SELF-CONTROL AT COLLEGE

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Discussion Paper 16 / 675

17 June 2016

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June 13, 2016

Abstract

In this paper we develop the observation that college students may suffer from self-control problems (O'Donoghue and Rabin (2007)). In our model students face a self-control problem when making choices about *how* to learn: students acquire education using different combinations of study and tuition (S and T). We consider an 'asymmetric' self-control problem, where students can commit to T but not S and investigate how this affects their decisions.

We show that the degree of self-awareness interacts with how students learn and how this determines the ability to self-correct by precommitment. Finally we show how the appropriate pricing of tuition can ameliorate these problems.

Keywords

Human Capital, Learning, Self-control, Hyperbolic Discounting

JEL codes: A12, D91, I20, I23, D03.

*We are grateful to Nikolaos Kokonas for earlier comments on a draft of this paper. A preliminary version of this paper was presented at the XXIII Meeting of AEDE in Spain, the 2014 FUR conference in Netherlands, and the 2015 LEER workshop in Belgium. We are grateful for comments from participants at all three.

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1 Introduction

In this paper we investigate how self-control problems might impact on the capacity of students to acquire human capital and the role colleges might play in this process. Self-control problems are particularly important at college because students experience freedom for the first time and will frequently admit that once they arrive at college they fail to deliver on the good intentions they formed when they took the decision to apply. There are two hypothesis about the role of higher education: the human capital model (Becker (1962)) and the signalling model (Spence (1973)). In both models students can suffer from self-control problems.

The capacity to overcome problems with self-control and the role that tuition might play in mitigating such problems is the topic of this paper. The recent announcement by the UK government (BIS (2016b)) that it intends to introduce a Teaching Excellence Framework (TEF) to complement the Research Excellence Framework (REF) has highlighted the importance of teaching in higher education. As part of this process the government has announced that it intends to publish information on contact hours and tuition intensity (BIS (2016b) and BIS (2016a)). In earlier work we have modeled the relationship between how much tuition students receive and how much study they undertake. In that paper fully rational agents optimized their time allocation between study, tuition and consumption. In this paper we link this time allocation problem with the problem of self control. In the context of this problem a renewed emphasis on contact hours and tuition intensity makes sense: even high ability students may not be independent

learners.

The example of college students has been used to motivate models of self-control in the literature (e.g. O'Donoghue and Rabin (2007)). There is also an empirical literature supporting these claims (e.g. Ariely and Wertenbroch (2002)). Until recently, in the context of higher education an explicit model has not been considered worthwhile. Hopkins (2016) uses Dynamic Self Control (DSC) preferences to consider a model in which students, of varying ability, allocate their time between study and leisure. In his model a university sets a minimum amount of study that all students must meet. Students choose how much to study and in doing so signal both their ability and their level of self-control. Since these characteristics are jointly signaled an employer will be uncertain of the exact combination. In his model universities do not engage in teaching and decisions about pedagogy have no impact on self-control.

In our paper we argue that the details of how students learn can interact with self-control problems. We use a two input education production function (Study and Tuition), which leads to a natural definition of two learning parameters (Independence and Flexibility). We allow individual heterogeneity across both parameters.

We develop a self-control model in which students motivation is reduced by a present bias. We show that, for a given degree of self-control, how students learn can amplify or ameliorate the original problem. In our model the self- control problem will be most acute for students who choose to learn on their own. We go on to show that how colleges price and bundle tuition may have surprising implications for the problems caused by self-control. For

example we show that paying for tuition has few of the motivational benefits that have frequently been claimed. Subsidizing tuition is a 'virtue subsidy' analogous to a 'sin tax' (O'Donoghue and Rabin (2003)). Finally we consider what safeguards colleges can put in place to motivate students.

2 Literature

Self-control modifies the model of inter-temporal choice by altering the specification of time-preference. This can be formalized with a hyperbolic function (Loewenstein and Prelec (1992)). Hyperbolic discount rates are time-dependent, with a high discount rate in the short run and a lower rate over the long run. This creates a conflict between the preferences we hold today and those we will hold in the future. Laibson (1997) introduces a much simpler discrete version of this model with a quasi-hyperbolic discount rate, which is now the standard way of modeling self-control.

O'Donoghue and Rabin (2003) and (2006) have used this framework to show how problems of self-control can be ameliorated using "sin taxes". These papers are motivated with examples of individuals who consume both a good where consumption today only influences utility today (carrots) and a good with negative health consequences tomorrow (chips). The papers explore how the interaction between heterogeneous preferences and the levels of self-control result in deviations from the efficient outcome. In their work O'Donoghue and Rabin (1999) emphasize the importance of self-awareness. Individuals who understand that they have a self-control problem ('Sophisticates') will act differently to those who do not ('Naifs'). They show that

sophisticated individuals can sometimes take steps to reduce consequences of self-control. In other cases self-awareness can lead to a worse outcome (O'Donoghue and Rabin (2000)). For a summary of their work on self-control see O'Donoghue and Rabin (2007).

