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History-dependence in a rational addiction model

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Abstract

Defining *habitual* behavior as a positive relation between past and current consumption and addiction as a strong habit, Becker and Murphy (Journal of Political Economy, 1988) studied a model for rational addiction. They identified multiple steady states as another key feature of addiction. In the present paper it is shown how the interplay of addiction with a budget constraint may generate multiple long-run steady states. In the most interesting case, there exist two boundary saddle-point equilibria, as well as an unstable steady state in-between. The basins of attraction of the upper and the lower equilibria are separated by a threshold. Convergence to the lower long-run steady state may be interpreted as 'cold turkey', i.e., an immediate exit from consumption.

Keywords: Optimal control; Addiction behavior; History dependence

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1. Introduction

Addiction is a key concept in the dynamics of drug consumption. To design efficient measures for the control of drug epidemics one has to understand the mechanism of how

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the intensity of drug consumption changes from light (i.e., temporary) to heavy (i.e., permanent) use.

Addiction is not restricted to smoking, alcohol or illicit drug use. People get addicted also to work, eating, music, their standard of living, other people, religion or many other activities (see Becker and Murphy, 1988). The core idea of the economic theory of *rational addiction* states that individuals maximize utility consistently over time, and increases in past consumption raise current consumption (compare Becker and Murphy, 1988; Becker, 1992; Stigler and Becker, 1977; Iannaccone, 1986; Leonard, 1989). The claim of Becker and his coauthors is that even addictive individuals are rational in the sense that they are forward-looking agents maximizing a utility function with stable preferences, anticipating the future consequences of their choices. The aim of the present paper is to gain insights in rational addiction theory by taking into account a budget restriction. To this end a variant of the Becker and Murphy (1988) model is analyzed. The central assumption of this rational addiction approach is condensed in the utility function, which does not only depend on current consumption, but also on a measure of past consumption. Or, to put it in the language of dynamic optimization, accumulated consumption acts as state variable (consumption capital or habit) appearing as additional argument in the utility function. As already introduced by Ryder and Heal (1973) certain complementarities may cause addictive behavior. In particular, these authors have shown that a so-called adjacent complementarity of utility is responsible for addiction. Utility functions then exhibit the property that the marginal consumption utility increases when the stock of the consumption capital is greater. Or, to put it in a more plausible way: someone is addicted to a good only when past consumption of a good raises the marginal utility of present consumption. Such an effect, however, is only necessary but not sufficient for potential addiction. Among other variables, addiction depends also on the time preference rate of the decision maker. It can be shown that, ceteris paribus more impatient individuals get more easily addicted (see Becker and Murphy, 1988). These authors and Orphanides and Zervos (1995) mentioned the multiplicity of steady states as a key feature of addiction.

In particular, Becker and Murphy (1988) discussed the existence of a critical stock of the consumption capital, around which the optimal paths depend crucially on their initial state. The main purpose of the present paper is to analyze this history-dependence in the context of DNS-(Skiba-)thresholds (see Skiba, 1978; Dechert and Nishimura, 1983). The latter seem to be a more pervasive phenomenon in dynamic optimization models for economic processes than it has been assumed so far (compare, e.g., Feichtinger and Wirl, 2000; Deissenberg et al., 2004).

A dynamic consumer model is presented in which the discounted utility stream over time is maximized. The utility function exhibits adjacent complementarity, i.e., marginal utility of consumption increases with the amount of past consumption. Like in Bardsley (1998), who used a similar framework to analyze a dynamic game between an addict and a dealer, the state variable is accumulated consumption, while the consumer also has to deal with a budget constraint.

In the present context, the existence of a critical state implies two long-run steady states, which are approached by different optimal consumption patterns. While the upper equilibrium is generated by the budget constraint, the lower occurs due to a reduction of