The psychological cost of saving – an agent-based modelling approach

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Abstract: In this paper, an alternative hypothesis to the standard economic models of saving is proposed, based on new research in behavioral and computational economic. The importance of traditional factors of influence for saving is acknowledged, but the explanatory spectrum is extended by focusing on the conformity variable. If each individual from a specific group may initially have a low propensity to consume (and implicitly a high propensity to save), under group dynamics and direct/indirect group pressure all the individuals may change their behavior, leading to a new group mainly characterized by a propensity to consume. The hypothesis was validated by using NetLogo simulations, finding that saving behavior is bind by a psychological cost which has the potential to switch the individuals' focus from a saving philosophy centered on benefits, to a philosophy centered on costs.

Keywords*: agent-based model, saving behavior, behavioral economics, social conformity.*

JEL Classification*: C63, D03, D14*

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Introduction

From capital formation and economic growth (Solow, 1956; Griffin, 1970; Mohan, 2006), to accomplishing future material objectives and reaching a decent retirement (Skinner, 1988; Lusardi, 1999), savings play a crucial role in our life and their role is of the utmost importance in both macroeconomic and microeconomic theories. Thus, it is only natural to encounter such a great number of models trying to depict saving's determinants and motives, as well as, in a standard fashion, to propose some type of normative horizon for the appropriate level of individual savings.

Within the vast category of explicative models, it is almost certain to discover common factors as current income, price index, consumption habits or uncertainty of future incomes as predictive variables for the level of individual savings. Nowadays, the general norm in both specialized literature and practice continues to be dominated by this type of knowledge, extended by a number of variations, but in the same conceptual horizon. An important contribution is brought by Caroll (2006), who points out as a major challenge the reaction front of uncertainty. Naturally, there are many explorations of mathematical and computational aspects of optimal behaviors (with or without uncertainty) that have lead economists to include risk aversion in their saving models (Kimball, 1993) and more recently, with the behavioral economics flavor, loss aversion (Bowman et.al., 1999).

These are essential improvements, showing a high degree of scientific elegance and precise logical mechanisms but unfortunately there is still observed a relative weak correlation to reality, both in descriptive and predictive terms, especially in the last years. The standard justification brings up the issue of the lack of data for certain categories of households (the top rich, the top poor etc, problem persistent also in the US), which is true but covers just a small fraction of the complete picture. We are facing some new and dynamic structures of a consumption and credit-based society in which the dissaving phenomenon has taken over and has become almost a habit. The classical theories arguing the importance of savings for the good functioning of an economy are somewhat reduced to silence or simply ignored, given the negative rates of savings registered in the last 30-40 years in most European countries, US (the most significant decreases are seen along the highest levels of income, Browning and Lusardi, 1996) and Latin America (according to the data available on OECD and the World Bank).

Within this context, one of the important attributes of these theories that constitutes a limit in their formulation and development is the hypothesis that

individuals are independent and isolated economic agents (this applies even when talking about households), making their consumption and savings decisions in a static environment, or based on projections about the future quite similar to the states of the world described in the realm of decision theory. Thus, not only that individual interactions are completely neglected, but also the manner in which a person processes the environment is mostly under the cover of perfect rationality that would either way not allow the subject any type of deviations from the rational objective of maximizing utility.

At a general level, this situation has started to be addressed through the new interdisciplinary field – Behavioral Economics, which basically aims to bring more realism into the economics models, with the help of psychological insights, sociological ones and other relevant inputs from collateral disciplines (Camerer & Loewenstein, 2004). The definition of economic rationality is mostly historical and mathematically technical which makes it fantastically hard to fit in practice. Moreover, it imposes an ardent need for the formulation of some other types of rationality and not by simply dismissing everything else as being irrational behavior. The concepts of bounded rationality (Simon, 1979) or ecological rationality (Gigerenzer et al., 1999) are examples of more realistic and comprehensive paradigms to analyze economic decisions, inclusive of the impact of non-economic variables.

