# Do Quasi-Hyperbolic Preferences Explain Academic Procrastination? An Empirical Evaluation*

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## Abstract

Traditional neoclassical thought fails to explain questions such as problems of self-control. Behavioural economics have explained these matters on the basis of the intertemporal preferences of individuals and, specifically, the so-called $(\beta, \delta)$ model which emphasises present bias. This opens the way to the analysis of new situations in which people can adopt incorrect indecisions that make it necessary for the government to intervene. The literature which has developed the $(\beta, \delta)$ model and its implications has generated a categorisation of people that is widely used but which lacks a systematic empirical evaluation. It is important to value the need for this public action. In this article, we develop a method which makes it possible to verify the main implications that this model has to explain the procrastination of university students. Using an experimental time discount task with real monetary incentives, we estimate the students' $\beta$ and $\delta$ parameters and we analyse their correlation with their answers to a series of questions concerning how they plan to study for an exam. The results are ambiguous given that they back some of the model's conclusions but reject others, including a number of the most basic ones, such as the relation between present biases and some of the categories of people, these being essential to predict their behaviour.

*Keywords*: Behavioural economics, problems of self-control, welfare analysis, experimental economics.

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## 1. Introduction

Economics has been broadening its subjects of analysis to study questions which were previously outside its traditional area of interest. The extension has enabled the introduction

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of a different perspective to that used in other disciplines but has highlighted the difficulties of explaining a series of phenomena through the traditional economic perspective. This has allowed for the reconsideration of numerous questions of traditional economic analysis and has even opened the door to new proposals of economic policies.

Behavioural economics has been founded on the study of phenomena that conventional neoclassic economics does not have an explanation for, or whose explanations are unsatisfactory. Its analysis is based on the cognitive limitations of people that do not permit them to assimilate all the information necessary to adopt complex decisions. This often leads them to follow simple rules which disregard a good part of the salient information. For example, they give more relevance to events which take place close to them in space or in time than what they objectively have. Furthermore, it uses behavioural biases found by psychology to understand behavioural economics. Madrian (2014) underscores the importance of this question, as it allows for the locating of market failures in addition to those traditionally considered. But it also opens the way to proposing new formulas of economic policies or carrying out a different valuation of those which are usually applied. Congdon *et al*. (2011) define three broad categories of psychological biases that can be the source of market failures: imperfect optimisation, limited self-control and non-traditional preferences. Limited self-control, a phenomenon this work is centred on, is manifested in the discrepancy between people's intentions and their actual behaviour. People frequently plan to behave in a specific way but end up doing so another way. They likely procrastinate, or they modify their choices according to their emotional state, or small barriers, which objectively are not so, are significant impediments of their actions. To disregard the effects of this issues can lead to choosing mistaken instruments of economic policies. For instance, Campbell *et al*. (2011) note that the effectiveness of the supply of obligatory information as a way of resolving market failures, such as the existence of externalities, is limited if the consumers do not understand the information, if they believe that it is not relevant to the adopting of their decisions, or if they do not know how to access it or use it.

Self-control problems can be understood as the incapacity of some subjects to dominate their desires to achieve their aims. Among them, procrastination stands out. This has concerned economists since at least Strotz (1956). According to Akerlof (1991), procrastination takes place when the current costs are unduly stressed in comparison with those of the future. This leads people to postpone tasks without realising that, when it is again the time to do the task, they will put it off again. The most widespread explanation of this way of behaving is based on people's intertemporal preferences and explains how behaviour is planned in time, and why such a plan is reneged when it implies carrying out tasks that are costly in terms of effort. The decision of the present reduces the future well-being and people later regret their choices. The phenomenon is analogous to an externality towards oneself and it is sometimes denoted as internality. The traditional conclusion of neoclassical economics is that people are the best guarantors of their own interests and supposes that they are the ones who best know how to choose what will improve their well-being. Yet this is not ensured when biases exist. To measure the internalities requires identification of the impact of agents' choices under their own experienced utility. This is similar to how a traditional externality requires identification of an agent's impact on the utilities experienced by others.

The analysis of procrastination has been used to explain phenomena such as drug addiction and, in general, the adoption of numerous habits considered harmful or unhealthy (Read and Van Leeuwen, 1998). In the area of economics, its consequences have been especially studied for decisions with respect to savings (Thaler and Shefrin, 1981). Procrastination has also been used to illustrate why the availability to pay with a credit card grows as postponing the payment reduces the current value of the debt (Prelec and Simester, 2001); explain the functioning of bureaucracies in an alternative way to the agent-principal model (Akerlof, 1991); and show that spectators' choices of their type of films give rise to biases towards commercial films (Read *et al.,* 1999), to cite only a few outstanding examples.

Faced with the design of public actions, the detailed knowledge of these aspects is important as the difference between people's intentions and their actions can vary as a response to very small changes in the context of their choice (Madrian and Shea, 2001). But furthermore, the degree of self-control depends on the current state of the deciders and their emotions. Elements such as stress, an overloading of information or fear can set off impatience and motivate radical changes in behaviour. According to behavioural economics, in the cases in which many people show cognitive biases or a lack of self-control, the role of the government should not be limited to a minimum, given that people cannot free themselves from the mistakes of their decisions. It is indispensable to know the mechanism which produces these discrepancies to discern when a nudge is necessary (Thaler and Sunstein, 2008).

Chetty (2015) points out that the decision to include behavioural elements in economic models must be considered as being more a pragmatic than a philosophical choice. Nevertheless, given the multitude of biases which distance people from the behaviour predicted by conventional models, it is necessary to determine which are decisive and introduce them. To identify the optimal policy requires evaluating the extent to which the utilities experienced by people differ from the decisions that they really adopt. Yet this opens the door to arbitrariness. This is why it is imperative to empirically measure the degree to which utility and decisions are detached from each other, which explains the methods that we propose to use in this work. Specifically, the literature has suggested measuring experienced utility using data on self-reported happiness. This is an analogous approach to that employed in the contingent evaluation methods which assess externalities (Diamond and Hausman 1994). Likewise, the idea has arisen in other articles of calibrating the structural parameters of a model that includes behavioural biases. We employ this notion in the central part of this work.

In this line, this article proposes methods to measure people's degree of error in their decisions and when they do so, as well as to analyse their consequences in terms of well-being. Its aim is to analyse a specific reality – the daily activity of university students in preparing a subject – and measure the degree to which this process fits what the theory predicts. To do so, an empirical methodology is introduced which enables this verification to be carried out.

The so-called quasi-hyperbolic discounting allows for modelling of the behaviour of people who postpone their decisions or procrastinate. Its use has been generalised and has

fostered the development of a typology of people with different behaviours regarding self-control problems. However, the relation between quasi-hyperbolic discounting and different time preferences has not been the object of a systematic empirical evaluation. The main aim of this article consists in verifying whether the model explains the procrastination of a sample of university students when performing their academic activities. To do so, we have carried out two surveys which permit us to find out their study habits and the students' characteristics. One of them includes a habitual discount task that has enabled to us to infer the students' time preferences and to characterise them according to the degree of consistency that they present. This information allows for verification of most of the implications of the explanation of self-control problems based on quasi-hyperbolic preferences. Specifically, the relation between present biases, the type of time preferences people have, and their behaviour and the costs of their self-control problems in terms of well-being and poor academic performances are verified.

The article's main conclusion permits the establishment of an inverse empirical relation between the size of the present bias and maintaining behaviours consistent with the students' time preferences, as the model that we aim to verify predicts. Nonetheless, we have not found a relation with the rest of the categories of people or with the rest of the theory's implications. We believe that our results are important in that they shed light on the almost non-existent empirical basis of the $(\beta, \delta)$ model and its conclusions. On the other hand, our evaluation also gives keys to valuing the extent to which it is necessary to design new action instruments in the educational area.

The article is structured in 6 sections, including this introduction. In the second, we review the economic literature that analyses self-control problems, their implications for public policies and their relationship with time preferences. The third indicates the empirical and experimental methodology followed to analyse the questions proposed. The fourth describes how the database was built and carries out a brief analysis of its descriptive statistics. The fifth shows the models which have been used to empirically verify the aspects analysed and extensively analyses the results obtained. The article ends with a conclusions section.