In contrast to public policy choices (O'Donoghue and Rabin (2003) and (2006)), DellaVigna and Malmendier (2004) examine how firms respond to consumer biases in the market for health clubs. They show that firms selling to such consumers have incentives to reduce the self-control problems experienced by their customers. In their model firms sell both "leisure goods" and "investment goods". Investment goods have current costs and future benefits whereas leisure goods have current benefits and future costs. Firms charge two-part tariffs with usage prices less than marginal cost for investment goods and higher than marginal cost for leisure goods.

Mental accounting has been proposed as a response to self-control problems (Thaler (1985)). This involves a process whereby fungible assets are mentally framed into different accounts. Since these accounts are assumed to be non-fungible, mental accounting will influence decisions. Levitt et al. (2012) have applied these ideas can be applied to how students learn.

Koch and Nafzigera (2014) create an endogenous model of mental accounting. Throughout the paper an example is given of students allocating time between study and leisure. Here individuals set goals to tackle their self-control problems. These goals result in reference points that ensure poor performance is painful. The paper sets out the conditions under which setting goals can work. In the context of the student, accounts can be defined as either time (e.g. effort) or outcome (e.g. grades). The paper looks at the

breath of such accounts (e.g. Daily or weekly accounting) and highlights the costs and benefits of broader and narrower accounts.

Learning contracts are a similar idea which have been much discussed in the pedagogy literature (Stephenson and Laycock (1993)). These collaboratively written agreements between students and teachers are indented to promote self-directed learning. The contract will define a set of learning objectives and mechanisms by which these objectives can be achieved. A possible explanation for the success of this policy is that the contract creates reference points that give rise to mental accounts.

There also exists a large educational literature on self-control and student motivation (Ames (1992)) and for a survey see Schunk et al. (2013)). This literature addresses three questions: What are the determinants of motivation amongst students? How does motivation affect attainment? How can teachers promote student motivation? Explanations for poor motivation include (Legault et al. (2006)): low expectations of success (e.g. locus of control), low aspirations (e.g. reference points) and failure to perceive benefits (e.g. hyperbolic discounting).

Numerous studies have investigated the relationship between motivation and classroom attainment (Schunk et al. (2013)). For example Pintrich and De Groot (1990) look at the performance of seventh grade students. They found that self-reported measures of self-efficacy and intrinsic value were positively related to cognitive engagement and performance. In addition, the recent literature on human capital and personality formation has shown that motivation is a malleable personality trait (Almlund et al. (2011)). In that literature motivation has a large impact on attainment.

Levels of motivation may vary systematically amongst students, depending on observable characteristics such as race, class or gender. This has led to an emphasis on the role of culture and context in determining motivation. For example, Chinese students are more likely to attribute success to effort than their US counterparts and therefore Chinese students may have more inherent motivation to study (Salili et al. (2001)). Well-documented gender differences include the finding that boys respond better to competition than girls (Gneezy and Rustichini (2004)). These ideas, combined with the belief that motivation is plastic, has led to a literature offering advice to teachers (e.g. Brophy (2010)) and to governments (Almlund et al. (2011)). The advice to teachers seeks to encourage intrinsic motivation and provide appropriate extrinsic incentives.

There is a difference between the responsiveness of students to different teaching technologies, and questions of student motivation. In this paper, we explore how outcomes are jointly determined the interactions between how students learn and their motivation.

3 Self control problems in production

In our model students are producers of education and consumers of the income stream generated by this education. A meaningful self-control problem cannot be formalized by simply discounting either the inputs or outputs of the production function. Firms are usually assumed to maximize profit, π, rather than the utility of profit $U(\pi)$[1]. Discounting can only be motivated

[1]Since, in a one period model maximizing π is equivalent to maximizing $U(\pi)$

in producer theory by introducing time preference and therefore a utility maximizing owner[2]. In the context of producer theory discounting therefore needs to be carefully motivated.

In our model the student produces education which determines future earnings. Although the self-control problem undermines the ability to study, the hyperbolic discount parameter does not enter the education production function. The student behaves as if the graduate premium is smaller than it is, therefore it is the weight attached to the graduate premium that must be hyperbolically discounted.

4 Model

This is a three period model: choices are made in period 0, costs are incurred in period 1 and benefits realized in period 2. Time periods are normalized to 1 and $\delta = 1$. The student has a present bias given by $\beta \leq 1$ (Laibson (1997)).