The paper is build in this behavioral and complexity economics spirit and it aims to offer a simple explicative model to emphasize the neglected power of the conformity need of any individual living in a community, in the direction of analyzing how this need influences his or her saving behavior. We acknowledge the very thin and general existing theory of conformity in economics (Bernheim, 1994) but a different approach is proposed, through an application departing from the Altruism model (Wilensky, 1998), enhanced by Netlogo simulations. The main idea is that if each individual from a specific group may initially have a low propensity to consume (and implicitly a high propensity to save), under group dynamics and direct/indirect group pressure all the individuals change their behavior in order to be more similar to the next person, leading to a new group mainly characterized by a propensity to consume. What we manage to prove, through different simulations and incorporation of the latest research in Behavioral Economics is the existence of a psychological cost of saving. The cost has the potential to change the focus from a saving philosophy centered on benefits and to open up a new path of understanding saving behavior in relation to deeper psychological insights.

Theoretical background on economic versus non-economic factors in modeling saving behavior

In this section the main additions brought to the standard savings model are tackled, underlying the contributions related to non-economic factors impacting consumption or savings. Following a chronological tradition, the Keynesian theories seem the best starting point. The law of Keynes regarding the growth of aggregate consumption with a decreasing rate while the current income is increasing has proven a solid degree of accuracy and logic in time, remaining until today a reference point for consumption and research studies. Given this high frequency of use and broad level of acceptance, the theory is often labeled as pertaining to the standard economic discourse. However, the work of Keynes does not present any type of proof indicating that the functioning mechanisms of the law are based on the principles of utility maximization (D'Orlando & Sanfilippo, 2010). By contrary, what it can be identified are dominant explanations of a psychological nature for postponing consumption (thus for saving) – "*Precaution, Foresight, Calculation, Improvement, Independence, Enterprise, Pride and Avarice*" – or for making it for salient and immediate – "*Enjoyment, Shortsightedness, Generosity, Miscalculation, Ostentation and Extravagance*" (Keynes, 1973: 107–108).

Moreover, the Keynesian perspective views the inclination to consume as tightly interlinked with social and institutional factors, acting as amplifiers or inhibitors of the psychological determinants. A special place is allocated to habits and social conventions. In this sense, decisions under uncertainty are described by taking into account a significant weight for the present, explicitly represented by investing the present opinion to be a reference point in further evaluation, and the inclination towards the collective point of view. This understanding of the Keynesian legacy on saving is quite conflicting with the common framework on liquidity preferences, emphasizing three main categories of savings motives – transaction, precautionary and speculative – all of them discussing only economic aspects.

The confusion is enhanced through the next historical economic models considered as mainstream in this area – the standard model of lifecycle savings (Modigliani and Brumberg, 1954) and the permanent income model (Friedman, 1957) – models that are actually shifting off from Keynes by assuming a intertemporal maximization of utility. In other words, it is imposed a hypothesis of a rational agent, able to perform an exponential discounting of the future. In both models, saving is not derived anymore from current consumption but it is defined either as a function of the accumulations in a certain stage, either as dependant of the permanent income. Not last, a supplementary hypothesis appears, restricting even more the framework through the idea of smooth consumption:

‘‘young, whose incomes are below their permanent income, borrow to finance consumption; the middle-aged save for retirement; the old dissave” (Thaler, 1990:195).

Current economic research has begun to give more and more credit to alternative models postulating the influence of non-economic factors for explaining different economic behaviors. An important segment of such approaches is rooted in the emerging field of behavioral economics and puts a special emphasis on psychological variables.

The idea of bounded rationality may seem self-explanatory for an outsider of the economics field, but it is yet very hard to be accepted inside, where the guiding principles are maximization and cost-benefit approaches. The use of heuristics and empirical rules in the context of savings usually encompasses the mental accounting phenomenon (Shefrin & Thaler, 1988) and hyperbolic discounting (Laibson, 1997). In order to be complete, the framework must also examine the personal characteristics of an individual that may lead to the invalidity of standard models, both explicative and predictive. Along with already known concepts like dynamic inconsistency or the importance of time preferences (Frederick et. al, 2002), the paper investigates other psychological factors, even less considered by economists. Therefore, the propensity to consume is understood either through lack of perfect self-control or the existence of a present-focus bias, while insufficient saving is correlated not only with an insufficient income but also with the tendency to procrastinate.

