lire or to lose all the capital invested. What is the most you are prepared to pay for this security?" The answer to this question is, again, a reservation price, above which the investor rejects the offer. Denoting the reservation price by z, an unfavourable state of nature results in income of $w - z$, a favourable state results in $w - z + 10$, and expected income is $w - z + 5$, where all values are again measured in millions of lire. Following Guiso and Paiella (2001) and Eisenhauer and Ventura (2003), who used this question to obtain a measure of risk aversion, it is quite easy to show that:

$$A(w) = -U''(w)/U'(w) = \frac{10 - 2z}{50 - 10z + z^2} \tag{11}$$

where, again, a second order Taylor expansion (this time around w) has been used to obtain the coefficient of absolute risk aversion. It may be worth noticing that expression (11) has been computed by considering the 10 million lire at stake as a gross gain, i.e. not taking into account the price of the lottery, z. Alternatively, as in Guiso and Paiella (2001), the reward might be considered as a net gain, which would ultimately lead to a slightly different expression for (11). However, as it was claimed in Eisenhauer and Ventura (2003), there are good reasons to stick to either interpretation, and since the adoption of one or the other version does not affect the results of the subsequent analysis in a substantial way, only expression (11) will be used.

A remark is worth making. It can be easily checked that as z varies between 0 and w the coefficient of absolute risk aversion varies between 0.20 and – 0.20 (negative risk aversion identifies a risk lover). In particular, this means that absolute risk aversion will never exceed the upper limit of 0.20, and that among people reporting a zero value for z many will in fact have a coefficient of risk aversion higher than the upper limit, and our data are not such to reveal it. On average, therefore, we could think that the measures of absolute risk aversion we get from (11) will underestimate the true coefficients, but they will still be useful for our main purpose.

In fact, by setting $k = -A(w)$ we can evaluate expression (10) for all the individuals in our sample. Now, taking the first derivative of (10) with respect to k, yields:

$$\frac{\partial \beta}{\partial k} = \frac{0.5x_2(x_1 - x_2)}{[1 + k(10 - 0.5x_1)]^2 x_1} \tag{12}$$

as x_1 and x_2 are both positive and $x_2 \geq x_1$.

In view of (12) and of the previous comments about the potential downward bias in our measure of absolute risk aversion, we can expect β to be, on average, underestimated (nevertheless, we should also consider the fact that the bias affects the second order term of the Taylor approximation).

IV A PRELIMINARY LOOK AT DATA

Our initial sample consisted of 3,933 people, from the year 2000 Survey of Household Income and Wealth, all of whom were asked questions E12, E13 and E14. Out of this group of people, we eliminated 696 individuals as they either declared not to know the answer, or simply refused to answer questions E12 and E13. On the other hand, also in the case of question E14 some (just 20) agents refused to answer the question and some declared they did not know the answer. A total of 3,193 household heads did answer the question, and for 2,020 of them the answer was $z = 0$. Only agents reporting $z \geq 0$ were kept in the final sample. Furthermore, for some 308 cases we had $x_1 = 0$ and $x_2 \geq 0$. As the magnitude of x_2 was in most cases such to dispel the idea of a sort of threshold effect at work (whereby agents would recognise the difference in utility only over a two-years horizon and not on a one year horizon) we discarded those units from the sample (i.e. the response of those agents was attributed to lack of understanding or to a different discounting behaviour). Finally, deleting from the sample all the agents who reported a value of $x_1 \geq x_2$ and all the agents for whom the difference between x_1 and x_2 was such to yield a value $\beta > 1$ (in view of the remarks following the derivation of expression (10), in Section III), we were left with a total of 2,228 cases, which is still a large number, compared to the samples used in the previous contributions to this stream of literature.

Just to give an idea of the relative variability of time preference factors we could say that just about 10 per cent of the whole sample feature discount factors range from 0.03 to 0.5, whereas about 87 per cent of the sample display discount factors larger than 0.7.

In Table 1 below, are reported the main results of the calculations carried out on these survey data, according to the model presented in the previous section, and performed over a large number of different subgroups. The first column contains the description of the particular socio-demographic group under investigation. The other two columns contain, respectively: the size of the group and the mean value (within each group) of the average factor of time preference, β.