In period 0, the student makes decisions about future college attendance. Students choose between colleges that offer different levels of tuition (T), which the student will bundle with a chosen level of study (S) to obtain education $E_i(S, T)$. The student is fully informed about their education production function (section 4.1). Thus the student chooses S^* and T^* to maximize:

$$U^t = u_0 + \beta(u_1 + u_2) \tag{1}$$

[2]Discount rates may also appear as prices in a firms cost function. However this represents the market rate of interest rather than an individual's time preference.

Where $u_1 = w^1(1 - S - T) - pT$ is utility at college, w^1 is the non-graduate wage and p is the price of tuition. $u_2 = w^2(E_i(S,T))$ is utility after graduation and w^2 is the graduate wage (a function of E). u_0[3], which is not a function of S or T, is the utility before college.

Since both costs and benefits of S and T are *"in the future"*, the student's present bias does not do not affect her initial choice of S^* or T^*. Thus, she will S^* and T^* to maximize:

$$\nu = w^1(1 - S - T) - pT + w^2(E_i(S,T)) \tag{2}$$

In period 1, the student attends the college of her choice. We assume that the T^* chosen in period 0 is fixed but that the student can reconsider how much S to choose[4]. Now, since the cost of studying is in the present and the benefit is in the future, present bias will mean the student behaves as if the graduate premium is smaller than it it. This gives rise to a self-control problem, with the student choosing S' to maximize:

$$U^t = w^1(1 - S - T^*) - pT^* + \beta w^2(E_i(S,T^*)) \tag{3}$$

In period 3, the student graduates with education $E_i(S', T^*)$. This means

[3]Reduced expenditure on tuition cannot be used used for consumption in period zero.

[4]Since we assume that S cannot be observed, strategies for dealing with self-control must operate through T by influencing the level of S. This is true for both students and colleges. This contrasts with the existing literature where policy would be expected to operate directly on S.

that with a self-control problem, realized utility is less than the first best:

$$w^1(1-S^*-T^*)-pT^*+w^2(E_i(S^*,T^*)) > w^1(1-S'-T^*)-pT^*+w^2(E_i(S',T^*)) \tag{4}$$

For convenience we use $w^2 = w^1 + E_i(S,T)$ and this allows us to define the *Graduate Premium* (GP) as:

$$GP = (E_i(S,T)) - w^1(S+T) - pT \tag{5}$$

By evaluating Equation 5 at (S^*,T^*) and (S',T^*) we can define the *Potential Graduate Premium* (PGP) and *Realized Graduate Premium* (RGP).

4.1 Education production function

Following Huxley and Peacey (2014) students produce education from S and T via an individual specific CES function:

$$E_i(S,T) = (\alpha_i S^{\rho_i} + (1-\alpha_i)T^{\rho_i})^{\frac{1}{\rho_i}} \tag{6}$$

where α_i and ρ_i are a student's learning parameters: *Independence* and *Flexibility*. Independence measures the weight given to each input in the production function. Independent learners will choose to make most of their human capital investments in the form of study and therefore the output elasticity for study will be higher than for tuition. Flexibility is a measure of how a student can adapt to different combinations of the two inputs. The more easily the inputs can be substituted the more flexible the learner will

be. Flexibility determines whether learners view tuition and study as gross substitutes or gross complements.

4.2 Naifs and Sophisticates

Following O'Donoghue and Rabin (1999) we consider students who are Naifs and Sophisticates.

Naive students, unaware of their self-control problem, believe they will behave as they would like to behave. Whereas Sophisticated students, aware of their self-control problem, correctly predict how their future selves will behave.

A Naif will act in the manner set out in Section 4. A Sophisticate, knowing that she will choose $S(\beta, T) < S^*(T)$ according to Equation 3, will choose $\hat{T}$ in period 0 to maximize:

$$U^t = w^2(E_i(S(\beta, T), T)) + w^1(1 - S(\beta, T) - T) - pT \tag{7}$$

This results in a choice of $\hat{T} \neq T^*$, and a hence a realization of $\hat{S} \neq S'$. In Section 5.3, we show that the success of the Sophisticate's strategy will vary with her learning.

5 Results

In this section we simulate the model and generate a set of results. Each simulation considers otherwise identical students with different values of β. The program (see appendix) evaluates all the possible combinations of (S, T) to

calculate the maximand, (S^*, T^*), of Equation 2. S^* and T^* are used to calculate PGP. In the same way and now using T^*, the program then calculates the maximand, S', of Equation 5. S' and T^* are then used to calculate the RGP[5]. The simulation is then run for different sets of the learning parameters (α, ρ) and different prices of tuition (p).