Naturally, a special attention must be given to the need for conformity, this being the main explicative factor around which our model is build. The essence in comprised in Ash’s conformity experiment (1951) regarding the way group pressure can distort individual behavior. There are many situations prone to a conformity based behavior, as it was shown by different replications of the original experiment and of course with the help of other research frameworks: introduction of new products on the market or implementation of new business strategies (Bikhchandani et. al., 1992), paying taxes or contributing to other public goods (Keser & van Winden, 2000), criminal activities in a neighborhood (Ludwig et al. 2001), political behavior etc. The dominant implications are however in the area of consumer behavior, for a wide range of product categories involving not only an intrinsic value but also a social one: entertainment, cars, fashion, houses, touristic destinations etc (Garcia et.al, 2010).

The link between conformity and saving is an indirect one, mediated by the function of consumption expressing a certain social status signal, group

membership or self-esteem (Witt, 2010). More precisely, the visible phenomenon will be a conformity tendency towards consumerism, the current social norm of developed societies, and the natural consequence will be undersaving: in a society with a high enough proportion of individuals inclined to consume, this will modify in time the individual's profile, normally inclined to saving, making it similar to those inclined to consume. An important amendment here is that this type of conformity differs from rational imitation and informational cascades (Bardsley & Sausgruber, 2005) because a learning process through which individuals are improving their interest cannot be observed. By contrary, the normative conformity illustrated in this case is independent of the material implications of adopting it, independence reflected by what we have called the psychological cost of saving.

Agent based modeling – an alternative for explaining consumption and saving behavior

In this section an agent based model will be presented, for explaining the potential mechanisms that determine individuals to deviate from the behavior suggested by standard economic theories. Moreover, we plan to manipulate variables so that to obtain information on the effective measures to be taken for sustaining the desired behavior on the long term. The fundament of our work is the Altruism model (Wilensky, 1998) elaborated in Netlogo, which is part of a class of models in evolutionary biology and takes into account the manner in which a certain genetic characteristic is transformed, as a result of social or environmental pressures.

Our model assumes two types of agents observed for the trait „attitude towards savings": a type will be inclined to save and the other will be inclined to consume. This second characteristic can be tracked as the results of gene, family and close environment influence (Cronqvist, Siegel 2013). In consequence, a constant value α_i will be presumed, specific to each individual i pertaining to the population, registering fluctuations from this level on. For simplicity, initially the value α will be presumed the same for all the agents, but furthermore this specific value allows us to build an individual fitness (WTC for individuals inclined to consume and WTS for individuals inclined to save). The agent may feel an increase in its fitness when the environment is supportive or a decrease when the environment is oppressive.

In the first stage of the simulation the parameters of the models are set – the saving and the spending probabilities, which provides the proportion of the two

types of agents in the whole population, as well as the cost and the benefit of saving. Then, after pressing the „Setup" button, the program will randomly generate the agents as little squares of different colors (in our case they will simply be black and white) .

The model assumes that each agent has four neighbors, but can be easily generalized to 8 neighbors. In order to observe the evolution of the main characteristic – inclination to save - we define a method for measuring the fitness through a function, as follows:

$$WTS\ (i) = \alpha + f(\%\ WTS\ neighbors) - Cost \quad (1)$$

$$WTC\ (i) = \alpha + f(\%\ WTS\ neighbors) \quad (2)$$

The fitness function defined above is dependent on the number of individuals within an agent's group, having the same inclination to save. For the case of individuals inclined to save we will also take into consideration the cost of such a choice, this leading to the fact that an individual inclined to save will have a lower fitness compared to those inclined to consume. The psychological fundament of this manipulation will be explained in the next section, based on the existing results in the literature.

Our intention for the next step is to allow the group pressure and therefore the need for conformity to manifest. This step involves a transformative algorithm for the value of an agent's fitness, following similar rules of the original model Altruist. More precisely, at each stage of interaction an agent will have a fitness computed as a combination between its own fitness and the fitness of the agents that may have an influence upon him. The members in the influence group having the same profile, thus the same inclination to save or consume, act as supporting individuals, while those that have a different inclination are inducing a pressure to conform.

