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Evidential probability of signals on a price herd predictions: Case study on solar energy companies

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ABSTRACT

Many investors fail due to following prices. An imitating herd in the stock market influences not only people's wealth but economic stability. This research proposes a notion of price herd which simulates price behavior and its practice. Based on this concept, a model evidentially solving the signal probabilities of the price herd to predict its behavior is proposed. Empirically, the model is applied in the financial database, available from Taiwan Economic Journal, to analyze the solar energy industry during 2009–2014. In the results, it successfully identifies the herding signal, predicts the price downward 43% (0.99 close to the reality) in 2011, discloses a debtor herd beyond investors, and reveals the rational behavior of the price herd. Its technique centers in the prediction of information cascade, the induction of dominance-based rough set approach, and the approximations and granules of rough set theory.

1. Introduction

The downward of securities price caused by a herd usually hurts people's wealth and economic stability. A herd is defined as ignoring their own information and following the decisions of others, i.e. imitating [1]. In the financial market, the price plays a collective phenomenon of everything. Under the consideration of uncertainty, price and herd were wondered to be mutually exclusive [2] although some herds could arise from price variation [3]. The reason could arise from that the imitating groups often behave differently and change over time, the price fluctuation often diverges, and the herding analyses usually are not consensual in results [4–8]. In order to explore the gear between prices and herds, we propose a notion of price herd (PH), i.e. a herd simulates price behavior and its practice. PH behaves in the way: buying securities when prices increase and selling when prices decline. Its characteristic estimation and behavior prediction has been interesting for stakeholders of companies, industries, and government, etc. [9–11,5,12,3].

Theoretically, the herd analysis has two aspects: prediction and estimation. The former usually explains a herd with its collective behavior. Its highlights include fads and fashion of economics [13], investment herds [14,3], information cascades [1,15–17], herding behavior [7], and so forth. They mostly verify their proposals by predicting herds' behavior. Alternatively, the latter includes social class [13], desire of social psychology [14], network effect [18], social diffusion [7], public belief [3], and so on. They mostly verify their proposals by estimating herds' characteristic. The integration of the characteristic estimation and the behavior prediction can make a herd analysis more complete. However, lack of evidence between prices and

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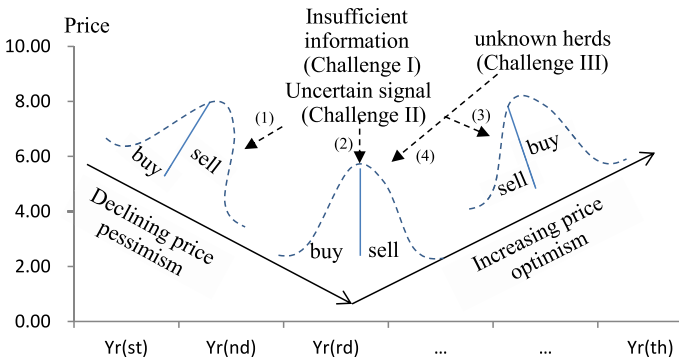

Fig. 1. The challenges of BHW.

herds makes the integration difficult, because the characteristic estimation might be overfitting and the behavior prediction might be over arbitrating. Identifying evidence becomes the key to analyze and predict PH.

In the literatures related to PH [14,15,2,19,6,3,8], a herding signal has been studied popularly. The signal means a sign triggering imitation in a sequential series or in an informationally efficient environment. However, PH's characteristic has not been analyzed. Our plan thus starts from analyzing PH's characteristic to identify its signal then predict its price. The prediction will take advantages of the information cascade (Bikhchandani, Hirshleifer, and Welch [15], abbreviated as BHW), which has citations up to sixty-three hundred times by Google survey on 15 May 2017. So far, BHW has been playing a paradigm of the herd prediction. It only uses a signal and a value as inputs [15,1]. Its signal expresses gain or loss information about action and its value is about action (adoption or rejection) on a target. However, BHW is not easy to apply in practice. Its problems can be stated in three aspects. Firstly, the details of securities' transactions are not possible to be provided due to privacy [20,21]. The insufficient information about herds is named Challenge I. Secondly, the U-shape price is assured as a herding behavior [3]. But the signals to upward or downward are not easy to identify due to uncertainty, ambiguity, and inconsistency [2,22,23,5,7,8]. The signal identification is thus named as Challenge II. Thirdly, the collective prices might comprise multiple herds with different behavior. Disclosing unknown herds [14,24,3] is more difficult than the previous two. We name this as Challenge III. These challenges are presented in Fig. 1 with a U-shape pattern, i.e. (A) Illustrating PH's behavior of selling, buying, and changing faces insufficient information and uncertain signal; (B) At the moment of changing behavior, disclosing herds faces multidimensional analysis. In order to solve these challenges in Fig. 1, we use the dashed lines (1), (2), (3), and (4) to illustrate our plan. We will use public information to make inference in disclosing the characteristics and signals for PH. Finally, a new herd will be identified by analysis in multiple variables.

The entry point of solving the previous challenges lies in identifying PH's signals with public prices which can derive the characteristic of PH. The price here is treated as a PH's behavior. A model named evidential signal of price herd (ESPH) is thus proposed to derive PH's characteristic from current prices to predict future prices. The 'evidential' means the relevance between prices and herds is reliable as evidential. For illustrating ESPH, we choose a case study, i.e. a price herd of Taiwan's solar energy industry from 2009 to 2014. The reason of choosing this period is that the world was struggling outward from the global crisis in finance. The herding behavior was not clear and investors were in a caution state at the moment. In that environment, a price herd has a big chance to appear.

Our research goal will fulfill ESPH based on Altman variables which have financial information related to securities price. ESPH uses the public prices as PH's behavior to find out PH's characteristic in finance. The identified characteristic is a signal of PH. The relevance between financial characteristic and securities price is expressed with evidential probability of signal (EPS, symbolized as e'_j). In the design to work out the research plan (1), (2), and (3) presented by the dashed lines in Fig. 1, ESPH contains two sub models: The first is built from rough set theory (RST) and dominance-based rough set approach (DRSA), named price herd of rough set (PHRS) which will generate PH's signals composed of granules (basic atoms of knowledge of RST [25]). The granules verified as having certain relevance are evidence. The second is built from BHW, named information cascade of price herd (ICPH) which will take e'_j to predict. The integration of PHRS and ICPH is presented in Fig. 2 where the higher prices position at the upper half of samples, the priori signal is a hypothetical characteristic of PH before making an inference, the posteriori signal is an induced characteristic from the priori, and j is an index of variables (attributes) containing the characteristic of PH. By applying e'_j as an input of prediction, the prediction result will verify the effectiveness of e'_j and the posteriori signals. The notion of PH thus can be testified.

The inference in Fig. 2 is a backward method in which PHRS induces the posteriori signal by solving e'. The dashed lines mean that the priori signal and the higher prices are ingredients of making e' which is used to classify PHs and assumes a signal indicator for prediction. Empirically, a case study about Taiwan economic journal (TEJ) during 2009–2014 will illustrate all terms aforementioned. The technical terms are described next.