1. Introduction

Financial and economic crises are well documented in the literature. The 17th century witnessed the boom and bust of the first acknowledged bubble, which took place in a flowered Netherlands: the speculative fever over tulips that swept up in the Dutch society in mid-1600s (nowadays known as "Tulipomania") raised up flower bulbs prices and spawned a subsequent crash. Three centuries after the episode, a major financial bubble led to the Great Depression (1929—1939), one of the longest-lasting economic turndowns in the history up to date.

The deepest wound, however, was yet-to-come: in 2007—2009, when a housing market boom and bust dragged the worldwide economic into a tough recession. Many financial and non-financial companies went into bankruptcy (including the too-big-too-fail Lehman Brothers), thousands of investors were wiping out the market and, more sadly, millions of people lost their jobs or homes.

Each of these financial bubbles has raised questions against the prediction power of traditional economic models, whose main assumption was the rationality of economic agents. Various researchers have argued that the blame of dysfunctional financial markets lies with a higher degree of (intrinsic-to-all-markets) "moral hazard" (Ericson and Doyle, 2003), while others highlighted specific macro and micro-level factors that led to determined financial bubble. These explanations line up with the traditional theory and, deep down, keep strings attached with the tenet of rationality.

On the other hand, other authors would take a more radical and disruptive path while trying to explain economic agents' behaviors in dysfunctional markets. They would let go of the rationality assumption and argue that emotional factors blurred agents minds and let them take poor economic decisions.

Last but not least, there's a third and increasing line of argument (the one we shall pursue in this article), which takes into account the concept of bounded rationality. This concept was first introduced by Simon (1957) and, in the context of financial bubbles, may imply that the financial agents did not seek for all the necessary information to take the best decisions or were unprepared to deal with the complexity of the financial products.

Searching, selecting and interpretating financial information are costly to consumers and it may lead them to take economic decisions relying on inaccurate information. It seems like a rational choice since consumers weigh the trade-off between (i) the cost of seeking information and educating themselves and; (ii) losing their investments if the available information is not trust-worthy. This choice, however, may leave a breach to predatory behaviors, where sellers would take advantage of cognitively limited buyers.

One of the first frameworks addressing predatory behaviors in dysfunctional financial markets were proposed by Mesly et al. (2019). Huck et al. (2020) and Mesly et al. (2020) extended their work with insightful aggregations, such as combining the Lotka Volterra's model, borrowed by Biology, with the traditional demand-supply theory.

The main purpose of this article is to develop a satisfactory explanation for predatory behaviors in financial market and how these behaviors may lead the economic system into a crash even though just a small portion of agents acts in a predatory way. To achieve this goal, we take Mesly et al. (2020) theorical framework, which uses Lotka Volterra's equations, as a starting point. The model is presented right in the section below.

2. A framework on financial predation in economic crises

2.1. Adapting predator-prey model to a financial-crisis environment

Lotka Volterra's predator-prey model was found to be useful in many other fields beyond Ecology. There's a meaningful – and yet timid – literature regarding the use of the LV equations in economic theory, which starts with Goodwin's model for the relationship between wage and employment growth and stretches over models that describe the cyclic behavior of deposits and loans. In this article, we present an adapted Lotka Volterra's predator-prey model which depicts predatory behavior between economic agents in the context of a financial crisis. We specifically develop this framework from the 2007-2009 financial crisis perspective; therefore, we focus on the housing market dynamics and characters.

Our adapted model starts with a representative economy where there are two economic agents: (i) sellers of subprime housing mortgages; and (ii) potential house buyers. The relationship between sellers and buyers of subprime mortgages may present itself as a predatory interaction, which obeys Lotka Volterra's equations. As presented in prior section 2.1, LV equations take in the following form:

$$\frac{dx}{dt} = rx - \alpha xy, \text{for prey}$$

$$\frac{dy}{dt} = \alpha\beta - vy, \text{for predators}$$

In the context of our subprime-infected housing market, sellers act as predators, while buyers may find themselves into prey positions. As such, $\frac{dx}{dt}$ $\left(\frac{dy}{dt}\right)$ represents the changes in the number of sellers (predators) and buyers (prey) over time. Reinterpreting the coefficients in an economic sense, r is the rate at which new potential buyers hit the market, while v is the rate at which sellers leave it. The parameter α measures the probability of a prey getting caught by a predator or, in a more financial language, the probability of a buyer encountering and purchasing a subprime mortgage from a predatory

seller. Finally, the parameter β equals the rate at which sold mortgages attracts new sellers to the housing market, which, from a buyer's point of view, can be a proxy for the risk of purchasing a mortgage. All four parameters may (and should be) calibrated with real-world financial data.

From a model engineering perspective, our model is as simple as it gets: a pair of first-order differential equations, with four known parameters (r, v, α, β) and two variables (x, y). A more catching discussion may lay under which kind of circumstances predatory behaviors may prevail in financial markets. This is exactly the topic we would like to address in the subsection that follows.

2.2. On the predatory behavior in financial market

The traditional theory on consumer behavior takes rationality as main assumption. In times of crises, however, conventional economic models may fail to provide a satisfactory explanation on consumers' and sellers' behaviors. We do not intend to let go of the rationality tenet, but otherwise suggest that consumers operate under *bounded* rationality in dysfunctional financial markets.

3. References

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