In the sections 5.1 and 5.2 we consider the interactions between these parameters for a Naif learner[6]. In section 5.1 we focus on the interaction between how learning parameters and β by holding price constant. In section 5.2 we consider how changing the price of tuition influences the severity of the self-control problem. In section 5.3 we show that the benefits of being self aware vary with how a student learns[7].

5.1 Learning parameters and β

The results in this section are illustrated in Figures 1a,b,c. Each Figure is drawn for one value of the flexibility parameter[8]. For each Figure we consider an independent and a directed learner[9]. This gives six types of learner and for each we allow the level of self-control to vary over the full range; with $\beta \in [0, 1]$ on the horizontal axis.

In general the graduate premium (vertical axis) will vary with the learning parameters, however symmetric values of alpha (e.g. $\alpha = 0.25$ and $\alpha =$

[5]The simulations measured units in 0.01hours ($\Omega = 24$), and considered 1000 values of $\beta \in [0, 1]$.

[6]A discussion of the learning parameters can be found in Huxley and Peacey (2014).

[7]The program for the Sophisticate (see appendix), works in a similar way to the Naif set out above.

[8]$\rho = 0.5$ (gross substitutes), $\rho = 0$ (Cobb-Douglas) and $\rho = -5$ (gross compliments).

[9]We consider $\alpha = 0.25$ and $\alpha = 0.75$

0.75) generate the same potential graduate premium[10]. This is shown by the dashed horizontal line at the top of each Figure. RGPs for each learner are shown by curves, since these are influenced by β (Result 1). If the individual does not attend college then the graduate premium is zero, shown by the dashed horizontal line through the origin.

Result 1. *Higher levels of self-control reduce the gap between PGP and RGP for all learners.*

When $\beta = 1$, in period 1 a student will stick to her plan to study $S' = S^*$ and this means RGP=PGP. As her level of self-control declines she increasingly fails to achieve her potential. When $\beta = 0$ the self-control problem is so serious that when the student arrives at college present bias means that she behaves as if there is no benefit to acquiring education. Therefore she will devote no time to private study (i.e. $S' = 0$). Since $S' < S^*$, RGP<PGP[11]. Result 1 can be seen in Figures 1a,b,c: The RGP curves for both learners slope upwards and converge on the dashed PGP line.

Result 2. *In the presence of self-control problems RGP can be negative.*

There is a time cost to college that results from attending classes and from studying. Present bias can result in employing fewer inputs and producing less education. This reduction in S, may mean that the return from T^* is now lower than the forgone wage. Since T^* was contracted in period 1, this would result in a negative graduate premium. In this case the individual should not have attended college.

[10]For a given ρ and when $p = 0$.

[11]Even with $S' = 0$, since she contracted T^* in period 1, she may still acquire education.

The critical level of self-control, $\tilde{\beta}$, for which $\beta < \tilde{\beta}$ would result in the learner attending college and receiving a negative graduate premium will depend on how she learns. $\tilde{\beta}$ is illustrated in Figures 1a,b,c by the point where the two RGP curves cross the dashed GP=0 line[12].

Result 3. *The consequences of a given level of self-control depend on how an individual chooses to learn.*

Independent learners plan to study more than their directed counterparts to generate the same level of education and thus their failure to study has more serious consequences. In general, independence increases the cost of a given level of self-control (in Figure 1a,b,c compare the RGP for each learner). If the self-control problem is severe the graduate premium may be negative (Result 2). In this case there can be an offsetting gain because, while both learners receive very little education[13], the independent learner contracted for less tuition (in Figures 1b,c the RGP curves for the two learners cross at GP=0). In other words, losses are limited because less time and money is wasted on an investment that will never yield a positive return.

Since the RGP is initially more responsive to β for an independent learner, $\tilde{\beta}$ will be higher than for an equivalent directed learner. This result implies there is a range of self-control levels for which directed learners should and independent learners should not enroll in college. This is shown in Figures 1b,c.

[12]Moreover, for some learners this $\tilde{\beta}$ may not exist. Directed learners for whom Study and Tuition are highly substitutable would still have a positive RGP even if $S' = 0$ and $\beta = 0$. An example of such a student is represented by the directed learner in Figure 1a.

[13]This "offsetting gain" can only arise if S and T are sufficiently complementary (See Figure 1a).

Complementarity means that a reduction in study will reduce the marginal product of the Tuition that has already been contracted for. Increasing complementary has two implications. Firstly, the cost of not studying (given T^*) will increase. This means the student is less likely to succumb to her self-control problem. Secondly, when she does succumb to her self-control problem, there will be larger reductions in the RGP. For independent learners the first effect is likely to dominate, whereas for directed learners the second effect is likely to dominate (compare RGP for directed learners in Figures 1a,1b and 1c).

