
Did Sarbanes-Oxley Deliver? Insider Trading and Information Externalities

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Abstract

We examine corporate insider transactions around Sarbanes-Oxley §403 (SOX) regulatory regimes and subsequent Wall Street Journal (WSJ) media postings, and provide new evidence on the trade-off tension between private information transfer and stock trading costs. SOX increased insider abnormal returns in conjunction with market-maker induced higher trading costs—clustered around purchases by non-executive directors in intangible rich firms. We reject the notion that the major beneficiary of SOX reported insider transactions is the transfer of an information externality to outside investors. Our alternative interpretation is continuous rent extraction by insiders—increased by an internal information externality to less informed non-executive directors (per Fishman and Hagerty 1995), at the expense of outside investors. Rent extraction was reversed after WSJ postings of Form 4. Highlighted are cost trade-offs from regulations intended to address investor information asymmetry and the incremental role the media plays in disseminating second hand and pre-trading private information.

Keywords: insider regulatory cost/benefits, media and insider trading, insiders and intangibles, adverse trading costs and Sarbanes-Oxley

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1. Introduction

Measuring the costs and benefits of regulation is an important but challenging task for financial market observers. Regulation is generally framed in terms of a response to market failure in an attempt to improve social welfare. The importance of this question lies in the consensus belief in financial economics that market efficiency is associated with the extent and quality of information made available to investors. One area that fails the test

documented area where abnormal returns are continually extracted, signaling a possible market there of in security markets is the trading area Are insider trading regulations effective in transferring information externally to investors?

It is now widely accepted that corporate insiders (board directors, managers and officers) have a superior information advantage about their company's future prospects and successfully trade on that information (Seyhun, 1992; Lustgarten and Maude, 1998; Ke et al., 2003; Ali et al., 2011; Badertscher et al., 2011; Hillier et al., 2014; Gider and Westheide, 2016). This advantage is particularly enhanced around earnings announcements (Hillier and Marshall, 2002), firms with high levels of intangibles and accounting accruals (Aboody and Lev, 2000; Beneish and Vargus, 2002), and after accounting manipulations (Sawicki and Shrestha, 2008; Agrawal and Cooper, 2015). In short, the direction of an insider's transaction reflects a superior comprehension of strategy, the quality of published financial statements and fundamental mispricing (Piotroski and Roulstone, 2005).

Are insider trading regulations effective in transferring information externally to investors? The importance of this question lies in the consensus belief in financial economics that market efficiency is associated with the extent and quality of information made available to investors.

Hence, if outside investors have improved access to insiders' asymmetric information set then that information should be more quickly impounded into prices and limit any undue trading advantage. In 2002 and 2003 the Sarbanes-Oxley Act (SOX) implemented two regulations to enhance disclosure practices by making insider trades more timely and transparent. The modus

operandi of SOX was designed to increase information flow and the equity and integrity of stock markets, and to reduce the trading advantage of corporate insiders.

It is an open question, however, as to whether the tighter regulations of SOX curbed insider trading activities. Brochet (2010) documents that after SOX the short-term stock price reaction to insider purchases was stronger, and interpreted this as greater information content arising from the changed regulations. Hillier et al. (2015) reported individual trading heterogeneity increased after SOX, signalling that personal attributes matter more when profitable trading activities are challenged by tougher regulations. They conclude that SOX had little impact on individual behaviour and suggest that opportunities for monopoly type profit trading have arisen consistent with Bris (2005).

Our approach is to apply a longitudinal study that identifies the introduction of SOX regulations and reporting on the Wall Street Journal (WSJ) as threshold events to test for changes in insider behaviour and the impact on prices and trading costs. We find that insider profitability for purchases increased after SOX concurrently with increased trading costs for outside investors.¹ Results are robust to matching with firms that had no insider trading and firm specific governance and financial attributes. The greater impact came from an increase in profitable trading by outside directors as a surrogate for uninformed insiders and increased internal information flow (Fishman and Hagerty, 1995). Finally, after reporting on the WSJ both insider profitability and trading costs were reduced showing the public benefits of wider dissemination that accelerated reporting on EDGAR. Our results affirm that insider profitability and investor trading costs are highest when outsiders are inattentive to SEC listings and when there is greater information asymmetry between insiders and outsiders.

We measure insider trading profitability by applying a four factor Carhart model that controls for risk, size, book/market and momentum (CAARs), and insider induced trading costs by the probability of informed trading (PIT) extracted from the adverse selection component of the Bollen, Smith and Whaley (2004) bid-ask spread model (BSW). Testing is based on 204,250 insider transactions for 3,955 firms traded on NASDAQ over the 1999 to 2007 period.

¹ Results for insider sales were not significant consistent with sales in the U.S. driven by non-information factors and Hillier et al. (2015).

In this paper we pose the SOX regulations effective in achieving its stated objectives? To answer, we conduct a natural experiment by analysing pre and post regulatory insider trading returns along with the impact on trading costs to investors. We then ask how SOX affected internal and external information flows and who were the winners and losers, by inferring a pool of uninformed insiders and exploring media reporting as a potential external information flow channel.

We note that prior research on the benefits from insider regulations is almost entirely focused on examining post-insider-traded (risk adjusted) returns. This approach is based on the premise that rapidly changed returns signal a movement towards fundamental value, enhancing price credibility and reduces trading risk. Moreover, it also provides a timely information externality to outside investors and reduces the probability of insider stealth trading. Along these lines, Fidrmuc et al. (2006) conclude that condensed and higher short term CAARs from a 5-day insider reporting requirement in the U.K. (compared to up to 40-days in the U.S.), represents increased information to investors. Similarly, Brochet (2010), after the SOX (2002) requirement for insiders to report within two days, interpreted an increase in short term purchase CAARs and trading volumes as increased information timeliness and transparency.

However, interpreting *increased* CAARs as an information externality to investors, and not rent extraction by insiders, can be problematic. For example, Fidrmuc et al. (2006) also note that firms controlled by other companies and individuals unrelated to the directors, experience significantly lower CAARs. They comment "...this suggests that monitoring by these blockholders reduces information asymmetry and ensures that management focuses on value maximization" (p.2933). Additionally, Brochet reports no change to 10-day purchase CAARs, for both pre and post SOX, at +3%. These conflicting interpretations may lead to another interpretative question. Is the almost instantaneous market adjustment post SOX, compared to the slow leakage pre SOX, a reduction in trading opportunities? That is, before SOX, investors could replicate the directional transactions of insiders but afterwards replication possibilities deteriorated (Hillier et al., 2015).

Other research questions whether increased CAARs constitute an information externality. A global study by Bris (2005), shows that after insider trading regulations the profitability of

insider trades increases and increases further after legal enforcement—suggesting monopoly profits for the remaining and more aggressive insiders. Betzer and Theissen (2009) report that the chair of the monitoring supervisory board in Germany, extracts higher CAARs than all other board members—suggesting information transfer to non-executive directors. Moreover, insider trading returns are significantly higher in countries with stronger shareholder protection regulations (Fidrmuc et al., 2011; Goncharov et al., 2013), in regulated industries (Reeb et al., 2014), and government controlled industries (Borisova and Yadav, 2015). Explanations range from price reinforcement to information capture by privileged insiders.

A less sympathetic view is that insider induced CAARs represent rent extract by withholding or managing information release before trading. For example, by using discretionary earnings manipulation (Bartov and Mohanram, 2004; Sawicki and Shrestha, 2008; Agrawal and Cooper, 2015), and misleading management disclosures (Cheng and Lo, 2006). More likely to occur in firms with lower ethical standards (Skaife et al., 2013), with higher financial information asymmetry (Aboody and Lev, 2000, Betzer and Theissen, 2009), and in firms with inattentive outside investors (Hillier et al., 2015). Consequently, if there are incomplete governance markets and less than fully informative pre-trading environments, then post insider traded CAARs contain a complex mixture of qualitative information transfer and insider rent extraction. However, one aspect is clear—insiders profit from their informed trading—but it is less clear if net economic benefits flow to outside investors.

Aside from the interpretative tension in CAAR, we argue that CAAR focussed research overlooks two critical dimensions of SOX: it ignores the impact on market liquidity (Borisova and Yadav, 2015) and the possibility of internal information capture (Fishman and Hagerty, 1995). That is, whilst insider regulations are designed to increase the availability of asymmetric information to outside investors, in practice, regulations can actually create unintended information internalities. We report new findings that the first-order impact of SOX was to provide internal information flows to less informed insiders. Essentially, our paper supports Hillier et al.'s (2015) contention that broad-brush regulations do little to restrain the opportunistic behavior of individuals.

To do so we consider both profitability and transaction costs before and after SOX. Consistent with a regulatory information transfer story, accelerated reporting narrows the

window for predatory ex-post insider trading and should reduce incentives to withhold or manipulate pre-traded private information. Market makers then face a lower risk of trading against informed insiders allowing them to reduce bid-ask trading spreads. An alternate prediction is that the volume of privately informed insiders increases as information is internalized (Fishman and Hagerty 1995), resulting in liquidity traders exiting the market which increases price volatility and lowers investor welfare (Leland 1992, Repullo 1999).² An increased probability of trading with better informed insiders causes market makers to price protect by widening bid-ask spreads. We report significant and contemporaneous increases in post-SOX CAAR and PIT for insider-purchases after 60 days. Insignificant differences are recorded for insider sales. This is consistent with heightened willingness by insiders to exploit positive information even after SOX regulations designed to constrain (Lee et al., 2014), resulting in increased trading costs and a potential deterioration in the cost of capital (Borisova and Yadav 2015). Results are robust to endogeneity controls for firms without insider trading and to a number of corporate governance controls.

