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Detecting the presence of insider trading via structural break tests

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ABSTRACT

The occurrence of abnormal returns before the unscheduled announcement of price sensitive information is a potential indicator of insider trading. We identify insider trading with a structural change in the intercept of an extended capital asset pricing model. To detect such a change we introduce a consistent timing structural break test (CTSB) based upon a *U*-statistic type process. Unlike the traditional CUSUM test, the CTSB test provides a consistent estimator of the timing of a break in the intercept that occurs across the whole evaluation period. We apply our test to a rich data set covering 370 price sensitive announcements relating to FTSE 350 companies. Our test is able to detect potential insider trading far more reliably than the standard CUSUM test. We also show that the majority of suspected insider trading takes place in the 25 days prior to the release of market sensitive information.

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1. Introduction

The detection of insider trading is generally considered to be essential to maintaining the integrity of the financial system and consequently its detection is given a high priority by the Securities Exchange Commission (SEC) in the US and the Financial Services Authority (FSA) in the UK. Recent research of Grégoire and Huang (2009) has analyzed some of the consequences that insider trading and inside information have on the cost of issuing new equity. In particular, their model indicates that such information can cause the market to demand a higher premium over the risk-free rate of interest on newly issued equity.[1] As such financial regulators have incentive to detect such trading and where appropriate prosecute this form of market abuse.

There are several alternative approaches in the literature to detect insider trading. From a statistical point of view, Dubow and Monteiro (2006) develop a measure of market cleanliness based on detecting abnormal stock returns prior to the release of an announcement of price sensitive information. The authors implement an extended capital asset pricing model to capture the dynamics of risky returns and use a definition of abnormal returns as the residuals of the corresponding time series regression. To detect insider trading, they use bootstrap techniques to approximate the finite sample distribution of the sequence of abnormal returns before an unscheduled announcement and compare this distribution against the magnitude of 4 days and 2 days cumulative returns taken 4 days before and 1 day after the announcement to see if these observations are in the tails of the bootstrap distribution. This method is further refined by Monteiro et al. (2007) to allow for serial correlation and conditional heteroscedasticity in the data.

Other methods are employed by regulators, for example, the Korea Exchange employs a market stock price monitoring model combined with a period stock price monitoring model to detect abnormal transactions. The market stock price model develops two linear regressions: one for stock price and the other for trading volume. Both models are used to detect when prices/volumes deviate from some normal trading range. The period stock price monitoring model detects variations in cumulative average returns and consists of three models: a stock price base model, a trading volume base model and a concentration ratio base model. A more sophisticated model of insider trading is developed by Park and Lee (2010) who use their model to characterize the time series of

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[1] In a similar vein Vo (2008) has shown that when information of this nature is not disclosed to financial markets in a timely fashion the price of equity is positively correlated with this information.

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stock price returns. To identify insider transactions using a time series, they assume that information exposed from insider trading at time t can be determined by a particular mixed strategy AR(1) process which they use to establish that the return series must follow an ARMA(1,1) process. They develop three criteria for detecting insider trading and conduct two validation tests.

In this paper, we argue that a natural methodology to detect possible insider trading is to look at unexpected changes in the idiosyncratic component of capital asset pricing models. In particular, we claim that the occurrence of insider trading leading to abnormal price movements will be potentially reflected in sudden shifts in the mean of asset pricing equilibrium models. Thus, we identify insider trading with a structural change in the intercept of an extended asset pricing model that, as for the previous authors, includes lags of the idiosyncratic return and of returns on the market portfolio. However, in contrast to the work of Dubow and Monteiro (2006) and Monteiro et al. (2007) we take a novel view on the statistical detection of insider trading. Using their theoretical extended capital asset pricing model (ECAPM) for pricing the risk premium on a risky asset, we develop a powerful new statistical test called the consistent timing structural break test (CTSB) which is designed to detect insider trading prior to the announcement of price sensitive information and, importantly, we are able to place an approximate timing on the insider trading.

The main advantage of our proposed test is that it can detect possible insider trading in the run up to the release of price sensitive information compared to the traditional CUSUM test which proves to be poor at picking up potential insider trading in the lead up to a price sensitive announcement. Also, compared to the bootstrap technique previously discussed, our method is more straightforward and less data-dependent since the asymptotic theory of the test is well known, implying that critical values can be tabulated. As such, by means of simple critical values it can alert regulators of potential cases of insider trading. The application of our method to a rich data set covering 370 price sensitive announcements relating to FTSE 350 companies shows that there is evidence of abnormal returns and potential insider trading for 92 companies comprising the index. As a by product, we also show that the majority of suspected insider trading takes place in the 25 days prior to the release of market sensitive information.