Table 1. *Discount Factors Across Different Socio-demographic Groups*

Group	*Size*	*β*	*Group*	*Size*	*β*
All	2,228	0.904			
Men	1,512	0.910	Household = 1	402	0.880
Women	716	0.891	Household = 2	590	0.907
Age <= 30	81	0.790	Household = 3	526	0.900
30 < Age <= 40	366	0.915	Household = 4	512	0.927
40 < Age <= 50	467	0.910	Household > 4	198	0.894
50 < Age <= 60	481	0.910	Employee	777	0.908
60 < Age <= 70	421	0.914	Self-employed	302	0.912
Age > 70	412	0.893	Unemployed	58	0.867
Elem. school	626	0.891	Housewife	184	0.906
Middle school	580	0.892	Retired	894	0.900
High school	665	0.922	Northern residents	951	0.924
College	216	0.926	Central residents	488	0.905
Married	1,558	0.911	Southern residents	789	0.878
Unmarried	232	0.873	Wealth < 100mm	680	0.864
Divorced	123	0.888	Wealth >= 100mm	1,548	0.921
Widower	315	0.898	Income < 20mm	235	0.847
Home owners	1,565	0.918	Income >= 20mm	1,993	0.910
Renters	423	0.855	Mortgage holder	154	0.923
			No Mortgage	1,092	0.916

A rapid inspection of Table 1 reveals interesting information as to the dynamics of the utility discount factor across relevant dimensions such as: gender, age, level of education, civil status, size of the household, job type, area of residence, income and wealth situation and credit availability.

First of all, we may notice that the magnitude of time preference factors is very much in line with results of other recent studies. In fact, our β's have an overall average of 0.904 and a standard deviation of 0.207. In Lawrance

(1991), for example, estimated time preference factors vary from 0.88 to 0.81.

Focusing upon the various socio-demographic groups in which we have divided our sample, it is possible to recognise some interesting patterns.

If time preference does not seem to vary much across genders, we can also immediately notice that utility discounting is not constant across classes of age. In particular, very young (up to thirty years old) individuals seem to be particularly impatient, as they heavily discount future consumption. At the upper end of the age scale (>85) agents behave in quite an opposite way (i.e. they display very little discounting). This is in open contrast with the recent theory of "life cycle" discounting (Trostel and Taylor, 2001), very rapidly sketched in the introduction, which would definitely imply an opposite empirical implication (i.e. very low, or even negative, discounting for young people and very high discounting for the very elderly).

For intermediate age classes, corresponding to the mature phases of adulthood (which often entail the establishment of a family with children and heavier duties), discounting remains roughly constant at a "normal rate" up until a pre-retirement age, where it increases again. This is indeed the phase of life cycle in which people accumulate more.

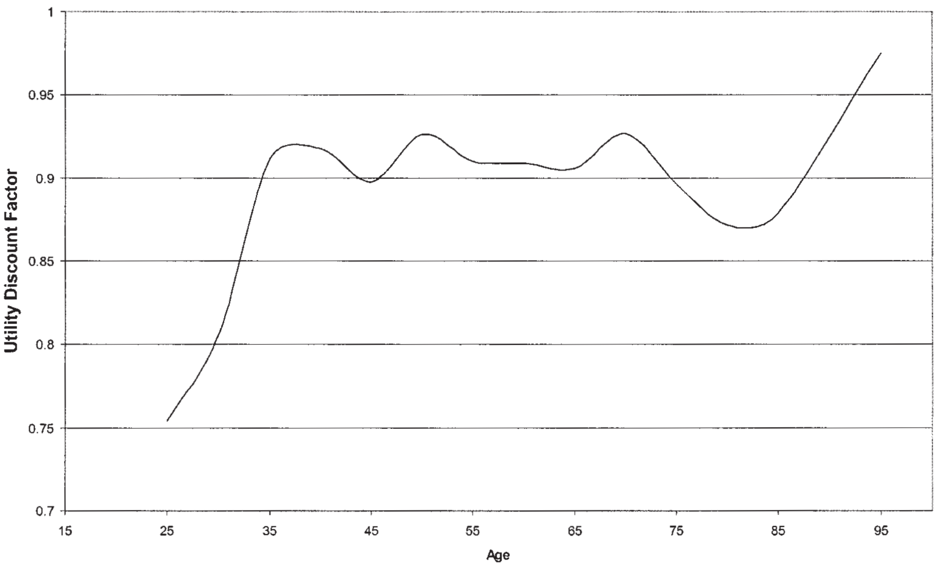
Figure 1 plots the factor of time preference β against classes of age, and has been drawn dividing the whole sample into sub samples of five years each (from 25 to 85 years and a final group of older people). The graph confirms the picture that we depicted in the previous paragraph, of a non monotonic relationship between age and time preference.

