Pacific-Basin Finance Journal xxx (2016) xxx–xxx

Contents lists available at ScienceDirect

Pacific-Basin Finance Journal

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

Pinning down an effective measure for probability of informed trading☆

James Petchey, Marvin Wee, Joey Yang *

Accounting & Finance, UWA Business School, The University of Western, Australia

ARTICLE INFO

Article history:
Received 5 October 2015
Received in revised form 27 May 2016
Accepted 10 June 2016
Available online xxxx

Keywords:
Probability of informed trading
Autoregressive conditional duration
Insider trading
M&A announcements

ABSTRACT

This paper investigates whether measures of the probability of information-based trading (PIN) estimated from microstructure models capture the effects of information asymmetry and trading by informed traders. To address the issue of the joint hypothesis, we examine the effectiveness of these measures using a sample of merger and acquisition (M&A) announcements that are known to be associated with illegal insider trading. We find that the PIN measure decreases prior to the announcements, while a modified measure that allows for the autoregressive conditional duration (ACD) of trades and the time-varying probabilities of news better reflects the presence of informed trading. Our results also suggest that the modified specification (PIN-AACD) overcomes some of the estimation problems found in the PIN measure in prior research.

1. Introduction

The need to measure the likelihood of information-based trading and quantify the amount of private information has seen the proliferation of metrics and the development of models of information asymmetry in the market microstructure literature. The probability of information-based trading (PIN) model, developed by Easley et al. (1997a, 1997b) and further modified by Easley et al. (2002), has been widely used due to its quantitative nature and theoretical underpinnings.[1] Despite the acceptance of its theoretical framework, testing the PIN model empirically is problematic due to the joint hypothesis problem. Recent studies that have examined trading around merger and acquisition (M&A) announcements have failed to find an increase in the microstructure measure in an environment that is allegedly associated with a high level of informed trading, hence raising doubts about the effectiveness of the PIN measure. For example, Aktas et al. (2007) show the PIN measure decreases in the period prior to an M&A announcement.[2]

An important and often ignored step in tests of the effectiveness of the PIN measure is verifying that the treatment sample is associated with informed trading. Hence, if we observe no change, or a decrease in the PIN measure, prior to the M&A announcement, it is unclear whether we could attribute this to the ineffectiveness of the measure, or that there is no informed trading in the sample of takeover announcements examined. We address this issue by examining the performance of the PIN measure using a sample that is known to be associated with information-based trading. This is the first study, to the best of our knowledge, to

☆ We thank Adrian Cheung, Tom Smith, participants at the 2015 Financial Markets Corporate Governance 2015 conference and the anonymous reviewer for helpful feedback.

* Corresponding author.
E-mail address: joeywenling.yang@uwa.edu.au (J. Yang).

[1] For instance, the definition of market efficiency given in Fama (1991) makes it pertinent to examine how private information affects asset prices.

[2] Gordon et al. (2014) also show that PIN does not significantly affect the pricing of smaller resources stocks in Australian markets, a result that seems somewhat counterintuitive given these stocks are likely to be subjected to high information asymmetry and behavioral biases, as shown by Kumar (2009). Similarly, Benos and Jochec (2007) find the measure decreases prior to earnings announcements. Furthermore, Duarte and Young (2009) show that PIN is priced in Fama and MacBeth's (1973) regressions due to liquidity rather than information asymmetry.

http://dx.doi.org/10.1016/j.pacfin.2016.06.006
0927-538X/

formally address the joint hypothesis problem in a test of the effectiveness of the PIN measure by using a sample of takeover announcements that have been found and reported by the Securities Exchange Commission (SEC) to involve insider trading.

Research in this field has seen the development of a variety of methods to detect informed trading from alternative PIN models[3] to the use of different market data.[4] Some of these studies discussed the estimation issues associated with the PIN measure, whereas others developed new models based on different theoretical frameworks. However, there is a lack of research to explain why the PIN measure fails to empirically capture the increase in the level of informed trading. We address this issue by using another specification that is similar in its theoretical underpinning to the PIN model, i.e., the PIN autoregressive conditional duration (PIN-AACD) model developed by Tay et al. (2009), in our tests of informed trading. In particular, we identify the estimation issues associated with the PIN measure, examine if the PIN-AACD model shows an advantage in terms of its ability to detect informed trading, and investigate the reasons why the PIN-AACD model offers improvements over the PIN model.

