APPLICATION OF HYPERBOLIC DISCOUNTING MODEL TO CZECH HOUSEHOLD SAVING BEHAVIOR

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Abstract

Solid empirical evidence supports the idea of time-inconsistency in human preferences. According to hyperbolic model, people tend to discount distant-future (near-future) events at lower (higher) rates. As a result of conflict between patient future self and impulsive present self, individuals reverse their preferences. Although practical implications of hyperbolic discounting model for saving behavior can be found in numerous research papers (e.g. Laibson, 1997; Angeletos et al., 2001), the majority of them draw conclusions from empirical analysis of U.S. household behavior. Therefore, it is not clear if their results are not culture-specific. In this paper we seek an answer to the following question: will findings from the aforementioned research hold true if we examine the essence of hyperbolic discounting within a very different cultural context? As a result of analyzing various statistical data (saving rates, asset composition, consumption structure, and household indebtedness) over time, we show that in many cases Czech households do not behave in accordance with hyperbolic discounting model.

Key words: hyperbolic discounting; household saving behaviour

JEL Code: D14, D91, E03

Introduction

Individuals are constantly torn between preferences of their current and future selves. To mitigate the influence of the present focus bias, people use different self-regulation strategies. Significance of self-control is growing because human inventions bring new temptations, which are increasingly difficult to counteract. Whereas in 1900 only 5 percent of deaths could be attributable to personal decisions, this figure jumped to 22 percent in 1950 and 44.5 percent in 2000 (Keeney, 2008).

Lack of self-control can have devastating consequences for our financial health as well. With the help of applying hyperbolic discounting model, behavioral economists have found that human obsession with the present moment leads to wealth accumulation insufficient for future generations, overspending, inferior investment strategies, and even

bankruptcy. These results are based on empirical investigation of U.S. household behavior though. In this paper we assess the applicability of the above findings within Czech cultural context. We show that Czech households (who are not subject to overconfidence, are fairly conservative, and whose attitude to "snowball" borrowing is traditionally different) have mostly time-consistent saving preferences.

The remainder of this paper is structured as follows: First, we give a general overview of hyperbolic discounting and its applications, provide evidence for high fidelity and reliability of the model, give deeper insight into commitment technologies and classify individuals based on their awareness of self-control problems. Second, we describe implications of hyperbolic discounting model for individuals' saving decisions. Third, we analyze different data from the Czech Statistical Office to identify trends in line (in conflict) with hyperbolic discounting.

1. Hyperbolic discounting: its essence, applications and role in explaining household saving behavior

1.1 Hyperbolic discounting model: its nature and the power of self-control

Although rational choice theorists argue that people have time-consistent preferences, the empirical investigation of individuals' intertemporal decision-making leads to different results. Human beings are susceptible to instant gratification and in many cases they are unlikely to correctly predict their future behavior. As a result of the present focus bias, people tend to concentrate too much on the current moment, whereas the role of distant future events is underestimated. If we look at time inconsistency from mathematician's viewpoint, we will come up with hyperbolic discounting model. According to it, discount rate π decreases as time increases[1] ($\pi = \beta / (1+\varepsilon t)$, where ε – present focus bias) what leads to overdiscounting (underdiscounting) of near (distant) future.

One could find different arguments in favor of the idea that hyperbolic discounting lies at the core of intertemporal decision-making. First, various experiments prove inbuilt human inclination to discount hyperbolically: people often neglect medical checkups because of immediate inconvenience (long-term benefits do not seem motivating enough); they tend to procrastinate, insufficiently exercise, and overconsume harmful goods focusing on instant pleasure and ignoring future costs (obesity, drug addiction, etc.)[2]. Second, the desire for instant gratification has neuroscientific evidence. As a result of fMRI study (where

[1] On the contrary, exponential discounting (which is preferred by mainstream economists) implies constant discount rate π.
[2] Apparently this list is not exhaustive.

