An unreliable canary: Insider trading, the cash flow hypothesis and the financial crisis

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ABSTRACT

This paper investigates whether measures of aggregated insider trading could have predicted the wider economic change that occurred in the UK around the time of the financial crisis. Seyhun's (1988, 1992) cash flow hypothesis is the underpinning rationale driving the investigation. Within a vector auto-regressive framework, this study disentangles the relationship between returns and the activities of insiders in UK listed firms in order to validate Seyhun's assertions in this context. Findings suggest that, unlike the US, the relationship is not present. Instead, aggregate measures of trading decisions show that insiders are more likely driven by public perception than by private information.

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1. Introduction

Share trading by managers and directors within their own companies has fuelled academic debate for some time. Numerous studies show that insiders often trade profitably on the private information that they hold (Finnerty, 1976; Jaffe, 1974; Jeng, Metrick, & Zeckhauser, 2003; Lin & Howe, 1990; Seyhun, 1986; Wisniewski & Bohl, 2005). Not only are individual trades profitable but when aggregated, these can be used to predict changes at an economy wide level (Iqbal & Shetty, 2002; Seyhun, 1988, 1992).

Much of the research on insider trading is concerned with gauging the possible informational value contained in individual trades. However, a small but convincing body of work suggests that aggregated measures of these transactions could be used to pick up on signals which are as yet invisible to outsiders but which herald impending change on a macroeconomic scale (Seyhun, 1988, 1992). The idea is that decision-makers within a firm who pick up on variations in cash flows that signal an alteration in future financial performance will trade on this information. When the event is specific to the firm an aggregated measure would not pick this up but if it were common across all firms it could indicate a shift in economy-wide performance. The argument does not imply that insiders are themselves privy to

this wider change. If this were the case, it would be unlikely that they would restrict trading to their own company when a wider less risky investment vehicle might provide a safer investing opportunity (Seyhun, 1992). Rather, the situation is more like that of the 'canary in the coalmine'; the altered circumstance detected by insiders precedes a wider recognition of forthcoming macro-economic fluctuations. The actions of insiders' acting independently but en-masse, rather than those of a conscious collective become the sum of perceived opinions about the financial health of individual companies.

This study's objective is to investigate Seyhun's (1988, 1992) assertions using the transactions of insiders within firms across a number of sectors listed on the London Stock Exchange. Specifically, the study investigates whether an aggregated measure of insider behaviour could have been used to predict the onset of the 2008 financial crisis, a period of uncertainty widely characterised in the British media as the 'Credit Crunch'. The findings produced here offer a perspective which contradicts that posed by Seyhun. In the years surrounding the financial crisis, aggregated measures of insider trading gave no indication of the macroeconomic change that was to come. While this paper does not question the validity of Seyhun's findings it calls into question the applicability of the hypothesis in a jurisdiction outside the US, namely the UK.

The following section provides an overview of existing research, assessing the informational value of declared insider behaviour. The regulatory context in which this research has been undertaken is

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illustrated in Section 3. Section 4 discusses the methodological choices made to conduct the study. Section 5 describes the data sample and how it was obtained. In Section 6 the results are discussed. Section 7 concludes the study.

2. Predicting market returns using insider trades

Much of the existing research on aggregated insider trading concludes that movements of indices constructed using this data pre-empt market movements (Chowdhury, Howe, & Liu, 1993; Iqbal & Shetty, 2002; Seyhun, 1988, 1992). This means that analysing what corporate insiders do on aggregate enables the astute observer to reconstruct their portfolios to account for economy-wide factors that are not as yet reflected in the markets. Trends drawn from an aggregation of individual trades are founded upon the reasoning that because firm-specific reasons cancel each other out, a generalized reaction to events common to all firms by the same netting off process becomes discernible. During periods where circumstances are similar for all firms in the market, an aggregation of trades produces a common direction in trading that responds to slight change in macroeconomic conditions that may not yet be visible (Seyhun, 1988). The insider, from her vantage point is well positioned to observe unexpected changes to cash flows. But, as only firm specific events can be seen, the trading decisions she makes are independent of those made by insiders in other companies.

Previous studies that use this reasoning have traced the link between these aggregated measures and macroeconomic shifts (Jaffe, 1974; Jiang & Zaman, 2010; Seyhun, 1992). These report a positive time differenced relationship between aggregate measures of purchases and sales with subsequent market returns. The connection is facilitated by an insiders' willingness to act upon price sensitive information. This tendency is well documented (John & Lang, 1991; Karpoff & Lee, 1991; Ke, Huddart, & Petroni, 2003) and demonstrates that insiders, informed about future prospects of a firm, adapt their actions to suit the nature of the news they receive. For this study, it is therefore reasonable to hypothesise that insiders may have been able to pick up on the signals relating to changing conditions in each of their institutions. If these variations are consistent across all firms, then insider behaviour signals a reaction to an altered circumstance common to all.