Our paper contributes to the existing literature in three ways. First, using a sample of M&A announcements that are associated with convicted cases of insider trading, we are able to formally test the effectiveness of the PIN as a proxy of information asymmetry in a setting controlled for the presence of information asymmetry. Second, a performance comparison analysis between the PIN and PIN-AACD measures enables us to explicitly address issues associated with the PIN as a tool to capture the changes in information asymmetry. Given that both models are based on similar theoretical foundations, the comparison of the performance of the PIN-AACD and PIN measures enables us to determine whether it is the estimation problem, rather than the theoretical underpinning, that limits the PIN's ability to identify informed trading activity. Third, we test whether the PIN-AACD model offers an improvement over the PIN measure for detecting informed trading.

According to the theoretical models of Kyle (1985); Easley and O'Hara (1987) and Glosten and Milgrom (1985), trading by privately informed traders will cause prices to shift as new information is revealed as a result of their trading. Meulbroek (1992) shows evidence of insider trading prior to M&A announcements, and that trading by insiders has an impact on the cumulative abnormal return (CAR). Abnormal returns are consistent with trading by insiders who have private information and trade to profit from this advantage, which results in their information being gradually incorporated into the price. Keown and Pinkerton (1981) document that abnormal returns prior to M&A announcements are largely driven by insider trading, an argument supported by the findings of Dennis and McConnell (1986). Bhattacharya et al. (2000) find evidence that on Mexicana de Valores that insider trading is so prevalent that prices fully incorporate the information before its public release. When insiders trade, Kyle (1985) predicts a gradual shift in price, while Easley and O'Hara (1987) predict an imbalance between buys and sells. The PIN, as a proxy for informed trading that measures this imbalance, should therefore show an increase prior to an M&A announcement if there is an increase in insider activity.

Aktas et al. (2007) show that the PIN measure decreases prior to M&A announcements, a result that contradicts much of the research on the level of information asymmetry prior to M&A announcements. We re-examine these findings by restricting the sample of announcements to those associated with convicted cases of insider trading, thereby mitigating concerns over whether information asymmetry existed and informed traders were trading. Controls for market-wide effects, such as changes in economic conditions or industry characteristics, are also included via a sample of matched control firms that had no announcements over the same period as the sample firms. This setting allows us to more confidently examine whether the PIN measure is effective for measuring information asymmetry.

In the first part of our analysis, we test whether the PIN measure detects an increase in informed trading. Detection is defined as an increase in the measure prior to an M&A announcement. Given the shortcomings in the application of the PIN model and its resultant ineffectiveness in measuring information asymmetry (see Section 2), we explore various issues associated with the PIN measure in a comparison analysis to see whether the PIN-AACD measure offers an improvement in performance. We use the PIN-AACD model as it is based on the same theoretical framework as the PIN model, but utilises a different estimation method. The PIN-AACD estimates arrival rates directly using high frequency data and produces the PIN on a daily basis. The PIN-AACD may offer increased sensitivity and become a better proxy of information asymmetry. The finding that PIN-AACD is a better measure than the PIN would imply that the problem with the PIN measure lies in the estimation of the measure rather than the derivation of the model. Issues with the estimation could be associated with a lack of sensitivity due to long estimation periods, inaccurate measurement of arrival rates using aggregated buy/sell data, or estimation bias.

Our main finding is that the PIN measures decrease prior to M&A announcements, even when the presence of informed trading is controlled for to eliminate the joint hypothesis problem. For the control firms that have had no announcements, the PIN measure remained constant over the periods studied. Further, it is found that the decrease in the PIN measure for our sample is largely driven by firms with large market capitalisation and high aggregate trading activity, consistent with an increase in estimation bias. Conversely, the results for the PIN-AACD model show an increase in the estimated probability of informed trading prior to M&A announcements. Further tests show the measure from the PIN-AACD model with time-varying probabilities of news performs better than the PIN measure in detecting illegal insider trading and is a better proxy for information asymmetry. The in-depth tests of the model parameters imply that the superior performance of the PIN-AACD supports the theoretical models that the derivation of the PIN measure is also based on, such as that of Easley and O'Hara (1987), which uses trade arrival rate

[3] For a brief overview of these PIN modifications: see Aslan et al. (2011) for PPIN; Easley et al. (2012) for VPIN; Chang et al. (2014) for DPIN; Gan et al. (2015) for CPIN; Tay et al. (2009) for PIN-AACD; Duarte and Young (2009) for APIN in a decomposition of PIN into an information asymmetry component and a liquidity component; Preve and Tse (2012) for APIN-AACD; Bollen et al. (2004) for the probability of informed (PI), where PI is derived in the context of option pricing; and Yan and Zhang (2012) for improved PIN via achieving global maxima in the estimation.

[4] See Augustin et al. (2015) and Podolski et al. (2013) for models to detect informed trading using options trading data.

Please cite this article as: Petchey, J., et al., Pinning down an effective measure for probability of informed trading, Pacific-Basin Finance Journal (2016), http://dx.doi.org/10.1016/j.pacfin.2016.06.006