## 2.  The problem of self-control and intertemporal preferences

The mainstream economic analysis that assumes that rational people adopt results consistent with their preferences has great difficulties in explaining self-destructive behaviours, for instance drug addiction or compulsive food consumption. Dissatisfaction with the approach, in spite of its attempts[1] to explain such phenomena, has fostered the search for alternatives based mainly on concepts common in psychology and framed in the area of behavioural economics. These explanations of lack of self-control have revolved around time preferences and possible shortsighted calculations of the benefits and costs of actions[2]. Ifcher and Zarghamee (2011) indicate that the psychological framework for lack self-control overlaps with the economic concept of time preference.

The analysis of the problems of self-control lies within the study of pathological divergences between the choices of people and their preferences. The most accepted explanations are based on the proposal that there are two types of thought: one which gives swift, automatised and unconscious answers; the other is slow thought that is logical and is done consciously (Kanheman, 2001). For example, Bernheim and Rangel (2004) use this framework to analyse drug addiction. For these authors, the mechanisms of semi-automatic answers are beneficial, especially in stable environments, because they generate quick answers in multiple circumstances. Notwithstanding, they can lead to systematic mistakes that can be serious. In their model, people can make decisions "coldly", imposing cognitive control. This type of decisions results in the choice of the alternative preferred. But there also exists a "hot" mode in which decisions and preferences can differ.

Thaler and Shefrin (1981) contemplate a double personal plan in the adoption of decisions to explain self-control problems. Each person has a farsighted-planner and shortsighted-doer nature which maintains a kind of agent-principal relation with divergent interests. The planner obtains utility uniquely through the actions that the executor carries out. The model predicts that people will establish restrictions of their own behaviour mainly in the actions whose benefits and costs are produced at different moments. The actions of the planners can consist of modifying the preferences of the executor, acting on their incentives or limiting their set of possibilities of choice. Gul and Pesendorfer (2001) show, in a similar framework, how temptations can be combatted by establishing limitations to the set of choices. Likewise, Fudenberg and Levin (2006) indicate that this view is compatible with much evidence of magnetic resonance images, as many decision problems can be explained as a game between a sequence of impulsive short-term selves and patient long-term selves.

Models based on an agent-principal problem centre their explanation on time preference biases. O'Donoghue and Rabin (1999) explain how people procrastinate. The "long-term self" establishes the plan, but what is commonly called *losses of self-control,* caused by present biased time preferences, arises. Their effect is that immediate gratifications are valued to a greater extent than if the actions had been carried out at a later moment. This same idea has fostered later versions that have modelled a broad range of decisions, such as saving and drug consumption.

This has propagated the need to rethink the explanation of how decisions in time are adopted, which has been dominated by the theory of discounted utility. This theory was developed by Samuelson (1937), who extended Irving Fisher's previous idea to multiple periods. Discounted utility reduces all motives which lead people to value the future in relation with the present to a unique parameter known as the discount rate. The discount factor enables people to interchange the future utility with that of the present. Koopman (1960) later demonstrated that the model could be obtained from a series of plausible axioms and this model gained in relevance.

More formally, the standard model of temporal preference designed by Samuelson (1937) is based on the existence of an exponential temporal discounting rate which is constant over time. For all t, the utility of an individual would be:

$$U^t(u_t, u_{t+1}, ..., u_T) = \sum_{\tau=t}^{T} \delta^\tau u_\tau \tag{1}$$

Where $\delta \in (0, 1]$ is the discounting factor.

If individuals have a bias towards immediacy, it is necessary to weigh the remoteness or nearness of the event. This can be introduced by employing a quasi-hyperbolic temporal discounting model; see Strotz (1956), Phelps and Pollak (1968) and Laibson (1997)[3] Concretely, the bias of the preferences is inserted via a function designed by Phelps and Pollak (1968) in the context of intergenerational altruism. This function adds an additional factor to Samuelson's intertemporal preferences which weigh the utilities obtained in periods following that which is taken as a reference. In this way the model introduces the present bias by overdiscounting the utility obtained in periods subsequent to the reference. We can rewrite the utility function to include such biases as:

$$U^t(u_t, u_{t+1}, ..., u_T) = \delta^t u_t + \beta \sum_{\tau=t+1}^{T} \delta^\tau u_\tau \tag{2}$$

Where $0 \leq \beta, \delta \leq 1$, $\beta$ measures the present bias. If it is close to 1 it hardly exists, that is to say, the now is not especially valued with respect to the afterwards. On the contrary, a $\beta$ close to 0 indicates an impatience or excessive eagerness to achieve an immediate reward.

The model explains the decision to undertake actions whose benefits and costs are generated at different moments. The problem of self-control arises when the discount rate rises at the time of performing the action, generating a recalculation of the total balance of benefits and costs stemming from it. The result may be different to that provided by the long-term discounting rate and cause a change of decision. People do not change their preferences, or at least they do not change them permanently or stably. Once the moment has passed, they return to a stable or reflexive situation. To evaluate the cost of the lack of self-control, the reference is the decisions that a person with time consistent preferences would adopt and which are those that would be chosen in the long run, given their time preference.

O'Donoghue and Rabin (1999) propose a classification of people according to their time preferences. People with a present bias have time preferences consistent over time and do not suffer from self-control problems. We can distinguish two types among those who have a present bias. On the one hand, sophisticated people are aware of their bias and of the self-control problems that this will cause them. To avoid them they adopt measures which, in general, consist in carrying out the action before. The result is suboptimal but better than no action[4]. Naïve people do not foresee that they will suffer self-control problems. They have present biases the same as sophisticated people but, unlike them, they plan the future ignoring their present biases. As they do not adopt any kind of cautionary measure, it is likely that they will support the totality of the costs of well-being. These are due to not adjusting to the planned behaviour which, a posteriori, they would have liked to carry out.

O'Donoghue and Rabin (2008) later introduced the category of the partially sophisticated to define people who are aware of their present bias but underestimate its degree. The

condition can be introduced using a parameter that we can denote by $\hat{\beta}$, which measures the agents' estimations of the size of their own biases. In the case of a person with consistent time preferences, $\hat{\beta}=\beta=1$. If a bias exists, $\beta < 1$. Naïve people believe that their behaviour will be consistent with their preferences, but actually they have a present bias, therefore, $\hat{\beta}=1>\beta$. If the agents are sophisticated, they correctly predict their present bias, and therefore their self-control problems, so $\hat{\beta}=\beta<1$ will occur. Finally, partially sophisticated agents will have $\hat{\beta}<\beta<1$ as they are aware of their self-control problems but underestimate their magnitude[5].

The empirical literature has concentrated on testing the relationship between discounting rates and behaviours which reveal a lack of self-control to attempt to underline the lack of coherence of the traditional vision in explaining compulsive behaviours. The most common practice has been to exploit the evidence provided by laboratory or field experiments, which are grounded on some method of inference of people's temporal preferences. These experiments usually consist of asking the individuals to choose between sums of money, real or fictitious, which are smaller in a close moment in time and greater later[6], in order to calibrate when the utility of both is balanced[7]. For example, Meier and Sprenger (2012) have studied the relationship between present bias and the financial solvency of individuals. Reynolds (2006) explains drug consumption and gambling, Kirby *et al*. (1999) heroin addiction, Bickel *et al*. (1999) smoking and Weller *et al*. (2008) obesity.

Reuben *et al*. (2015) stand out for having a direct relation with our study aim. Their work analyses the relation between time preferences and procrastination through a series of laboratory experiments and field work with a population of students. They estimate the parameters which define the time preferences via a set of tasks of the type indicated in the previous paragraph and the level of trust, cognitive skills and gender are among the controls used.