We then explore the question, why did this occur and who were the major beneficiaries from increased transaction disclosure? Informed by conjectures of internal information capture by uninformed insiders (Fishman and Hagerty 1995) and subsequent insider herding (Bikhchandani et al. 1992), we analyse the trading activities of non-executive directors as a proxy for less informed insiders.³ After SOX we find substantial increases in their average dollar trading volumes (up 31%), an increase in trading costs through the adverse selection component (up 24%), and increased 60 day trading profits (up >100%). In contrast, executive director trading volumes, costs and profitability increase only slightly. This result is reinforced by comparatively higher profitability and trading cost increases in intangible intensive firms as a proxy for higher information asymmetry/advantage (Aboody and Lev, 2000; Gider and Westheide, 2016).

Our final focus is a search for potential alternate information transfer channels. We know that because of investor attention constraints, stock prices do not promptly reflect public

² In the Leland (1992) model, prices increase in conjunction with reduced liquidity and increased volatility. The degree of total economic welfare becomes a trade-off between gains from more efficient prices (after information transfer) and increased trading costs. Repullo's (1999) model predicts higher risk premiums with a negative impact on investment and welfare.

³ Less informed insiders infer information from the direction of counter-party informed trades and/or from increased endogenous information flows.

information (Jeng et al., 2003; Cohen and Frazzini, 2008; Bushee et al., 2010), and insiders exploit inattentive outsiders and significantly profit from trading on relevant public information (Alldredge and Cicero, 2015). Research also shows that the media plays an incremental role in reducing information asymmetry and affecting market prices—even if that information is second-hand and imparts no new information (Tetlock 2007, Li et al. 2011, Tetlock 2011). Hence, if investors are basically “inattentive” with reduced ability to locate and process price sensitive information, then media reporting may reduce asymmetric information and affect insider trading (Rogers et al. 2016). We find after wire service media reporting by the Wall Street Journal, a significant reduction in insider profitability and the liquidity costs of trading.

Our research contributes by providing several new results around insider trading: (i) there is a trading cost trade-off from allowed corporate insider trading, exacerbated in opaque accounting firms, (ii) after SOX there is continued profitability for directors significantly increased for non-executive directors, along with increased trading costs, and (iii) WSJ media postings reduced insider profitability and lowered trading costs. That is, at all times insider trading by directors was profitable, but less so under different information channels. For entrenched shareholders, gains and losses depended on the direction of trade. For outside investors there was a distinct trade-off between information transfer from insider induced price signals and increased costs—contextually determined by transaction direction, the information channel regime, and their ability to be attentive to “trading signals”. Results, provide lessons for regulators about the internalization of private information, increased trading costs, and other forms of information dissemination.

The paper now proceeds as follows. Section II provides the background to the hypotheses, section III outlines the research design, section IV describes the data, section V reports the empirical results, and section VI contains the conclusion.

2. Background

2.2 SOX and trading costs

2.3 SOX and information transparency

Our final tests address the manner in which insider trading is made transparent to the investing public. There are two significant events that potentially increased visibility. The first is when electronic reporting of Form 4 on SEC EDGAR and individual firm websites was additionally required (30 June 2003), and when the Wall Street Journal (WSJ) made the EDGAR filings available through its media posting service (20 January 2004).

Debreceeny et al. (2002) find that reporting of financial information on websites increases information flow to outside investors, whilst Rogers et al. (2016) argue that EDGAR reporting is relatively opaque resulting in restrained information transfer. Tetlock (2007, 2011) further argues that the media, by simply repeating information already in the public domain, enhances information dissemination to the public—affecting market prices, even though that information is stale and contains no new analysis. This occurs if there is investor inattention and non-trivial market frictions, that impede the ability of outside investors to quickly understand and impound information (Li et al., 2011), especially if that information is specialised or remote (see also Jeng et al., 2003, Bushee et al., 2010).

Our question is whether WSJ posting impacted insider profitability and trading costs when compared to the SOX disclosures. There are two competing predictions. First, if SOX facilitated extensive external information transfer through accelerated reporting and electronic listing, the WSJ postings are effectively stale non-news and would have little impact. Second, if the media plays a significant incremental role in disseminating insider transaction information to a wider investment audience and reduces insiders' ability to rent extract from private information, then costs and profits are reduced.⁴

Post Trading Information Transfer to Outsiders

Faced with competing motives and trading event consequences, regulators are charged with determining insider trading regulations that enhance economic and social benefits. SOX §403 initiated two such regulations designed to increase the speed and transparency of outside

⁴ This prediction relies on the proposition that mispricing (and the availability of potential insider profits) is negatively associated with the extent of news dissemination (Drake et al. 2014); inattention by outside investors to insider filings on SEC EDGAR (Rogers et al., 2013).

information flow from insider transactions reporting under §16 of the Securities Exchange Act of 1934. Specifically, effective August 29, 2002, insiders were required to report trading in their own stock (Form 4) by the second business day after the transaction, in stark contrast to the prior deadline of ten (calendar) days following the end of the month in which the transaction occurred (timing-SOX1).⁵ In the second iteration, beginning not later than June 30 2003, electronic filing on EDGAR was additionally required (transparency-SOX2). The purpose was to augment the insider information externality by rapidly increasing flow and transparency (Fidrmuc et al. 2006). After SOX (August, 2002) there was a significant increase in post insider CAARs (Brochet 2010), consistent with the global study of Bris (2005) that insider trading laws increase the incidence and profitability of insider trading. Our first research focus is to explore whether each iterative SOX reporting requirement induced differential information and cost effects.

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Given these outside information transfer arguments then regulations that accelerate and make more visible insider transactions are socially desirable (Brochet 2010). SOX accelerated

⁵ Effectively reducing the time frame of reporting Form 4 from a maximum of around 40 business days to two business days. Furthermore, Form 5 filings previously allowed to be reported at the end of the fiscal year were also caught under the two day rule by SOX1.

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reporting the type of trade and identity of the insider in an attempt to reduce information uncertainty, increase price confidence, and to produce a more ‘level playing field’ for investors. Kyle (1985) outlines a theoretical model that predicts how this might occur. In the pre-SOX longer 40-day reporting environment, information is slowly released through insider stealth trading using a series of camouflaged sequential auctions to maximise profits (ie., insiders act as information monopolists).⁷ In SOX1, because transactions are reported within two trading days, insiders are forced to act more like a one shot trader where the monopoly value of private information rapidly decays because of the reduced ability to stealth trade. Finally, in SOX2preWSJ, when trading information becomes more publicly accessible via EDGAR then an insider’s information advantage theoretically decays even faster.

3. Research Models

Estimating Cumulative Average Abnormal Returns

Cumulative average abnormal returns (CAAR) are used as a proxy to measure price relevant information flow after SOX (Brochet 2010). They are estimated from a Carhart four factor model with market return proxied by the NASDAQ composite index, and risk free return, size, book-to-market and momentum benchmark factors downloaded from Kenneth French’s website. Firm daily abnormal return (AR) is estimated as follows:

$$AR_{it} = R_{it} - \beta_i R_{mt} - \gamma_i SMB_t - \delta_i HML_t - \theta_i MOM_t \quad (1)$$

where AR_{it} is the Carhart adjusted abnormal return of firm i at day t , R_{it} is the observed return on firm i at day t , R_{mt} is the difference between the corresponding return on the NASDAQ composite index and the risk free rate on day t , β_i is the market risk premium for the firm of interest on day t estimated over the period $t-180$ to $t-61$, and γ_i , δ_i , and θ_i are Fama-French characteristic returns for size, book-to-market and momentum to capture firm level performance characteristics widely accepted in the literature (e.g. Seyhun, 1986; Rozeff and Zaman, 1998; Lakonishok and Lee 2001; Jenter, 2005). The event day is defined as the day an insider trades. Daily ARs are then cumulated and averaged across the pre and post trading (-10, +10 and +60 days) to form CAAR.

⁷ Insiders have up to 40 days to report transactions.

We use a longer 60 trading day post trading window to capture lagged price adjustments and longer investment horizons (Lakonishok and Lee 2001, Lee et al. 2014), both insider transaction and reporting events, and to allow for differential impact across four potentially different information diffusion regimes.⁸ For robustness, we track results against Fidrmuc et al. (2006) and Brochet (2010) and further calculate comparative one factor beta market model returns and buy-and-hold returns.

Estimating PIT from the Adverse Selection Component

Raw changes in bid-ask spreads have been used to estimate trading costs and changes in information asymmetry (Easley et al. 2002, Duarte et al. 2008). However, a market maker's raw bid-ask spread is a dynamic multi-dimensional function of order-processing, inventory holding, and adverse selection costs—and these are not necessarily time-invariant. For example, the contribution of fixed order processing costs will fall when trading volume increases, but inventory holding costs will increase.⁹ Hence, raw bid-ask spreads are a noisy proxy of dynamic changes in trading costs and changes may be erroneously attributed to changes in the informed trading cost component.

To account for these limitations we apply the BSW (2004) model to extract the probability of informed trading (PIT), represented by α_3 from the following bid-ask spread regression:

$$SPRD_i = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,i}(\tau_i) + \alpha_3 (IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i)) + \varepsilon_i \quad (2)$$

where $SPRD_i$ is the bid-ask spread of stock i in which insider trading occurs, α_0 represents the exchange mandated minimum tick size, and $\alpha_1 InvTV_i$ (the inverse of trading volume) represents fixed order processing costs. From a market maker's perspective the total inventory holding premium consists of a common expected inventory cost across all trades, IHP_U plus an incremental cost associated with the probability of trading with an insider that has an information

⁸ Information diffusion may differ considerably. PreSOX has a reporting lag of up to 40 days and information is possibly released through a series of camouflaged sequential auctions; SOX1 has a reporting lag of two trading days; WSJSOX2 requires reporting on EDGAR where information theoretically becomes more visible; and in post-WSJSOX2 an insider's transaction has potential wider public newspaper dissemination.

advantage, $(p_i)IHP_i$ over the inventory holding period (τ_i). Thus, $(p_i)IHP_i$ represents the market maker's compensation for the adverse selection cost component of the spread.