Insiders have shown a propensity to engage in successful market timing (Chowdhury et al., 1993; Piotroski & Roulstone, 2005), yet the decisions to trade are influenced not only by the nature of the information but the regulation that dictates the extent of the action which they can take. As both legislation and enforcement can differ between countries (Bhattacharya & Daouk, 2002), it is possible that the relationship between an aggregated measure of insider trading and market return might not exhibit consistency across states with markedly different legal systems. By this reasoning, one could plausibly suggest that inferences based on studies conducted in the US are not necessarily applicable in a UK context.

In the UK, studies show that insiders can identify mispricing in shares of their own companies (Gregory, Matatko, Tonks, & Purkis, 1994; King & Roell, 1988; Korczak, Korczak, & Lasfer, 2010; Pope, Morris, & Peel, 1990). However, the capacity for outsiders to profit from imitating insider behaviour remains contentious. Hillier and Marshall (1998) and Darpas and Guttler (2011) produce conflicting findings on the announcement effect associate with declared insider trades. A thorough review of the literature reveals that no studies have as yet dealt with the issue of how aggregated measures relate to subsequent market returns. The contribution this study makes is that it investigates whether this phenomenon, which is so much in evidence in the US, is observable in the UK context. The macroeconomic change that grew out of the financial crisis provides a suitable backdrop for this investigation. It is reasonable to ask whether the behaviour of insiders prior to this period provided clues as to what would occur

both in this area and the entire economy over subsequent months. In effect, the study asks whether an aggregated measure of insider behaviour could have been used to predict the worst moments of the financial crisis.

Sectoral differences have been noted in the market timing success of insiders and adds a further perspective to our investigation. In particular, insider trading in the banking sector has been shown to be successful both within the US and Canada (Madura & Wiant, 1995; Lee & Bishara, 1989). These studies show that individuals earn greater returns on their personal portfolio transactions than their counterparts from other areas of business (Baesel & Stein, 1979). A higher degree of informational asymmetry also exists between insiders and uninformed traders in smaller banks where the outside focus from analysts and investors is less intense (Madura & Wiant, 1995). Within Europe, Del Brio and Miguel (2010) use a sample taken from firms trading on the Spanish stock market to find that at firm level, mispricing can be identified, however an aggregate measure lends nothing to the predictability of returns. This study is also unique as there are no UK studies which look at the predictive capacity of returns using aggregated banking insider measures around periods of intense economic uncertainty, such as that which occurred in the months leading up to the onset of the recent financial crisis. Findings show that insiders in the banking sector subsample were no more aware of the impending change than those across the entire sample.

3. Regulatory context

In the UK, insider dealing is controlled within a legislative framework that attempts to protect the markets against abuse so that a fair trading environment is ensured for all market participants. Both the Financial Services and Markets Act (2000) (FMSA) and the Criminal Justice Act (1993) endow the Financial Conduct Authority (FCA) with the regulatory, investigative and enforcement powers needed to protect the markets from a range of abuses, insider dealing is of particular concern. For offenders, penalties can extend to a maximum prison sentence of seven years and/or a fine to which there is no set limit (Rider, Alexander, Linklater, & Bazley, 2009). Surveillance is the favoured technique of regulators; the FCA have spent considerable resources developing a monitoring presence which it claims has acted as a strong deterrent against illegal behaviour (Cole, 2007). Despite this, conviction rates are low. While the pursuit of some prosecutions has yielded success, this is not generally the outcome. It is difficult to fully establish all the facts that are required to prosecute a case (Fidrmuc, Goergen, & Renneboog, 2006). Instead, evidence of effectiveness rests on falling measures of illicit activity. This could be seen, for example, in decreasing levels of unusual activity prior to takeover bids (Cole, 2007). One particular aspect of surveillance is to compel directors and executives to disclose the trades that they make within their own firms.

The listing rules published by the FCA, set the standards for participants in the UK financial markets. Within this the conditions governing the use of price sensitive information is contained in the Disclosure and Transparency rules (Section 3.1.2). Under these rules, those persons who discharge managerial responsibilities are required to provide to their company written notification within four working days of all transactions on their accounts involving shares, derivatives or other financial instruments relating to that firm (Listing Rules FSA Handbook 2010). The issuing company is then required to disseminate this information to the markets along Regulatory Information Service newsfeeds no later than the first business day following receipt of the news. In the UK, the term insider is used to cover both executive and non-executive members of the board of directors this is dissimilar to the US in that the definition excludes other employees and large shareholders (Fidrmuc et al., 2006). The Model Code on Director Dealings (2010), which is a non-statutory best practice guideline for listed companies, discourages insiders from trading on their companies own shares without prior

clearance from either the board, chief executive or company secretary, depending upon the position of the individual (Listing rules Model code FCA handbook 2010 LR 9 Annex 1). The code also stipulates that a 'close period' be observed sixty days prior to annual or half yearly earnings announcements and thirty days before quarterly results. In comparison, counterparts in the US do not face the same periods of trading suspension, but are required to disclose their activities throughout with the result that the US dataset has higher frequencies of disclosure (Bettis, Coles, & Lemmon, 2000). Until the implementation of Section 16 of the Sarbanes Oxley Act (1988) in the US in 2002 there was a much greater difference (up to forty days) in the reporting requirements between both systems.