participants had to choose between smaller/earlier and larger/later monetary rewards), McClure, Laibson, Loewenstein, & Cohen (2004) showed that limbic structures (which are involved in impulsive behavior) are activated by the choice of immediate money sums while prefrontal and parietal cortex areas (which are associated with reasoning and cognitive control) showed similar activity for all types of rewards, regardless of their delay. Involvement of the emotional component could explain the indulgent nature of our present self whereas presence of the rational component could help gain insight into patience of our future self. Third, hyperbolic discounting has been observed in animals. In the experiment conducted by Rachlin & Green (as cited in Siegel & Rachlin, 1995) pigeons demonstrated preference for immediacy while choosing between smaller immediate amount of food (SS reinforcer) and larger delayed amount of food (LL reinforcer)[1]. However, impulsive behavior could be controlled by either pre-committing oneself at the earlier stage to LL reinforcer or "refraining from switching from one behavioral pattern to another" (Siegel & Rachlin, 1995, p. 119). Whereas in the former case the choice of LL reinforcer excluded the possibility of subsequent preference reversal (what served as strict commitment), in the latter case disruption of behavioral pattern was possible (soft commitment), but the cost of switching to SS alternative prevented pigeons from yielding to temptation for response defection.

Similar to animals, people resort to self-binding or shielding themselves against future undesirable behavior although their forms of commitment are understandably more progressive. To avoid procrastination, individuals are willing to self-impose deadlines which are likely to be more costly than externally imposed deadlines. For instance, in Ariely and Wertenbroch's experiment (2002) most students preferred to set deadlines considerably before the last day of the class what implied higher grade penalty in case of delay. Despite this, their grades were lower compared with given evenly-spaced deadlines what resulted from suboptimal spacing of tasks. Nevertheless, this commitment device is still effective as it improves individual's performance relative to the case when maximally delayed deadlines are chosen.

The importance of self-binding strategies becomes especially evident in health care-related situations. As a result of conducting a set of studies, Trope & Fishbach (2000) found that people tend to self-impose higher financial penalties or bolster the value of unpleasant experience to prevent the failure of completing an activity with higher immediate costs but significant delayed benefits (e.g. longer period of abstinence from glucose-containing food vs.

[1] Interestingly, pigeons tend to discount delays to a greater degree compared with humans. This provides evidence of pigeons' more severe self-control problems.

feedback on eating behavior). Moreover, individuals who ascribe high importance to good health are willing to make a reward contingent on their choice (i.e. receiving it after having undertaken an unpleasant procedure).

It's also worth mentioning that the probability of pre-committing (or, in other words, exercising self-control) depends on the degree to which an individual is naive. Some people ("naifs") do not realize that they are hyperbolic discounters ("my actual future behavior will coincide with my prediction"); therefore, they have little incentive to restrict their future freedom of choice. Others ("sophisticates"), on the contrary, are aware of their dynamically inconsistent preferences and they prefer to refrain from current indulgence in order to avoid future temptations[1].

After we have provided a general overview of human overattentiveness to the present moment and underestimation of future outcomes, we can take a closer look at the role which hyperbolic discounting plays in household financial decision-making.

1.2 Implications of hyperbolic discounting for saving decisions

In this section we focus on the intrapersonal dynamic conflict arising from different attitudes of earlier and later self to future consumption and saving. People like to make ambitious promises to themselves to save more money for retirement but in future they find it extremely difficult not to spend all their financial resources on consumption. Laibson (1997) considers intertemporal financial decision-making as part of a game where current selves are trying to maximize their welfare by creating liquidity constraints for future selves. The holding of an illiquid asset is likely to prevent future splurging[2]. Although earlier self cannot influence later self's decision with regard to spending its labor income (therefore, we are speaking about partial commitment), it can successfully decrease the access to previously accumulated assets. Decision of future liquidity constraint depends on expected consumption: if its level is likely to be above the desirable one, earlier self will limit future liquidity to the highest possible extent; otherwise, no restrictions on future choice will be imposed.

Although earlier self uses seemingly effective commitment device to prevent later self from spendthrift behavior, it is unclear why we observe worldwide falling household saving rates. According to Laibson (1997), there are several factors which contributed to the decline of U.S. personal savings rates during the 1980s. First, consumers started to receive larger part of national income, and they reflected this increase in consumption. As future self has only

[1] However, when sophisticated people feel too pessimistic about their future behavior, they tend to succumb to their temptations and even do not try to stop themselves by exercising self-control (O'Donoghue & Rabin, 1999).

[2] Despite obvious simplications made in the golden eggs model (Laibson, 1997), it still reflects reality in the sense that the sale of illiquid assets usually implies obstacles such as high transaction costs or information-related problems.

partial binding obligations towards present self, it is prone to overspending of its current income. Second, the U.S. market became flooded with abundant opportunities of instantaneous credit. Advances in financial technology enabled consumers to instantly borrow against illiquid assets and made partial commitment impossible what resulted in lower capital accumulation and reduced welfare.

