Interdependency among addictive behaviours and time/risk preferences: Discrete choice model analysis of smoking, drinking, and gambling

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ARTICLE INFO

ABSTRACT

This paper simultaneously measures the rate of time preference and the coefficient of risk aversion, as well as investigates the interdependencies of four addictive behaviours: smoking, drinking, *pachinko* (a popular Japanese form of pinball gambling), and horse betting among a sample of the Japanese population. We reach two main conclusions. First, there are significant interdependencies among the four addictive behaviours, in particular between smoking and drinking and between gambling on *pachinko* and the horses. Second, we conclude that the higher the time preference rate and the lower the risk aversion coefficient becomes, the more likely individuals smoke, drink frequently, and gamble on *pachinko* and the horses.

1. Introduction

In currently developing economic psychology, or behavioural economics, one crucial topic is investigating addictive behaviours including smoking, drinking, and gambling.[1] Referring to the related literature, there are two models of research regarding addictive behaviours: rational addiction and bounded rational addiction (Messinis, 1999). The rational addiction model argues that utility maximizing consumers consider the future consequences of their past and current consumption of addictive substances (Becker & Murphy, 1988; Stigler & Becker, 1977). On the other hand, the bounded rational addiction model assumes that many drug, tobacco, and alcohol addicts regret their reliance on these substances (Akerlof, 1991; Winston, 1980) and argues that addiction results from mistaken beliefs about the likelihood of being addicted (Orphanides & Zervos 1995; Orphanides & Zervos 1998). From this point of view, we investigate the following issue. Although recently many studies have

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[1] See DiClemente and Hantula (2003) as to a review of the applied behavioural literature in consumer choice.

investigated addiction based on bounded rational addiction models (Bernheim & Rangel, 2005; Kan, 2007), discussion has concentrated on the transition of addictive behaviour over time (*vertical addiction*). In this paper, we emphasize the interdependencies among addictive behaviours (*horizontal, or cross, addiction*).

Following rational addiction models, vertical addiction is defined as habit forming behaviour; utility function is given by $U(c, S)$, where c denotes current consumption, S denotes its consumption stock, and vertical addiction is indicated by $d[\partial U/\partial c]/dS > 0$. Turning to horizontal addiction, the utility function is given by $U(c_1, c_2, \ldots, c_i, \ldots, c_n)$, where c_i represents some addictive behaviour, and horizontal addiction is indicated by $d[\partial U/\partial c_i]/dc_j > 0$ for $i \neq j$.[2]

When investigating addictive behaviours, economic-psychological parameters including the rate of time preference and the coefficient of risk aversion play key roles. For example, research on time preference has reported that smokers are more impatient than non-smokers; furthermore, a significant positive correlation between the amount smoked per day and a higher discounting rate has been observed (Baker, Johnson, & Bickel, 2003; Bickel, Odum, & Madden, 1999; Mitchell, 1999; Odum, Madden, & Bickel, 2002; Ohmura, Takahashi, & Kitamura, 2005; Reynolds, Richards, Horn, & Karraker, 2004).[3] The research on risk preference remains unable to determine whether smoking and impulsive probability discounting are related (Mitchell, 1999; Ohmura et al., 2005; Reynolds, Karraker, Horn, & Richards, 2003). We also introduce studies on addictive behaviours other than smoking: heavy drinkers highly discount delayed monetary rewards more than social or non-drinkers (Madden, Bickel, & Jacobs, 1999; Madden, Petry, Bodger, & Bickel, 1997); pathological gamblers more readily discount monetary rewards than non-gambler (Alessi & Petry, 2003; Petry, 2001; Petry & Casarella, 1999); furthermore, the severity of gambling problems is associated with discounting rates, and pathological gamblers with substance abuse disorders (alcohol, cocaine, or marijuana) more impulsively discount delayed rewards than those without such problems (Alessi & Petry 2003; Petry 2001; Petry & Casarella 1999). Based on these viewpoints, we will explore the following: expanding upon the previous studies concerning the relationship between addictive behaviours and the rate of time preference, this paper investigates the relationship between addictive behaviours and risk aversion coefficients that has not yet been fully addressed.