Although both countries' legislation covers much of the same ground through prohibiting grossly unfair or abusive trading activities, it is reasonable to suspect that the differing recording requirements produces datasets that carry different informational value. For instance, Kyriacou, Luintel, and Mase (2010) note a disparity in the magnitude of informed transactions between US and UK executive trading of awarded options. They find that this difference is owed not just to contextual changes in remuneration and taxation but also to the differing nature of regulations governing the practice. Consequently, the answers to research questions which are broadly similar may vary according to the geographical focus of the research and the period in which these questions were asked. The implication is that UK data, at least until recently, held different informational content than that which is held on US insider activity (Fidrmuc et al., 2006). A study that shifts the focus to the UK may not necessarily reach the same conclusions as that carried out in the US.

4. Methodological choice

The difficulty with modelling an aggregated measure of insider trading against market returns is that an investigator needs to be satisfied that the variables are truly endogenous. For example, while it may be reasonable to hypothesise a relationship where an aggregated measure of insider trades anticipates price movements how can one be sure that market-wide fluctuations do not instead instigate a general reaction on the part of insiders. The solution is to relax the need to adopt a-priori assumptions on the inter-relationships between variables through employing a vector autoregressive framework, a method first introduced by Sims (1980).

The VAR framework estimates the following system of equations:

$$y_t = \phi + \sum_{i=1}^{p} \psi_i y_{t-1} + \varepsilon_t, \quad t = 1, 2 \ldots \ldots T \tag{1}$$

In this system ϕ is the vector of intercepts, y_t represents a vector of three variables which include continuously compounded market indices return for the FTSE 100 market index, an aggregated measure of the number of insider trades and a series of keyword usage in English language publications to represent public knowledge of the event, all three are endogenous to the model.

Optimal lag length p is selected using the Akaike information Criterion (Akaike, 1973, 1974). Residuals in the model are set to zero where $\varepsilon_t = 0$. Cholesky decompositioning is engaged to facilitate the variance–covariance matrix. Granger causality testing (Granger, 1969) is the first step taken in the analysis, where causality is inferred from the temporal relationship between variables The VAR framework also includes a measure of accumulated responses to one standard deviation innovations until there is a return to equilibrium. The impulse response functions do not require a specific ordering of variables. For those interested, Pesaran and Shin (1998) provide a formalised outline of the process in detail. Finally, variance decomposition is used to attribute the proportion of forecast error variance in each variable between itself and others in the system, this procedure originates in Lütkepohl (1991).

5. Data description and measurement of insider transactions

This paper's objective is to examine whether an aggregated measure of insider activity across UK sectors could have lent itself to predicting the onset of the 2008 financial crisis, a period commonly referred to as the 'Liquidity crisis' or 'Credit Crunch' (Brunnermeier, 2009). Using a vector autoregressive model, it is possible to pick apart the relationship between an aggregate measure of insider trading in UK returns on the FTSE 100 market index. Also included in the model is a variable representing the intensity in coverage of the crisis in the UK published media, this controls for the possibility that insider trades could in fact have been a reaction to publicly available information.

The data on insider trading required for this model was obtained from the Director Deals database, a resource listing insider trades on UK listed firms reported to the Financial Services Authority over the period beginning in October 2004 and ending in May 2009. Only open market transactions are used, as the motivation behind these is more likely to be made on the basis of an individual's personal knowledge of the company's situation (Iqbal & Shetty, 2002). Included are trades by both executive and non-executive directors and other individuals exercising managerial responsibility within the firm as per the requirements of the model listing code. The dataset covers 3426 firms listed on the main and alternative equity investment markets of the London Stock Exchange. The time period over which the sample is selected is designed to encapsulate the full series of events that led to the crisis. In total there are 25,688 insider transactions of which 20,073 are open market purchases and 5615 are open market sales. Over the 56 months in the sample the total value recorded for both open market sales and purchases reached a total of GBP £15,591,312,476. Of the full calendar years within the sample period 11% of the total value of transactions was traded in

Table 1
Summary statistics.
The three variables in the panel listed below are explained as follows. ΔCC denotes the number of articles where the term 'credit crunch' is used in a given month in all English language publications contained in the Lexis-Nexis database. This series has been first differenced to induce stationarity. The sample period stretches over 56 months from October 2004 to May 2009. The variable *Ret* denotes the monthly continuously compounded returns on the equally weighted FTSE 100 Index sourced from DataStream. The ΔNI variable denotes the aggregate monthly net number of insider transactions that were made over the time span reflecting the intensity of trading activity in either direction (Iqbal & Shetty, 2002) the unit root has been removed using first differencing. The data on insider trades was provided by Director Deals. The first column reports the number of months in the study while the second provides the arithmetic averages for each variable; the third offers a measure of volatility while the third and fourth and fifth columns show the median and the range values. The results of the Augmented Dickey–Fuller stationarity tests (Dickey & Fuller, 1979) are given in the eighth column, the final column provides the McKinnon (1996) one sided p-values for the test results. The appropriate lag length for the test was set at ten using the Schwarz Bayesian Information Criterion (SBIC) (Schwarz, 1978).