Further implications for life-cycle saving decisions can be found in the paper by Angeletos et al. (2001) where households are divided into exponential and hyperbolic types. As mentioned above, the former case implies constant discount rate π what means that individuals have time-consistent preferences and thus there is no conflict between their temporal selves. In comparison with exponential households, hyperbolics have smaller (larger) liquid (illiquid) wealth holdings, are less successful in the life-cycle consumption smoothing and borrow more heavily on credit cards. To prevent future selves from spending spree, hyperbolic households invest more in illiquid assets. Although this form of wealth is not helpful in case of income shocks, hyperbolics highly value illiquidity as a result of comparatively low long-term discount rates. Simultaneously, households with time-inconsistent preferences tend to hold relatively small amounts of liquidity. However, this commitment does not help them weaken their desire for instant gratification and they end up aggresively borrowing on credit cards. In addition, hyperbolics experience difficulties in smoothing consumption over the life-cycle. As their marginal propensity to consume out of predictable changes in income is higher than zero[1], we observe co-movement between their consumption and income. This means that hyperbolic household consumption will respond to sharp drop in labor income around retirement (although it is an anticipated event) in the similar way.

With the help of empirical evaluation of their simulation predictions, Angeletos et al. (2001) showed that hyperbolic discounting model much better approximates data derived from the U.S. household surveys. However, we are concerned about its explanatory power in the context of Czech culture.

2. Czech household saving preferences: an intertemporal perspective

In this chapter we consider selected macroeconomic indicators and their dynamics to understand if Czech household saving behavior is consistent with principles of hyperbolic discounting. As self-control problems tend to escalate with technological developments,

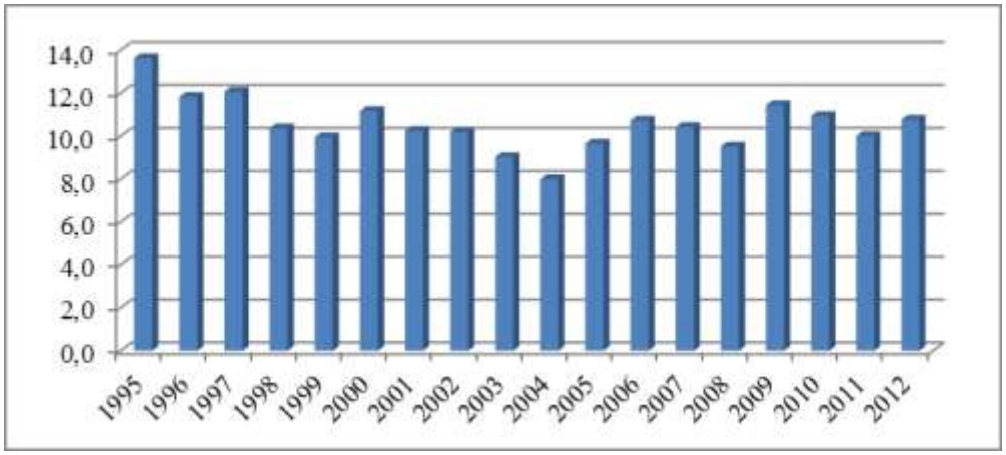
[1] According to authors‘ simulation-based estimations, exponential households also have MPC different from zero. However, it is much lower than the value of this coefficient in case of hyperbolic households (0.03 and 0.166 respectively).

which provide consumers with increasingly tempting opportunities (and transition to a market economy could be an excellent demonstration of this), the starting point for our statistical analysis is the year 1993[1]. For the purposes of this paper, we restrict our attention mainly to those data which can be compared with the findings mentioned in the previous section.

Saving rates. As can be seen from the below graph, there were periods when Czech households saved less from their disposable income (compared with previous years). However, it doesn't necessarily mean that their preferences are hyperbolic. Although the period 1995-1999 was characterized by declining saving rates (except for the year 1997 when currency crisis led to extremely high interest rates presumably motivating people to augment delayed consumption), there could be explanations of this trend other than access to instantaneous credit or novel opportunities for impulse buying. Individuals may have been simply confused with new environment and economic volatility[2]. The upward trend in saving rates during 2004-2006 shows that Czech people are able to wisely manage their finances, and rising salaries (which accompany economic growth) are unlikely to tempt them to splurge. Moreover, at the height of the financial crisis (2009) Czech household saving rate achieved 11.4 percent, its fourth-highest value during the whole observation period. In the same period gross disposable income increased as a result of more generous unemployment benefits and other social allowances and favorable tax law changes (Dubská, 2013), but household final consumption expenditure stagnated (+0.2%[3]). Although in 2009 wages decreased by 1.6 percent, redistribution processes provided households with more financial resources. However, Czech people didn't squander this money proving again their ability to resist the lure of instant gratification.