Burks *et al*. (2012) compare the goodness of different methods of inferring time preferences, contrasting the extent to which the discount factors estimated by each one explain different phenomenon. Specifically, they analyse the accumulation of human capital (Eckel *et al*., 2007), savings (Ashraf *et al*., 2006) and academic results (e.g., Shoda *et al*., 1990). The different estimations use experiments carried out on middle-aged workers with low skill levels. The functional form which best predicts the decisions analysed is quasi-hyperbolic discounting, calculated from a set of choices over sums of money at different moments in time.

Another outstanding work is Nardotto's (2011), which identifies the different categories of people described above, along with their characteristics. It uses a sample of frequencies of access and tariffs contracted by users of a university gymnasium along with their academic qualifications. They build a suboptimal index or "cost" for not fulfilling their own plan that is explained by the people's characteristics. This divides the people into consistent (or rational), naïve or sophisticated, comparing the planned behaviour with what is finally carried out. To build this fixed classification, a threshold of 25% of mistakes includes the unpredictable motives that prevent fulfilling the plan. This work finds that 40.6% of the people

predict well and are catalogued as rational. 51.1% have optimistic preferences with respect to their forecasts of attendance and are catalogued as naïve, and 4.3% are catalogued as sophisticated.

Lastly, Wong (2008) analyses the preparation for the final exam of a subject by a group of degree students. He identifies consistent, sophisticated, ingenuous and partially ingenuous individuals using two questionnaires. The first questionnaire is about the amount of study that students consider ideal and which they estimate that they will actually do and is asked halfway through the term. The second questionnaire is done the day of the exam and infers, a posteriori, the amount of study really done. This work finds a small percentage of consistent students who trust in fulfilling their ideal study plan and indeed do so. Among the inconsistent, three behaviour patterns are identified. The naïve who predict the fulfilment of their ideal study plan but do not fulfil it. The sophisticated who fulfil their forecasts but whose plans do not correspond with what is ideal. The author interprets this behaviour with an awareness of future self-control problems and the design of a plan to minimise their consequences. Lastly, the partially naïve are aware that their self-control problems will lead them to not fulfilling their ideal plans and so they also design plans which try to compensate for this, but they do not fulfil them. Wong (2008) employs the delay foreseen in the ideal plan to measure the degree of temporal inconsistency and the delay foreseen in the chosen plan as a measure of the individual's degree of sophistication.

The article concludes that any delay, foreseen or not, has negative effects on the academic results, even controlling for the time really dedicated to studying, which registers those caused by reasons other than self-control problems. It underlines that sophisticated individuals do not manage to reduce the negative effects of self-control problems. The article interprets this result as being a consequence of these individuals' poor distribution of study time.

Our work follows Wong's closely, but additionally introduces an eliciting of time preferences. In this way, we can empirically evaluate if the ($\beta$, $\delta$) model predicts the characterisation of people according to their time preferences from the present bias and the discount factor, in the way argued by O'Donaghue and Rabin (1999, 2008).

## 3. Methodology and database

### 3.1. Procedure

Our study is founded on a database of degree students that we elaborated ourselves and which was obtained via surveys. Its design, described below, analyses their behaviour in planning, preparing and developing of their academic activities, as well as their results. This behaviour differs among them in the planning of the preparation of the subject and in the degree to which they fulfil this plan. Furthermore, within the group of those who do not

fulfil their plan, people can be distinguished by their degree of awareness of their future failures. The students likewise differ in their intertemporal preferences, characterised mainly by each one's discount factor and present bias.

A time discount task was implemented to infer the discount rates and the possible present biases. On the other hand, in order to classify the people we had to obtain information on the extent to which they fulfil their plan and if they are aware, a priori, of what they are going to do. The questionnaires that include the experimental discount task have been designed combining the methodologies developed by Burks *et al*. (2012) and by Wong (2008). The hypothesis which we verify is that the likelihood of the students fulfilling their plans depends on the type of intertemporal preferences that they have, controlling for their different personal and socio-economic characteristics. Moreover, we examine if the present biases lead to self-control problems and, where appropriate, to supporting the costs of well-being which they cause, as O'Donaghue and Rabin (1999, 2008) predict. In this way we test the empirical basis of their model.

The sample includes students of the compulsory subject of Macroeconomics, corresponding to the second course-year of the Degree of Finance and Accounting of the University of Seville, Spain. The subject is taught in 8 groups of a similar size: half in the morning and the other half in the afternoon. The centre determines the assignation of the students to the groups by extra-academic criteria, which establishes a similar profile in all of them. The content of the course is the same and includes an identical exam for all the students.

### 3.2. Questionnaires and classification of individuals

The data was obtained through two questionnaires. The first questionnaire is done midterm and contributes most of the information, including the experiment and the controls. At this point in the course, the students had information on the content of the subject and its difficulty and could carry out a precise estimation of the requirements of the work needed to prepare it. The survey was carried out during the same week with all the groups in the second hour of a two-hour session. Each student signed his/her authorisation to participate in the experiment and read the paper's instructions. The instructions clarified the voluntariness of the activity and that it would not affect the mark of the subject in any way. Likewise, they indicated precisely how to do the time discount task. The process by which the data would be anonymised was also explained, placing special emphasis on the need to give sincere answers. In this way, the students had incentives to respond to the discount task. This made it possible to also sincerely answer the rest of the questions. The researchers did not teach most of the groups and significant differences were not found in the answers given by their students and the rest. In any case, in spite of the insistence on the sincerity of the answers and that there was an anonymous handling of the questionnaires from the moment in which they were handed out, there exists the possibility of an *experienced demand effect*, as authors such as Zizzo (2010) and De Quidt *et al*. (2017) indicate. Nevertheless, these same authors

justify the use of this type of questionnaires, especially when "pseudo-volunteer" students are not interviewed, as is our case.

Lastly, special emphasis was placed on generating trust in the payments being made in cash. To do so, the chronology of all the possible payments was developed during the course, the teachers who did the study were known by the students and also their contact data was indicated to them, and especially where their offices were. It was also pointed out that if the option awarded was one of those postponed, a promissory note for the corresponding amount would be handed out. Trust in the effectiveness of the payments is a crucial question for a person to appropriately reflect about their time preferences. If subjects have doubts, they could choose the immediate option despite having preferences for the greater amount[8].

The second questionnaire was handed out coinciding with the final exam, reiterating that to do it did not affect the mark in any way. This moment was chosen because it enabled all the students to be brought together in a similar emotional and attentive situation. This questionnaire had only 7 very brief questions. We are aware that the subjective impression about the performance in the exam could affect the answers given in this questionnaire. However, it was impossible to find a better situation in which to carry out this essential task.

The classification of the people into consistent, sophisticated, naïve and partial naïve was based on the method developed by Wong (2008). Specifically, in the first questionnaire the students were asked to estimate how much time, in days and daily hours, they should ideally devote to the preparation of the subject and a forecast of what they thought they would actually do. In the second questionnaire, they were asked to indicate, a posteriori, the time that they had finally spent. In both cases there existed notable differences between the amounts indicated and, therefore, the distribution of the degree of answers carried out to please the interviewer may behave as a random variable. From the answers given, three variables were defined that measured the time of ideal and planned study, calculated from the first questionnaire, and real, calculated with the answers of the second. These amounts have served to classify the people as consistent if they plan to study the amount of time which they consider ideal and later fulfil this plan. Among the inconsistent, the naïve have been identified, who predict studying the ideal amount but in the end study less, and the sophisticated who plan to study less time than what they consider to be ideal and so fulfil these plans to face the self-control problems which they anticipate that they will have. Lastly, the partially sophisticated are aware that they have self-control problems which will lead them to not fulfil their ideal plans and therefore also prepare less ambitious plans; yet they do not fulfil them either[9].

## 3.3. Temporal discounting task

The discount rates and the present biases have been estimated from the first questionnaire using the procedure described by Burks *et al*. (2012), with slight modifications. This

consists of a conventional task in which the people choose between receiving smaller amounts of money sooner or larger ones later. The task had 40 options grouped into 4 blocks. In each decision the people had to choose between getting €30[10] after a delay or a smaller amount earlier. In each block the smaller-sooner prizes were reduced in intervals of 2 euros. In blocks 1 and 2 the smaller amount was received immediately and in blocks 3 and 4 they had to wait 7 days. In block 1 they had to wait 7 days to get the €30, in block 2, 2 months; 1 month in block 3 and 3 months in 4.