5.2 Price of tuition and β

In this section we investigate the relationship between self-control and price for a given learner.

Result 4. *Increasing the price of tuition reduces the RGP for most students. The exception being students with severe self-control problems (low β) who will no longer enter higher education.*

By changing the relative price the two inputs, a tuition subsidy is analogous to a 'sin tax' (O'Donoghue and Rabin (2003)). This reverses the usual argument in favor of charging students for their education[14]. A rise in the price of Tuition will always lead to a fall in T^*. However, both expenditure on Tuition and S^* may increase or decrease, depending on the elasticity of substitution. If the price rise results in a substitution away from Tuition

[14] "The student financed by loan is likely to have a greater sense of individual responsibility. He knows that he has to pay the price later on and is therefore all the keener to get the most out of what he is buying" (Robbins (1963))

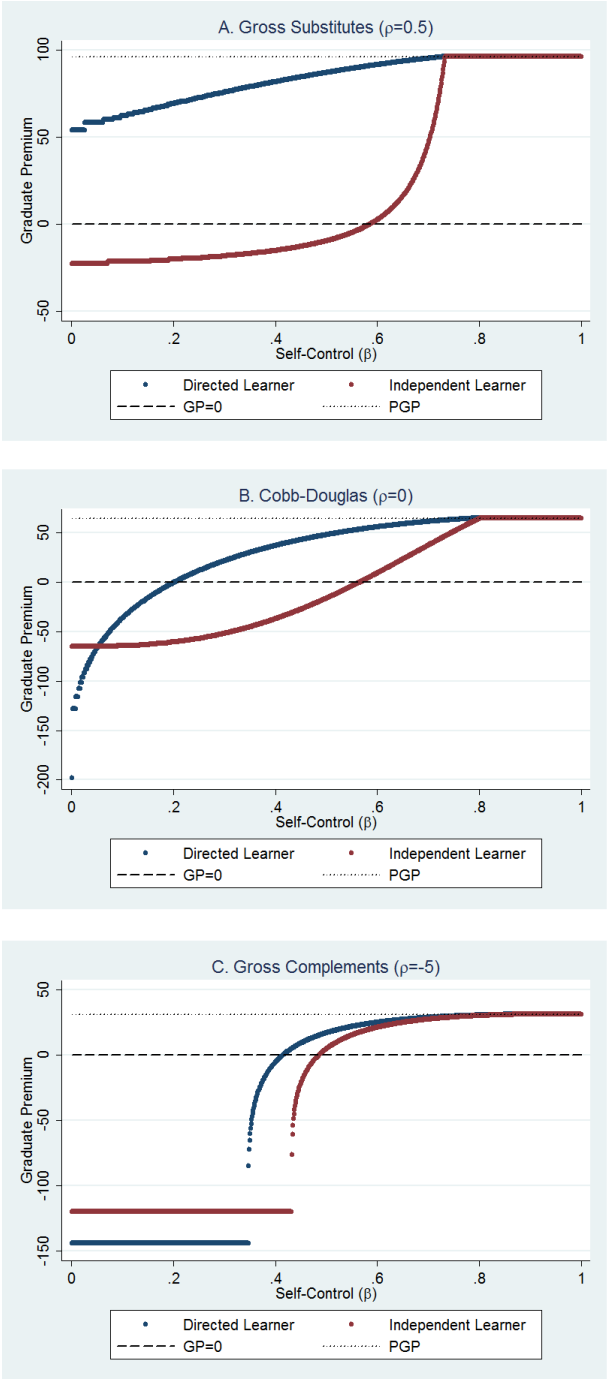

Figure 1: The severity of self-control problems depends on the learning parameters