It also turns out that time preference is not constant across levels of education. In fact, less educated people appear to be discounting future consumption at a somewhat higher rate than better educated people (as β ranges from a low value of 0.891 to a higher than average value of 0.926). This finding might be considered as fairly counterintuitive, in as much as a higher level of education provides a better insurance for future consumption (as it is usually associated to better prospects of future income and wealth) and might be thought to induce people into willing to consume more today (as tomorrow more and maybe better consumption opportunities will be available). On the other hand, a higher level of education also means less "defective recognition of future utilities" (to quote again Becker and Mulligan, 1997), which should bring about a smaller amount of discounting.

Unmarried and divorced people appear to discount future more than married people; this might be considered as further evidence that uncertain future prospects (and lack of some kind of natural insurance, provided by the family itself) plays a fundamental role in determining impatience.

The rate of time preference also varies with family size, increasing as the size of the household grows from one to four members, and decreasing

Figure 1: *Age and Time Preference*



thereafter. As for job positions, it also seems that the unemployed discount future consumption more than other categories of agents and this, again, points at the decisive role played by uncertainty in determining time preference. It also seems possible to provide a rough geographical characterisation of impatience, in as much as people residing in the north of Italy seem to be more patient than people living in regions of the centre; the latter, in turn, seem to be more patient than those living in the south and in the islands.

As could be expected, time preference factors also vary according to income and wealth. In fact, worse off agents (both in terms of income and in terms of wealth) feature lower discount factors than more affluent agents. This is quite close to what has been suggested in previous empirical works. (Lawrance, 1991), for instance, finds a strong negative correlation between rates of time preference and labour income or levels of education (which is consistent, at least to some extent, with our results). Various explanations have been put forward to justify this negative relationship. On the one hand, impatience might reduce investment in education, which will directly translate into lower income prospects. On the other hand, strong time preference might be deeply rooted (also for cultural reasons) in less affluent classes of people (as was suggested by Maital and Maital, 1977). If capital markets are imperfect, moreover, and do not allow for borrowing against future labour income (which is often the case), less patient people might opt for careers with flat (and lower) wage paths, as opposed to others offering relatively low wages at the outset and much higher wages later on.

That time preference should not be constant across income and wealth had also been observed by Fisher (1930), who noted that small income levels would produce high rates of impatience, partly from "lack of foresight and self-control" and partly because agents would think that "provision for the present is necessary both for the present itself and the future as well".

Referring back to Table 1 we may also notice that time preference is also variable with respect to another important variable related to family wealth, namely a dummy variable indicating whether households own the place of residence, or simply rent it. As it might have been expected, in view of the effect that uncertainty seems to play on utility discounting, house owners are more patient than those renting their dwellings. Finally, we explored the dynamics of utility discounting with respect to a variable related to credit availability. The fact of having had, in the past, an opportunity to access the credit market, represented by the mere fact of holding a mortgage, does not appear to substantially affect time preference factors, as revealed by the last two rows of Table 1. This will be contrasted, in the next section, with the effects on time preference parameters of being (or perceiving to be) credit constrained.

V TIME PREFERENCE: A TOBIT ANALYSIS

Having explored, though only in a rather qualitative way, the dynamics of time discounting with respect to various socio-economic factors, we may turn to a more structured investigation of the determinants of pure time preference. To do so, we need an estimation technique which may account for both the effect of independent variables onto the probability of agents' displaying positive rates of time preference ($\beta < 1$) and their effect onto the relative magnitude of such coefficients. A Tobit analysis was therefore performed, whose results are contained in Table 2.

As independent variables, also in view of the previous, qualitative, statistical investigation, we chose to include the following: age, area of residence, the coefficient of absolute risk aversion (computed according to expression (10)), a dummy variable equal to 1 if the head of the household (who is the one who answers questions E12-E14) or some other member of the household held a life insurance contract, and zero otherwise, household size, sex, education, a variable representing financial constraints affecting the household, and total wealth. Two more dummies, AREA2 and AREA3 take value one, respectively, when the unit resides in the Centre and, respectively,

Table 2: *Time Preference: a Tobit Analysis*

Variable	*Coefficient [p-value]*
CONSTANT	1.200 [.000]
AGE	.003 [.000]
AREA2	–.028 [.377]
AREA3	–.117 [.000]
RISK AV.	–.086 [.817]
LIFE INS.	–.133 [.000]
HHSIZE	.038 [.000]
SEX	.032 [.199]
EDUCATION	.017 [.048]
FINANCIAL CONSTRAINTS	–.223 [.003]
WEALTH	.000000103 [.004]
R2	.036
SAMPLE	1:2228

the South (including islands) of the Italian peninsula. The dummy variable corresponding to residing in the North is, of course, the intercept.