To estimate the discount rates and the present biases, we suppose that the person considers the quantity $x_i$ received at a prior moment in time as indifferent to €30, t periods after measured in days, from the moment when the test was done. For blocks 1 and 2 in which the option nearest in time is immediate, the relevant rates are estimated making the quantity $x_i$ resolve the following equation:

$$u(x_i) = \beta \delta^t u(30) \tag{3}$$

where $\delta$ is the individual's long-term discounting factor

$t$ is time, measured in days

$\beta$ is the individual's present bias

In blocks 3 and 4 in which it is necessary to choose between a sum $x_i$, $s$ periods later counted from when the test is performed, or €30, $t+s$ periods later, both sums will be indifferent when the following equation is fulfilled,

$$u(x_i) = \delta^t u(30) \tag{4}$$

As the two sums are collected in the future in this case, the present bias is cancelled on the two sides of the equation and the long-term discounting rate can be estimated.

The equations are linearised to perform the estimations and it is assumed that the utility function u is linear over the relevant range of monetary quantities. That is to say,

$$\log u(x_i) - \log u(30) = \log \beta + t \log \delta \tag{5}$$

when the sooner quantity is collected immediately, and

$$\log u(x_i) - \log u(30) = t \log \delta \tag{6}$$

when the two quantities are received after the task. The relevant parameters were estimated for each individual with the data obtained from the experiment. Concretely, the following specification permits the estimation of $\beta_i$ and $\delta_i$ in the choices which involve immediate collection:

$$\log x_{i,k} - \log 30 = \log \beta_i + t_k \log \delta_i \tag{7}$$

and those that involve delayed collection,

$$\log x_{j,k} - \log 30 = t_k \log \delta_i \tag{8}$$

In all the cases, $x_{i,k}$ is calculated as the average between the lowest quantity nearest in time accepted and the highest and most distant in time rejected[11], in each one of the k blocks of questions; tk is the delay in days of the highest payment. The average estimated discount factor, $\delta$, is 0.995 and the present bias, $\beta$, 0.795.

After carrying out the experiment in each group, a binary choice student of the class list was randomly selected. This person was paid, if they had carried out the test, based on the option that they had marked in the specific binary choice.

A *subjective index of postponement* which measures the tendency of people to postpone carrying out their academic tasks was also calculated. The indicator is an additional method of analysis of the relation between time preferences and the tendency to procrastinate, though it does not enable the establishing of differences or categories between people. To do so, the first questionnaire included the following questions in which a choice had to be made between *always, almost always, sometimes, almost never* or *never:*

*I generally prepare in advance for the exams*
*I try to complete the work assigned as soon as possible*
*I put off the work of the courses I don't like*
*I try to finish my important work with plenty of time in hand*
*I put off for tomorrow what I can do today*

The answers were transformed to a numeric scale from 1 to 5. The index is defined as the summation of 5 scores. It takes the value 5 with the least degree of postponement – that is to say, the person never postpones the tasks related with the studies – and 25 for the people who do so always[12].

## 3.4. Sample and controls

The sample is made up of the 231 students who correctly answered the two question-naires. Table 1 shows the distribution of types according to the answers. The percentage of students catalogued as consistent is low (11.3%), similar to Wong (2008). The *naïve* are 18.6%, the *sophisticated* are 46.3% and, lastly, the *partially sophisticated* are 20.8% of the total. 47 participants indicated that they planned to study more time than they considered ideal. They were included, according to the time of real study, in the group of consistent or naïve. Likewise, 107 people specified that they studied more time than they had planned. We

have supposed that, in the first questionnaire, they underestimated the work necessary and had adjusted their plans during the term. We have classified them as consistent or sophisticated according to the criterion explained above.

**Table 1**
**TYPOLOGY OF INDIVIDUALS ACCORDING TO THE PLANNING OF THEIR STUDIES**

| Category | Num. | Perc. |
|---|---|---|
| Consistent | 26 | 11,3% |
| Naïve | 43 | 18,6% |
| Sophisticated | 107 | 46,3% |
| Partially sophisticated | 48 | 20,8% |
| **Total** | **231** | **100%** |

The survey requested information about relevant aspects of the person: gender, age, where they live and where their parents live, nationality, work situation, studies and work situation of their parents, and monthly income availability, including whether the income came from work or from a family allowances. This variable measures the amount of money the students have for their personal expenses. It does not measure the family income, although it can be influenced by it. Likewise, the students were asked for information related to their studies and about their ability, through prior marks, if they repeated subjects, whether they have received a scholarship, their level of English and, their degree of satisfaction with their studies. Risk preferences were inferred through three hypothetical questions from the survey used in Exadaktylos *et al*. (2013)[13]. The responses were codified with a 1 if the individual preferred the safe option, 0 otherwise. Adding the responses together allowed the construction of a *risk aversion index* which classified individuals into *risk lovers, risk takers, moderate*s and *risk averse*. The control of the attitude towards risk is normal in this kind of literature, given that it is very likely for uncertainty about the future to affect the decisions adopted in the intertemporal choice task (Andersen *et al*., 2008).

As was indicated before, special emphasis was placed on assuring the credibility of the delayed payment scheme. Nevertheless, it is likely that, even so, doubts persisted concerning whether the money would finally end up being received if they opted for postponing the payment. It is logical to think that distrustful people in general would more likely act in this way than the rest, so trust in others was measured through the question

*What is your level of trust in others? Evaluate from 0 (no trust) to 10 (great trust)*

In another block, questions were included about subjective and emotional aspects. We especially wished to infer the degree of self-confidence, as the literature points to fear of doing something badly as a motive which induces people to postpone their tasks (Çapan, 2010). We asked them about their degree of satisfaction with their studies and with life in general to capture the effect of a possible lack of motivation or drive. Finally, we requested

information about different behaviour habits which can be related with self-control problems, such as being a smoker and the intensity of the habit, and their body mass index.

Table 2 shows the descriptive statistics of the main variables used in the calculations. The marks, both those related with the access to university exam and with the subject, were expressed on a scale whose maximum is 10. The degree of satisfaction with their studies, with life in general, self-confidence and trust in others varied between 0, *very dissatisfied* and 10, *very satisfied*, which is the maximum value.

**Table 2**
**DESCRIPTIVE STATISTICS OF THE SAMPLE**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Age | 231 | 22,758 | 4,815 | 18 | 51 |
| Gender | 231 | 0,420 | 0,495 | 0 | 1 |
| Late shift | 231 | 0,506 | 0,501 | 0 | 1 |
| Full-time student | 231 | 0,883 | 0,322 | 0 | 1 |
| Living with their parents | 231 | 0,636 | 0,482 | 0 | 1 |
| Rural origin | 231 | 0,147 | 0,355 | 0 | 1 |
| Spanish | 231 | 0,944 | 0,231 | 0 | 1 |
| College-educated father | 231 | 0,199 | 0,400 | 0 | 1 |
| College-educated mother | 231 | 0,169 | 0,375 | 0 | 1 |
| University entrance exam marks | 228 | 5,420 | 1,082 | 4 | 8,79 |
| Average score from beginning of studies | 227 | 1,181 | 0,397 | 1 | 3 |
| Repeater | 231 | 0,208 | 0,407 | 0 | 1 |
| Calls out | 229 | 0,943 | 0,889 | 0 | 5 |
| Satisfaction with their studies | 230 | 6,660 | 1,494 | 2 | 10 |
| Scholarship student | 229 | 0,197 | 0,398 | 0 | 1 |
| English level | 231 | 1,216 | 0,516 | 1 | 4 |
| Scores of the subject | 222 | 6,697 | 1,804 | 0,75 | 10 |
| Income level | 226 | 1,845 | 1,123 | 1 | 5 |
| Smoker | 231 | 1,489 | 0,927 | 1 | 4 |
| Height | 230 | 1,697 | 0,092 | 1,5 | 1,92 |
| Weight | 229 | 64,883 | 12,293 | 41 | 110 |
| BMI | 229 | 22,419 | 3,188 | 15,74 | 34,95 |
| Satisfaction with life in general | 230 | 7,513 | 1,588 | 0 | 10 |
| Self-confidence | 230 | 7,161 | 1,911 | 0 | 10 |
| Trust in others | 230 | 6,150 | 1,585 | 0 | 9,5 |
| Class attendance | 231 | 4,571 | 0,562 | 3 | 5 |
| Subjective postponement index | 228 | 17,640 | 3,113 | 8 | 24 |
| Risk aversion | 229 | 2,515 | 0,705 | 0 | 3 |