The inventory holding premium (IHP_i) for the informed insider is valued by an in-the-money call with the exercise price equal to the ask price, assuming the true price of the stock is somewhere above the ask price (as a proxy for informed trading).¹⁰ For general uninformed traders, the inventory holding premium (IHP_U) is equal to the value of a slightly out-of-the-money call option with an exercise price equal to the ask price, assuming the true price of the underlying stock is somewhere between the bid and ask.¹¹

We run the BSW equation across the four delineated periods for each firm for each day to extract the α_3 coefficient. We then calculate the average percentage that the market maker estimates he/she is trading with a privately informed trader using the BSW algorithm around the insider trading date (-10, +10 and +60 days). In enacting the research design, insider transactions are decomposed into purchase, sales and mixed trading days.

3. SOX and Data Descriptives

SOX insider regulations

The stated purpose of the SOX regulations is to accelerate the revelation of insider information to outside investors through reduced filing delays and increasing transparency. This is pragmatically accomplished by requiring directors to accelerate the reporting of trades in their own stock (Form 4) by the second business day after the transaction¹² (29 August 2002), and by electronic filing of Form 4 on the SEC EDGAR electronic system and firm websites (30 June

¹⁰ When the true price is only slightly above the ask price then the probability of an informed trade is high—as the price moves further in-the-money the probability of informed trading becomes lower.

¹¹ See Bollen, Smith and Whaley (2004) for a full explanation of the model. A key issue is that when a market maker makes a sale they have exposure until an offsetting buy order comes along. The hedge to this exposure is modelled as an out-of-the-money call option with the expected time to the offsetting trade as the time to maturity. We make some adjustments to the original BSW model by using transaction based trading times (rather than fixed calendar times), by calculating volatility input from a GARCH (1,1), and by applying a 1% in-the-money call option for IHP_i using the technique outlined in Sidhu et al. (2008). We drop the competition factor as it proved to be insignificant in our regressions probably as a result of the increasingly competitive nature of the NASDAQ exchange. We thank Tom Smith for advisory input on these changes. Finally, the PIN estimate of Easley et al. (2002) was also considered but proved to be biased due to a high degree of zero boundary solutions.

¹² In stark contrast to the prior deadline of ten days following the end of the month in which the transaction occurred.

2003). Hence, as attentive well informed insiders trade and report, investors are deemed to receive an externality from a more rapid incorporation of private and public information into prices.¹³

Data are obtained from four different sources: (i) the Thomson Reuters database to collect 204,250 insider transactions from 3,955 companies where trading occurred on the screen based NASDAQ stock exchange¹⁴ over the 1999 to 2007 period; (ii) CRSP to gather bid-ask prices, trading volume, stock returns, SIC code, total transactions for all trading, and the number of shares outstanding; (iii) the Worldscope database for accounting variables; and (iv) the Corporate Library for corporate governance variables. Initially, only firms that witnessed insider trading over the period are collected and, following Sidhu, Bollen, Smith and Whaley (2008), only stocks that have a total of five transactions a day. These filters resulted in an initial sample of 204,250 insider transactions.

The data is segmented into four inter-temporal periods—preSOX, SOX1 (timing), SOX2preWSJ (transparency), and SOX2postWSJ—to provide three regulatory and one media transaction reporting test periods.

[Table 1 about here]

Distributions by direction of trade, frequency and inter-day clustering of insider transactions, after decomposition into purchase, sale and mixed trading days, are displayed in Table 1. There are several notable observations. First, most insider transactions are sales (about 69%). Second, trading is unidirectional with a very a low percentage of mixed intra-day insider trading (less than 2%), and given mixed trading days are very low in volume, they are disregarded in subsequent analysis. Third, trading is non-random and clustered, with about 83%

¹³ A good deal of research supports an information transfer proposition from insider trading. Examples include:—information transfer comes from access to both private information, analytical skills and a superior comprehension of public financial information (John and Lang 1991, Aboody and Lev 2000, Ke et al. 2003, Ali et al. 2011, Veenman 2013)—insiders are more attentive to public information because of their undiversified asset holdings and outside investors are less attentive (Alldredge and Cicero 2015)—insider trading affirms the quality of public domain news through price innovations (Lustgarten and Maude 1998, Fidrmuc et al. 2006, Badertscher et al. 2011, Fidrmuc et al. 2013).

¹⁴ The NASDAQ market is chosen over the NYSE market for several reasons. The NYSE is an open outcry system where orders are viewed and consolidated around the specialist post. Combined with the professional relationships that evolve on open exchange floors this makes NYSE trading less opaque and less profitable. By contrast NASDAQ offers relatively anonymous, unconsolidated and geographically dispersed screen-based trading; that induces NASDAQ dealers to make longer term inter-temporal adjustments to the spreads when insiders trade (Khan et al. 2005). Moreover, screen based trading is now the dominant form of stock trading and hence an analysis of NASDAQ provides the more generalizable research environment to assess insider trading impacts.

of purchases and sales occurring within a period of ten days after the initial insider transaction occurred. Finally, there is greater level of clustered activity for purchases with 68% occurring on the initial trading day compared to 54% for sales.

Data was further decomposed into the four sub-periods to check for potential changes in trading day distributions and activity. The clustered inter-day distribution for sales activity remained stable. For purchases, the trading percentage on the first observed transaction day (0) remained relatively stable in the range 64%-70%, but the later post nine days trading in SOX1 and the SOX2preWSJ periods significantly increased to between 32%-35%, from about 22% in the two other periods.¹⁵ Hence, the introduction of SOX induced a greater clustering of insider purchases with an increased degree of follow-the-leader type trading.

Table 2 contains basic statistics for insider traded firms. Insider purchase firms have a higher average quoted spread at \$0.13 (sales \$0.08) with a lower average price \$12.95 (sales \$20.99), a higher annualized return volatility of 0.64 (sales 0.54), and lower trading volumes with a higher average holding period of 2.69 minutes (sales 1.23). At first pass, these statistics are consistent with a higher level of price (information) uncertainty indicated by purchase trading in smaller riskier stocks with lower trading liquidity. A comparative analysis across the four sub-samples shows that this relative relationship remains consistent across the four reporting regimes.¹⁶

[Table 2 about here]

4. Empirical results

4.1 SOX, insider profitability and trading costs

¹⁵ The data period generally witnessed an increase in insider trading activity. After SOX, monthly purchases remained steady but increased by 150 percent after WSJ reporting, with sales increasing by 48 percent after SOX with a further 22 percent increase after WSJ reporting.

¹⁶ Purchase spreads were highest in SOX2preWSJ at \$0.16 (sales \$0.08) and lowest in SOX2postWSJ at \$0.10 (sales \$0.06).

In this section, we examine the extent to which the information flow from SOX changed insider profitability and trading liquidity. The stated purpose of SOX was to accelerate the revelation of insider information to outside investors through reduced filing delays and increasing transparency. This is pragmatically accomplished by requiring directors to accelerate the reporting of trades in their own stock (Form 4) by the second business day after the transaction¹⁷ (29 August 2002), and by electronic filing of Form 4 on the SEC EDGAR electronic system and firm websites (30 June 2003). Hence, as informed insiders trade and report, investors are deemed to more easily extract an externality from a rapid incorporation of private and public information into prices.¹⁸

Enhanced information flow infers a reduction in predatory insider trading and lower profitability from insider trades. The shorter reporting window the type of trade and knowledge of the identity of the insider, theoretically reduces stealth trading and induces a rapid decay in the value of asymmetric information (Kyle, 1985).¹⁹ In addition, SOX may have induced a form of ex-ante external governance by providing a greater emphasis on regulatory disclosure. In turn, inducing second-order impacts of increased ‘tone-at-the-top’ and internal governance resulting in increased pre-transaction information dissemination and reduced opportunities for predatory trading (Brudney, 1979; Huddart et al., 2001; Leuz et al., 2003; Skaife et al., 2013).²⁰ Furthermore, if a reduced window for profitable ex post trading raises corporate awareness and increases internal ‘tone at the top’, then the overall quality of pre-transaction information dissemination might also increase (per Brudney 1979, Huddart et al. 2001, Leuz et al. 2003, Skaife et al. 2013).

Consequently, improved governance with more private information imbedded into prices before and after an insider trades, should increase price efficiency with outside investors more

¹⁷ In contrast to the prior deadline of ten days following the end of the month in which the transaction occurred.

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¹⁹ In the pre-SOX 40-day reporting window, information is slowly released through a series of camouflaged sequential auctions to maximise profits (ie., insiders act as information monopolists). After the requirement to report within two trading days, insiders are forced to act more like a one shot trader resulting in the rapid decay of the monopoly value of private information. Kyle (1985) provides an in-depth analysis.

²⁰ Resulting in reduced pre-traded manipulated discretionary earnings (Bartov and Mohanram, 2004; Sawicki and Shrestha, 2008), and selective management disclosures that ex-ante (mis)inform and strategically influence prices (Cheng and Lo, 2006).

inclined to enter the market and post limit orders. This leads Brochet (2010) to state that SOX insider regulations are socially desirable because they facilitate accelerated price adjustments and produce a more ‘level playing field’ for investors.²¹

The external information flow argument of reduced asymmetric information and lower insider profitability also extends to trading costs. Market microstructure theory predicts that market makers adjust bid-ask spreads to compensate for adverse selection costs from competing with better informed insiders. Hence, if SOX is effective in inducing an increased disclosure regime, then market makers should adjust bid-ask spread margins downwards to take account of lower adverse selection costs (Kyle, 1985; Frijns et al., 2008). Under these scenarios, expectations are that SOX reporting regulations will reduce both long term post-traded insider profitability and market related trading costs.