[1] As not all statistical data for the year 2013 are available yet, our analysis will cover period till 2012.
[2] It is also possibile to find alternative explanations for falling saving rates in 2000-2004. Not only inflation dropped (from 10.7% in 1997 to 3.9% in 2000), interest rates were decreasing and wage growth was slowing down. As humans are susceptible to money illusion, they need time for adaptation to new price and interest rate levels and rate of labor income growth, which at first can change their approach to saving.
[3] This is the second-worst result in the period 1993-2009.

Fig. 1: Czech household saving rates in 1995[1]-2012 (as a percentage of gross disposable income, %)



Note: The data for graph construction were retrieved from http://www.czso.cz/csu/redakce.nsf/i/cr:_makroekonomicke_udaje

Wealth accumulation and asset composition. In comparison to other institutional sectors, Czech households succeeded in faster accumulation of fixed and financial capital (Dubská, 2013). In the former case they invested mainly in real estate which was intended to serve as a home in future. Although favorable economic climate contributed to relatively high average annual growth rate of fixed capital (14.1 percent during 2005-2007), the investment substantially decreased in the subsequent years (-3.5 % in 2009 and -11.8% in 2011). Due to high illiquidity, Czech households reduced their acqusition of fixed assets in times of financial crisis and high uncertainty. However, the fear of future recession and demotivating interest rates[2] did not induce people to undermine the benefits of their future savings and, therefore, spend all disposable financial resources. According to Dubská (2013), household financial assets at the end of 2011 were nearly 22 percent higher than their value at the end of 2007. For the sake of higher liquidity, Czech households also deposited much more money into checking accounts in 2011 (71.1 percent increase compared with 2007). Although time deposits combined with checking accounts made up approximately 56 percent of all personal financial assets in 2011, the former ones did not show significant increase since 2009. It is noteworthy that under favorable economic conditions Czech households prefer short-term over long-term time deposits; during crises and recessions the trend is reversed. Apparently in case of economic growth individuals see spending or investing opportunities in the near

[1] The data for two years 1993-1994 are unavailable.
[2] For instance, in 2012 increased inflation led to negative interest rate returns on savings accounts.

future, which will require their deposited funds. In such situations Czech households seem to focus on short-term gains at the expense of long-term benefits of saving[1].

Two more types of financial assets should be mentioned here. During 2007-2011 Czech household savings related to life insurance increased by more than 32 percent, whereas in case of additional pension insurance this figure amounted to 42.9 percent (Dubská, 2013). One possible explanation for this could be provided by hyperbolic discounting model. During economic downturn, benefits of future financial stability became more salient and meaningful. As a result, Czech households increased their discount rate with respect to long-term welfare (what implied bigger savings for achieving a desirable level of well-being).

Consumption dynamics and structure. In the period 1993-2008 we observe rising household final consumption expenditure (except for 1998). The pace of its growth was relatively fast. Whereas in 1993 investment into financial and fixed assets amounted to nearly 80 percent of household spending, during 2005-2008 this ratio[2] dropped to almost 25 percent (Dubská, 2013). As a result of financial crisis and subsequent recession, growth of consumption expenditure slowed down and eventually became negative (according to Czech Statistical Office (2014), 0.2% in 2009 and -2.2% in 2012). Despite this, during 1993-2011 personal spending was following ascending trend (+ 6.7% on average per year); therefore, there is a reason to assume that transition to market economy awoke Czech households' desire for instant gratification (by providing them with new temptations). However, gained insight into changes which happened in consumption structure over time will probably lead to another conclusion. During 1993-2011 Czech households significantly reduced food, clothing, and footwear spending. Conversely, housing, water, energy, and fuel expenditure increased. Czech households were limited in their response to rising prices of these items as their consumption is an integral part of modern life. In addition, people started to spend more on health, education, culture, recreation, and sport (Dubská, 2013). Interestingly, transition to market economy did not lead to higher expenditure on products whose purchase is usually associated with impulsive behavior (e.g. food and clothing)[3]. On the contrary, Czech households began to invest more in goods which imply long-term benefits but short-term costs. For example, people became willing to pay for services rendered by private educational institutions (which didn't exist in the past), spend their time and energy on studying, and

