ISSN 1809-046X

Artigo original Link do doi: https://doi.org/10.5281/zenodo.18332383

EFEITO DISPOSIÇÃO NA COMERCIALIZAÇÃO DE GRÃOS: PROPOSTA DE UM SIMULADOR COMPUTACIONAL

DISPOSITION EFFECT IN GRAIN MARKETING: PROPOSAL FOR A COMPUTATIONAL SIMULATOR

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RESUMO

O efeito disposição é um viés comportamental amplamente reconhecido, observado em diversas situações, e sua relevância está consolidada na literatura de economia e finanças, mas está em estágio inicial fora desse campo específico. Acompanhando as descobertas de Mattos e Fryza (2014) e Vollmer, Hermann e Musshoff (2019), o principal objetivo deste artigo é apresentar um simulador computacional para ser utilizado em experimentos que examinem a presença do efeito disposição na comercialização de grãos. Na implementação do simulador foram utilizados designs de experimentos anteriores (Weber; Camerer, 1998; Vollmer; Hermann; Musshoff, 2019), os quais forneceram o arcabouço conceitual. Para sua validação, foi realizado um experimento em 102 universitários brasileiros, onde os participantes mostraram maior propensão em vender commodities agrícolas quando seus preços estavam acima do custo de produção, em comparação com a venda quando os preços estavam abaixo do custo de produção. Os resultados permitem conjecturar que o

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simulador, além de operacional e de fácil manuseio, é apropriado para verificar a presença do efeito disposição nos indivíduos ao comercializarem grãos.

PALAVRAS-CHAVE: Efeito disposição. Comercialização de grãos. Vieses comportamentais.

ABSTRACT

The disposition effect is a behavioral bias widely recognized and observed in various situations. Despite being consolidated in the economics and finance literature, it is still at an early stage outside this specific field. Following the findings of Mattos and Fryza (2014) and Vollmer, Hermann and Musshoff (2019), the main objective of this article is to present a computer simulator to be used in experiments that present the disposition effect in grain marketing. Designs from previous experiments (Weber; Camerer, 1998; Vollmer; Hermann; Musshoff, 2019) were used to implement the simulator, which provided the conceptual framework. To validate it, an experiment was carried out on 102 Brazilian university students, where participants were keener to sell agricultural commodities when prices were above the cost of production, compared to selling them when prices were below the cost of production. The results allow us to conjecture that the simulator is not only operational and easy to use, but also suitable for checking the disposition effect in individuals when trading grains.

KEYWORDS: Disposition effect. Grain marketing. Behavioral bias.

INTRODUCTION

The disposition effect is a widely recognized behavioral bias observed in a number of cases: when exercising options, among futures market operators, investment fund shareholders and university students, for instance. The relevance of studying the disposition effect is well-established in economics and finance literature, but is in its infancy outside this specific field. Mattos and Fryza (2014) and Vollmer, Hermann and Musshoff (2019) pioneered the presence of the disposition effect in the decisions of Canadian and German farmers during the marketing of grains. This article

presents a computational simulator, adapted from studies by Weber and Camerer (1998) and Vollmer, Hermann and Musshoff (2019), to be used in experiments that examine the presence of the disposition effect in grain marketing.

Being a more effective alternative than applying questionnaires, a laboratory experiment via computer justifies the development of the simulator, especially because it offers greater control, both in terms of the calculations carried out by the participants, and in the total participation time. Furthermore, it allows any variable being studied to be isolated, whereas the use of historical market data may be subject to contamination from other causes. Additionally, the originality of this work lies in developing the first Brazilian computational simulator, dedicated to investigating the presence of the disposition effect in grain marketing.

This work is organized into four parts. The first section presents the introduction. The second describes the development of the simulator, while the third section shows an experiment with the simulator. Finally, the final considerations are presented.

1 COMPUTER SIMULATOR FOR GRAIN MARKETING

Based on previous studies, the design of the simulator will be presented next, followed by its development and presentation of the interface.

1.1 Simulator design

Designs of the experiments conducted by Weber and Camerer (1998) and Vollmer, Hermann and Musshoff (2019) provided the conceptual framework for developing the simulator. Table 1 summarizes the differences between the designs adopted by the authors and the one actually used.