Variables	Observations	Mean	Standard deviation	Median	Minimum	Maximum	ADF test	p-Value
ΔCC	56	0.4351	1.7367	0.0382	−0.6316	9.7204	−4.9009	0.0011
Ret	56	−0.0003	0.0561	0.0076	−0.2275	0.1174	−7.2574	0.0000
ΔNI	56	−0.0016	0.1465	−0.0225	−0.3296	0.3795	−11.3564	0.0000

Table 2
Pearson correlation coefficients for the variables used in the vector auto-regression. Reported in this table are the Pearson product moment correlation coefficients between variables employed in the study. The ΔCC variable is the measure of the number of articles in which the phrase 'Credit Crunch' appears in the English language publications appearing on the LexisNexis database. The series has been transformed using first differencing to induce stationarity. The *Ret* variable represents the equally weighted continuously compounded monthly returns taken from the FTSE 100 Index, DataStream is the source. ΔNI denotes the aggregate monthly number of net insider transactions made over the sample period. The observations span 56 months from October 2004 to May 2009.

	ΔCC	*Ret*	ΔNI
ΔCC	1.0000		
Ret	0.0640	1.0000	
ΔNI	0.2146	−0.3584	1.0000

2007; this was followed by 25% in 2006 and 44% in 2007, in 2008 this value fell back sharply to 16%. These figures possibly indicate a link between the periods characterised by increased uncertainty and insider activity.

In order to create a measure that encapsulates both the nature and extent of insider activity over the sample period, an index of aggregate insider activity is constructed. This is based on the net number of insider trades (*NI*) and is similar to a measure used in Iqbal and Shetty (2002).

$$NI_t = \sum_{i=1}^{n_t} \frac{(P_{it} - S_{it})}{P_{it} + S_{it}} \qquad (2)$$

where P_t represents the aggregate number of insider trades across all firms making purchases in a given month and S_t denotes the aggregate number of sales over the same period. This variable is employed in the VAR model to represent the intensity and direction of insider trading over the given period as it provides an indication of the trading as it occurs in each direction. In our sample of insiders, there are periods where there is an absence of trading within a particular month. Where this occurs, the observation assumes a value of zero. Following testing for a unit root using the Augmented Dickey–Fuller test the variable was found to be non-stationary. To satisfy the requirements of the methodology, first differencing was applied to this variable to achieve stationarity in the series.

The second variable employed in the model portrays the extent to which the crisis was covered in the UK published media. This variable is used as a proxy measure for the degree to which attention to the

Table 3
Granger causality tests.
Displayed below are the results for the Granger causality tests for three vector auto-regression models, each of which includes two of the three endogenous variables used in the study, namely ΔCC which represents the first difference of media coverage of the crisis, *Ret* which denotes the continuously compounded returns on the FTSE 100 Index and ΔNI which provides a measure for the direction and intensity of insider trading. The sample period covers 56 months beginning in October 2004 and ending in May 2009. For each model the Granger (1969) method is used to test for causality in both directions. An F-test is employed to test the null hypothesis of no causality existing between the variables, the results of these along with corresponding p-values are provided below. Within each model the optimal number of lags has been determined using the Akaike Information Criterion (Akaike, 1973, 1974) where the maximum lag length is set at one.

| Models with endogenous variables	F-statistic	p-Value
H0: ΔCC does not Granger-cause *Ret*	0.2728	0.6037
H0: *Ret* does not Granger-cause ΔCC	0.0546	0.8161
H0: ΔNI does not Granger-cause *Ret*	0.4110	0.5213
H0: *Ret* does not Granger-cause ΔNI	0.1074	0.7445
H0: ΔCC does not Granger-cause ΔNI	5.3431	0.0248
H0: ΔNI does not Granger-cause ΔCC	0.0038	0.9513

unfolding situation was portrayed over the period in question. The advantage of using this variable is that it can establish whether the reaction of insiders was to commonly held information or to their own. The variable is endogenous to the model as it is conceivable that market fluctuation could influence media coverage as could an increase in disclosed trades. There are precedents in the literature for using such a measure. Shiller and Case (2003) conduct a search of the LexisNexis database for the number of times the term 'Housing Bubble' appeared in publications to construct an indication of the extent to which attention given to the possibility of a 'Bubble' might precede the actual collapse of the housing market. The term 'Credit Crunch' was the phrase which typified the financial crisis and which the media in the UK began to use as a catchword to describe the situation. This study captures the use of this phrase in all English language publications through constructing a variable made up of the number of these keyword hits. The frequency of these was recorded by conducting a search of all UK publications on the LexisNexis UK database. The results were then collated on a monthly basis. In order to meets the condition of stationarity required of variables used in VAR analysis the series was transformed using first differencing to create a usable 'credit crunch' variable (ΔCC). As might be expected with the term '*Credit Crunch*' the dramatic increase in the frequency with which this term was used in the media began in late 2007 and peaked around the time when the lending difficulties between banks had reached a critical point in October 2008.

