Chapter 3
Market Input Analysis

3.1 Introduction

Unlike most of physical systems, especially engineering systems, in which the system inputs are generally well-defined and structured to meet certain specifications and requirements, the stock market has too many input factors that might influence its internal behaviors and hence its outcomes. On the other hand, the output of the stock market, i.e., the market closing price used in our modeling process, is fixed once the market is closed and is relatively clean compared to its counterpart in the engineering systems, in which their outputs are normally coupled with measurement noises. This chapter focuses on the selection of appropriate input influential factors for the system adaptation framework under study.

In the stock market, it is common to have a mixture of information, some quantitative, some qualitative and some that cannot be measured at all through common sense. Additionally, since the market follows the law of demand and supply, market fluctuations are affected by the collective behavior of the investors. In such a system, the feedback effect may be more complicated than or even completely different from the usual physical systems. Hence, identifying the external information that affects the market is essential to modeling, as it represents the interaction of the whole system with its environment.

The input selection is one of the key elements in our framework, which in fact may become even more decisive in certain situations. The fast changing external force is generated by the information outside the stock market such as the economic, fundamental and various other influential factors. These influential factors work as the input to our framework to regulate stock prices through the adaptive filter. As their effect on the market changes from time to time, identifying the most influential factors in the given period of time is critical to yield good predicting performance. As mentioned earlier, the information contained in the historical stock prices form the internal force, which is reflected in the internal model, representing the slow dynamics of the price series. The external force is much more complicated compared to its internal counterpart, requiring a time-variant adaptive filter to capture its fast changing dynamics.
In this chapter, we propose some new forms of market influential factors together with a procedure to identify the most crucial input elements for the system adaptation framework. It involves an empirical selection process and then follows by statistical tests. Once again, the U.S. stock market, more specifically, the DJIA, is taken as an illustrative example to demonstrate the practicality of our selection process. The investigation of other markets including those from China, Hong Kong and Singapore will be reported later in Chapter 5.

### 3.2 Influential Factor Selection

Many results can be found in the literature concerning the influential factors of the stock market, most of which come from economic and sentiment aspects. Economic indicators are generally used to judge the well-being of the economy and predict its future performance. They fundamentally determine the movement of stock prices as the stock market has become an increasingly important component of the economy. Interest rate, inflation rate, money supply and commodity price are all widely accepted as economic indicators. A famous and one of the earliest studies of this topic is from Chen et al. [29], the results of which indicated that a set of economic variables including industrial production, interest rate, inflation and oil price are important in explaining expected stock returns. Bodurtha et al. [20], Campbell and Ammer [25], Binder and Merges [16], Kim [66] and Rapach et al. [108] have done similar studies. They investigated the predictive power of future dividends, discount rates, price-level uncertainty and ratio of expected profits to expected revenues.

Besides economic indicators, investor sentiment becomes a crucial factor in recent studies. Sentiment indicators act as a measurement of the situation of demand and supply, representing the general opinion of the investors towards the market. Their contributions to short-term variations are particularly significant. Baker and Wurgler [10, 11] provided a general method to measure investor sentiment; by their approach they have demonstrated how sentiment affects the stock market as a whole. In addition, the reactions of the stock market to noise trader risk [86], aggregate earning news [79], aviation disasters [41] and even terrorism activities [74] have also been investigated. All these works are based on some sentiment indicators, among which the Chicago Board Options Exchange Volatility Index (VIX) is a very common one used for measuring the fear of investors.

Based on some empirical research, we first select a set of key influential factors, which include both economic and sentiment indicators, and perform necessary preprocessing to reform the selected indicators such that the resulting data will be better fit to our proposed framework. After which, we then apply a series of statistical tests, which include linear time-varying and/or nonlinear causality tests as well as multicollinearity tests, on each selected indicator to detect its causality relationship with the internal residue. More specifically, a linear test is first conducted on each input–output pair of the adaptive filter, i.e., the influential factor and the internal residue. A nonlinear causality test is to be further carried out if no significant