(*Continued*)

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| Beta | 215 | 0,795 | 0,178 | 0,233 | 1,211 |
| Delta | 214 | 0,995 | 0,004 | 0,979 | 1,003 |
| Ideal hours of study | 230 | 79,130 | 78,309 | 6 | 600 |
| Planned hours of study | 229 | 64,498 | 89,699 | 1,5 | 480 |
| Total hours of study | 226 | 56,115 | 75,434 | 2 | 630 |
| Consistent temporal preferences | 231 | 0,113 | 0,317 | 0 | 1 |
| Naive temporal preferences | 231 | 0,186 | 0,390 | 0 | 1 |
| Sophisticated temporal preferences | 231 | 0,463 | 0,500 | 0 | 1 |
| Partially sophisticated temporal preferences | 231 | 0,208 | 0,407 | 0 | 1 |

As can be noted, although there are variables where data are, for different reasons lacking, these are quite few. The two variables which accumulate a greater number of missing values –16 and 17, respectively– are the discount factor, $\delta$, and the present bias, $\beta$. These missing values correspond to people who did the time discount task inappropriately because they did not adequately understand its mechanics. This group presents similar characteristics to those of all the sample, so there is not a special pattern which motivates error in the test and that can affect its results.

## 4. Results

The first question which we study is if the discount rates and the present biases predict people's tendency to procrastinate and determine the typology of their time preferences. To do so, we have estimated two groups of differentiated models in the dependent variable. In the first, the category of the people was explained as consistent, naïve or sophisticated. The other group explains the subjective index of postponement defined in the previous section. The variables are analysed with versions of the model differentiated in the number of controls included. The text only shows the explanatory variables that were statistically significant.

The estimations are carried out using the linear probability model (LPM). With categorical endogenous variables it is normal to use discrete-choice models. However, the literature has gradually settled for the use of simpler estimation techniques because they do not generate significant differences in the coefficients estimated, while they reduce the interpretation problems of the discrete-choice models (see Ferrer-i-Carbonell and Frijters, 2004).

The different specifications of the model that explain the consistent time preferences are shown in Table 3. As can be noted in the table, the likelihood of being characterised as a consistent person grows with the $\beta$ factor, which inversely measures the present bias. Specifically, the $\beta$–coefficient is positive and marginally significant in models 3 and 4, which

include all the controls. The result shows that the likelihood of being consistent decreases the greater the present bias is. This agrees with our initial hypothesis, though the relation is relatively weak. The complete model (4) also identifies other characteristics of people with consistent time preferences. Specifically, they tend to do a greater total number of study hours. In contrast, students with lower levels of monthly allowances have a lower tendency to have time preferences of this type. This result suggests that students with lower levels of income could be adopting worse decisions, which coincides with recent findings in this vein[15].

**Table 3**
**RELATIONSHIP BETWEEN CONSISTENT PEOPLE AND THEIR TIME PREFERENCES**

| Variables | (1) model 1 | (2) model 2 | (3) model 3 | (4) model 4 |
|---|---|---|---|---|
| Delta | -7.107 | -6.601 | -8.901 | -8.846 |
|  | (7.250) | (7.302) | (7.058) | (7.085) |
| Beta | 0.238 | 0.232 | 0.273* | 0.278* |
|  | (0.170) | (0.172) | (0.163) | (0.163) |
| Monthly allowance under €200 |  |  | -0.127* | -0.115* |
|  |  |  | (0.067) | (0.067) |
| Monthly allowance between €200 and €300 |  |  | -0.135* | -0.129* |
|  |  |  | (0.073) | (0.075) |
| Total study time |  |  | 0.002*** | 0.002*** |
|  |  |  | (0.000) | (0.000) |
| Constant | 7.002 | 6.920 | 8.957 | 8.600 |
|  | (7.122) | (7.179) | (6.902) | (6.939) |
|  |  |  |  |  |
| Observations | 214 | 214 | 209 | 209 |
| R-squared | 0.009 | 0.019 | 0.235 | 0.250 |

*Standard errors in parentheses.*
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

The analysis has been limited to subgroups in order to better know the characteristics of people with these preferences. Specifically, the relation between the $\beta$ factor and the condition of consistent is only found when the sample is limited to women, to students of the afternoon classes and to non-repeaters. In the case of the first two groups, the significance rises to 1%. A relation between the present biases and consistent preferences is not noted in the rest of the groups. This indicates that there may be different patterns which explain people's type of time preferences. The robustness of the results has been tested estimating logit and probit models. The estimations are similar to those obtained with the LPM, though the $t$ statistic of the $\beta$ factor coefficient only attains the value of 1.32 and cannot be considered statistically significant.

Table 4 shows the value of the coefficients and the standard deviation of the $\delta$ discount rate and of the $\beta$ factor of the estimations of the groups considered and of the discreet choice models for the model which includes all the controls.

**Table 4**
**RELATION BETWEEN CONSISTENT PEOPLE AND THEIR TIME PREFERENCES.**
**ANALYSIS OF THE ROBUSTNESS OF THE RESULTS**

| Variables | (1) Probit | (2) Logit | (3) Men | (4) Women | (5) Repeat-ers | (6) Non-re-peaters | (7) Morning classes | (8) After-noon classes |
|---|---|---|---|---|---|---|---|---|
| Delta | -23.256 | -39.977 | -2.029 | -12.542 | -15.586 | -9.509 | -1.837 | -11.850 |
| | (52.058) | (95.744) | (11.465) | (9.352) | (18.671) | (8.247) | (11.622) | (10.031) |
| Beta | 1.416 | 2.752 | 0.093 | 0.559*** | 0.213 | 0.339* | -0.235 | 0.770*** |
| | (1.133) | (2.088) | (0.290) | (0.205) | (0.331) | (0.199) | (0.242) | (0.239) |
| Constant | 14.931 | 20.211 | 2.990 | 11.463 | 15.294 | 9.258 | 2.628 | 10.962 |
| | (453.614) | (899.217) | (11.199) | (9.215) | (18.687) | (8.066) | (11.414) | (9.741) |
| Observations | 209 | 209 | 89 | 120 | 44 | 165 | 104 | 105 |
| R-squared | | | 0.303 | 0.422 | 0.436 | 0.281 | 0.280 | 0.384 |

*Standard errors in parentheses.*
*** p<0.01, ** p<0.05, * p<0.1.*

The rest of the time preference typologies do not have a statistical relation with the present biases. The specific case of the naïve is especially outstanding as the theory considers that the disproportionate preference for immediateness is its main determinant. Tables 5 and 6 show the inexistence of a statistical relation between discount rates and present biases and the consideration of people as naïve or sophisticated.