The remaining variable used in the analysis is the continuously compounded return on the market index (*Ret*), which shows the return on the FTSE 100 index provided via DataStream. This measure has been
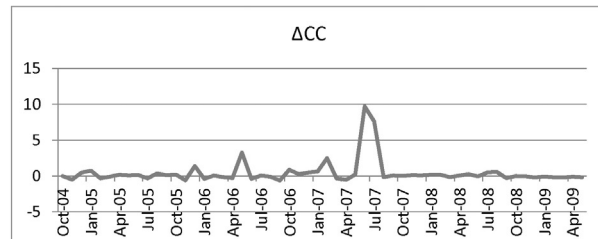
A) FTSE 100 Index return
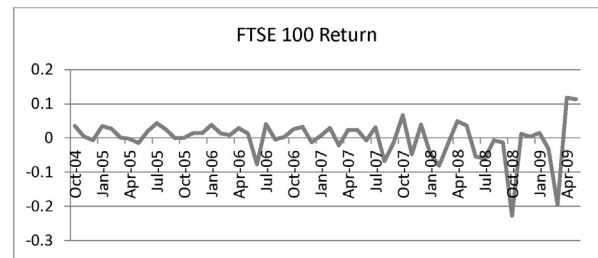
B) Differenced aggregate measure of net insider trades
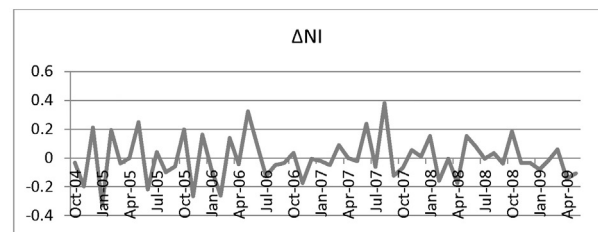
C) Differenced measure of keyword hits for the term 'Credit Crunch'

Fig. 1. Data plots of time series of variables used in the VAR system.

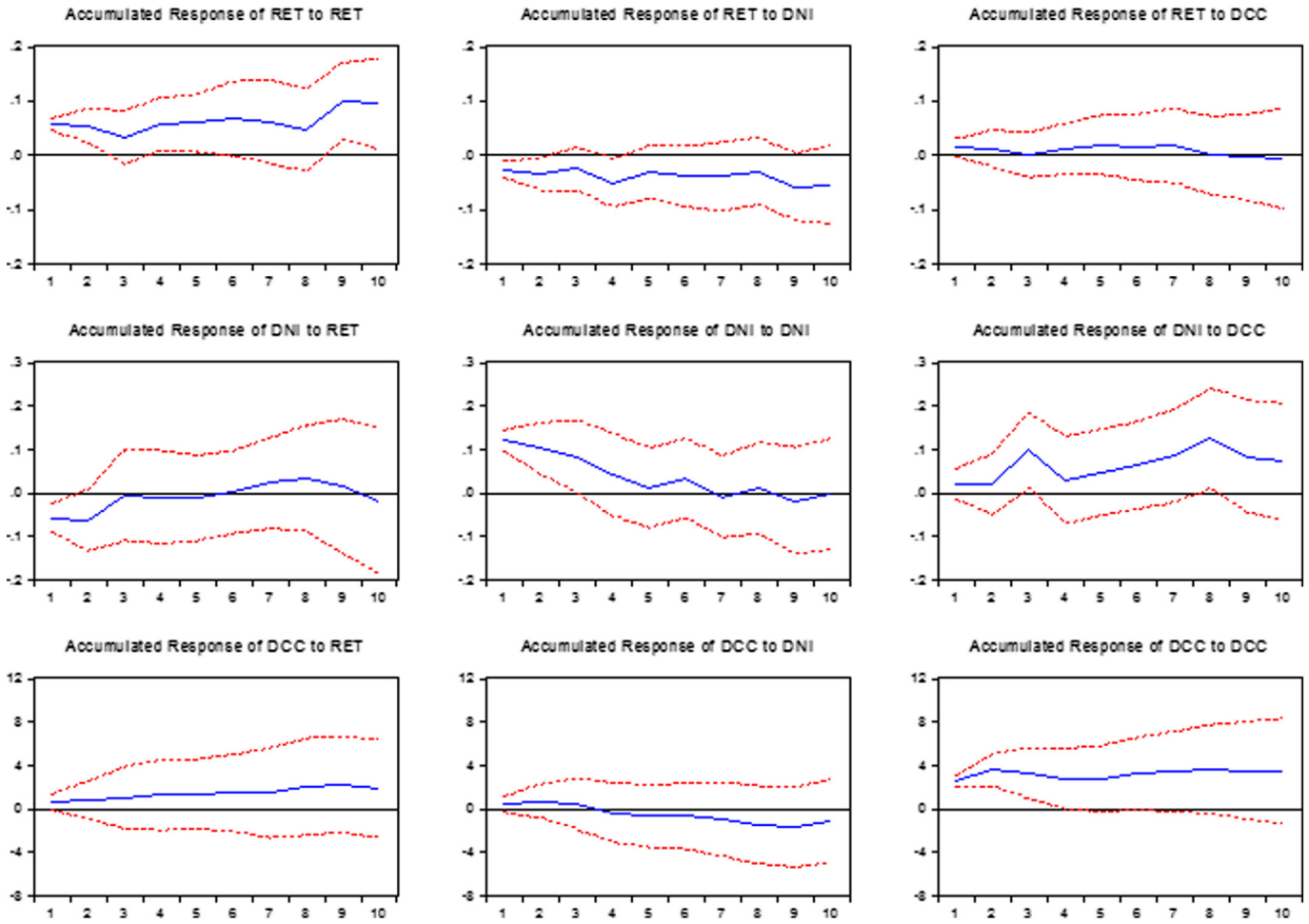Accumulated Response to Generalized One S.D. Innovations ±2 S.E.

