Chapter 3
The Market Fraction Hypothesis under Different Genetic Programming Algorithms

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ABSTRACT

In a previous work, inspired by observations made in many agent-based financial models, we formulated and presented the Market Fraction Hypothesis, which basically predicts a short duration for any dominant type of agents, but then a uniform distribution over all types in the long run. We then proposed a two-step approach, a rule-inference step, and a rule-clustering step, to test this hypothesis. We employed genetic programming as the rule inference engine, and applied self-organizing maps to cluster the inferred rules. We then ran tests for 10 international markets and provided a general examination of the plausibility of the hypothesis. However, because of the fact that the tests took place under a GP system, it could be argued that these results are dependent on the nature of the GP algorithm. This chapter thus serves as an extension to our previous work. We test the Market Fraction Hypothesis under two new different GP algorithms, in order to prove that the previous results are rigorous and are not sensitive to the choice of GP. We thus test again the hypothesis under the same 10 empirical datasets that were used in our previous experiments. Our work shows that certain parts of the hypothesis are indeed sensitive on the algorithm. Nevertheless, this sensitivity does not apply to all aspects of our tests. This therefore allows us to conclude that our previously derived results are rigorous and can thus be generalized.

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INTRODUCTION

There are several types of models in agent-based financial markets literature. One way of categorizing them is to divide them into the N-type models and the Santa-Fe Institute (SFI) like ones (Chen, Chang, & Du, 2010). The former type of model focuses on the mesoscopic level of markets, by allowing agents to choose between different types of strategies. A typical example is The fundamentalist-chartist model. Agents in this model are presented by these two strategy types and at any given time they have to choose between these two. Examples of such N-type models in the literature are (Brock & Hommes, 1998; Amilon, 2008; Kirman, 1991, 1993; Lux, 1995, 1997, 1998; Winker & Gilli, 2001; Boswijk, Hommes, & Manzan, 2007). A typical area of investigation, using these models, is fraction dynamics, i.e., how the fractions of the different strategy types change over time. However, what is not presented in most of these models is novelty-discovering agents. For instance, in the fundamentalist-chartists example, agents can only choose between these two types; they cannot create new strategies that do not fall into either of these types. On the other hand, the SFI-like models overcome this problem by focusing on the microscopic level of the markets. By using tools such as Genetic Programming (Koza, 1992) these models allow the creation and evolution of novel agents, which are not constrained by pre-specified strategy types. Such examples from the literature are (LeBaron, Arthur, & Palmer, 1999; Chen & Yeh, 2001; Arifovic & Gencay, 2007; Martinez-Jaramillo & Tsang, 2009).[1] However, these kinds of models tend to focus on price dynamics, rather than fraction dynamics (Chen et al., 2010).

In a previous work (Chen, Kampouridis, & Tsang, 2011; Kampouridis, Chen, & Tsang, 2010), we combined properties from the N-type and SFI-like models into a novel financial model. We first used Genetic Programming (GP) as a rule inference engine, which created and evolved autonomous agents; we then used Self-Organizing Maps (SOM) (Kohonen, 1982) as a clustering machine, and thus re-created the mesoscopic level that the N-type models represent, where agents were categorized into different strategy types. This allowed us to test for the plausibility of the *Market Fraction Hypothesis (MFH)* (Chen et al., 2010, 2011), which states that the fractions of trading strategy types that exist in a financial market constantly change over time.

However, because of the fact that an important part of our financial model was based on GP, we are interested in examining whether our previous derived results can hold under different GP algorithms. Therefore in this chapter, we test the MFH under two different GP algorithms, in order to prove that the previous results are *rigorous* and are thus not dependent on the choice of the GP algorithm. Proving this is a very important task, because it allows us to generalize our previously derived results.

The rest of this chapter is organized as follows: we first present the MFH, along with its testing methodology, and discuss the two different GP algorithms that are going to be used for the tests in this chapter. We then present the experimental designs, and also present and discuss the results of our experiments. Finally, we conclude this chapter and discuss future work.

THE MARKET FRACTION HYPOTHESIS

Within a market there exist different types of trading strategies. For instance, the fundamentalist-chartist model informs us that in the market there are two types of strategies, the fundamental and the chartist. The MFH tells us that the fraction among these types of strategies keeps changing (swinging) overtime. The following two statements are the basic constituents of the MFH, as presented in (Chen et al., 2011; Kampouridis et al., 2010).