Fishman and Hagerty (1995) intercede by proposing that the first channel of information transfer is not to outside investors. They distinguish between informed and uninformed insiders and argue that insider disclosure rules have unintended effects that increase internal information flow to uninformed insiders. Asymmetric information is captured from informed insiders by uninformed insiders through several avenues: (i) they can now more readily observe the more transparent trading of informed insiders,²² (ii) through an enhancement of richer internal networks,²³ and (iii) because uninformed insiders have a greater incentive to search for and capture price sensitive information because of their undiversified asset holdings (Alldredge and Cicero, 2015). This internal information transfer results in an increased pool of informed insiders who now proceed to trade in an ‘information cascade’ (Bikhchandani et al., 1992). Market makers react with an upward adjustment to the adverse selection component.²⁴

²¹ In a perfect scenario, the only asymmetric information that an insider would release by trading would be the qualitative affirmation of publicly available information—a pure public good argument.

²² Fishman and Hagerty (1995) explain as follows. Suppose the disclosure of a stock sale by insider A (uninformed) leads to a drop in the stock price. If insider B (informed) then reports a buy and insider A knows that his/her initial transaction was based on liquidity reasons, then insider A (or other uninformed insiders) now update their information set with the knowledge that buying (or not selling) stock is a profitable opportunity.

²³ By observing accelerated transaction reporting through internal governance requirements—tabling at board, reporting to audit/financial/ethic sub-committees, or by word of mouth/rumour through managerial social networks.

²⁴ Such an outcome is also consistent with Leland’s (1992) thesis—liquidity reduction occurs if less informed investors exit the market because higher reporting visibility alerts them to the degree of insider activities. More so if investors perceive they are faced with an “unfair trading advantage” and/or suspect insiders manipulate data and withhold price sensitive information. Likewise, they may also exit if insider trading makes it riskier for them to post limit orders, since subsequent informed trades may quickly move prices against the standing order and lead to increased adverse selection problems (Stoll 1989).

Several reasons are mentioned as to why outsiders might not immediately garner the information benefits from SOX. Investors are inattentive and less motivated to follow insider trading (Alldredge and Cicero, 2015), there are non-trivial market frictions and search costs that impede the ability of outside investors to rapidly understand and impound information (Barber and Odean, 2008; Dellavigna and Pollet, 2009; Li et al., 2011), the motive behind any inside trade is not discernible to outsiders and any reported pattern of insider trading is effectively a noisy external signal (Kyle, 1985; Fishman and Hagerty, 1995), and insider reporting through EDGAR is obscure to outsiders (Rogers et al. 2005).

Such an outcome is also consistent with Leland's (1992) thesis that allowing insiders to trade leads to a counter-veiling reduction in market liquidity and increased trading costs. Liquidity reduction occurs if less informed shareholders exit the market because of higher visibility they are alerted to the degree of insider activities. More so if outsiders perceive they are faced with an "unfair trading advantage" and/or they suspect insiders manipulate data and withhold price sensitive information. Likewise, they may also exit the market if insider trading makes it riskier for them to post limit orders, since subsequent informed trades may quickly move prices against the standing order thus increasing adverse selection problems (Stoll 1989). Moreover, because market makers are profit motivated to adjust bid-ask spreads in accordance with trading risk and if the ratio of private informed traders increases, then they are faced with an increased probability of adverse price selection. To conserve profitability they react by increasing bid-ask spreads based on the proposition that changes in the level of active informed insiders is an important driver of trading costs. The impact on bid-ask spreads from the several scenarios considered in this paper is rather complex. Hence, addendum one provides an enhanced theoretical analysis in conjunction with a graphic illustration of the impact from several regulatory regimes a market maker perspective.

Essentially, the influx of increased informed insiders raises the bid-ask spread above that previously observed.²⁵

²⁵ The impact on bid-ask spreads from the several scenarios considered in this paper is rather complex. Hence, addendum one provides an enhanced theoretical analysis in conjunction with a graphic illustration of the impact from several regulatory regimes a market maker perspective.

The mandatory SOX reporting regulations increase expected insider trading profits, relative to delayed reporting, and this increase comes at the expense of outside investors who trade at wider bid-ask spreads.

Therefore, it is not inherently obvious that SOX directly increases information flow to outside investors.

Having introduced a tension between the impact of the SOX regulations on trading costs and insider profitability we now have several competing predictions. SOX implies a reduction in information asymmetry and trading costs, albeit with an initial price reaction around reporting date. Brochet (2010) followed up by predicting and reporting a short term five day post-SOX increase in abnormal post trading returns. But this result is consistent with both accelerated information discovery to outside investors and internal information transfer to uninformed insiders. We extend this analysis by undertaking a longer term co-joint analysis. If information asymmetry is reduced, we predict a short term increase in abnormal returns and trading costs as insider information is initially revealed, then followed by a longer term decay (in both) as the monopoly power of private information decays (Kyle, 1995). However, if there is internal information transfer that increases the pool of informed insiders, then we predict an increase in both profits and trading costs for an identified class of less-informed insiders. Simply put, longer term co-joint reduction (increase) of costs and profitability indicate reduced (increased) information asymmetry.

Prior research on corporate insider trading has a concerted focus on uncovering positive abnormal returns as a proxy for information transfer. There are three major outcomes of interest

to this paper: insider purchases provide the highest post trading profits,²⁶ insiders are generally contrarian traders, and regulations that accelerate reporting significantly accelerate short term profitability. We repeat these analyses along with the co-joint impact of SOX on trading costs and explore information dissemination both internally to board members and externally to investors. Our starting point is the consideration of several competing theoretical propositions.

Regulatory Benefit/Cost Implications

At this stage, we summarise the above three hypotheses within a benefit/cost tradeoff framework. By focusing solely on profitability as a proxy for external private information transfer proxy, we cannot distinguish between external information transfer to outsiders (H1) or internal private information transfer to (less)uninformed insiders (H3). By adding trading costs we are able to distinguish between the two—a reduction indicates external information transfer and an increase indicates internalised private information transfer. Further clues emerge if we observe a continuance in profitability over a longer time period, consistent with information not flowing to a wider base of outside investors. Moreover, by adding a further hypothesis on ex ante information flow (H2), we also distinguish on any increased prerogative to pre-release price sensitive private information. These scenarios are simply outlined in the following schema.

<i>SOX regulatory hypotheses</i>	<i>Profitability</i>	<i>Trading costs</i>
H1: Private information transfer to outsiders – post insider trading	<i>Increased Post-SOX</i>	<i>Reduced Post-SOX</i>
H2: Private information transfer to outsiders – pre insider trading	<i>Reduced Post-SOX</i>	<i>Reduced Post-SOX</i>
H3: Private information transfer to uninformed insiders	<i>Increased Post-SOX</i>	<i>Increased Post-SOX</i>

Our interest is in abnormal returns post insider trading as a proxy for information transfer and trading profitability (both realised and potential) and any changes across the three defined regulatory sub-periods. We are also interested in contrarian price reversals from pre to post

²⁶ Insider sales are generally referred to as non-information liquidity trades (Lakonishok and Lee 2001), notwithstanding that some sales are information motivated in specific situations (Cohen et al., 2014; Alldredge and Cicero, 2015).

trading, as an information signal of mispricing—regardless of whether it is based on superior qualitative knowledge or manipulated factors.

Table 3 reports CAAR extracted from the Carhart four factor model. The combined total price reversal of CAAR from pre ten days to post ten days for both purchase (positive reversal) and sales (negative reversal), is a constant 3-5%. This is consistent with insider trading providing information on investor mispricing via contrarian price signals (see Piotroski and Roulstone 2005; Sias and Whidbee 2010; Veenman 2013).

In post trading profitability, after SOX there are significant increases for purchases at both the ten and sixty day benchmarks. The ten day CAAR in SOX1 are 117% higher than preSOX (1.88% to 4.09%) and 182% higher in SOX2preWSJ (1.88% to 5.31%). These results are consistent in terms of direction and size with Fidrmuc et al. (2006) and Brochet (2010). Further, profitability continues to accumulate over the following fifty days, adding a further 8.49% in SOX1 and 5.05% in SOX2preWSJ. Similar in size and direction to the preSOX fifty day increase of 6.58% (1.88% to 8.46%), signalling higher profitability with little constraint in the “chilling effect” of maintained private information. For sales no statistical difference is delineated at ten days but the sixty day profitability is significantly different from preSOX, albeit at lower relative levels than purchases.

[Table 3 about here]

Based on CAARs, the consistent contrarian and post insider trading results support ex-post traded price information transfer.^{27,28} We are able to reject (H2) but we cannot distinguish between (H1) and (H3). What is obvious is that insiders extracted profits from their trading, with entrenched shareholders increasing their wealth after insider purchases and losing wealth after insider sales, to a greater extent after SOX. For potential and existing shareholders who wished to trade the market to mitigate losses or extract gains, there were lagged transaction opportunities—less so after sales.

²⁷ Results from the Carhart estimates were also checked against the one factor market model and the buy-and-hold returns. There was a high level of consistency between the contrarian nature of 20-day returns, the higher level of post-trading returns for purchases, and the relative degree of difference between the four information trading periods (we thank Philip Brown for this suggestion).

²⁸ The observation in SOX2preWSJ of a positive CAAR of 2.1% in the ten days before insider trading, may be argued to be ex ante information transfer. However, a check of PIT showed a substantial increase of 52.5% which supports an internal information transfer interpretation.