Table 1. Design differences

Variables	Weber and Camerer (1998)	Vollmer, Hermann and Musshoff (2019)	Proposed simulator
Number of assets	Six	Six	Six
Nomenclature of assets	Anteile	Good	Produto
Number of periods	3 + 15	3 + 11	3 + 11
Randomly-generated prices	Yes	Yes	Yes
Identical price range for all	Yes	Yes	Yes
Prices influenced by the trading actions of others	No	No	No
Probability of price variation	1/3	1/3	1/3
High probability assets	“++” = 65% “+” = 55%	“++” = 65% “+” = 55%	“++” = 65% “+” = 55%
Neutral probability assets	“0” = 50% “0” = 50%	“0” = 50% “0” = 50%	“0” = 50% “0” = 50%
Low probability assets	“-” 45% “--” = 35%	“-” 45% “--” = 35%	“-” 45% “--” = 35%
Initial price ($)	Different for each asset	Same for all assets (15)	Same for all assets (1.500)
Rising (or falling) price variation($)	1, 3 and 5	0,50, 1,50 and 2,50	50, 100 and 150
Display of previous prices	Yes	Yes	Yes
Allowed operations	Buy and sell	Sell	Sell
Initial amount ($) allocated individually to the subjects	10.000 (in cash for purchase and sale)	90 (in assets stored for sale)	900.000 (in assets stored for sale)
Minimum marketing batch	Free	10%	10%
Short selling or the possibility of using borrowed money to trade	No	No	No
Remuneration of cash on hand	No	No	No
Subjects informed of high (or low) probabilities	Yes	Yes	Yes
Use of financial rewards	Yes	Yes	Yes
Application methodology	in person	On-line	in person
How the experiment was conducted	Questionnaire	Computer simulations and questionnaires	Computer simulation

Subjects	University students	Rural producers	University students

Source: Weber and Camerer (1998) and Vollmer, Hermann and Musshoff (2019).

Small changes were made with the aim of adapting the simulator to the Brazilian context. Among them, it was decided to name the assets with the neutral term “Produto” to avoid any influence that the names of agricultural commodities (e.g., soybeans, corn and wheat) could exert. Using the market name of an asset could influence participants' decisions as to when to sell or hold the asset. The variables *Initial price* and *Rising (or falling) price variation* were based on the values defined by Vollmer, Hermann and Musshoff (2019), but multiplied by one hundred. This decision was made taking into account that the amount of $15 adopted by the authors does not represent a value consistent with any considerable volume of an agricultural commodity in Brazil.

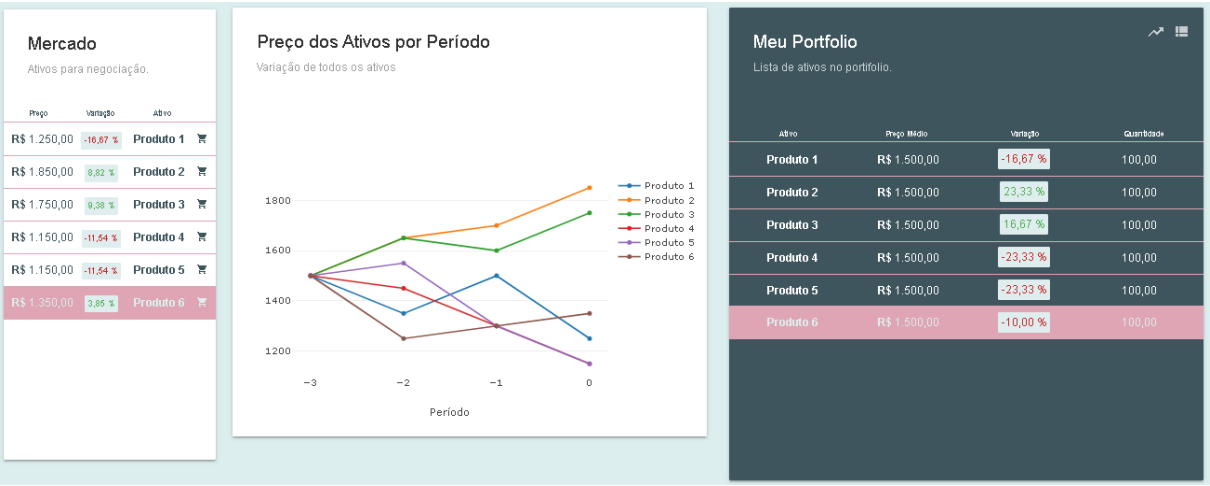
1.2 Development and interface

The previously mentioned design attributes were implemented in a grain marketing simulator software named *Simulador Colheita & Mercado*[4]. The simulator is a web application made up of the website, the app, APIs and database. The website was developed on the WordPress platform using the Javascript and html5 app, while the APIs were developed on the WordPress template and the MySQL database. Description and functionalities are described below.

