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Phase-shifting behaviour revisited: An alternative measure

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HIGHLIGHTS

- The KOSPI200 futures market exhibits phase-shifting behaviour.
- The return-based measure captures the unique pattern of phase-shifting behaviour.
- Large trades demonstrate the phase-shifting phenomenon more clearly than smaller trades.

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ABSTRACT

This study re-examines the recently documented phase-shifting behaviour of financial markets using an alternative measure, an intraday return-based measure. While most previous studies on phase-shifting behaviour adopt the volume-imbalance measure proposed by Plerou et al. (2003), we find that our return-based measure successfully captures phase-shifting behaviour, and moreover exhibits a unique pattern of phase-shifting that is not detected when the classical volume imbalance measure is used. By analysing a high-frequency dataset of KOSPI200 futures, we also find that large trades reveal phase-shifting behaviour more clearly and significantly than smaller trades.

1. Introduction

Since Plerou et al. [1] first proposed the concept of phase-shifting behaviour in financial markets in their seminal paper in the field of econophysics, subsequent empirical studies have examined phase-shifting behaviour using global market data [2–8]. These studies find that financial markets undergo structural changes and phase-transition when certain state variables exceed some critical point. They name this phenomenon phase-shifting or phase-transition behaviour, based on its similarity to the phase change of materials in physics. For example, in an experimental situation in which the outside conditions are changed, water does not change into vapour when the outside temperature is changed from 99.8 to 99.9°C, but starts to boil and vaporize when the temperature exceeds 100°C. Econophysicists note that around some critical points, even small changes in market state variables can cause dramatic changes in the properties of the financial markets, just as a small increase in temperature around the boiling point of water completely changes its phase.

In the field of economics, some innovative studies have tried to relate the concept of phase-shifting behaviour to structural changes of markets and/or social systems.[1] Levy [15] proposes that the phases of social systems are more likely to shift

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[1] Majority of economic papers adopt structural regime-switching models such as Markov regime-switching models and regime-switching vector error correction models [9–14] to examine endogenous changes in market regimes. Only a small fraction of innovative and interdisciplinary studies analyse regime changes of financial markets using statistical physics approaches and explain regime changes using the phase-shifting phenomenon, which is a well-known phenomenon in the area of physics.

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when the individuals who make up the social systems are inclined to conform to one another. Levy [16] further explains that the cause of stock market crashes is phase-shifting behaviour, pointing out that the stock market collapsed in October 1987 in the absence of outside event shocks that can cause a fall in stock prices, such as the 9/11 terrorist attacks and the US subprime market crisis. He maintains that the heterogeneity of investors plays a crucial role in market crashes. Yalamova and McKelvey [17] relate the phase-shifting behaviour of markets to behavioural biases of investors. They claim that trading habits, such as herding behaviour, noise trades, and chartist behaviour, which are reported in the behavioural finance literature, often cause phase-shifting of financial markets.

Although there are several innovative studies that have aroused academicians' interest in the phase-shifting phenomenon in financial markets, most phase-shifting behaviour studies are still in their infancy. Studies in the economic literature mainly involve theoretical discussions and some simulation results [15,16]. Moreover, when examining phase-shifting behaviour, most articles in the field of econophysics depend on the classical volume imbalance measure suggested by Plerou et al. [1].[2] In addition, except for the recent study of Ryu [8] that attributes the observed phase-shifting behaviour to the dominance of individual trades, few studies relate the phase-shifting behaviour of markets to traits of trades; instead, most simply report the phase-shifting phenomenon in terms of global financial markets.

This study seeks to fill this gap. Using an intraday return-based measure that is expected to gauge the unique aspects of phase-shifting behaviour that might be overlooked by the volume imbalance measure, we re-examine the phase-shifting behaviour of the KOSPI200 futures market, one of the most liquid and hottest index futures markets in the world. We also investigate whether phase-shifting behaviour shows different patterns depending on trade size. Considering that trade size conveys meaningful and significant information, especially in the KOSPI200 futures market [18–22], it is surprising that the role of trade size has not been considered in the literature on phase-shifting; we anticipate that the empirical results of this study will expand our knowledge of phase-shifting behaviour.[3]

The remainder of this study is organized as follows: Section 2 introduces the KOSPI200 futures market and explains why it is meaningful to analyse this market using a return-based measure. Our sample data are also presented in Section 2. Section 3 introduces our return-based measure, which captures the dynamics of phase-shifting behaviour of the KOSPI200 futures market. Empirical findings and a discussion of these findings are provided in Section 4, and Section 5 concludes this study.

2. KOSPI200 futures market and sample data

The KOSPI200 futures market is one of the most liquid and popular index futures markets in the world. Since the Korea Exchange (KRX) launched the KOSPI200 futures in 1996, the futures market has maintained its standing as a global top-tier index futures market. The trading volume of the KOSPI200 futures is still increasing as more world-wide investors show interest, and is supported by the synergistic effect of combined trading with the KOSPI200 options, the single most liquid derivatives contract in the world [40–45].

Our reasons and motivations for re-examining phase-shifting behaviour in the KOSPI200 futures market are as follows. First, the highly abundant liquidity of the KOSPI200 futures market and the sharp increase in trading volume in recent years reflect investors' concerns and interest in this market. Therefore, the market behaviour revealed by intraday futures trading will have meaningful implications for econophysicists and market practitioners who pay attention to the dynamics of liquid financial markets.

Second, there is little market friction and asset prices are quite informative in the KOSPI200 futures market. These factors make our analysis more credible. For example, because of the lower transaction costs and taxes relative to equity trading and the abundant liquidity provided by individual investors, informed investors can focus on their intraday trading strategies, which enable active information flow and make transaction prices more informative. In this situation, information and news are instantly reflected in the futures prices and our return-based measure becomes more informative and meaningful.

Third, and most importantly, the size of trades is known to convey substantial information in the KOSPI200 futures market. Although a substantial portion of futures trades are just one-contract-size trades, some trades are extremely large in the futures market [6,18–21]. This unique distribution of trade sizes implies that trade size itself can contain meaningful information. Therefore, the futures market provides an ideal setting to examine the role of trade sizes in explaining the observed phase-shifting behaviour. In addition, considering that futures traders tend to decide the sizes of their orders and trades depending on their wealth, experience, and trading knowledge, investigation of phase-shifting behaviour according to trade size will help us to understand the unique traits of the KOSPI200 futures market.

The KOSPI200 futures market opens at 9:00 and closes at 15:15 on a normal trading day. During the last 10 min (from 15:05 to 15:15) and during the hour-long pre-opening session (from 8:00 to 9:00), standing orders are transacted under the

[2] To the best of our knowledge, the study of Hwang et al. [6] is the only exception. They introduce the return-based measure as a subsidiary analysis tool.

[3] Numerous articles in the financial economic literature emphasize the informational role of trade size and analyse the information content embedded in the size of trades. However, whether there is a positive association between trade size and the information quality is still an open empirical question. The majority of studies claim that large trades are more informative than smaller trades [18,21,23–30]. In contrast, another strand of research argues that small-sized trades have higher information content, especially when informed investors fragment their trades for strategic reasons such as "stealth-trading" [19,31–38]. Studies in the field of econophysics have also started to focus on the implications of trade sizes in stock markets [39].