In the attempt of reaching an equilibrium point between the need to adapt to the environment and the need to maintain his own coordinates, the agent will transform his/her fitness after a rule defined by a lottery (Wilensky, 1998). After computing his/her own fitness, each agent enters a relation with the group members. There is an assessment of the agent's fitness, with the same inclination to save or to consume (including the evaluated agent) and with a different inclination, after which an average value of the fitness is computed, from the total of the influencing group.

Average fitness WTC = ∑(fitness agents WTC)/number of agents in the influence)

Average fitness WTS = ∑ (fitness agents WTS)/ number of agents in the influence)

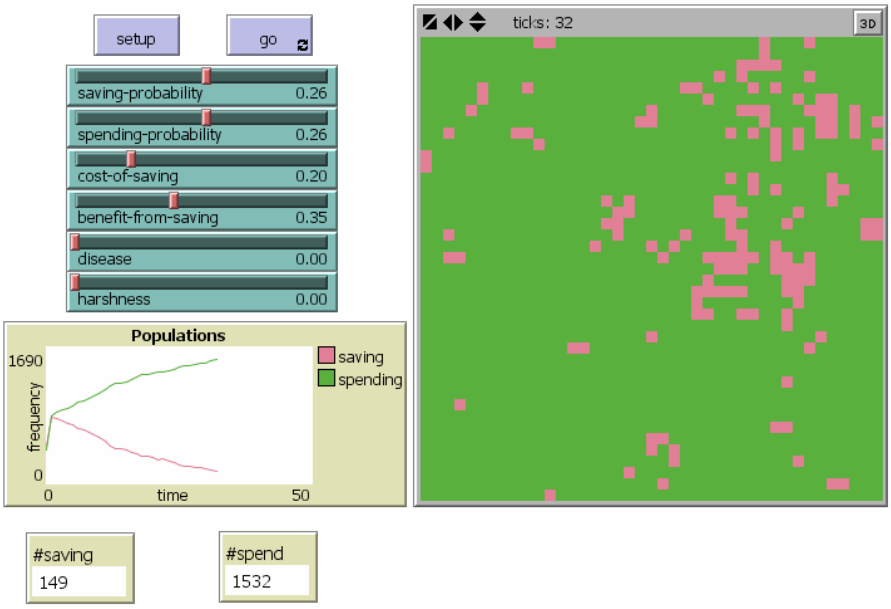
At the next step, the fitness of an agent will be

– Average fitness WTC with p probability

– Average fitness WTS with 1 – p probability

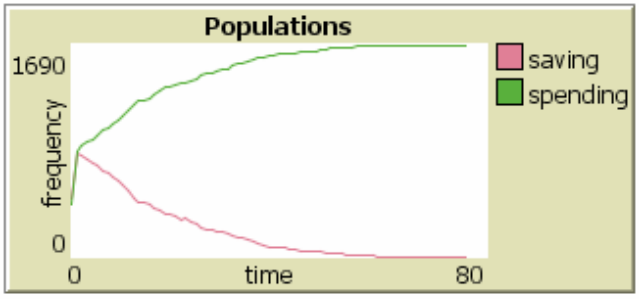
where p is the probability that the agent will fail under the pressure of conformity and it depends on the individual characteristics.

Figure 1. NetLogo screen capture of an intermediate interface of the model



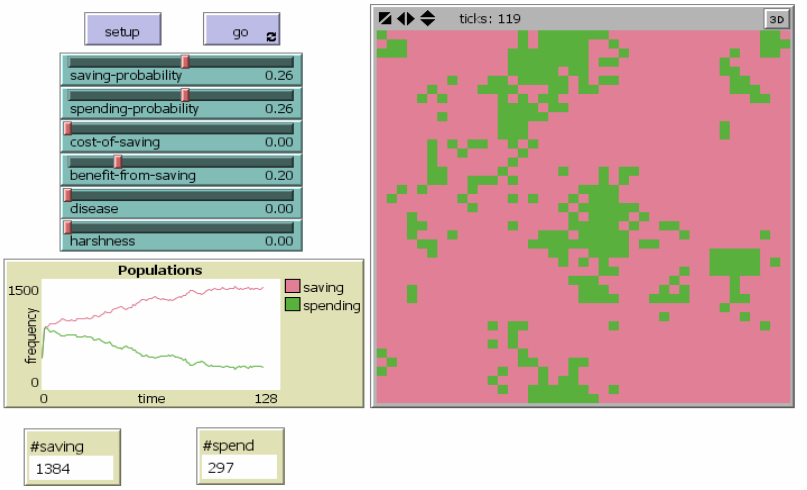
As exemplified in Figure 1, by simulating the model it becomes obvious that the need for conformity can be a pressure that results in an inclination to save replaced by an inclination to spend. More exactly, the number of the agents inclined to save decreases rapidly and the population ends up consisting of agents inclined to consume, as Figure 2 shows.