Fig. 2. Impulse response functions: accumulated responses to generalized one S.D. Innovations ± 2 S.E. for models including the ΔCC, Ret and ΔNI variables. Displayed above are the impulse response functions for the vector auto-regression model used in this study. The lag length was attained using the Akaike Information Criterion (Akaike, 1973) with a maximum lag length set at ten. The optimal lag specified for the models displayed above is eight.

chosen to represent the changing fortunes of the entire UK market over the sample period.

Descriptive statistics of the three variables are displayed in Table 1. The degree of dispersion in the credit crunch variable can be attributed to the explosion in the magnitude of coverage as it occurred from June 2007 onward. The average figure for returns over the period is negative and is suggestive of the fall in the price level of stocks over that time. The net number of insider trades is negative suggesting that insiders were more likely to sell rather than buy stocks during the sample months. Unit root tests conducted on each of the three variables establish that the variables are stationary and match the assumptions required for VAR analysis and Granger causality tests (see Table 1). An Augmented Dickey–Fuller (ADF) test using the Schwarz Bayesian information criterion (SBIC) proposed by Schwarz (1978) to establish optimal lag length confirms that at a 99% confidence level all three variables are stationary, satisfying the VAR requirement for stationarity.

The cross correlation matrix in Table 2 is contrary to what may be expected and demonstrates a positive rather than negative association between returns in the market index and media coverage of the financial crisis. However, as the degree of correlation is slight this serves to alleviate any concerns we could have about the direction of the relationship. The negative cross correlation between the

market return variable and the net insider transactions suggests that insider's engage in contrarian trading behaviour by making purchases when prices fall. The positive association insider trades have with keyword hits indicate that insiders, rather than trading on privately held information, could act in accordance with news of macroeconomic change, Granger causality analysis in addition to impulse response functions confirm the nature of this relationship (see Table 3 and Fig. 2).

6. Empirical results and analysis

Seyhun (1988) and Chowdhury et al. (1993) state that a clear predictive relationship is discernible between aggregate insider trades and market returns. The findings produced here disagree with this position. Across all the investigative tools available the results produced are not consistent. The findings for the Granger Causality analysis are outlined in Table 3 where the optimal lag length is set to one. These fail to reject the null hypothesis that the differenced insider measure does not have an effect on market returns. Neither is the relationship in evidence in the opposite direction. The results are clear in that in this instance a time differenced link between insiders and the market is not in evidence. The Granger Causality analysis brings up one interesting point, the measure of media

Table 4

Variance decomposition.

Reported in the panel below is the forecast error variance decomposition for the vector auto-regression model used in the study. Each of the endogenous variables are analysed to gauge the proportional contributions of variation in one variable to the forecast error variance in both itself and the remaining variables in the model. The figs. in the table are expressed in percentage terms and the forecasted decomposition appears at three different horizons, these being three, six and ten months respectively. The variables include ΔCC, which represents the first differenced measure of the number of articles containing the phrase 'credit crunch' that appear on the LexisNexis database. Also included is the variable Ret which represents the continuously compounded monthly returns of the FTSE 100 Index, which was provided by DataStream. The final variable included in the model is the net insider index (ΔNI) which records a measure of the intensity and direction of insiders trading taken from data sourced from Director Deals. The sample period extends over 56 months from October 2004 to May 2009.

Variables explained	By innovations in			
	Horizon (months)	Ret	ΔCC	ΔNI
Ret	3	62.2181	14.2013	23.5805
	6	48.1989	14.9578	36.8433
	10	56.3107	12.8892	30.8000
ΔCC	3	0.6660	94.9377	4.3962
	6	0.8116	86.7687	12.4197
	10	2.6437	79.8344	17.5219
ΔNI	3	4.0790	29.7179	66.2032
	6	7.5133	35.3024	57.1843
	10	9.646860	37.4364	52.9167

coverage appears to have a relationship with the activities of insiders. This first differenced series of keyword hits pertaining to the 'Credit Crunch' at a lag of one month appears to be related to insider activity. If one is to infer causality from the time difference as suggested by Granger (1969) then this delivers a further contradiction to the cash flow hypothesis that says that insiders are able to uncover initial changes in their own firms. Instead, this indicates that Insiders are reacting to macroeconomic events as they are reported through the press alongside the rest of the investing public (Fig. 1).

