The Introduction of Memory in Financial Choice

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1 Introduction

Financial decision has been considered as a rational choice that can be axiomatized perfectly within the framework of Expected Utility Theory (EUT). Nevertheless, this scientific focus, in spite of its high level of applicability and dominant position, presents a number of paradoxes, and it has been increasingly noted that theoretical conclusions differ from the financial decisions and behavior observed.

We propose an alternative, related to Behavioral Finance [1], that incorporates the effects of memory into the decisions of a financial agent. In our case, the agent is able to change the proportion of fixed and variable claims in an investment fund every month. This decision has no fiscal consequences according to current regulations. Bearing this in mind, we propose a modification of Gilboa and Schmeidler's Case-based Decision Theory [3]. The latter defends financial choice in accordance with the similarity of the current problems to past experience and memories of previous problems and actors, and their consequences. The connexionist approach, Artificial Neural Networks (ANN) to be more precise will be used, to represent past knowledge and its influence on choice, traditionally estimated by means of an econometric approach. In particular, we work with Kohonen maps, which allow information to be organized according to the degree of similarity in the variables that describe each case or problem.

Moreover, we introduce two substantial extensions to this analysis, namely

(i) combining past cases/problems to generate new cases/outcomes within the general approach of the Theory of Evidence and Dempster's Rule [4]

(ii) an analysis of volitional uncertainty, both as regards the criteria for making a decision to be employed and the alternative chosen [2] [5].

In this way, we obtain a better approach to the representation of reality because we overcome standard paradoxes and the excessive simplification of reality that is produced by the optimization of expected utility as a criterion for rational choice. Moreover, we improve arbitrariness in the definition and estimation method for measuring similarity because we use an objective, neutral procedure to cluster past cases or memory. In addition, we explain the heterogeneity of the behavior or decisions observed not only on the basis of risk aversion but also by means of a different function of memory/similarity.

2 Mathematical instruments

From the very beginnings of the experimental scientific method of analysis, researchers have defended the idea that “from similar causes, similar effects are also expected”. When this idea is applied to financial decision, it implies the existence of a bias towards the use of a selected memory in the process of considering the best choice; this process involves the same procedure being repeated. This memory is here called memory-pattern.

This typology of memory can be seen in the graphic representation of similar behaviour patterns and it can be measured in terms of similarity or distance between the case or current situation and past ones, so that the same evolution or effect is expected from situations with the same origins or cause. Alternatively, and in order to overcome arbitrariness in measuring this similarity, it is possible to apply ANN. Thanks to their non-supervised learning design, they can cluster patterns without the number of groups being defined beforehand or even with no description of the prototype for each cluster.

Nevertheless, memory-pattern does not allow participants in financial markets to learn, or to modify the consequences that are derived from the same past situation… We use the notion of ‘collective memory’ in order to bring together the effects of the past that influence financial behaviour, with the aim of taking advantage of this information in future decisions.

We propose using self-organizing Kohonen maps to incorporate this kind of memory in financial management because they store past information in the form of a topological map, in a similar way to the human brain, according to the similarity or proximity among the data or variables that make up each set [7]. Similar patterns will be located in nearby areas, clustering financial phenomena and establishing border-lines that define different climates of acting. The application of Kohonen maps allows us to detect these zones, to interpret their characteristics, to act consequently, and to learn from the results obtained in the past at the same time as we observe the learning process through the trajectories of the patterns in the map.

3 Problem description and resolution

We consider the financial problem of a small investor, or comparably of the manager of an investment fund, who has to decide what proportion of fixed and variable claims should make up the fund. In particular, we describe the problem of a monthly choice of the typology (fixed, mixed-fixed, mixed-variable or variable) or composition of the investment fund. The variables that describe this problem, in addition to the choice of the percentage of fixed claim (Public and Private Debt) and of variable claim (IBEX 35), are all related to the Spanish financial market:

- Average, maximum and minimum variation of IBEX 35 in past periods.
- Variation in the interest rate in the last month and with respect to the initial value.

- Variation in the yield of Public Debt in the short-term (1 year) and long-term (10 years).
- Variation in the average yield of Private Debt.
- Average profit of investment funds.
- The fund most recently occupying first place in the investment fund tables for each category.
- Expert recommendations, opinions in specialized media.
- Financial environment: oil price, inflation, business profits, unemployment rate, and rate of GDP growth.

In the model of Gilboa and Schmeidler [3], the problem is solved by means of a utility function, which is optimized with respect to the best action (fund composition choice). Case-based decision theory incorporates memory in an explicit way in financial choice through the similarity with past cases (problem, action, consequence). Rubinstein [6] also justifies the use of a function of similarity in financial decisions by means of psychological bias in the comparison of data.

The utility function is obtained as the sum of similarities between the current problem and past ones, with a different weight according to the utility of each respective consequence of every action. This similarity is presented as a function of distance between problems. The degree of similarity may or may not affect the selected memory or it may be dependent on the importance of past consequences (loss aversion).

According to this model, financial choice depends excessively on the form or distance of the function of similarity. A way to overcome this problem is by using ANN, which help in clustering information in accordance with similarity, but in objective terms. We work with a kind of ANN that, in addition to memory, incorporates learning in the cluster process according to the similarity between past cases [7]. In this way, the action chosen incorporates the best associated similar past outcomes and also learning as a consequence of modifications in financial behavior. Thus, we improve Gilboa and Schmeidler's model on the basis of a less arbitrary estimation of the similarity, which also incorporates learning and the consequent behavior modification.

From this clustering of information, the best action or investment fund composition is chosen according to the outcomes forecast as a result of similarity with the memory selected. In addition, we propose that the combination of the most similar problems in every choice should be incorporated through using Shafer's Theory of Evidence and Dempster's Combination Rule [4]. The evidence of every outcome can be approximated by nearby cases and their relation with all selected memory. In this way, memory and learning are complemented and reinforced by more than only known situations.

Finally, when interpreting the outcomes, we will bear in mind the decisional environment as regards time preference, socialization of choice, overconfidence in financial choices, and volitional uncertainty [2] [5]. This broad interpretation helps us to understand the heterogeneity of choice, diversity of results, and provides a better justification of the influence of the past financial market trends, behavior and decisions.

4 References

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