In the main interface, participants can access the following windows: Market, Asset Price by Period and My Portfolio. Through them, they can follow asset prices, their graphical evolution and check their portfolio. Figure 1 shows the simulator at the start of the experiment, when the participant has not yet made any sales decisions. In the “Asset Price by Period” window, the evolution of the historical price series is displayed to give an idea of the price trend of each asset. In the “My Portfolio” window, you can see, for example, that the participant has 100 tons of each asset stockpiled to be sold in the coming periods.

[4] Registered at the Brazilian National Institute of Industrial Property (BR512024001942-1).

Figure 1. Simulator main screen



Source: Simulador Colheita & Mercado (2024).

After each participant completes their simulation, the software generates an output file that records all operations performed. This information is then stored in a database that calculates the disposition effect.

2 EXPERIMENT CARRIED OUT WITH THE SIMULATOR

This section will first describe the experiment, its participants, the financial rewards and finally, the data analysis.

2.1 Experiment

Most experiments (CAAE: 67250523.5.0000.5350) on the disposition effect use university students and are conducted in experimental economics labs. With this in mind, an invitation was sent out to students over the age of 18, enrolled in Business Administration and Agronomy courses, to voluntarily take part in a grain marketing experiment. 102 students agreed to do so. This number of participants can be considered adequate, since most research in experimental economics involves groups of around 35 individuals, as highlighted by Smith et al. (1988).

Offering monetary incentives serves as a stimulus for participants, who shall pay attention to the tasks and instructions in the experiments, and behave as close as possible to real-life decisions (Camerer; Hogarth, 1999). Following this line of thought, the experiment used monetary incentives, where a prize of one hundred *reais* was awarded to the participant who obtained the highest financial return from the sale of agricultural commodities, i.e. the first-place winner.

To calculate the disposition effect, two approaches based on Odean (1998) were used: aggregate (all subjects) and individual (per subject). In the aggregate analysis, two proportions are used to measure the disposition coefficient and its intensity: the proportion of realized gains and the proportion of realized losses. Realized gains (losses) comprise the number of transactions that were closed at a profit (loss).

This analysis is based on a comparison between the proportion of realized gains, given by the ratio of realized gains to the sum of realized gains and unrealized gains, and the proportion of realized losses, given by the ratio of realized losses to the sum of realized losses and unrealized losses, as described:

$$PGR = \frac{NGR}{NGR+NGNR} \quad (1)$$

$$PPR = \frac{NPR}{NPR+NPNR} \quad (2)$$

$$CD = PGR - PPR \quad (3)$$

In individual analysis, a proportion of realized gains and losses is calculated for each participant, and then averaged across participants, as set out below.

$$PGR_i = \frac{GR_i}{GR_i+GNR_i} \quad (4)$$

$$PPR_i = \frac{PR_i}{PR_i+PNR_i} \quad (5)$$

$$CD_i = PGR_i - PPR_i \quad (6)$$

Where: GR are realized gains; GNR are unrealized gains; PGR is the proportion of realized gains; PR are realized losses; PNR are unrealized losses; PPR is the proportion of realized losses; CD is the disposition coefficient; *i* is the individual.

2.2 Checking the presence of disposition effect

Below are the results of the analysis, which verified the presence of disposition effect between the participants in the experiment, and a control group. The intention of using a control group, composed of robots, which were developed to make random decisions, aimed to follow the methodology used by Da Costa Jr. et al. (2013).

Table 2. Descriptive statistics of the disposition coefficients at aggregate level

Variables	Participants	Robots
Realized gains (GR)	941	259
Unrealized gains (PR)	804	405
Proportion of realized gains (GNR)	2119	520
Unrealized losses (PNR)	4363	828
PGR=GR/(GR+GNR)	0,3075	0,3325
PPR=PR/(PR+PNR)	0,1556	0,3285
Disposition coefficient (CD = PGR - PPR)	0,1519	0,0040
Standard Error (PGR-PPR)	0,0097	0,0215
Z statistic (standard normal)	15,5843*	0,1862
(value-p)	0,0000	0,4261

*significant at 1%.

Source: Prepared by the authors (2024).

Considering the results presented in Table 2, participants in general sold a greater proportion of agricultural commodities when the price was above the cost of production[2], compared to when the price was below the cost of production. In this case, the proportion of realized gains to total gains (PGR) was 0.3075. And the proportion of realized losses, in relation to total losses (PPR), was 0.1556. This result provides evidence confirming the presence of the disposition effect at an aggregate level, since the positive difference between PGR and PPR (CD = 0.1519) is statistically significant.