The question is probed further through the VAR system that includes the endogenous variables and their lags. The maximum lag length is set to ten and the optimal indicated to be one using the Akaike information criterion (Akaike, 1978). A graphical depiction of the magnitudes of the accumulated response in each variable to one standard deviation positive shocks introduced to the dependent variable within each model within the system is shown alongside confidence intervals in Fig. 2. The graph of specific interest is that which shows the response in market returns to innovations in the insider measure. At a lag of four months a negative response is marginally significant; when this is taken alongside the results of the earlier Granger Causality analysis the mixed nature of the results means that it is unlikely that a relationship exists. However, the earlier results that link media coverage to insider activity are again confirmed by the impulse response functions. Here a statistically significant response is in evidence at three and eight months respectively. Taken together, the results of both these modes of analysis indicate that the collated actions of insiders were a reaction to events as they unfolded on the public stage rather than a response to nuanced changes at firm level.

Variance decomposition is the final tool available in the VAR toolbox. This allows an investigator to gauge the proportion of forecast error variance in each variable that is attributable both to itself and to others within the system. Table 4 reproduces the contributions of each of the variables broken down to three, six and ten months respectively. Confirming earlier findings in this study it appears that the share of insider activity in the changes in the market is relatively small at each of the horizons recorded. Attributable variation ranges between 4% and 9% across the range of horizons whereas the change forecast error variance in the insider measure appears to be driven in the main by

returns at 23% to 36% and by media reportage which is shown to vary between 4% and 17%.The reactivity on the part of a sample of declared insider trades to publicised events is not something which has as yet been documented for a UK sample.

It has been argued that the predictive capability of aggregated insider measures should be relegated to insider purchases alone (Chowdhury et al., 1993).This investigation finds that when looked upon separately neither purchase or sales could replicate these findings. The same analysis is conducted using trades from insiders in Banks and Financial Institutions. This line of inquiry is based upon the premise that banking insiders may have known more about the nature of the crisis than their counterparts across other sectors. Again, no evidence of a relationship is uncovered. In the interests of brevity, results for both these inquiries are not reproduced here but are available from the author upon request.

6.1. Robustness

In order to test for the robustness of the assertions made above. The investigation is extended to incorporate other measures of aggregated insider trades. Another way to reach an aggregate measure of insider activity would be to look at the net volumes of insider trading in order to determine the overall direction of trades. Increased trading volume has been used as an indication of heightened levels of informed trading (see Keown, Pinkerton, & Bolster, 1992). The variable of insider activity is constructed as follows:

$$NVI_t = \sum_{i=1}^{n_t} \frac{(VP_{it} - VS_{it})}{VP_{it} + VS_{it}} \tag{3}$$

where VP_{it} is a measure of the aggregated value of insider trades across all companies making purchases in a given month and VS_{it} denotes this in terms of sales during the same interval. The time series is first differenced to induce stationarity and is entered into a VAR system alongside the returns on the FTSE 100 and the first differenced time series of 'Credit Crunch' keyword hits. Results remain as they do for our initial VAR system in that they continue to demonstrate no relationship between insider activity and market returns. Neither is there evidence of an existing link between the insider activity as it is represented here and the measure of media coverage. In the interests of conserving space, results for both of these systems are not given here but are available from the author upon request.

7. Conclusion

The cash flow hypothesis as posited by Seyhun (1988) is an important idea that promised to function as an early warning system for investors of wider of economic change. From the findings in this study it can be concluded that aggregations of insider trades fail to signal the impending macroeconomic shift in the context investigated here. As a consequence, the extent to which this measure could act as a predictor is called into dispute. Vector autoregressive analysis allows researchers to look at the interactions and links between variables without relying upon the a-priori assumptions required of structural equation modelling. Through this neutral system of investigation, this study uncovers that Granger causality tests show that the insider trading measures could not forecast changes across all market sectors or in the industry where the problems originated. The impulse response analysis, which is designed to emphasise the nature of the relationship through inducing a reaction in the remaining variables within a model to positive shocks to each variable in turn within the system confirms the absence of a link. In light of this, it would seem that Seyhun's hypothesis would have proved inadequate had investors been using signals drawn from it to restructure their portfolios ahead of the 2008 financial crisis.

A further conclusion reached here is that aggregations of declared insider trades appear to show a collective reaction to publicised events. This implies that insiders, at least in their declared trades, do not appear to be any more informed than the investing public. The lesson to be learned from this is that investors should exercise caution in using any signals generated from declared insider trades. This is because the motivations to trade may not be based on the kind of expert knowledge of the firm that information vendors who sell collated datasets of Director's trades wish to convey of their data products. The findings here show too that one should also be cautious about transferring conclusions reached of empirical findings which are relevant to one jurisdiction to another. Subtle differences in the legislative and enforcement context may mean that similarly constructed datasets could have differing informational value.