The variable that we use to measure the extent of financial constraints is a dummy related to the following question (C68 in the original numbering of the year 2000 questionnaire): "In 2000 did you or another member of your household consider the possibility of applying to a bank or a financial company for a loan or a mortgage but then change his/her mind thinking that the application would be rejected?" The dummy takes value one if the answer to the question is affirmative, and zero otherwise. A unit value could therefore be taken to indicate the presence of (perceived) financial constraints.

As should be clear from a quick visual inspection of Table 2, the Tobit regression yields an extremely low coefficient of determination, which indicates a very large degree of variability in data. It is nonetheless instructive to look at the sign and probability values of the various estimated coefficients.

As could be expected from the analysis of Section III, the variable "age" enters positively in the regression, and this should be imputed to the dynamics of time discounting in the early stages of agents' working life. The coefficients of the variable "AREA2" and AREA3 are negative and of increasing absolute magnitude (though that of AREA2 is not statistically significant), indicating that as we move from the North to the Centre and to the South the probability of an agent's displaying a positive rate of time preference increases, as well as the absolute magnitude of the coefficient (as the intercept represents the dummy variable for Northern residents, the coefficients of the AREA2 and AREA3 dummies must be interpreted as differences relative to the intercept). This is particularly interesting, in view of the fact that we do observe higher degrees of capital accumulation in the North than in the Centre and in the South.

The two variables related to risk, "RISK AVERSION" and "LIFE INSURANCE" also display negative coefficients. Both variables are of interest, as they need not be highly correlated; many risk averse individuals, and in fact most of them, do not own a life insurance policy (for example, because they are income constrained), whereas an individual possessing a life insurance policy might in fact implicitly declare (from his or her answer to question E14) a smaller coefficient of absolute risk aversion than other agents who did not buy such a policy.

A positive coefficient is also attached to the variables household size and sex (taking value 1 if male and 2 if female) suggesting that as household size increases, household heads tend to be more patient (maybe accounting for the other members' preference satisfaction) and that women be relatively less impatient than their male counterparts (although the variable SEX is not significant in the regression).

The variables EDUCATION and WEALTH are also positively significant, further backing our hypothesis of uncertainty driven utility discounting, also in view of the considerations outlined in the previous section.

One of the most interesting variables to look at is, however, the one related to financial constraints. The negative and highly significant coefficient attached to it clearly indicates a role for market incompleteness in the determination of time preference. People who do not have access to means of redistributing income or consumption across time periods tend to discount utility to a much greater extent than agents who are not so constrained. We may notice, in passing, that this finding points at the role played by market incompleteness even in the absence of uncertainty, as the variable FINANCIAL CONSTRAINTS only relates to mortgage loans.

Our Tobit regressions were run under alternative hypothesis concerning the underlying distribution function (normal, logistic, extreme value) and yielded very similar results in all cases, which might be taken as an indication of robustness.

VI CONCLUDING REMARKS

This work constitutes a first attempt to gauge the importance of time preference factors, using survey data provided by the Bank of Italy Survey of Household Income and Wealth. The methodology used in this study to compute time preference factors is a direct one, which does not make use of econometric estimations, but of a simple second order Taylor expansion of an intertemporal utility function.

It is maybe worth it, at this point, to illustrate some of the potential advantages of this study over other comparable studies made using experimental data. On the one hand, we have to consider the number of individuals surveyed, which is of course by far larger than the number of participants in any experimental study so far conducted. Second, agents have been asked to answer a question related to their time preference in the course of an extremely broad survey, in which they are asked to dwell on many other aspects of their economic life including, for example, actual consumption, working and investment activities, which in a sense establishes a link between real life and hypothetical behaviour. Third, and more importantly, in the Bank of Italy Survey time preference attitudes of agents are elicited together with risk bearing attitudes, which allowed us to take into account the curvature of the utility function in computing time discounting. Last, but not least, all the information gathered in the Survey makes it possible to relate time preference to a large number of factors, including risk and market incompleteness.

The magnitude of time preference factors seems, in any case, comparable to that obtained in other recent econometric studies. The quantitative importance of time preference is confirmed, as well as the fact that it is not constant over a set of socio-demographic variables.

In particular, time preference is not constant over time, although it can be considered approximately constant for a long period of agents' lifetime. It is not constant over income and wealth as well, as it was also suggested in earlier works. The evidence reported in this study also points at a decisive role played by uncertainty and market incompleteness over time preference parameters, which should constitute an important topic for future research.

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