The paper is structured as follows. In Section 2, we discuss how to identify the occurrence of abnormal returns using an asset pricing model in equilibrium. In Section 3, we develop our novel test statistic for a structural break in the intercept and relate it to potential insider trading detection for an extended capital asset pricing model (ECAPM). Section 4 shows via a Monte-Carlo simulation that the statistical power of our CTSB test statistic is significantly greater than that of the traditional CUSUM test. Section 5 compares the performance of our test at picking up potential insider trading cases against a CUSUM test using a confidential data set relating to the release of 370 price sensitive announcements on FTSE 350 companies supplied by the FSA. Finally, Section 6 concludes.

2. Detecting insider trading via abnormal returns in equilibrium pricing models

Insider trading can be detected directly by looking at unusual trading volumes in the equities or derivative markets or alternatively by looking for unusual share price movements prior to a price sensitive announcement or a combination of the two. In their study, Dubow and Monteiro (2006) use the pricing approach and examine two kinds of announcements, trading statements by company issuers and public takeover announcements by companies to which takeover code applies. The methodology developed by Dubow and Monteiro (2006) and Monteiro et al. (2007) for detecting informed price movements and insider trading defines abnormal stock returns as:

$$AR_{it} = R_{it} - E_{t-1}[R_{it}] = \varepsilon_{it} \tag{1}$$

where AR_{it} is the abnormal returns, R_{it} refers to returns on stock i at time t and $E_{t-1}[R_{it}]$ is the expected return at time t conditional on information up to time $t-1$. The expected return can be modelled using time series or cross-section methods. We follow the literature on asset pricing in equilibrium and describe the dynamics of the expected return via an Extended Capital Asset Pricing Model (ECAPM) similar in spirit to the above authors' model but based on excess returns given by Eq. (2):

$$E_{t-1}[R^*_{it}] = \beta_1 R^*_{mt} + \beta_2 R^*_{mt-1} + \beta_3 R^*_{it-1} \tag{2}$$

where R^*_{it} denotes returns in excess of the risk-free asset R_t, R_{mt} refers to the market return at time t, and β_1, β_2 and β_3 are the slope parameters corresponding to the different risk factors. The use of lagged variables in the model acts as a filter for the presence of serial dependence in the data.

We argue that a natural methodology to detect possible insider trading is to look for a positive/negative shift in the mean of the abnormal return sequence caused by a change in the intercept of the above ECAPM. Theoretically, under a normal functioning of the market and the standard assumptions on market efficiency the risk premium on a risky asset can be modelled by the standard CAPM. We assume an extended version of it given by Eq. (2). Thus, if there is a positive (negative) price sensitive information that is only revealed to a reduced group of market participants the price of the stock is bound to increase (decrease) by a smaller amount than it would be in the case that the information was publicly available. Fig. 1 illustrates the difference for a positive price shock.

Note that unless the company raises more equity its supply curve is fixed at S_1. On the other hand, the demand curve is downward sloping. The D_1 curve is the demand curve of uninformed investors. The equilibrium price determined by P_1 corresponds to no insider trading and defines the return on that asset. In equilibrium the return on the asset can be expressed by Eq. (2). If there is a small group of informed traders that decide to trade on the asset then the new demand curve shifts to the right to D_2 implying a new equilibrium price P_2 which is higher than P_1 but smaller than the equilibrium price P_3 that would prevail if the inside information were fully publicly available corresponding to demand curve D_3. The return implied by the difference between P_2 and the initial price P_1, denoted R_{ins}, is the sum of the return produced by trade from uninformed investors, denoted R_{uni} plus an extra quantity α due to private information and given by the difference between P_2 and P_1. In equilibrium, the risk premium on the asset required

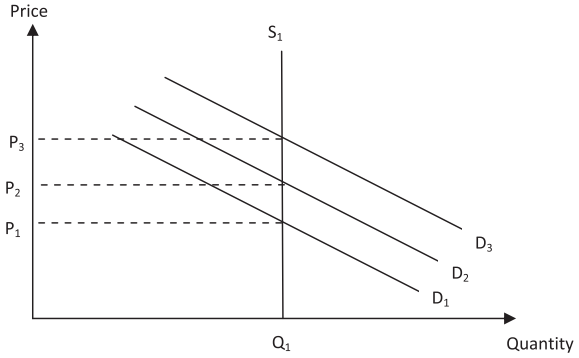

Fig. 1. The effects of insider trading.

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