At this point, we explain the two approaches adopted in this paper. First, we develop a simple method to simultaneously measure the rate of time preference and the coefficient of risk aversion. As Rachlin and Siegel (1994) suggest, the nature of the interaction between the rate of time preference and the coefficient of risk aversion has remained controversial because most previous studies measured them separately, which is analytically unsatisfactory.[4] Accordingly, this paper simultaneously measures the rate of time preference and the coefficient of risk aversion at the individual level based on discrete choice experiment (DCE) and mixed logit (ML) model analysis.[5]

Second, we examine the interdependencies of plural addictive behaviours and time/risk preferences. Barsky, Juster, Kimball, and Shapiro (1997) measured preference parameters related to risk tolerance and intertemporal substitution and analyzed their interaction with "risky" behaviours, including smoking, drinking, noninsurance, and stock speculation. Kapteyn and Teppa (2003) exploited hypothetical choices among different consumption streams to infer the rates of time preference and considered some interesting behavioural extensions, including habit formation.[6] Donkers and van Soet (1999) also showed that household behaviour depended on the rate of time preference, the rate of risk aversion, and the information set. This paper deals with such addictive behaviours as smoking, drinking, playing *pachinko* (a form of Japanese gambling involving the use of a Pinball machine), and betting on the horses and analyzes the influence of time/risk preferences on those addictive behaviours.[7] Also, considering the problem of endogeneity, this paper investigates interdependencies among addictive behaviours by a two-step probit estimation method.

Finally, the main conclusions of this paper can be summarized in two points. First, we conclude that one who smokes, plays *pachinko*, and gambles on horses has a higher rate of time preference and a lower coefficient of risk aversion. On the other hand, drinkers have a lower rate of time preference and a higher coefficient of risk aversion. However, if we narrow the definition of drinker (i.e., drinking every day), we discover that regular drinkers conversely become more impatient and risk-seeking. Second, we find strong interdependencies between smoking and drinking and between *pachinko* and gambling on horses. Furthermore, weak interdependencies are found between smoking and *pachinko* and between drinking and gambling on horses.

The paper is organized as follows: Section 2 explains the method of sampling data and discusses their characteristics. Section 3 proposes discounted and expected utility models for estimating preference parameters and portrays a mixed logit model analysis. Section 4 discusses the interdependencies among addictive behaviours based on a two-step probit estimation method. Section 5 draws concluding remarks.

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[2] It would be interesting to extend the analysis to 'beneficial addiction' including jogging and swimming. There is some controversy as to whether jogging and swimming can be also considered addictions (Holden, 2001); excessive exercise can cause unhealthy outcomes (McKenzie, 1999) and can also be a harmful addiction in this case.

[3] Some research found the opposite: smokers exhibited lower discount rates (Chesson & Viscusi, 2000).

[4] A few studies have tried to integrate the measurements of time and risk preferences. Examples include Rachlin, Raineri, and Cross (1991), Keren and Roelofsma (1995), Anderhub, Guth, Gneezy, and Sonsino (2001), and Yi, de la Piedad, and Bickel (2006).

[5] In health economics, obtaining reveal preference (RP) data is sometimes difficult, since the market is incomplete; it is advantageous to utilize stated preference (SP) data using experiments and questionnaire surveys. As such, this hypothetical technique has been applied in healthcare settings, and previous results have revealed that SP results have internal validity and consistency (Viney, Lanscar, & Louviere, 2002).

[6] They interestingly discovered that the rate of time preference was robust with respect to the different assumptions regarding habit formation, while the coefficient of relative risk aversion changed substantially across specifications.

[7] In p*achinko*, the object is to increase the number of pachinko balls to exchange for cash or prizes.