Appendix A

Table
VAR parameter estimates and t-statistic values
Parameter estimates and t-statistic values in vector auto-regression which includes ΔCC, Ret and ΔNI variables. The Akaike Information Criterion (Akaike, 1973) was used to select an optimal lag length of eight.

	RET	ΔNI	ΔCC
RET (−1)	−0.336664	0.064601	1.869341
	[−1.67229]	[0.14523]	[0.23018]
RET (−2)	−0.398145	0.211858	3.466849
	[−2.01178]	[0.48451]	[0.43426]
RET (−3)	0.117354	−0.17687	−1.387428
	[0.54675]	[−0.37296]	[−0.16024]
RET (−4)	0.162235	−0.645378	0.399186
	[0.75806]	[−1.36486]	[0.04624]
RET (−5)	0.480483	0.245894	−0.565757
	[2.22429]	[0.51520]	[−0.06493]
RET (−6)	0.136990	−0.360032	−7.324099
	[0.57629]	[−0.68550]	[−0.76380]
RET (−7)	−0.117181	0.146195	2.771824
	[−0.48823]	[0.27568]	[0.28629]
RET (−8)	0.906727	0.027291	4.834157
	[2.76641]	[0.03769]	[0.36562]
ΔNI (−1)	−0.140891	−0.169826	2.248471
	[−1.28626]	[−0.70173]	[0.50887]
ΔNI (−2)	−0.037026	−0.101804	0.056452
	[−0.34043]	[−0.42364]	[0.01287]
ΔNI (−3)	−0.186629	−0.319857	−3.729273
	[−1.70721]	[−1.32428]	[−0.84568]
ΔNI (−4)	0.080683	−0.542657	−0.657803
	[0.75198]	[−2.28912]	[−0.15198]
ΔNI (−5)	−0.02907	0.136066	−1.299987
	[−0.26334]	[0.55788]	[−0.29194]
ΔNI (−6)	0.077313	−0.468371	−6.561796
	[0.73169]	[−2.00621]	[−1.53945]
ΔNI (−7)	−0.001111	−0.329283	−2.908874
	[−0.01003]	[−1.34629]	[−0.65140]
ΔNI (−8)	0.224778	−0.108117	0.571603
	[2.24326]	[−0.48836]	[0.14141]
ΔCC (−1)	0.002205	0.003611	0.422339
	[0.39683]	[0.29411]	[1.88395]
ΔCC (−2)	−0.002329	0.028281	−0.262845
	[−0.39101]	[2.14875]	[−1.09384]
ΔCC (−3)	0.006903	−0.018486	−0.012637
	[1.04757]	[−1.26963]	[−0.04754]
ΔCC (−4)	−0.003952	0.025576	0.135983
	[−0.59898]	[1.75433]	[0.51089]
ΔCC (−5)	0.006544	−0.000592	0.165867
	[0.90967]	[−0.03722]	[0.57155]
ΔCC (−6)	−0.00805	0.020135	−0.093747
	[−1.11788]	[1.26552]	[−0.32272]
ΔCC (−7)	0.004393	−0.000834	0.184692
	[0.66395]	[−0.05707]	[0.69204]
ΔCC (−8)	−0.015847	0.011283	0.021494
	[−2.62450]	[0.84571]	[0.08824]
R-squared	0.616343	0.642610	0.353634
Adj. R-squared	0.216005	0.269681	−0.320836

A) FTSE 100 Index return
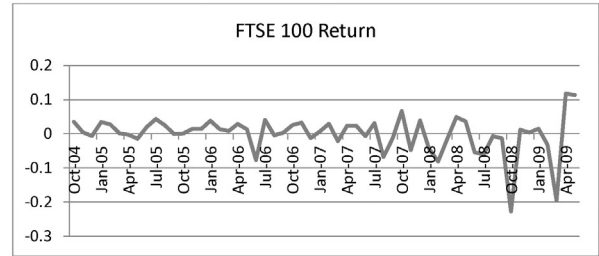
B) Differenced aggregate measure of net insider trades
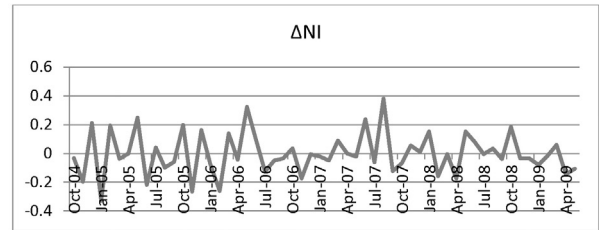
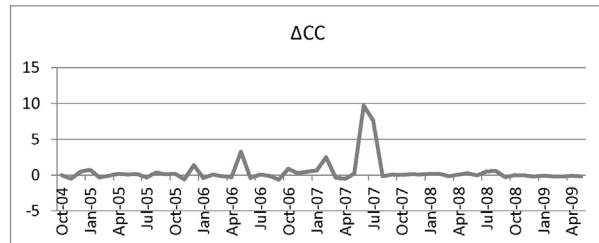C) Differenced measure of keyword hits for the term 'Credit Crunch'

Figure. Data plots of time series used to construct variables used in the VAR system.

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