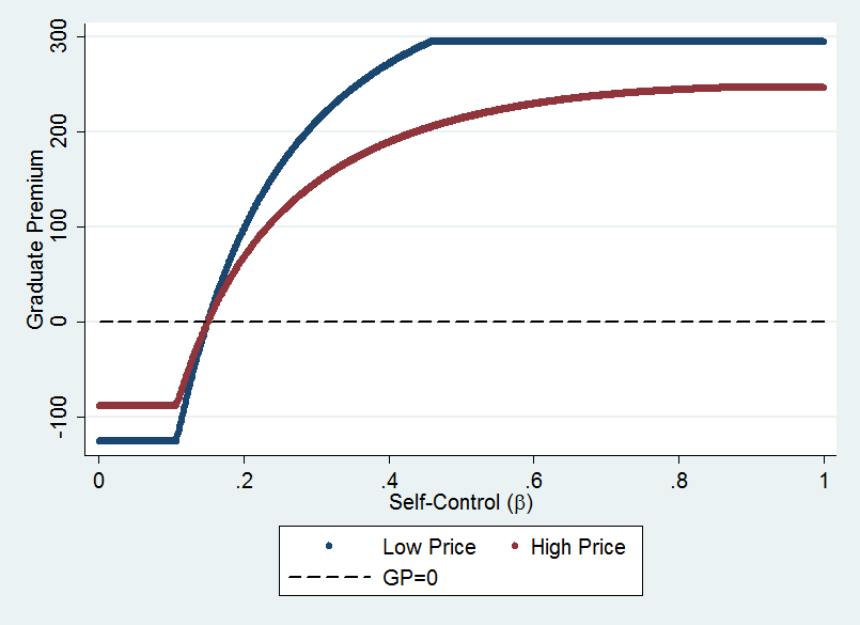

Figure 2: Changing the price of tuition

the individual is worse off for two reasons. Firstly, the new bundle will cost more. Secondly, this new bundle leaves the learner more susceptible to her self-control problem (because she now relies more heavily on study).

However, if the self-control problem is severe the student may commit in period 0 to investments that will yield a negative return (Result 2). In this case, a price rise can reduce expenditure on Tuition, making the student better off. Figure 2 illustrates this case for students facing a high and low price.

5.3 Sophisticates and Naifs

As explained in section 4.2, in period 0 Sophisticates can take steps to reduce the consequences of their self-control problem once they enroll in college. In

this section we examine the welfare effects of this strategy by comparing the outcomes for Naifs and Sophisticates.

Result 5. *However students choose to learn, the RGP of a Sophisticate will be weakly greater than the RGP of a Naif. If $\beta > \tilde{\beta}$ this benefit increases in independence and flexibility.*

In our model, all students are perfectly informed about their education production function. Naifs use this to calculate (S^*, T^*) whereas Sophisticates understand that in practice $S' < S^*$, and this has implications for their optimal choice of Tuition (see section 4.2).

If $\beta > \tilde{\beta}$, Sophisticates will purchase additional tuition in period 0. This has two effects. The first effect is a direct effect: students purchase extra T in order to compensate for the low S that they anticipate will result from their self-control problem. The second effect is an indirect effect: by increasing the cost of self-control, students will increase the amount of study they undertake at college. This is similar to increasing the complementarity between S and T. This formalizes Thaler's example of self-aware alcoholics who chooses to take the drug Antabuse (Thaler and Shefrin (1981))[15].

If $\beta < \tilde{\beta}$, Sophisticates will not attend college and therefore never obtain a negative RGP. In other words, they know when not to back a loser.

For high levels of complementary between S and T, the benefits of being self-aware are limited. For these students the scope for benefiting from both the direct and indirect effect is limited. Substitution is not practical and there is little potential to increase the marginal benefits from study. For

[15]This example is a commitment strategy which increases the cost of an action - rather than ruling it out.

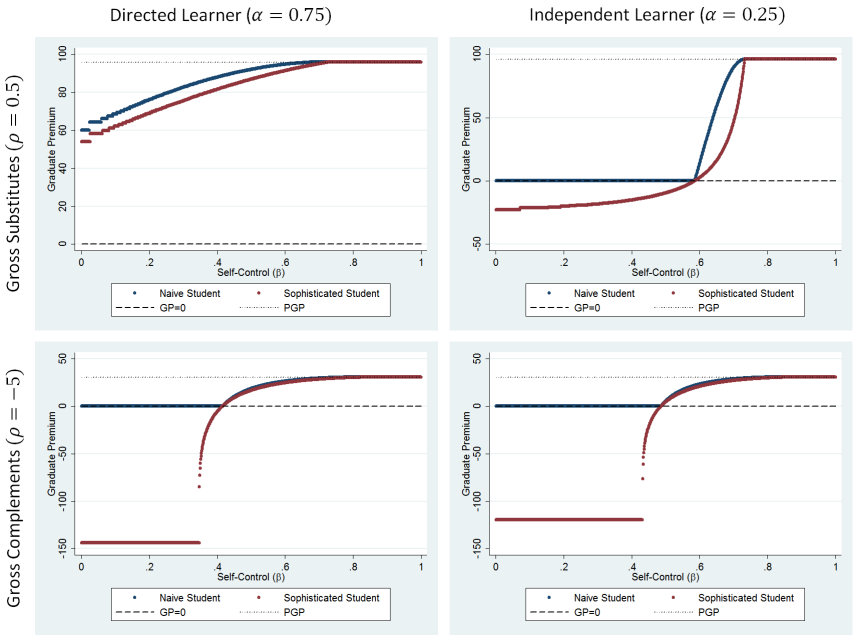

Figure 3: Naifs and Sophisticates

these students the benefit of knowing when not to enroll in college still exists.