Table 3. Descriptive statistics of individual disposition coefficients

Variables	Participants	Robots
Participants	102	50
Presented disposition effect	91	24
Did not present disposition effect	11	26
PGRi average	0,3060	0,3391
PPRi average	0,1512	0,3327
Cdi average	0,1542	0,0064
Cdi median	0,1647	-0,0046
CDi maximum	0,3954	0,1726
CDi minimum	-0,1260	-0,2500
Cdi standard deviation	0,1153	0,0955
t-test for mean CDi= 0	13,5651*	0,4767
(p-value - two-tailed)	0,0000	0,3168

*significant at 1%.

Source: Prepared by the authors (2024).

When analyzing the results obtained at the individual level in Table 3, it can be seen that the participants showed a greater propensity to sell agricultural commodities when their prices were above the cost of production (PGRi = 0.3060), compared to selling agricultural commodities when prices were below the cost of production (PPRi = 0,1512). These results are consistent with the CDi statistics (0.1542), indicating that the participants in general demonstrated the presence of the disposition effect at individual level.

Considering the reference study by Vollmer, Hermann and Musshoff (2019), which measured a disposition coefficient equal to 0.1830 to German farmers, this article found a lower value (CD = 0.1519). When comparing the disposition coefficient found with experiments carried out with university students, the value was higher than the study by Ormos and Joó (2014) with a disposition coefficient of 0.1410 when analyzing the negotiation patterns of Hungarian university students. It was also higher than the study by Da Costa Jr. et al. (2013) with a disposition coefficient equal to 0.1055, when applying an experiment on Brazilian university students.

In relation to the control group, the robots did not show statistically significant values that demonstrated the presence of the disposition effect, either at aggregate or individual level. This finding is in line with the study by Da Costa Jr. et al. (2013), who mention that robots do not manifest the disposition effect and therefore do not rule out the possibility that the phenomenon is actually caused by a cognitive illusion of the human brain.

The aim of this section was not to identify the causes or factors that influence the magnitude of the disposition effect, something widely discussed in the literature (Kaustia, 2010; Thaler, 1999, among others), nor did it seek to discuss the measured values with previous research. Rather, it seeks to demonstrate that the results of the experiment allow us to conjecture that the simulator, in addition to being operational and easy to apply, is appropriate for verifying the presence of this behavioral bias called disposition effect in individuals trading grains.

FINAL CONSIDERATIONS

The aim of this work was to propose computer simulation software, adapted from the studies by Weber and Camerer (1998) and Vollmer, Hermann and Mussohoff (2019), to be used in experiments designed to verify the presence of the disposition effect in grain marketing.

The proposal to build the simulator came up from the need to open up a new line of research into the decision-making process in grain marketing in Brazil. Traditionally, studies in this field are based on the notion of rationality, disregarding behavioral implications and how psychological biases can affect grain marketing decisions. In addition, there is evidence (Cabrini; Irwin; Good, 2007; Zhao; Yue, 2020) that the individual behavior of rural producers in grain trading does not necessarily follow the assumption of rationality, but displays characteristics of prospect theory and other alternative theories.

Another motivation was practical application, since individuals predisposed to the disposition effect tend to obtain lower financial returns compared to those not predisposed. According to Mattos and Fryza (2014), due to the high volatility of agricultural prices, identifying the ideal time to sell grain is a relevant decision, since

selling production too early can eliminate the chance of selling at better prices in the future. However, holding on to it for too long, plus storage costs, could result in selling it at even lower prices. In this respect, studies finding that economic agents involved in grain trading are not immune to the disposition effect have relevant implications for the economy, since grain trading represents a significant part of Brazil's Gross Domestic Product.

Finally, it is well worth highlighting the importance of computer simulation as a methodological instrument for future research into the grain marketing business. In this sense, we recommend its use in experiments that look to verify the presence of the disposition effect in rural producers, company and cooperative traders, as well as agricultural advisors.

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Material extraído da tese de doutorado intitulada: Efeito disposição na comercialização de grãos: uma investigação junto aos produtores rurais do Noroeste Gaúcho. Tese (doutorado) – Universidade Regional do Noroeste do Estado do Rio Grande do Sul (Campus Ijuí, RS). Doutorado em Desenvolvimento Regional. Disponível em: https://www.unijui.edu.br/estude/mestrado-e-doutorado/desenvolvimento

Artigo apresentado em 12/08/2024
Aprovado em 05/10/2025
Versão final apresentada em 10/10/2025

Editora chefe: Carla Cardi Nepomuceno de Paiva.