To distinguish between (H1) and (H3) and verify the rejection of (H2), we now turn to the cost of trading results. This extension also allows us to measure incremental costs for current shareholders to exit the market, for investors to purchase after insider trading activity, and to infer any effect on firms' cost of capital. Our theoretical basis accepts that market makers have inherent (but uncertain) indicators of privately informed trading, and profit maximising market makers will increase bid-ask spreads to hedge against an increased probability of counter-party informed trading. Conversely, after the general dissemination of private information to all investors, competitive market makers will respond by lowering bid-ask spreads.

[Table 4 about here]

Table 4 reports average PIT derived from equation (2) across the regulatory event periods. PIT significantly increases across all test intervals in the two post SOX regulatory periods after insider purchases. The ten day (post) purchase PITs increase over the preSOX from 0.2933 to 0.3600 (22.7%) and 0.4375 (49.2%) with similar increases over sixty days. There was no significant change in PIT before or after insider sales, again reinforcing the non-information liquidity/rebalancing argument.

To obtain an understanding of the relative bid-ask cost impact, we convert the alpha coefficient into a percentage component of the spread. For SOX1 post ten day purchases we obtain 12.0% adverse selection costs,²⁹ leaving 37.5% for tick size, 17.9% for order processing costs, and 32.6% for inventory holding costs. This compares to an adverse selection cost component of 8.8% in the preSOX period. Finally, if we apply the Easley et al. (2002) benchmark, that a 0.10 point estimate change leads to a 2.5% increase in the required annual return and taking the changed PIT level at sixty days, there is an increase in annualised cost of capital of up to 3.76%. Taken together for purchases, post SOX induced increased PIT, which translated into an increased adverse selection component of the bid-ask and possible increases in the cost of capital for firms. The evidence rejects (H1), confirms the prior rejection of (H2) and supports (H3)—that SOX induced a transfer of private information to less informed insiders.³⁰

²⁹ Bollen et al. (2004, Table 12) report 16.6% adverse selection costs for actively traded stocks, and Sidhu et al. (2008, Table 5) calculate adverse selection costs at 20.6% in the post-Regulation FD period.

³⁰ The observation in SOX2preWSJ of a positive CAAR of 2.1% in the ten days before insider trading, could be interpreted as ex ante information transfer. However, the corresponding PIT at 0.4134 is a substantial increase of 52.5%, supporting internal information transfer (H3) and an interpretation by market makers' of increased private trading.

Media Reporting Hypothesis

Media Reporting and Information Transfer

An ancillary question emerges about information transparency. That is, whether the website EDGAR reporting requirements of SOX2 induced wider public access and whether subsequent media reporting had any incremental impact. On the one hand, Debreceeny et al. (2002) find that reporting of financial information on websites increases outside investor interaction and provides more timely information dissemination. Alternatively, Rogers et al. (2013) argue that website EDGAR reporting is relatively opaque resulting in restrained information transfer that provides an enhanced role for the media.

Tetlock (2007, 2011) argues that the media, by simply repeating stale information already in the public domain, enhances information dissemination to the public—affecting market prices, even though that information is stale and contains no new analysis. This occurs if there is investor inattention and/or non-trivial market frictions that impede the ability of outside investors to quickly understand and impound that information (see also Li et al. 2011). From the 16th January 2004 the Wall Street Journal (WSJ) disseminated Form 4 filings on SEC's EDGAR system over their wire service.

The question is whether the WSJ postings significantly changed profitability and trading costs in comparison with the SOX regulations. There are two competing scenarios. First, the media plays an incremental role in further disseminating insider trading transaction information to a wider investment audience, thus reducing insiders' ability to retain and rent extract from private information. This approach relies on the proposition that mispricing (and the availability of potential insider profits) is negatively associated with the extent of news dissemination (Drake

et al. 2014). Alternatively, if SOX facilitated extensive external information transfer through accelerated reporting and electronic listing, the WSJ postings are effectively stale non-news and would have little impact. The one prior research that considers this aspect from an insider perspective is Rogers et al. (2013) who identify intraday price and abnormal volume effects after the WSJ reporting. They comment that their result is consistent with inattention by outside investors and an opaque SEC EDGAR website filing system. By extension, our media hypothesis is:

HYPOTHESIS 4: Subsequent reporting by the WSJ newswire service, by providing wider outside investor access to private information, will reduce profitability and trading costs to below preSOX levels.

Our further expectation is that price and cost impacts will be contained within insider purchases, because they comprise a higher level of information induced trading compared to the non-information based trading of sales (per Lakonishok and Lee 2001). Hence, our first post trading information based hypotheses is as follows:

V. RESULTS

Benefit/Costs Surrounding Insider Trading

Regulatory Impacts

Media Impacts

Media impacts are also contained in Tables 3 and 4. After WSJ media posting, there is a statistically significant drop in purchase CAARs from the two postSOX levels at both the post ten day and sixty day periods. Economically they are sizeable, for example falling by an average of 3.50% (ten days) and 5.46% (sixty days), after WSJ posting. The end result, compared to preSOX CAARs, is no difference at ten days and a sixty day drop of 42% (8.46% to 4.90%)—that is, a dampening of extended purchase profitability. The post trading CAARs for WSJ insider sales are generally small, stable, and non-significant when compared to preSOX.

For trading costs in the period after WSJ posting, the sixty day post purchase PITs fall by nearly thirty percentage points, which represents a 65.8% decrease, also representing a decrease of 43% below preSOX. These results are also mirrored by a drop in mean purchase bid-ask spreads from \$0.16 to \$0.10, an increase in average daily trading volumes from 185,000 to 449,000 transactions, a reduction in annualised volatility from 58% to 47%, and a fall in the adverse selection bid-ask component of 4.4%. For sales, PIT remains relatively steady across all SOX regulatory periods between 0.09-0.10, but similar to purchases, falls to 0.055 after WSJ.

In short, media postings of Form 4 had significant impacts. Postings were immediately associated with a reduction in profitability and costs of trading from postSOX levels. In addition, compared to preSOX, longer term CAAR and all PITs are lower after insider purchases. Our results positively support the media hypothesis (H4).

Overall, the analysis to date reveals a strong benefit/cost trade-off association. When CAAR increases so does PIT and vice versa—with both metrics positively tracking each other across all time periods, especially for purchases.³¹ That is, when profitability in the form of CAARs is offset by trading costs, the benefits from the release of the price embodied information externality become opaque. Our accumulated evidence suggests that (less) uninformed insiders are the primary beneficiaries and this is concentrated in purchase activity. Subsequently, we further explore this notion with additional analysis for insider purchases.

V. ADDITIONAL ANALYSIS AND ROBUSTNESS TESTS

Information Hierarchy

We next rely on the “information hierarchy hypothesis” that some insiders are more inside than others (Seyhun 1986, Lin and Howe 1990, Fidrmuc et al. 2006). According to Seyhun (1986), executive directors are more familiar with the day-to-day operations trade and have direct access to private information and, hence, their trading should have a greater impact on CAAR. On the other hand, non-executive directors have less direct access and are more likely to gain information access at regular board meetings, or more informally, through firm social networks. In particular, Seyhun shows that CAARs following the transactions of executive officers are significantly higher than those of non-executive directors (see also Lin and Howe 1990). If our

³¹ As predicted by prior research, there are relatively low and stable levels of CAAR and PIT after insider selling.

interpretation that the first channel of private information flow is internally to less informed insiders, then the information hierarchy hypothesis would predict the following:

HYPOTHESIS 5: The SOX reporting regulations, by internally highlighting private information contained in informed transactions, will increase profitability and trading costs after non-executive director' purchases.

Results are reported in Table 5. Across all periods, and consistent with the hierarchical hypothesis, executive director (EXD) transactions contain more price related information with higher post ten day reversals (2%-3% higher) and larger sixty day profitability compared to non-executive directors (NED). Our focus, however, is the impact on NED profitability after the SOX regulatory initiatives. PreSOX the average ratio of NED to EXD post trading CAARs was low (37.9%), but this substantially increased after SOX [(86.7%, SOX1); (55.1%, SOX2preWSJ)]. What is especially noticeable is the consistent (pre and postSOX) EXD CAARs at sixty days ($\approx 14\%$), but a large jump in NED profitability post SOX to 11.4%. Simply put, the improved postSOX profitability was driven by NED transactions.

Similar observations can be made for PIT, with EXD trading generally attracting higher levels but with NEDs increasing at relative higher rates after SOX1 (22% *cf* 11%). Results are consistent with EXDs having improved access to private information after SOX, with increased trading profitability, and market makers reacting by increasing their estimate of adverse trading costs. Consistent with prior results after WSJ reporting, CAAR and PIT decline to below preSOX levels.

Opaque Accounting Firms

In this section analysis is extended to include firms that constitute a higher amount of imbedded asymmetric information. Firms with high information uncertainty provide greater leverage for insiders to trade. Past research has shown that insiders trade on the quality of firm specific accruals (Beneish and Vargus 2002, Betzer and Theissen 2007), the value implications of past earnings (Veenman 2012), and accounting restatements (Badertscher et al. 2011)—suggesting that insiders more focus their trading on opaque accounting variables.³²

³² Evidence also exists that insiders play a predatory role in manipulating accruals, because of their opaqueness, before strategically purchasing (Bartov and Mohanram 2004, Sawicki and Shrestha 2008).

We concentrate on the ratio of intangibles to total assets to provide the opaque accounting focus—motivated by contextual attributes and a timing gap (Aboody and Lev 2000). The timing gap is when expenditures that create an intangible asset occur long before economic inflow is realized, creating a correlation lag between cost incurred and future revenue. Contextually, intangible valuation is also inherently idiosyncratic to particular firms and hence difficult to formulate and generalize, even within the same industry. In short, intangibles have firm-specific attributes, high uncertainty about future cash flows, and if agency costs are present, they are subject to manipulation. Consequently, intangible rich firms are likely contenders for incremental trading activity by insiders.