[1] If deposited funds are later invested (unfortunately, we cannot extract this information from available statistics), the detrimental effect on household long-term benefits related to savings can be offset by returns on their investment.
[2] The average value is used.
[3] However, we do not rule out the possibility that, as a result of increased competition, more cheap products became available. This means that Czech households were able to consume higher amounts of food and clothing, while being able to pay less.

undergo exam stress for the sake of obtaining a degree or receiving a diploma in the distant future.

Borrowing. According to Dubská (2013), Czech households have "healthy loans" because mortgages unquestionably dominate consumer loans (81% vs. 19% at the end of 2012). It could be interpreted as individuals' weak interest in short-term credit which is usually used to temporally satisfy the desire for immediate gratification[1]. Further proof of this could be found in personal debt dynamics. Although during 2004-2008 there was observed the marked increase in Czech household indebtedness, in subsequent years (2009-2011) pace of borrowing substantially slowed down. Moreover, during this time short-term loans decreased and people also started to borrow less from non-bank lenders[2]. This could mean that Czech people did not turn to credit in order to compensate for labor income stagnation (following wage decline in 2009), which was likely to negatively affect (and affected indeed) their current consumption[3]. In other words, their present selves succeeded in overcoming impatience and tightening their belts for the sake of higher future welfare.

Despite this positive conclusion, bad debt statistics are not so promising. According to Dubská (2013), the percentage of high-risk loans (in relation to overall household debt) rose from 2.7% at the end of 2008 to roughly 5% at the end of 2012. This could mean two things: (1) either hard economic times forced Czech households to concentrate excessively on the present moment (therefore, future costs of borrowing became severely underestimated)[4] (2) or people simply didn't predict financial crisis and subsequent recession. As a result of previous analysis (which disclosed lower borrowing in 2009-2011), we assume that the latter reason was decisive in this case.

Another worrisome trend in Czech household borrowing is the growing number of restructured loans (Dubská, 2013). Debt rescheduling does not solve individuals' debt problems, but postpones them for the future. This perfectly corresponds to hyperbolic discounting model: people overestimate the benefits of not repaying an existing loan now, but they underestimate costs of parting with their money in the long-run.

[1] In contrast to this, people are likely to take out long-term loans when they lack financial resources for investment.
[2] In the Czech Republic these organizations traditionally render such services as consumer loans and leasing to individuals.
[3] Another explanation could be that short-term loans are taken out by less creditworthy households (those who fail to keep enough liquidity to satisfy their current consumption needs), while long-term mortgages are taken out by younger people with higher earnings (Dubská, 2010). As a result, banks are more cautious in case of "naïfs" (therefore, they reduce lending to these customers during unfavorable economic times), but sophisticates are not borrowing-constrained.
[4] If this assumption had been true, Czech households would have acted as hyperbolic discounters.

Conclusion

Hyperbolic discounting is an invaluable tool for explaining human behavior in a variety of situations. It has important implications for our health, workload management, financial sustainability, and numerous other fields. We have focused on applying hyperbolic discounting to personal saving decisions. Findings based on empirical analysis of U.S. household saving behavior show that individuals have dynamically inconsistent preferences. After having gained insight into Czech household saving behavior, we haven't come up with such unambiguous results. On the one hand, we have found that transition to market economy led to higher personal consumption and indebtedness. On the other hand, such goods as education, recreation, sport, etc. accounted for the substantial share of consumption increase, while long-term loans primarily contributed to growth in personal debt. In combination with larger fixed capital accumulation during economic expansion, the above investment-related expenditures provide evidence that Czech households pay considerable attention to their future. The analysis of their behavior in hard economic times led us to similar conclusions except for the situation with debt restructuring.

Our research provides first insights into Czech savers' intertemporal decision-making. Further empirical validation of our findings is needed to make them useful to policymakers. Future work should continue our analysis at the individual level in order to test the hypothesis about generally present-unbiased saving preferences of Czech households. This is likely to help eliminate the majority of our speculations, which have arisen due to use of macro data, and take into account individual differences.

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