**Table 5**
**RELATIONSHIP BETWEEN NAIVE PEOPLE AND THEIR TIME PREFERENCES**

| Variables | (1) model 1 | (2) model 2 | (3) model 3 | (4) model 4 |
|---|---|---|---|---|
| Delta | -0.385 | -0.643 | 0.145 | -0.232 |
| | (8.519) | (8.568) | (9.059) | (9.151) |
| Beta | -0.008 | -0.010 | 0.010 | 0.004 |
| | (0.200) | (0.201) | (0.209) | (0.210) |
| Age-squared | | -0.001 | -0.001* | -0.001 |
| | | (0.000) | (0.001) | (0.001) |
| Constant | 0.567 | 0.140 | -0.621 | -0.073 |
| | (8.369) | (8.424) | (8.858) | (8.962) |
| Observations | 214 | 214 | 209 | 209 |
| R-squared | 0.000 | 0.013 | 0.058 | 0.065 |

*Standard errors in parentheses.*
*** p<0.01, ** p<0.05, * p<0.1.*

**Table 6**
**RELATIONSHIP BETWEEN SOPHISTICATED PEOPLE AND THEIR TIME PREFERENCES**

| Variables | (1) model 1 | (2) model 2 | (3) model 3 | (4) model 4 |
|---|---|---|---|---|
| Delta | -3.962 | -4.195 | -10.191 | -11.262 |
|  | (11.099) | (10.997) | (11.291) | (11.400) |
| Beta | -0.076 | -0.051 | 0.028 | 0.039 |
|  | (0.261) | (0.258) | (0.261) | (0.262) |
| Age |  | -0.088** | -0.084** | -0.081* |
|  |  | (0.040) | (0.041) | (0.042) |
| Age-squared |  | 0.001* | 0.001* | 0.001* |
|  |  | (0.001) | (0.001) | (0.001) |
| Gender |  | -0.107 | -0.152** | -0.167** |
|  |  | (0.069) | (0.072) | (0.074) |
| Living with their parents |  |  | -0.195*** | -0.196*** |
|  |  |  | (0.072) | (0.072) |
| College-educated father |  |  | 0.239** | 0.260** |
|  |  |  | (0.101) | (0.103) |
| College-educated mother |  |  | -0.225** | -0.225** |
|  |  |  | (0.106) | (0.107) |
| Constant | 4.464 | 6.078 | 12.078 | 13.023 |
|  | (10.903) | (10.812) | (11.041) | (11.166) |
| Observations | 214 | 214 | 209 | 209 |
| R-squared | 0.003 | 0.045 | 0.144 | 0.151 |

*Standard errors in parentheses.*
*\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.*

As is noted in Table 6, the students of the sample who are women, those who do not live with their parents and the youngest have a greater tendency to behave as sophisticated. No characteristic is found which favours the consideration of people as naïve.

The robustness checks carried out confirm these results with the unique exception of men with naïve preferences. This group has a tendency to present lower discount rates. That is to say, the most impatient men are more likely to have naïve preferences but, contrary to what the theory suggests, this probability decreases with the present bias (it grows with the $\beta$ factor) in a marginally significant manner. Table 7 shows the estimated values for naïve students in different groups of the sample.

As we indicate, the tendency to procrastinate is also measured through a subjective index of postponement of academic tasks. Table 8 estimates the relation between this and time prefer-

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ences through the LPM. As we see, the degree to which people procrastinate is not explained by the parameters which determine their time preferences. The total number of hours of study for the exam and the students' satisfaction with the career studied are the only determinants of their propensity to procrastinate. That is to say, the more motivated and more studious students are the ones who tend to postpone their tasks less. In spite of the relations not being statistically significant, the important quantitative effects that the discount rates and the present biases have also stand out, considering the small variations which are produced in these variables.

### Table 7
### RELATION BETWEEN NAÏVE PEOPLE AND THEIR TIME PREFERENCES. ANALYSIS OF THE ROBUSTNESS OF THE RESULTS

| Variables | (1) Probit | (2) Logit | (3) Men | (4) Women | (5) Repeat-ers | (6) Non-re-peaters | (7) Morning classes | (8) After-noon classes |
|---|---|---|---|---|---|---|---|---|
| Delta | 0.210 | -10.522 | -30.654** | 17.081 | -0.209 | -8.907 | -18.235 | 5.429 |
| | (36.970) | (64.152) | (14.299) | (12.981) | (38.391) | (9.547) | (14.387) | (14.058) |
| Beta | 0.042 | 0.273 | 0.678* | -0.301 | -0.303 | 0.295 | 0.464 | -0.328 |
| | (0.834) | (1.480) | (0.362) | (0.284) | (0.680) | (0.231) | (0.300) | (0.335) |
| Constant | -8.409 | -4.889 | 29.145** | -16.063 | 7.031 | 7.801 | 16.807 | -4.791 |
| | (35.700) | (61.869) | (13.967) | (12.791) | (38.423) | (9.338) | (14.130) | (13.652) |
| Observations | 196 | 196 | 89 | 120 | 44 | 165 | 104 | 105 |
| R-squared | | | 0.240 | 0.122 | 0.411 | 0.125 | 0.156 | 0.115 |

*Standard errors in parentheses.*
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.*

The analysis of the robustness of this variable does not include the estimation of discrete choice models given that we have treated it as continuous. Table 9 shows the rest of the groups considered before. As we can see, a statistically significant relation between the discount rates and the procrastination index has been found in the case of the men, the non-repeaters and the students in the morning groups. In these groups, the people with greater discount rates tend to postpone their academic activities to a greater extent than the rest. This reveals a relation between impatience and procrastination.

The explanation of procrastination through the quasi-hyperbolic discount also predicts that people with high present biases tend to have self-control problems as they postpone the tasks that they plan to carry out. In our case this can lead to the students not fulfilling the plan of preparation for the exam and finishing up with bad results. Therefore, there should exist a relation between the academic results and the present biases. To check this, we have estimated a model similar to the previous ones, but which controls by the group in which the student attends class in order to group together the differences in the teacher, the companions and the class hour. Additionally, variables related to the activity and the educational training of the parents have been introduced. The third group of variables has been maintained as in the rest of the estimations.

Table 8
RELATIONSHIP BETWEEN THE SUBJECTIVE INDEX OF POSTPONEMENT
AND TIME PREFERENCES

| Variables | (1) model 1 | (2) model 2 | (3) model 3 | (4) model 4 |
|---|---|---|---|---|
| Delta | 52.510 | 67.667 | 66.617 | 54.050 |
| | (70.122) | (69.194) | (71.373) | (70.154) |
| Beta | 0.047 | -0.364 | -0.690 | -0.545 |
| | (1.642) | (1.621) | (1.642) | (1.610) |
| Age | | 0.396 | 0.511** | 0.335 |
| | | (0.248) | (0.257) | (0.257) |
| Age-squared | | -0.008** | -0.009** | -0.006 |
| | | (0.004) | (0.004) | (0.004) |
| Total study time | | | -0.009*** | -0.009*** |
| | | | (0.003) | (0.003) |
| Satisfaction with their studies | | | | -0.453*** |
| | | | | (0.156) |
| Constant | -44.760 | -64.660 | -61.378 | -43.958 |
| | (68.916) | (68.012) | (69.806) | (68.743) |
| Observations | 211 | 211 | 206 | 206 |
| R-squared | 0.005 | 0.053 | 0.134 | 0.184 |

*Standard errors in parentheses.*
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.*

Table 9
RELATIONSHIP BETWEEN THE SUBJECTIVE INDEX OF POSTPONEMENT AND TIME
PREFERENCES. ANALYSIS OF THE ROBUSTNESS OF THE RESULTS

| Variables | (1) Men | (2) Women | (3) Repeaters | (4) Non-repeaters | (5) Morning classes | (6) Afternoon classes |
|---|---|---|---|---|---|---|
| Delta | 213.095* | 14.602 | -86.065 | 136.019* | 189.116* | 78.862 |
| | (119.312) | (91.503) | (209.734) | (75.653) | (102.543) | (106.190) |
| Beta | -5.760* | 0.403 | -0.637 | -1.972 | -0.479 | -2.013 |
| | (2.956) | (2.030) | (3.714) | (1.832) | (2.111) | (2.529) |
| Constant | -191.504 | -11.644 | 66.884 | -120.056 | -180.452* | -55.253 |
| | (116.759) | (90.124) | (209.740) | (74.029) | (100.721) | (103.124) |
| Observations | 87 | 119 | 43 | 163 | 101 | 105 |
| R-squared | 0.379 | 0.177 | 0.537 | 0.285 | 0.295 | 0.304 |

*Standard errors in parentheses.*
*** $p<0.01$, ** $p<0.05$, * $p<0.1$.*

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As can be seen in Table 10, there is a positive relation between the $\beta$ factor, the inverse of the present bias and the marks. Additionally, the negative sign of the discount factor indicates that as it grows (the lower the discount rate), the marks decrease or, in other words, people with a lower preference for immediateness or with a greater tendency to wait obtain better scores. Both results are coherent with the intuitive idea and verify the hypothesis predicted by the theory. However, no statistical relation has been found between the different types of students and their marks.