HYPOTHESIS 6: The SOX reporting regulations, by internally highlighting private information contained in informed transactions, will increase profitability and trading costs to a greater degree in intangible rich firms.

To test the intangible hypothesis (H6), data is obtained from 1,099 firms where intangible assets were recorded and where 19,146 insider purchases occurred. We then compared the level of opacity by partitioning firms into high (low) deciles 8-10 (deciles 1-3). We repeat estimates of CAAR using the four factor Carhart model and derive PIT after controlling for bias and firm controls (see Heckman analysis below) and report in Table 6.

Table 6 about here

The CAAR for the high ratio of intangibles in deciles 8-10 reaches a maximum of 16% post sixty days for the two postSOX regulatory periods—significantly higher than preSOX and for firms with a low ratio of intangibles. Similarly, SOX PIT is significantly higher than preSOX and comparatively lower in deciles 1-3. That is, both PIT and CAAR mirror the patterns observed in Tables 3 and 4, but at higher (lower) levels depended on the richness of intangible valuations within a firms accounting asset structure. In short, market makers assessment was increased private trading after SOX, associated with a higher level of intangibles. Finally, for SOX2postWSJ there are significant declines in CAAR and PIT across all firms down to or lower than preSOX levels. The decline was greater in high decile intangible firms.

For NED directors the sixty day return for high intangible firms was 18.10% from a lower preSOX base than EXD directors, with profitability after WSJ falling to 3.18% compared

to 6.46% for EXD. At all times NED's in high intangible firms were greater than low intangible firms. We also ran the analysis on high accrual/cash versus low accrual/cash firms and observed the same level of increase for NED's preSOX (3.79%)/postSOX (15.69%) at sixty days—significantly higher than low accrual firms (8.31%), with the fall after WSJ at similar rates.

Self-Selection Robustness

The extracted PIT has been derived from firms that only witnessed insider trading. It may be that PIT levels will be similar in size and directional change non-insider traded firms. Hence, we test the null of self-selection sample bias by implementing a two-stage Heckman (1979) to an additional 11,676 observations from NASDAQ firms who did not record insider trading on a calendar year basis. In the first stage, a model is formulated based on corporate governance proxies that influence market makers' probability assessment that a counter trader is transacting on price sensitive asymmetric information. The canonical specification is a probit regression taking the following form:

$$Pr(Y = 1|X) = \Phi(X'\beta) \quad (3)$$

where a dummy variable (Y) takes a value of unity for firms that record insider trading activity and zero otherwise, Pr denotes probability, Φ is the cumulative distribution function of the standard normal distribution with the parameters β estimated from maximum likelihood. The vector of regressors, X , contains the afore-mentioned control ratios of NED/EXD and intangibles/total assets plus a number of other factors predicted to affect the probability of informed trading. For governance, we add dummy coefficients for firms who have a company founder as a director, a CEO who holds a board chair position, and if an outside institution is a controlling shareholder; as well as the percentage of director shareholdings (Dechow et al. 1996). Other controls include size as an information proxy for the degree of analyst following (Frankel and Li 2004; Skaife et al. 2013), debt-to-equity for financial risk, the ratio of accruals/cashflow, and industry dummies for manufacturing and service industries (Piotroski and Roulstone 2005, Brochet 2010, and Skaise et al. 2013).

In the second treatment stage, the Inverse Mills' ratio (IMR) is generated by dividing the probability density function of firms having insider trading by its cumulative density function from the first stage. IMR (λ) is then included as an additional regressor that controls for omitted variables and the PIT from non-insider traded firms:

$$SPRD_i = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,i}(\tau_i) + \alpha_3 (IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i)) + \delta_0 \lambda + \varepsilon_i \quad (4)$$

Our expectation is for some reduction in the level of PIT, but that PIT will retain significance from the marginal trading of corporate insiders. Results are reported in Table 7:

Table 7 about here

An examination of Table 7 shows marginally reduced PITs, but retention of the basic functional form and characteristics previously observed in Tables 3 and 4. The Heckman transformation confirms that our insider trading sample is a biased sample that includes appropriate cost adjustments for private trading beyond non-insider traded levels. They would not induce us to change any prior interpretations.

Further Robustness Tests

We re-estimated CAAR using a one factor beta model and buy-and-hold returns and obtained interpretative results consistent with the four factor model. To the PIT results we applied the conversion algorithm of Bollen et al. (2004, p.136) to compute the percentage that adverse selection costs contributes to the bid ask spread. We find that, on average, minimum tick size contributes 41.5%, order processing 14.9%, inventory holding costs 33.7%, and adverse selection costs 9.9% (representing an average PIT of 0.227). Bollen et al. (2004) and Sidhu et al. (2008) report similar results.

After 9th April 2001 NASDAQ changed to decimalization claiming it would reduce trading spreads and increase liquidity. We tested for the decimalization effect by splitting the data into pre and post decimalization in preSOX. There was little change in the PIT for purchases with comparative post ten day (0.309 *versus* 0.314) and sixty day (0.236 *versus* 0.249), and insignificant differences for insider sales. In addition, both purchase and sale CAARs were rerun with no significant difference.

VI. CONCLUSION

Corporate insiders, through a privileged internal access, retain private asymmetric information—a potential information externality for several market participants. In this paper we examine several questions about benefit/costs from insider trading around regulatory impact, media

reporting, internal information hierarchy, and firm opacity. One significant contribution is the combination of the prior profitability (CAAR) analysis with increases in the adverse cost component of the bid-ask spread (PIT). PIT is determined by market makers driven by incentives (and competition constraints) to set spread profitability in order to price protect against adverse trading with more informed insiders. This market based assessment of the ebb and flow of private information provides a powerful test of trading cost changes.

Three competing SOX regulatory impact hypotheses are examined—external information transfer to investors (post- and pre-insider trading) and internal information transfer to uninformed insiders. Consistent with prior research we find contrarian trading, highly significant increases in CAAR after insider purchases, with the strongest accruing to NEDs and to insiders who traded intangible rich firms. Increased CAARs were significantly offset by contemporary increases in PIT. After Form 4 WSJ postings in January 2004, both CAAR and PIT levels fell significantly, in most cases to levels less than preSOX, confirming the role the media plays in dissemination stale information. Little significant impact was observed after insider sales in all event periods.

Whether SOX regulations or WSJ postings were successful depends on perception. First, SOX did not constrain the short term or lagged longer term profitability from executive director trading and, indeed, it increased the profitability from non-executive trading. Entrenched shareholders were passive net wealth gainers from offsetting purchase gains and sale losses. One interpretation is these price revisions represent an information externality transfer to outside investors that increased price efficiency. Our alternate interpretation is an unintended consequence of SOX, in that the information externality by insiders was retained and subsequently transferred to less informed insiders—at the expense of increased trading costs for outside investors—similar to the unintended chilling effect from Regulation FD (Sidhu et al. 2008). Our interpretation is further strengthened by the cumulative evidence from insider trading in intangible rich firms and the diminished insider profitability and trading costs after the broader information dissemination by the WSJ postings (Drake et al. 2014).

Consistent with prior post SOX research we find non-random clustered insider trading, contrarian insider returns, and significantly increased CAARs after purchases (Brochet 2010). Additional reporting on EDGAR had little significant incremental price impact. Our further cost

analysis, reveals new findings that after SOX there is a significant increase in PIT for firms with insider purchases, but no impact after sales.³³ A further finding is that WSJ postings reduced CAAR and PIT to levels below preSOX. That is, the media was a more effective information channel than SOX, and possibly enhanced the pre-trading information environment (Leuz et al. 2003, Rogers et al. 2013). Decomposition by executive and non-executive director purchase transactions provided insight into the primary beneficiaries after SOX. Non executive directors, who have less direct hierarchical access to private information, significantly increased their profitability at a greater rate than executive directors. Intangible rich firms with high levels of accounting asymmetry, less likely to be price disentangled by outside investors, provided even high insider profitability to non-executive directors, along with higher trading costs to investors. That is, SOX regulations and investor inattention enabled less informed non-executive directors a first channel opportunity to internalise the private information externality of informed insiders (per Fishman and Hagerty 1995).

Accordingly, several implications emerge. First, increased abnormal returns post insider trading may not always indicate private information transfer to outside investors with reduced trading costs. Second, the form of disclosure regulation can be important, in that accelerated disclosure in the absence of increased wider public transparency, might increase trading costs and enable strategically placed insiders to retain and profitably trade on private information. Third, it is useful to delineate firms by their proclivity to attract informed insider trading using accounting based ratios.

³³ Supporting the insider liquidity and rebalancing trading motives for sales (Lakonishok and Lee 2001).