Figure 2. NetLogo screen capture: the population of agents inclined to save ends up being driven to extinction



The behavior of the model is of course expected to be dependent on the initial parameters – the saving and spending probabilities, the cost of saving and in particular on the benefit of saving. The standard approach in Economics emphasizes the importance of these benefits in terms of how motivated is an individual to save when the interest rate is high. Our model provides a different perspective on this. In running the model for a particular setting of the parameters first we will set the cost of savings as being zero and the simulation shows that the population of agents willing to save survives and drives to extinction the agents inclined to consume (figure 3).

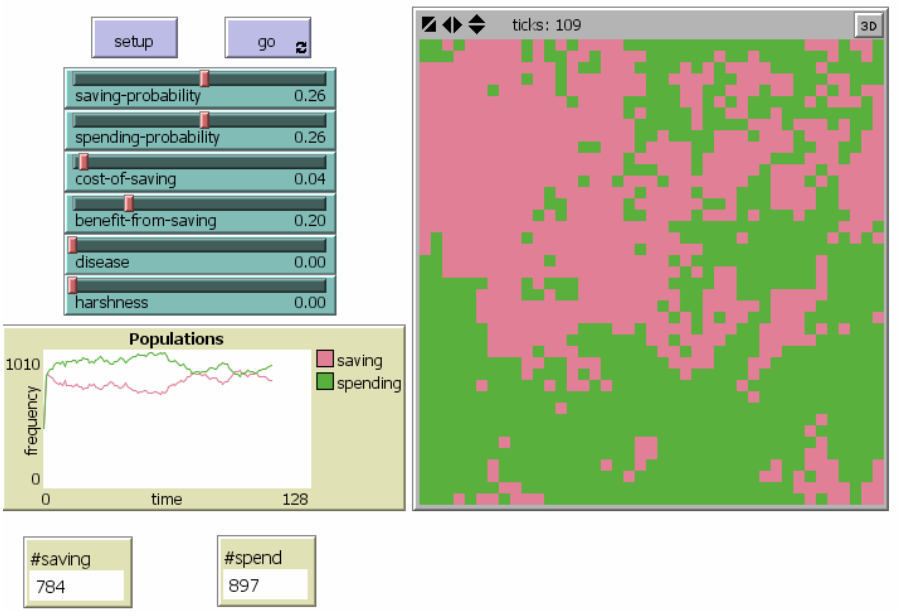
Figure 3. NetLogo screen capture – When the cost of saving is zero, the agents inclined to save win



Second, we will increase the cost of saving to a non – negative but still small amount, and the next figure will show how the two types of agents – those inclined to save and those inclined to consume begin to change their proportion to the detriment of those inclined to save. At this stage, however, there is still a certain balance between the number of the two types of agents are not as different as in the Figure 1, for example.

From a large number of simulation and different choices of the initial parameters can be derived that the population of agents inclined to save seems to survive whenever the benefit is around five times the cost, and is driven to extinction by the agents inclined to spend, whenever the benefit is less 5 times the cost. This result emphasizes the importance of the cost parameter and could have important consequences, if we think at the main tendency in the banking system to design the saving products according to the benefits the clients can get from them.

Figure 4. Screen capture – When the cost of saving is non – negative but still small, the number of the agents inclined to consume begin to increase to the detriment of those inclined to save



As long as the idea that the benefits could be so much high lacks any realism by the nature of savings itself, it may be the case that a focus on reducing costs and not raising the benefits could be far more effective in enhancing the saving behavior. The next section describes the potential components of this cost by discussing the existing literature in this field.