**Table 10**
**RELATIONSHIP BETWEEN MARKS AND TIME PREFERENCES**

| Variables | (1) model 1 | (2) model 2 | (3) model 3 | (4) model 4 |
|---|---|---|---|---|
| Delta | 10.216 | -26.666 | -93.501** | -91.110** |
| | (40.998) | (38.622) | (40.161) | (40.140) |
| Beta | 0.123 | 0.945 | 1.956** | 1.967** |
| | (0.965) | (0.916) | (0.950) | (0.943) |
| Gender | | 0.353 | 0.542** | 0.444* |
| | | (0.243) | (0.260) | (0.268) |
| Group 2 | | 1.995*** | 1.385** | 1.245* |
| | | (0.623) | (0.667) | (0.679) |
| Group 3 | | 2.667*** | 2.063*** | 1.886*** |
| | | (0.597) | (0.654) | (0.655) |
| Group 4 | | 1.579** | 0.892 | 0.923 |
| | | (0.612) | (0.660) | (0.658) |
| Group 5 | | 2.738*** | 1.735** | 1.679** |
| | | (0.624) | (0.680) | (0.683) |
| Group 6 | | 1.416** | 0.539 | 0.394 |
| | | (0.623) | (0.681) | (0.682) |
| Group 7 | | 0.456 | -0.338 | -0.376 |
| | | (0.624) | (0.681) | (0.678) |
| Group 8 | | 1.732*** | 0.652 | 0.502 |
| | | (0.665) | (0.724) | (0.723) |
| Monthly allowance between €200 and €300 | | | -0.706 | -0.725* |
| | | | (0.430) | (0.430) |
| Living with their parents | | | -0.610** | -0.578** |
| | | | (0.259) | (0.257) |
| Degree of risk 1 | | | 2.360** | 1.967* |
| | | | (1.117) | (1.123) |
| Degree of risk 2 | | | 2.826*** | 2.417** |
| | | | (1.056) | (1.065) |

(*Continued*)

| Variables | (1)<br>model 1 | (2)<br>model 2 | (3)<br>model 3 | (4)<br>model 4 |
|---|---|---|---|---|
| Degree of risk 3 | | | 2.433** | 1.903* |
| | | | (1.024) | (1.045) |
| Father entrepreneur +10 employees | | | 0.756 | 0.876* |
| | | | (0.520) | (0.523) |
| Mother pensioner | | | -1.405** | -1.507** |
| | | | (0.630) | (0.633) |
| Mother without education | | | -0.878* | -0.760* |
| | | | (0.451) | (0.452) |
| Mother self-employed worker | | | -1.793*** | -1.677*** |
| | | | (0.478) | (0.477) |
| Satisfaction with their studies | | | | 0.214** |
| | | | | (0.095) |
| Constant | -3.558 | 30.611 | 95.599** | 91.168** |
| | (40.277) | (37.920) | (39.208) | (39.292) |
| | | | | |
| Observations | 206 | 206 | 187 | 187 |
| R-squared | 0.001 | 0.227 | 0.395 | 0.416 |

*Standard errors in parentheses.*
*\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.*

The controls indicate that the men obtain better marks. There exists a group effect –that is to say, either the teacher, the companions or the class time– which generates consequences in the marks. The students who live with their parents have worse results. It may be that their productivity has less stimuli as they have less direct costs. The motivation which studying a satisfactory career causes is also transformed into better results. Lastly, the children of pensioner mothers, those of self-employed workers or, those without studies, get worse marks.

The last implication for the model that we are going to test is the prediction that self-control problems generate well-being costs in the people who suffer from them. According to this, not fulfilling the objectives planned causes dissatisfaction with one's own actions. Therefore, we measure the degree to which utility and decision distance themselves from each other and if the divergence is brought about by time preferences. To test this implication, the relation between the factors that determine $\beta$ and $\delta$ is estimated and the level of subjective well-being is measured through satisfaction with life in general. Table 11 shows the results.

As can be seen, the discounting factor has a positive effect upon the degree of satisfaction with life, having a statistical significance at the 5% level. According to this, more impatient people would be, removing the rest of the elements considered, those who report

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greater levels of satisfaction. The present biases do not have a statistically significant relation with the rates of happiness[16]. In this sense, and considering that this factor is the main determinant of the self-control problems, the evidence found in the sample of students analysed does not corroborate this implication of the theory. The other factors which favour satisfaction with life are self-confidence, satisfaction with studies and, trust in others. Having a rural origin and risk aversion also have a positive and significant effect.

**Table 11**
**RELATION BETWEEN THE LEVEL OF SUBJECTIVE WELL-BEING**
**AND TIME PREFERENCES**

| Variables | (1) model 1 | (2) model 2 | (3) model 3 | (4) model 4 |
|---|---|---|---|---|
| Delta | 52.267 | 59.246* | 53.580 | 53.074** |
| | (35.979) | (35.215) | (34.540) | (26.809) |
| Beta | -0.499 | -0.574 | -0.512 | -0.336 |
| | (0.835) | (0.817) | (0.798) | (0.617) |
| Age | | -0.236* | -0.195 | -0.021 |
| | | (0.125) | (0.126) | (0.099) |
| Monthly allowance under €200 | | | -0.886*** | -0.622** |
| | | | (0.326) | (0.255) |
| Monthly allowance between €200 and €300 | | | -1.034*** | -0.862*** |
| | | | (0.359) | (0.283) |
| Monthly allowance between €300 and €500 | | | -1.014** | -0.900*** |
| | | | (0.443) | (0.342) |
| Degree of risk 1 | | | 1.962** | 0.943 |
| | | | (0.973) | (0.764) |
| Degree of risk 2 | | | 2.520*** | 1.726** |
| | | | (0.911) | (0.717) |
| Degree of risk 2 | | | 2.687*** | 1.612** |
| | | | (0.896) | (0.714) |
| Total study time | | | 0.002* | 0.002 |
| | | | (0.001) | (0.001) |
| Trust in others | | | | 0.111** |
| | | | | (0.053) |
| Satisfaction with their studies | | | | 0.224*** |
| | | | | (0.060) |
| Self-confidence | | | | 0.405*** |
| | | | | (0.047) |
| Constant | -44.104 | -46.909 | -43.634 | -49.765* |
| | (35.349) | (34.605) | (33.776) | (26.258) |

(*Continued*)

| Variables | (1) model 1 | (2) model 2 | (3) model 3 | (4) model 4 |
|---|---|---|---|---|
| Observations | 213 | 213 | 209 | 209 |
| R-squared | 0.011 | 0.078 | 0.213 | 0.539 |

*Standard errors in parentheses.*
*\*\*\* p<0.01, \*\* p<0.05, \* p<0.1.*

## 5.  Conclusions

The consequences of biases in behaviour and problems of self-control have become important in economic analysis and are one of the bases of behavioural economics. Among the most accepted explanations of self-control problems it is noted that people's time preferences follow a quasi-hyperbolic form instead of the traditional discount. According to this, the absence of self-control is the consequence of the effect that present biases or a tendency to shortsightedly value the events which take place in the present have, overestimating them compared to those that will happen in the future. The basic interpretation of this proposal means that the people who have a disproportionate preference towards the present adopt different decisions when the moment of making a postponed decision approaches – and that this signifies assuming costs – from those that they would have made if they had decided in advance. The bias leads them to modify their cost-benefit analysis and to adopt decisions far removed from their long-term preferences. Under these premises, O'Donaghue and Rabin defined in various articles a classification of people which makes them more or less inclined to suffer self-control problems. These categories are mainly explained by the existence of present biases. Some of these types of people, specifically the naïve, do not manage to plan their behaviour or, seen from another perspective, repent, a posteriori, about decisions adopted in the past.