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Figure 1: Hypothetical impacts of insider trading disclosure regulation on the bid-ask spread—A market maker perspective

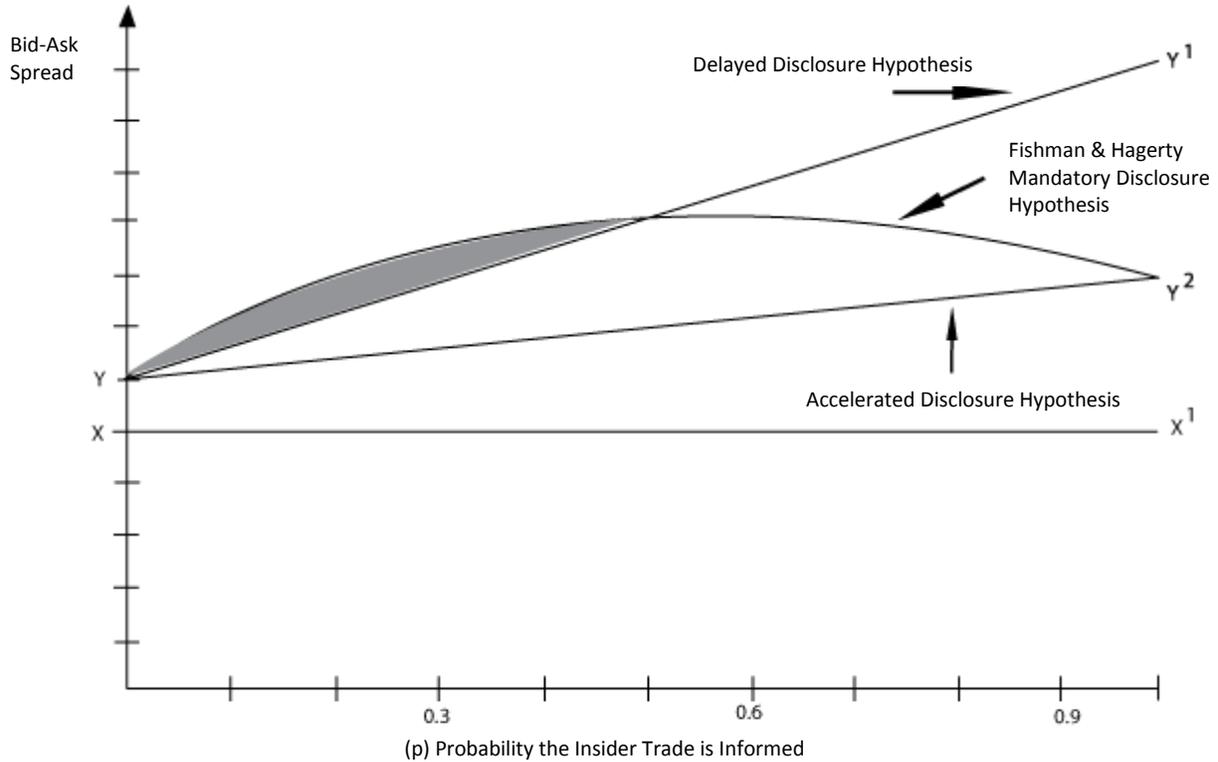


Figure 1 is informed by Fishman and Hagerty (1995, Figure 1) and represents several hypotheses concerning the impact of insider reporting regulations on the bid-ask spread. X, X^1 represents a bid-ask spread absent asymmetric informed insider trading, that compensates a market maker only for operating costs, with instantaneous information adjustment consistent with efficient markets. The linear function Y, Y^1 represents a delayed reporting disclosure regime (e.g. pre SOX). As (ρ) increases, the more likely the insider is informed and the more the market maker expects to lose to him/her, and therefore adjusts the bid-ask spread to compensate for expected losses. This functional relationship reflects a priori theory surmising that informed insiders attempt to maximise private information returns by undertaking stealth trading in smaller transaction blocks (Kyle, 1985; Ke et al., 2003). In the absence of information as to the precise nature (and identity) of underlying trading, the bid-ask spread may be maintained for a longer period.

The linear function Y, Y^2 represents an accelerated disclosure hypothesis (e.g. post SOX) that reveals to outsiders, in a more timely fashion, trading identity and magnitude of insider trading. Hence, private information is more rapidly revealed and consequently a competitive market maker lowers his/her assessment of adverse trading costs and consequently the bid-ask spread. The intercept $Y > X$ acknowledges imperfect information markets sans insider trading, and $Y^2 > X^1$ recognizes that not all asymmetric information held

by insiders will be fully revealed. Under the SOX rationale, accelerated insider disclosure would always position the bid-ask spread at a lower level than a delayed disclosure regime.

The Fishman and Hagerty (1995) mandatory disclosure hypothesis is represented by the curvilinear function Y, Y^2 . The first prediction is an increase in bid-ask spreads over both delayed disclosures (represented by the shaded area) and accelerated disclosures. Insider disclosures are most informative at the extremes of the probability of insider trading ($\rho=0$ and $\rho=1$), when the market maker can infer future transaction direction. An insider's disclosure is least informative (opaque) when $\rho \approx 0.5$ when uninformed and informed insiders are balanced and are just as likely to buy or sell at a later time ($\tau+1$). The bid-ask spread is then set at its maximum at this point and explains the curvilinear nature of the agency cost function (Fishman and Hagerty 1995, p.657-660). The shaded area represents two causation factors: (i) an increased bid-ask spread to compensate for the risk of trading with a higher ratio of previously uninformed insiders who have been newly converted into informed insiders through internal information arbitrage, and (ii) a loss of liquidity as investors decline to trade against the increased level of insiders. Internal information arbitrage opportunities depend on internal networks, the price/information value, and the ability of the disclosure regulation to inform outsiders (investor inattention). The second prediction is an increase in the profitability from inside trades.

Table 1: Inter-temporal distribution of insider transactions

	Purchases	cum%	Sales	cum%	Mixed	cum%
<i>By trading frequency and direction</i>						
0 day single intra-day transactions	38,343	63.3%	73,416	52.3%	0	0.0%
0 day multiple intra-day transactions	2,783	67.9%	2,991	54.4%	1310	41.5%
1 day	4,044	74.5%	18,334	67.4%	240	49.2%
2 days	879	76.0%	3,537	70.0%	55	50.9%
3 days	1,182	77.9%	4,981	73.5%	69	53.1%
4 days	714	79.1%	2,961	75.6%	50	54.7%
5 days	515	80.0%	2,548	77.4%	30	55.6%
6 days	517	80.8%	2,383	79.1%	31	56.6%
7 days	498	81.6%	3,425	81.6%	34	57.7%
8 days	285	82.1%	1,301	82.5%	13	58.1%
9 days	177	82.4%	689	83.0%	18	58.7%
≥ 10 days	10,664	100.0%	23,930	100.0%	1,303	100.0%
Total	60,601		140,496		3,153	

Table 1 reports the inter-temporal trading distribution properties of 204,250 insider transactions for a sample of 3,955 firms that witnessed insider trading over the period 1999 to 2007 on the NASDAQ stock exchange. The sample is divided into three groups: (i) only purchases during the day; (ii) only sales during the day; and (iii) mixed purchases and sales during the day.

Table 2: Descriptive statistics for insider traded firms

	<i>Purchases (60,601 obs.)</i>				<i>Sales (140,496 obs.)</i>			
	Mean	Median	P25	P75	Mean	Median	P25	P75
Quoted spread \$	0.1266	0.0625	0.0300	0.1400	0.0802	0.0400	0.0100	0.0900
Share price \$	12.95	9.99	3.91	18.15	25.17	20.99	11.64	33.03
Trading volume	342.54	40.61	10.98	164.96	1,332.77	221.75	61.88	689.04
Inventory holding premium	0.0188	0.0111	0.0051	0.0230	0.0150	0.0086	0.0045	0.0173
Annualized return volatility	0.6517	0.5090	0.3364	0.8061	0.5508	0.4421	0.3204	0.6500
Holding time	2.6930	2.0580	0.9746	3.9563	1.2286	0.7187	0.4077	1.4816

Table 2 reports descriptive statistics for insider purchase and sale firms on the NASDAQ stock exchange between 1999 and 2007. Quoted spread is the equal-weighted bid-ask spread; share price is the average share price; trading volume is the daily number of shares traded in thousands; inventory-holding premium is defined by $IHP = S[2N(0.5\sigma E(t)) - 1]$ where S is the last bid-ask midpoint and; and holding time is the square root of a firm's holding period (\sqrt{t}) estimated in minutes over a six hour trading day [$t = (360/\text{the number of trades per day})$]; averaged across firms. Annualized return volatility is estimated from a GARCH (1, 1) model using 60 trading days period prior to the initial insider trade: $y_t = X_t\beta + \varepsilon_t$, $\varepsilon_t \sim N(0, \sigma_t^2)$, $\sigma_t^2 = \sigma^2 h_t$, $h_t = \omega + \alpha_1 u_{t-1}^2 + \beta_1 h_{t-1}$.

Table 3: Joint Economic Impact of SOX

CAAR		Purchases			Sales		
<i>Event period</i>	(-10,-1)	(0,10)	(0,60)	(-10,-1)	(0,10)	(0,60)	
preSOX	-0.0148 (-14.73)	0.0188 (20.74)	0.0846 (86.75)	0.0219 (17.96)	-0.011 (-8.31)	-0.0064 (-4.89)	
SOX1	-0.0126 (-9.19)	0.0409* (33.78)	0.1258* (109.89)	0.0413* (25.02)	-0.0119 (-5.43)	-0.0642* (-28.6)	
SOX2	0.0211* (11.29)	0.0531* (27.14)	0.1036* (54.37)	0.0162* (8.99)	-0.0154 (-22.18)	-0.0243* (-57.35)	
PIT		Purchases			Sales		
<i>Event period</i>	(-10,-1)	(0,10)	(0,60)	(-10,-1)	(0,10)	(0,60)	
preSOX	0.2710 (24.93)	0.2933 (84.68)	0.2807 (77.01)	0.0898 (11.83)	0.0890 (3.96)	0.0921 (4.74)	
SOX1	0.3100* (39.34)	0.3600* (50.14)	0.3104* (91.84)	0.0912 (6.07)	0.0819 (4.71)	0.0933 (3.25)	
SOX2	0.4134* (25.64)	0.4375* (13.81)	0.4576* (36.01)	0.0962 (8.56)	0.0995 (7.43)	0.0993 (5.40)	

Table 3 reports cumulative average abnormal returns (CAAR) and the probability of informed trading (PIT) from 10 days before insider trading to 60 days after. CAAR is cumulated from a four factor Carhart model $AR_{it} = R_{it} - \beta_i R_{mt} - \gamma_i SMB_t - \delta_i HML_t - \theta_i MOM_t$ that measures profitability after controlling for risk, market to book, size, and momentum; PIT is derived from a modified BSW (2004): $SPRD_i = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,i}(\tau_i) + \alpha_3 (IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i)) + \varepsilon_i$ where $SPRD_i$ is the bid-ask spread of stock i in which insider trading occurs, α_0 represents the exchange mandated minimum tick size, $\alpha_1 InvTV_i$ is the inverse of trading volume representing fixed order processing costs, $IHP_{U,i}$ is the inventory holding premium for all traders, and $IHP_{I,i}$ is the inventory holding premium for informed (I) traders. t-statistics are shown in parenthesis and * signifies difference from preSOX at the 5% level.