Behavioral fundaments of hypothesis

Through their nature, agent based models try to emphasize collective behaviors departing from simple individual interactions. The results are surprising for two reasons: due to the concrete proof offered for the existence of a savings cost, observed in multiple simulations, and due to the psychological realism of such a cost. This second fact is highly important for the validity of our model, which successfully overcomes its theoretical limitations and fructifies its simplicity through this linkage with a new and neglected concept by standard economics.

As is the case with many new concepts, at this point of our research we can say for sure that the psychological cost of savings is not an opportunity cost but furthermore other factors that can be incorporated or considered as significant influences will be investigated. The couple consumption-saving acts like a very good quality mirror in pointing out other related concepts examined in the psychology of money literature. The pain of paying is such a variable defined as an emotion which appears when consumers make purchases and activates a certain structure of the brain – insular cortex – usually associated processing pain in different situations: electric shocks, risky decisions, loss forecasting etc (Prelec and Loewenstein, 1998). This neural ground allows the formulation of a strong implication: consumers are making decisions not by using stable utility functions, thus computing opportunity costs, but on the basis of the immediate pain of paying. Even more interesting is the correlation between the pain and instrument of payment, explained by the decoupling of costs and benefits (Rick et al., 2008). More clearly, the financial innovations developed in the last decades, starting with the credit card, are increasing the distance between costs and benefits by positioning individuals far away from the concrete, physical instances of money. The primary consequence is a lower pain of paying at the level of the society, especially in the developed societies.

Within this logic, our model is placed at a crossroad in the sense that it did not raised any questions until now given the existing level of the pain of paying, high enough to compensate and/or to hide the psychological cost of saving. The current results indicate a paradigmatic shift in this relationship, even if it is very

hard to estimate the direction and amplitude of this change. In a technical language, we do not know what stage of the process we are facing and how much iteration is needed in order to reach an equilibrium.

A realistic understating must also be achieved in what concerns the description of individual behaviors. In this case, the attention is focused on the following aspects:

- Why the fitness of an individual inclined to save is considered lower compared to the fitness of an individual inclined to consume?
- Why the fitness of both types of agents may be considered as a function of those members of the group which are inclined to save?

Once again, the research on the pain of paying proves to be extremely prolific by discussing not only contextual factors that may increase or decrease the pain, but also the strong individual profiles identified in practice (Rick et al., 2008): tightwads (consumers that are chronically more sensitive to the pain of paying) and spendthrift (consumers less sensitive to this type of pain). This classification serves as an answer to our first question, explaining the lower fitness of an individual inclined to save through his higher pain of paying.

Complementary arguments are brought by the large stream of papers analyzing the issue of self control. Broadly speaking, an individual inclined to save postpones his/her consumption, thus it postpones an immediate reward, which in the behavioral economics literature is acknowledged as a form of exercising self control and as a consuming psychological effort (Ariely & Wertenbroch, 2002). Basically, self control is portrayed as a muscle which makes the use of self-control in one setting to reduce the use of self-control in a subsequent (and unrelated) setting (Ackerman et. al, 2009). For strengthening the argumentation, the concept of present-focused bias needs to be integrated. The decision to save assumes that the individual is able to surpass this default, which is also psychologically consuming (Meier & Sprenger, 2010). This supports the idea that an individual inclined to save makes a big effort to maintain this orientation, justifying the cost introduced in the model. At the other end, individuals that use to immediately satisfy their wishes, become less tolerant with their peers, thus increasing the conformity pressure within the group. What derives from here is the realism of a new hypothesis stating that an agent inclined to consume has a higher wellbeing state generated by immediate gratification and the idea that he/she is superior, thus has a better fitness than an agent inclined to save.

The last issue important to expand in this section regards the manner of constructing the fitness function, by considering that both categories of agents are defining their fitness in relation with the number of individuals inclined to save. The fact that an agent inclined to save can feel motivated and his wellbeing can increase when he is around to similar individuals is a self-sustaining affirmation. The more interesting case is related to agents inclined to consume through the simple fact that those agents inclined to save are offering resources to those inclined to consume. In other words, the savings of different individuals are sources for bank loans or informal loans, justifying our second hypothesis.