Provided the learner is sufficiently flexible, both effects operate. Independent learners can more readily substitute S for T, and this permits sophisticates to 'claw back" some of the losses that result from their self-control problem.

Figure 3 compares the RGP of a Naif and Sophisticate. Each quadrant corresponds to a different type of learner: the columns show independence and the rows show flexibility. At the top right of each figure, when $\beta = 1$, $RGP_N = RGP_S = PGP$ as there is no self-control problem. For $\tilde{\beta} < \beta < 1$, $RGP_N < RGP_S$. This difference is greater for flexible learners (compare rows of Figure 3) and independent learners (compare columns of Figure 3). For $\beta < \tilde{\beta}$, $RGP_S = 0$ as the student decides not to attend college.

6 Conclusion

Previous work on the formation of human capital has usually ignored motivation. Models assume fully rational students will never have problems getting up in the morning, starting an essay, or keeping to a revision program. In the standard model, attainment is a function of two factors: exogenously determined ability; and effort, which is entirely determined by the reward structure (as in the principal-agent literature). The process whereby students make investments in human capital should surely incorporate insights from behavioural economics.

Using a two-input model (S and T) allows us to investigate the possibility that self-control problems operate differently on different inputs and therefore that the mix of study and tuition chosen will have implications for the severity of the self-control problem.

It is well known that some high-ability individuals can have problems with motivation (Heckman and Rubinstein (2001)). Our paper provides one explanation for college dropout by showing how these students overestimate their willingness to study once they arrive at college, and therefore obtain a negative graduate premium. Successful programs (e.g. Oreopoulos et al. (2014), Bettinger and Baker (2011)) to improve graduate rates have addresses this by focusing on motivation. We show the success of such programs may depend on how individuals learn.

The consequences of self-control are more severe for independent learners, and the scope for helping these learners is large. We go on to show that if the complementarity between study and tuition is high, policies that increase

tuition will also promote study.

The approach to policy taken by behavioral economists has been associated with policies that involve "libertarian paternalism" (Thaler and Sunstein (2003) and Colin et al. (2003)). It should come as no surprise that models built on neoclassical foundations incorporating cognitive biases emphasize voluntary interventions. This suggests a policy that corrects for the bias with minimal impact on the choices made by rational agents. The implications of this paper (and the literature e.g. Romer (1993)) point toward some form of compulsory attendance (e.g. compulsory classes or handing in of work). Compulsion benefits students with low levels of self-control who are tempted to skip class when they should not. However this gain must be offset against the cost of compulsion, as some students may benefit from skipping class to study independently.

We show that students who are self-aware when they choose a college can make choices that ameliorate the consequences of their problem. This suggests a role for policies that focus on nudging naive students into making sophisticated choices when applying to college. In either case, the tuition offered by universities must be public information. The recent proposal by the UK government that universities must publish information on contact hours and tuition intensity (BIS (2016a) and BIS (2016b)) can help students make better choices.

We show how the inefficiencies caused by the self-control problem can be reduced by appropriate pricing structures. For students who drop out of college, this would involve increasing the price of tuition to deter them from going in the first place. For students with a less severe problem, a 'vitue

subsidy' on tuition will lead to behavior changes that improve outcomes.

Finally our paper suggests a novel interpretation of the signalling hypothesis: students do not signal ability, which can be measured at low cost. Rather, highly motivated students can signal their work ethic by choosing a college where a large proportion of the learning is done via private study[16]. This comes at a cost: these students must choose an inefficient bundle of S and T.

Almost by definition, colleges cannot influence the study students undertake on their own. However, as we have emphasized study only ever takes place alongside some tuition. In this paper we have shown that how students learn and self-control jointly determine choices and success at college.

7 Bibliography

References

Almlund, M., Duckworth, A. L., Heckman, J. J., and Kautz, T. D. (2011). Personality psychology and economics. *NBER working papers series*, 2011(online):w16822–w16822.

Ames, C. (1992). Classrooms: Goals, structures, and student motivation. *Journal of educational psychology*, 84(3):261.

Ariely, D. and Wertenbroch, K. (2002). Procrastination, deadlines, and performance: Self-control by precommitment. *Psychological science*, 13(3):219–224.

Becker, G. S. (1962). Investment in human capital: A theoretical analysis. *The journal of political economy*, pages 9–49.