Table 4: PIT surrounding insider trading days

<i>Event period</i>	Purchases			Sales		
	(-10,-1)	(0,10)	(0,60)	(-10,-1)	(0,10)	(0,60)
preSOX	0.2710 (24.93)	0.2933 (84.68)	0.2807 (77.01)	0.0898 (11.83)	0.0890 (3.96)	0.0921 (4.74)
SOX1	0.3100* (39.34)	0.3600* (50.14)	0.3104* (91.84)	0.0912 (6.07)	0.0819 (4.71)	0.0933 (3.25)
SOX2preWSJ	0.4134* (25.64)	0.4375* (13.81)	0.4576* (36.01)	0.0962 (8.56)	0.0995 (7.43)	0.0993 (5.40)
SOX2postWSJ	0.1726* (68.13)	0.1783* (76.60)	0.1590* (12.16)	0.0623 (9.89)	0.0571 (19.43)	0.0554 (7.68)

Table 4 reports average PIT from a modified BSW (2004). PIT is extracted for the SOX regulatory and postWSJ media periods using : $SPRD_i = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,i}(\tau_i) + \alpha_3 (IHP_{I,i}(\tau_i) - IHP_{U,i}(\tau_i)) + \varepsilon_i$ Where $SPRD_i$ is the bid-ask spread of stock i in which insider trading occurs, α_0 represents the exchange mandated minimum tick size, $\alpha_1 InvTV_i$ is the inverse of trading volume representing fixed order processing costs, $IHP_{U,i}$ is the inventory holding premium for all traders, and $IHP_{I,i}$ is the inventory holding premium for informed (I) traders. * reports significant difference from preSOX at the 5% level.

Table 5: CAAR and PIT decomposed into executive (EXD) and non-executive director (NED) purchases

<i>Event period</i>	CAAR						PIT					
	(-10,-1)		(0,10)		(0,60)		(-10,-1)		(0,10)		(0,60)	
	NED	EXD	NED	EXD	NED	EXD	NED	EXD	NED	EXD	NED	EXD
preSOX	-0.018	-0.012	0.011	0.029	0.041	0.132	0.256	0.303	0.291	0.316	0.256	0.303
	(-14.21)	(-7.13)	(9.06)	(20.09)	(33.27)	(85.59)	(48.78)	(54.62)	(59.38)	(59.51)	(122.94)	(124.42)
SOX1	-0.007	-0.019	0.039*	0.045*	0.114*	0.146	0.286	0.319	0.355*	0.351*	0.300*	0.312
	(-4.14)	(-8.53)	(24.88)	(23.11)	(74.70)	(83.51)	(24.25)	(29.55)	(31.95)	(36.60)	(59.46)	(67.29)
SOX2preWSJ	0.022*	0.019*	0.039*	0.071*	0.079*	0.143	0.389*	0.413*	0.329*	0.437*	0.335*	0.458*
	(9.07)	(6.30)	(21.82)	(20.74)	(46.25)	(34.13)	(17.84)	(18.36)	(16.39)	(13.81)	(34.29)	(36.01)
SOX2postWSJ	-0.014	-0.026	0.016	0.023	0.013*	0.051*	0.170*	0.174*	0.154*	0.187*	0.164*	0.154*
	(-34.63)	(-34.83)	(39.37)	(37.62)	(40.82)	(50.24)	(37.63)	(56.97)	(37.15)	(66.99)	(83.71)	(7.84)

Table 5 shows cumulative average abnormal returns (CAAR) from a four factor model and PIT extracted from the modified BSW model surrounding transactions by executive (EXD) and non-executive directors (NED). t-statistics are shown in parenthesis and * signifies difference from preSOX at 5% level. EXD and NED are sorted by reference to the coding supplied by Thomson Reuter's.

Table 6: CAAR and PIT for insider purchases in intangible firms

CAAR						
<i>Event period</i>	(-10,-1)		(0,10)		(0,60)	
	Deciles 1-3	Decile 8-10	Deciles 1-3	Deciles 8-10	Deciles 1-3	Deciles 8-10
preSOX	-0.0120 (-8.55)	-0.0141 (-9.08)	0.0188 (16.31)	0.0268 (18.86)	0.0615 (45.79)	0.1165 (78.09)
SOX1	-0.0071 (-4.03)	-0.0104 (-4.69)	0.0308 (17.88)	0.0526* (27.05)	0.0971* (66.97)	0.1604* (89.37)
SOX2preWSJ	0.0027* (1.41)	0.0392* (9.65)	0.0323* (14.00)	0.0723* (23.74)	0.0653 (27.29)	0.1576* (44.39)
SOX2postWSJ	-0.0136 (-23.63)	-0.0213 (-35.88)	0.0117 (22.58)	0.0245* (44.56)	0.0287* (48.48)	0.0420* (71.32)

PIT						
<i>Event period</i>	(-10, 1)		(0,10)		(0,60)	
	Deciles 1-3	Deciles 8-10	Deciles 1-3	Deciles 8-10	Deciles 1-3	Deciles 8-10
preSOX	0.2276 (2.16)	0.3972 (6.87)	0.3017 (2.08)	0.2483 (5.78)	0.2808 (2.17)	0.2568 (6.73)
SOX1	0.2054 (2.82)	0.3770 (7.52)	0.2942 (2.05)	0.3648* (3.19)	0.2947 (2.21)	0.3978* (3.32)
SOX2preWSJ	0.2961 (1.74)	0.5065* (3.34)	0.3955* (3.83)	0.4368* (4.95)	0.3497* (2.14)	0.4123* (2.76)
SOX2postWSJ	0.2743* (8.86)	0.1836* (2.43)	0.2504 (7.63)	0.1349* (6.12)	0.1989* (4.41)	0.1316* (6.51)

Table 6 reports cumulative average abnormal returns (CAAR) and probability of informed trading (PIT) surrounding corporate insider transactions (18,340) for firms (1,099) decomposed by intangibles/total asset deciles—lowest (1-3); highest (8-10). CAAR are computed from a four-factor Carhart model. PIT is calculated using a modified BSW (2004) model and applying Heckman analysis with controls (after dropping intangibles/total assets). * reports significant difference from preSOX at the 5% level.

Table 7: PIT surrounding insider trading days after controlling for firm factors and self selection bias

<i>Event period</i>	Purchases			Sales		
	(-10,-1)	(0,10)	(0,60)	(-10,-1)	(0,10)	(0,60)
preSOX	0.1849 (9.28)	0.2238 (7.90)	0.2719 (28.05)	0.1107 (37.68)	0.0848 (6.96)	0.0934 (21.46)
SOX1	0.2485* (7.85)	0.2774* (9.84)	0.2919* (18.89)	0.1098 (45.97)	0.1173* (13.02)	0.1185 (29.83)
SOX2preWSJ	0.1540* (6.57)	0.2272 (9.69)	0.2489* (18.46)	0.0778* (46.25)	0.0769 (66.73)	0.0797 (49.87)
SOX2postWSJ	0.1144* (57.42)	0.1152* (41.05)	0.0886* (79.57)	0.0644* (36.13)	0.0600 (64.81)	0.0578* (71.31)

Table 7 reports average PIT from a modified BSW (2004) model using the Heckman model to control for self selection bias. PIT is extracted after applying: $SPRD_i = \alpha_0 + \alpha_1 InvTV_i + \alpha_2 IHP_{U,j}(\tau_i) + \alpha_3 (IHP_{I,j}(\tau_i) - IHP_{U,j}(\tau_i)) + \delta_0 \lambda + \varepsilon_i$ Where $SPRD_i$ is the bid-ask

spread of stock i in which insider trading occurs, α_0 represents the exchange mandated minimum tick size, $\alpha_1 InvTV_i$ is the inverse of trading volume representing fixed order processing costs, $IHP_{U,j}$ is the inventory holding premium for all traders, and $IHP_{I,j}$ is the inventory holding premium for informed (I) traders. The canonical specification for factors associated with informed trading takes the form of a probit regression in the first stage of the Heckman test in the following form: $Pr(Y = 1|X) = \Phi(X'\beta)$ where the dummy variable (Y) takes a value of unity for firms that record insider trading activity and zero otherwise, Pr denotes probability, Φ is the cumulative distribution function of the standard normal distribution. The parameters β are estimated using maximum likelihood. The vector of regressors, X , includes the ratios of EXD/NED and intangibles/total assets, as well as the natural log of market capitalization, debt-to-equity, accruals/cashflow, percentage of director shareholdings, and dummy variables if a director was a company founder, a CEO held the chair position, if the majority shareholder is an outside institution, and industry dummies for manufacturing and service. In the second treatment stage, the inverse Mills' ratio (IMR) is generated by dividing the probability density function of firms having insider trading by its cumulative density function from the first stage. IMR (λ) is then included as an additional regressor estimate of the omitted variables. * reports significant difference from preSOX at the 5% level.