Discussions, conclusions and future research

The aim of the model presented in the paper was to outline the need to conform to a certain group as a driver for changing a saving behavior into a consumption one. We adapted a preexisting simulation model in NetLogo in order to help for a better understanding of the situations in which individuals with a relatively high inclination to save may end up in creating groups with a strong orientation towards consumption. The main arguments discussed in the Behavioral Economics literature, offering a solid and realistic psychological fundament to our hypotheses, have also been presented.

The main finding of this work is the existence of a parameter – the cost of saving – which in our model mainly incorporates the psychological pressure coming from the social need for conformity. As the simulation indicates, this cost plays an unexpected high role in shaping the saving behavior, taking the control over any potential benefits a saving product would offer to a client. The implications have a significant impact on how a bank designs its products and could be also important in designing a policy to support the saving behavior.

The limits that may be imputed to the study are somewhat similar to its strengths – the relations between agents are expressing relatively simple interactions, thus being exposed to criticism regarding their lack of realism. The main counterarguments stand in the main characteristics of the complex systems which are usually described through such very simple interactions, being intuitive enough to obtain a coherent vision on the general behavior of the system. Not last, at this stage of the research, it is impossible to evaluate with accuracy whether adding some variables would actually improve the model or would just make it more complicated and less tractable.

Future lines of research will be focused on depicting some calibration methods for the model's parameters, in order to improve the realism of the simulation.

Also, since the psychological cost of saving is a concept that hasn't been used before in the literature, it needs investigation to find its components and how they relate with each other.

Acknowledgments

This paper has been financially supported within the project entitled *„SOCERT. Knowledge society, dynamism through research",* contract number POSDRU/159/1.5/S/132406. This project is co-financed by European Social Fund through Sectoral Operational Programme for Human Resources Development 2007-2013. Investing in people!"

References

Ackerman, J. M., Goldstein, N. J., Shapiro, J. R. and Bargh, J. A. (2009). You wear me out: The vicarious depletion of self-control. Psychol Sci, 20(3), pp.326-332.

Ariely, D. And Wertenbroch, K. (2002). Procrastination, Deadlines, and Performance: Self-control by Precommitment. Psychol Sci, 13(3), pp.219-224.

Ariely, D., Bracha, A. and Meier, S. (2009). Doing Good or Doing Well? Image Motivation and Monetary Incentives in Behaving Prosocially, American Economic Review, 99 (1), pp.544-555.

Asch, S.E. (1951). Effects of group pressure on the modification and distortion of judgments. In H. Guetzkow (Ed.), Groups, leadership and men (pp. 177–190). Pittsburgh, PA:Carnegie Press.

Bardsley, N. and Sausgruber, R. (2005). Conformity and reciprocity in public good provision. Journal of Economic Psychology, 26(5), pp.664-681.

Bernheim, D. (1994). A theory of conformity, Journal of Political Economy, 102 (5), pp.841-877

Bikhchandani, S., Hirshleifer, D. and Welch, I. (1992). A Theory of Fads, Fashion, Custom and Cultural Change as Informational Cascades, Journal of Political Economy, 100, pp.992-1026.

Bowman, D., Minehart, D. and Rabin, M. (1999). Loss aversion in a consumption–savings model. Journal of Economic Behavior & Organization, 38(2), pp.155-178.

Camerer, C. F., and Lowenstein, G. (2004). Behavioral economics: Past, present, future. In C. F Camerer, G. Lowenstein, & M. Rabin (Eds.), Advances in behavioral economics (pp. 3-51). Princeton, NJ: Princeton University Press.

Caroll, C.D. (2006). Consumption and Saving: theory and evidence. [online] NBER Research Summary, Available at: http://www.nber.org/reporter/spring06/carroll.html. [Accesed in March 2014]

Clark, A. E. and Oswald, A. J. (1996). Satisfaction and comparison income. Journal of Public Economics, 61(3), pp.359—381.