Bettinger, E. and Baker, R. (2011). The effects of student coaching in college:

[16]provided employers can observe amounts of tuition offered by different colleges

An evaluation of a randomized experiment in student mentoring. Technical report, National Bureau of Economic Research.

BIS (2016a). *Funding for higher education in England for 2016-17: HEFCE grant letter from BIS*.

BIS (2016b). *Success as a Knowledge Economy: Teaching Excellence, Social Mobility and Student Choice*, volume cm9258. The Stationery Office.

Brophy, J. E. (2010). *Motivating students to learn*. Routledge.

Colin, C., Samuel, I., George, L., Ted, O., and Matthew, R. (2003). Regulation for conservatives: Behavioral economics and the case for'asymmetric paternalism'. *University of Pennsylvania Law Review*, 151(3).

DellaVigna, S. and Malmendier, U. (2004). Contract design and self-control: Theory and evidence. *The Quarterly Journal of Economics*, 119(2):353–402.

Gneezy, U. and Rustichini, A. (2004). Gender and competition at a young age. *The American Economic Review*, 94(2):377–381.

Heckman, J. J. and Rubinstein, Y. (2001). The importance of noncognitive skills: Lessons from the ged testing program. *The American Economic Review*, 91(2):145–149.

Hopkins, E. (2016). Higher education as a signal of non-cognitive skills self-control preferences in a high temptation environment. *mimeo*.

Huxley, G. and Peacey, M. W. (2014). An economic model of learning styles. *CMPO Working Paper No. 14/XXX*.

Koch, A. K. and Nafzigera, J. (2014). Goals and mental accounting. *AER forthcoming*.

Laibson, D. (1997). Golden eggs and hyperbolic discounting. *The Quarterly Journal of Economics*, 112(2):443–478.

Legault, L., Green-Demers, I., and Pelletier, L. (2006). Why do high school students lack motivation in the classroom? toward an understanding of academic amotivation and the role of social support. *Journal of educational psychology*, 98(3):567.

Levitt, S. D., List, J. A., Neckermann, S., and Sadoff, S. (2012). The behavioralist goes to school: Leveraging behavioral economics to improve educational performance. Technical report, National Bureau of Economic Research.

Loewenstein, G. and Prelec, D. (1992). Anomalies in intertemporal choice: Evidence and an interpretation. *The Quarterly Journal of Economics*, 107(2):573–597.

O'Donoghue, T. and Rabin, M. (1999). Incentives for procrastinators. *The Quarterly Journal of Economics*, 114(3):769–816.

O'Donoghue, T. and Rabin, M. (2000). The economics of immediate gratification. *Journal of Behavioral Decision Making*, 13(2):233–250.

O'Donoghue, T. and Rabin, M. (2003). Studying optimal paternalism, illustrated by a model of sin taxes. *The American Economic Review*, 93(2):186–191.

O'Donoghue, T. and Rabin, M. (2006). Optimal sin taxes. *Journal of Public Economics*, 90(10):1825–1849.

O'Donoghue, T. and Rabin, M. (2007). Incentives and self control. *in Richard Blundell, Whitney Newey, and Torsten Persson, eds., Advances in Economics and Econometrics: Volume 2: Theory and Applications (Ninth World Congress), Cambridge University Press, 2007, pp. 215-245.*

Oreopoulos, P., Brown, R., and Lavecchia, A. (2014). Pathways to education:an integrated approach to helping at risk high school students. *Forthcoming.*

Pintrich, P. R. and De Groot, E. V. (1990). Motivational and self-regulated learning components of classroom academic performance. *Journal of educational psychology*, 82(1):33.

Robbins, L. R. B. (1963). *Higher Education: report of the committee appointed by the Prime Minister under the chairmanship of Lord Robbins, 1961-63.* Number 2. HM Stationery Office.

Romer, D. (1993). Do students go to class? should they? *The Journal of Economic Perspectives*, 7(3):167–174.

Salili, F., Chiu, C.-y., and Lai, S. (2001). *The influence of culture and context on students motivational orientation and performance.* Springer.

Schunk, D., Meece, J., and Pintrich, P. (2013). *Motivation in Education: Theory, Research, and Applications*. Pearson Education, Limited.

Spence, M. (1973). Job market signaling. *The quarterly journal of Economics*, pages 355–374.

Stephenson, J. and Laycock, M. (1993). *Using learning contracts in higher education*. Psychology Press.

Thaler, R. (1985). Mental accounting and consumer choice. *Marketing science*, 4(3):199–214.

Thaler, R. H. and Shefrin, H. M. (1981). An economic theory of self-control. *The Journal of Political Economy*, pages 392–406.

Thaler, R. H. and Sunstein, C. R. (2003). Libertarian paternalism. *The American Economic Review*, 93(2):175–179.