The proposition is attractive and articulates a logical explanation of this phenomenon but opens the door to new conceptual difficulties. For example, the economic analysis is based on people with stable preferences, at least during the time that the analysis lasts. This stability is the logical consequence of supposing rational people who do not randomly change their behaviour and who can therefore be the object of prediction. Admitting the possibility of present bias implies recognising that individuals can change their preferences or question the rationality of their behaviour. This has far-reaching implications for the ways of reasoning of economists.

The quasi-hyperbolic formulation has been considered in the literature of behavioural economics, which uses it extensively to model time preferences that underestimate the future (or potential) utility in relation to the current utility due to present biases. In brief, it constitutes a form of measuring the degree to which the decisions of the agents distance themselves from ideals and, therefore, opens the way to measuring the need of a public action. In general, to calculate the degree to which the real behaviours of people are removed from their

predictions through conventional models is a way of determining if policymakers should influence their actions.

Nevertheless, the main shortcoming of the approach is that the empirical verification is limited and, in any event, a good part of its logical developments is partial. The present article presents an unprecedented empirical verification of different aspects of the explanation and of the relationship between discounting rates, present-bias and self-control problems, carried out with a sample of university students during their activity. Specifically, it empirically checks the determinants of the different types of temporal preferences as well as their consequences. The preparation for the final exam of a subject is an example of a costly activity that is carried out in the future, susceptible of being planned for and therefore a candidate is likely to be affected by self-control problems. And though we have centred on the effects of present bias on the actions of university students, the approach can be extended to other topics. For example, Paserman (2008) estimates an employment search model with similar premises and uses it to predict the effect of the policies of unemployment benefits.

Our results show relatively weak evidence of the approach. Specifically, we have found empirical evidence that the lack of present biases leads to consistent behaviours, or, in another words, people who tend to fulfil the time plan that they had imposed on themselves. Furthermore, the relation only occurs for some groups of the sample, not for all, although in these groups it is sufficiently strong to be applied to all the sample. However, we have not found a clear empirical guarantee to the rest of the explanation's implications. We have especially not encountered a relation between the present biases and the time preferences of the people who behave as naïve or sophisticated. We have only identified a relation between discount rates and naïve preferences in men. Nor do our calculations enable corroboration of the majority of the consequences that the $(\beta, \delta)$ model predicts of self-control problems. Though we have noted that the absence of present biases improves academic results, a statistical relation has not been established with the levels of satisfaction with life that we have used as a measure of the self-control problems' costs of well-being.

Our results must be evaluated very cautiously. To take due account of them, it is necessary to recognise that the mechanism that underlies financial behaviour is not, necessarily, the same as that of another type of decision and to be aware that the behaviour in preparing an exam has been inferred through a hypothetical questionnaire. All this implies the need for additional research to be done to explore if the predictions of the model fail to be confirmed because of a failure of the theoretical model itself or for alternative reasons. Nevertheless, these limitations do not invalidate the main conclusion of our work, which shows that even recognising that the $(\beta, \delta)$ model represents a logical solution to explain self-control problems, it is necessary to analyse its empirical basis to be sure that it is an appropriate explanation of the behaviour of people, which may serve as a guide for possible proposals of public action.

# Notes

1.  See, for example, the view of rational addiction of Becker and Murphy (1988).

2.  Among the explanations of economists that are different to the preference for immediacy, we can also find, as in Akerlof (1991), that in which procrastination is the consequence of the prominence of the present cost.

3.  For a review in the context of decisions regarding consumption and saving, see Tanaka and Murooka (2012).

4.  This behaviour is one of the bases of the explanation held by the authors of drug addiction; it can be consulted in O'Donoghue and Rabin (2001).

5.  Akin (2012) has considered the possibility that these people learn by experience and adjust the size of their bias better over time.

6.  See Frederick *et al.* (2002) for a detailed review of the most important experimental studies and their results.

7.  Despite this being the most common method, it is not exempt from criticism. For example, Besharov and Coffey (2003) and Cubitt and Read (2007) maintain that the individuals who can contract debt discount the monetary prizes from the rate of indebtedness and not from their subjective rate of temporal preference. Likewise, it has been called into question that the discount rates of financial activities are equal to those which are used in another type of activities.

8.  See Solomon and Rothblum (1984), Howell *et al.* (2006) and Kagan *et al.* (2010), from among other studies which have analysed their causes.

9.  The same as Nardotto (2011), an error margin of 10% was accepted in the difference in the time planned and the ideal and of 25% between that planned and that finally done, to accept measurement or estimation errors.

10. The sample was mainly made up of university students who did not have other employment and therefore they had very low purchasing power. It was considered that this amount represented a sufficiently large incentive to cause reflexive answers. As a reference, the price of the menu of the school canteen is €5, a coffee in the cafeteria costs €1 and the national minimum wage was €21.38 per day when the task was done.

11. Burks *et al.* (2012) use the amount for which the person changes the future payment. We have considered it more appropriate to use the average because we have supposed that indifference will be found at some intermediate point of these two discrete values.

12. An alternative index has been calculated on the basis of the same five statements, employing a principal component analysis. The index obtained had an almost perfect correlation with that proposed, which is much more intuitive.

13. The three questions were the following:

    – We throw a coin into the air. Choose, from between these two options, that which you prefer: receive €1,000 irrespective of whether the coin lands heads or tails, or receive €2,000 if it lands heads and nothing if it lands tails.

    – Choose from between these two options the one which you prefer: either to receive a lottery ticket with an 80% probability of winning €45 and a 20% probability of not winning anything, or receiving €30.

    – Would you play a game in which you would win €1,500 if the coin landed heads and you would lose €1,000 if it landed tails?

14. There exist lost data in all the groups, except in one. 52.9% of the people who erroneously answered the discount task have afternoon classes, 41% are men with an average age of 22.8 years old, 88.2% only study and their average mark is 6.6.

15. For example, Chetty *et al.* (2014) indicate that less wealthy people tend to be less sophisticated financially. Bhargava *et al.* (2015) find that the households with a low income adopt inappropriate decisions when choosing between a group of health insurances; Bettinger *et al.* (2012) show that to offer information and help to low income students increases their access to University, and Hoxby and Turner (2014) that to raise the level

of information to parents about the access process and the net cost increases the likelihood of their children enrolling in and attending more select universities, among other outstanding examples.

16. Nor has a relationship been found between the type of people according to their temporal preferences and general satisfaction with life.

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## Resumen

El pensamiento neoclásico tradicional falla a la hora de explicar cuestiones como los problemas de autocontrol. La economía del comportamiento los explica en base a las preferencias intertemporales y en concreto, a través del denominado modelo ($\beta$, $\delta$) que pone el énfasis en los sesgos hacia el presente. Esta explicación abre el camino al análisis de nuevas situaciones en las que los individuos puedan adoptar decisiones incorrectas para las que sean necesarias acometer acciones activas por parte del gobierno. La literatura que ha desarrollado esta explicación ha generado una categorización de individuos que es ampliamente empleada pero que carece de una evaluación empírica sistemática, imprescindible para valorar la necesidad de dicha actuación pública. En el presente artículo, desarrollamos un método que posibilita contrastar las principales implicaciones que tiene este modelo para explicar la procrastinación de los estudiantes universitarios. Usando una tarea experimental de descuento temporal con incentivos monetarios reales, estimamos los parámetros $\beta$ y $\delta$ de las preferencias de los estudiantes y analizamos su correlación con las respuestas de los mismos a una serie de cuestiones sobre cómo planifican el estudio de un examen. Los resultados son ambiguos dado que respaldan algunas conclusiones del modelo, pero rechazan otras, incluyendo algunas de las más básicas como la relación entre los sesgos hacia el presente y algunas de las categorías de individuos, básicas para predecir su comportamiento.

*Palabras clave:* economía del comportamiento, problemas de autocontrol, análisis del bienestar, economía experimental.

*Clasificación JEL*: I210, D90