Cronqvist, H. and Siegel, S. (2011). The Origins of Savings Behavior, [online] AFA Denver Meetings Paper, Available at SSRN: http://ssrn.com/abstract=1649790. [Accesed in November 2013]

D'Orlando, F. and Sanfilippo, E. (2010). Behavioral foundations for the Keynesian consumption function, Journal of Economic Psychology, 31, pp.1035-1046

Frederick, S., Lowenstein, G. and O'Donoghue, M. (2002). Time discounting and time preference: a critical review, Journal of Economic Literature, vol. 40, no.2, pp. 351-401

Garcia, F., Lupi, R. M. and Resende, J. (2010). Conformity based behavior and the dynamics of price competition: a new rational for fashion shifts. mimeo.

Gigerenzer, G., Todd, P.M and ABC Research Group. (1999). Simple heuristics that make us smart, Oxford University Press.

Griffin, K. (1970). Foreign capital, domestic savings and economic development.Bulletin of the Oxford University Institute of Economics & Statistics, 32(2), 99-112.

Keser, C. and van Winden, F. (2000). Crowding-in and Voluntary Contributions to Public Goods. Scandinavian Journal of Economics 102(1), pp. 23-39.

Keynes, J. (1973). The general theory of employment, interest and money, Macmillan Cambridge University Press

Kimball, M. S. (1993). Standard Risk Aversion. Econometrica: Journal of the Econometric Society, pp. 589-611.

Laibson, D. (1997). Golden Eggs and Hyperbolic Discounting, Quarterly Journal of Economics, 112 (2), pp. 443-477.

Ludwig, J., Duncan, G.J., and Hirschfield, P. (2001). Urban Poverty and Juvenile Crime: Evidence from a Randomized Housing-Mobility Experiment. Quarterly Journal of Economics, 116, pp. 655-679.

Lusardi, A. (1999). Information, expectations, and savings for retirement.Behavioral dimensions of retirement economics, 81, 115.

Luttmer, E. F. P. (2004). Neighbors as negatives: Relative earnings and well-being. [online] NBER Working Paper, 10667, Available at: www.nber.org/papers/w10667. [Accesed in February 2014]

McBride, M. (2001). Relative-income effects on subjective well-being in the crosssection. Journal of Economic Behavior & Organization, 45(3), pp. 251—278.

Meier, S. and Sprenger, C. (2010). Present-biased preferences and credit card borrowing. American Economic Journal: Applied Economics, pp.193-210.

Modigliani, F. and Brumberg, R. (1954). Utility analysis and the consumption function: an interpretation of cross-section data. In: Kurihara, K. K. (Ed.), Post-Keynesian Economics. Rutgers University Press.

Mohan, R. (2006). Causal relationship between savings and economic growth in countries with different income levels. Economics Bulletin, 5(3), 1-12.

O'Donoghue, T. and Rabin, M., (1999). Doing It Now or Later, American Economic Review, 89 (1), pp.103-124.

Prelec, D. And Loewenstein, G. (1998). The red and the black: Mental accounting of savings and debt. Marketing Science, 17(1), pp. 4-28.

Rick, S.I., Cryder, C.E., and Loewenstein, G. (2008). Tightwads and spendthrifts, Journal of Consumer Research, 34(6), pp. 767-782.

Shefrin, H. M. and Thaler, R. H. (1988). The Behavioral Life-Cycle Hypothesis, Economic Inquiry, 26(4), pp. 609-43.

Simon, H., (1978). Rationality as a process and a product of thought, American Economic Review, pp.1-16.

Skinner, J. (1988). Risky income, life cycle consumption, and precautionary savings. Journal of Monetary Economics, 22(2), 237-255.

Solow, R. M. (1956). A contribution to the theory of economic growth. The quarterly journal of economics, 65-94.

Thaler, R., (1990). Anomalies: Saving, fungibility, and mental accounts. Journal of Economic Perspectives, 4(1), pp.193–205.

Wilensky, U. (1998). NetLogo Altruism model. [online] Availabe at: http://ccl.northwestern.edu/ netlogo/models/Altruism, [Accesed October 2013], [print] Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL.

Wilensky, U. (1999). NetLogo. [online] Available at: http://ccl.northwestern.edu/netlogo/. [Accesed October 2013], [print] Center for Connected Learning and Computer-Based Modeling, Northwestern University, Evanston, IL

Witt, U., (2010). Symbolic consumption and the social construction of product characteristics. Structural Change and Economic Dynamics, 21(1), pp. 17-25.