Physica A 394 (2014) 338–345

Contents lists available at ScienceDirect

Physica A

journal homepage: www.elsevier.com/locate/physa

Complexity in the Chinese stock market and its relationships with monetary policy intensity

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HIGHLIGHTS

- Method to formulate evolving stock index by Paasche compiling technique is shown.
- The Chinese stock market and the role of monetary policy intensity is presented.
- It is possible to use three variables to dynamically model the Chinese stock market.
- It is useless to regular market-complexity based on intensity of external factors.

ARTICLE INFO

Article history:
Received 1 June 2013
Received in revised form 21 August 2013
Available online 29 September 2013

Keywords:
Stock market
Complexity
Dynamics characteristics
Monetary policy intensity

ABSTRACT

This paper introduces how to formulate the CSI300 evolving stock index using the Paasche compiling technique of weighed indexes after giving the GCA model. It studies dynamics characteristics of the Chinese stock market and its relationships with monetary policy intensity, based on the evolving stock index. It concludes by saying that it is possible to construct a dynamics equation of the Chinese stock market using three variables, and that it is useless to regular market-complexity according to changing intensity of external factors from a chaos point of view.

1. Introduction

Complexity in the stock market belongs to the global characteristics of the system, and is under the influence of both internal factors, mainly referring to interaction between investment agents, and external factors including the macro-economy, the industrial economy, the regional economy and the company's development situation. However, it is difficult to use an empirical analysis method to study a certain factor's influence on the global characteristics of a socio-economic system such as a stock market due to the irreversibility. When a particular factor changes, other factors and system environments change accordingly, so it is hard to discuss the relationships between specific factors and system behaviors while keeping other factors unchanged according to empirical analysis methods.

However, the discrete space model [1] provides an experimental train of thought to study socio-economic systems, which shows the central idea of complexity science, that is, the overall structure can emerge from the restricted local interactions. After Schelling's research on the segregation of city communities [1], the discrete space model was widely used in many fields, including computer science [2], economics [3], sociology [4], and artificial life [5], and was considered to have significant advantages in the studies of self-organization, phase transitions, and emergent phenomena in complex systems.

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http://dx.doi.org/10.1016/j.physa.2013.09.047

Table 1
Evolution rules of general model.

Category of rules	The specific rules	The relevant parameters	Adjustment coefficient
Psychology analysis	Reverse operating	Indicator of the crazy buying and the panic selling	A_1
	Momentum trading	Probability of momentum trading	A_2
	Following the average cost of funds	Time interval	A_3
	Profit in the disaster	Indicator of disaster	A_4
Technique analysis	Price and volume analysis	Adjustment coefficient of the buying or selling probability according to the strength & weakness relationship	A_5
	Considering the cycle period	Period of cycle	A_6
	Trend analysis	Indicator of breakthrough and deviation	A_7
	OBOS analysis	Time of OB and OS	A_8
The fundamental analysis	Macro-economy analysis	Adjustment coefficient of the buying or selling probability and its actuation duration	A_9
	Industry analysis	Adjustment coefficient of the buying or selling probability and its actuation duration	A_{10}
	District analysis	Adjustment coefficient of the buying or selling probability and its actuation duration	A_{11}
	Company analysis	Adjustment coefficient of the buying or selling probability and its actuation duration	A_{12}
	News analysis	Adjustment coefficient of the buying or selling probability and its actuation duration and the decaying exponential	A_{13}

Regarding the stock market, the earliest application of the discrete space model was the Artificial Stock Market (ASM), developed by W. Brian Arthur in 1989; its modeling framework has been imitated by some domestic scholars [6–8]. However, we did not find that such studies include relationships between stock market behaviors and their influencing factors, and therefore cannot provide effective grounds for decision support.

According to the modeling idea of the discrete network, we constructed a single stock market evolving model based on genetic cellular automaton (GCA) [9], where classifier system put forward by J. Holland [2] is applied to optimize system parameters, then the CSI300 index was formulated so as to study the relationships between the complexity of the whole market and its factors, among which this paper will focus on the relationships between dynamics behaviors of the Chinese stock market and money policy intensity.

2. GCA model of evolving stock market

Considering the wholeness, the genetic cellular automaton model of the evolving stock market needs to be introduced briefly, and the stock market introduced here is a single one which could be used to be integrated to indexes.

The GCA model included a basic model, a general model, a special model and model optimization, where the basic model is the outcome of cellular automaton (CA)'s basic application in the stock market, and can be seen from the English version of our previous research works [10,11]; the remaining three parts are described as follows [9].

2.1. The general model

As a matter of fact, evolution rules can be expressed by a 3×3 matrix of state-transformation-probability P_Z, as is shown in formula (1). While the evolution rules of the basic model are imitations, those of the general model will be more rational, and investment analysis including psychological analysis, technique analysis and fundamental analysis will be combined into the basic evolution rules or the matrix of state-transformation-probability. The investment analysis rules of the general model are listed in Table 1.

$$P_z = \begin{bmatrix} p_{11} & p_{12} & p_{13} \\ p_{21} & p_{22} & p_{23} \\ p_{31} & p_{32} & p_{33} \end{bmatrix}. \tag{1}$$

Each of the rules in the table above is corresponding to an adjustment coefficient A which is used to adjust the matrix of state-transformation-probability P_Z. All the rules listed in Table 1 are gathered in a rules reservoir, which can be selected by CA's agents in every evolving step under a genetic algorithm process.

2.2. The special model

The special model is the embodiment of the general model, and its detailed work is to make certain the value of input parameters which are shown as Table 2.