How harmful is insider trading for outsiders? Evidence from the eighteenth century

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Abstract

This paper provides evidence on the financial consequences of insider trading for outsiders. We collect a novel data set that contains all equity trades of all corporate insiders and outsiders in an era without restrictions on informed trading. These data features allow us to study the profitability of insider trades and the expected loss outsiders incur due to insider trading. We show that access to private information creates a performance gap of 7% per year between insiders and outsiders. Nonetheless, outsiders' unconditional expected losses from insider trading are small because the probability of trading with an insider is low.

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1 Introduction

Increasingly stricter insider trading laws put pressure on corporate insiders to report transactions that are based on material and non-public information. However, despite ceaseless efforts by regulatory agencies to uncover illegal insider trading, there is little doubt that a substantial fraction of informed trades remain unobserved.[1] As a result, most existing studies on the prevalence and profitability of insider trading analyze a non-random and incomplete sample that only includes illegal insider trades detected by the regulator or self-reported insider trades.[2] The magnitude of the expected losses that outsiders face due to insider trading therefore remains unclear.

This sample selection issue is problematic for two reasons. First, it is unclear whether the profitability of *observed* insider trades is representative for the profitability of *unobserved* insider transactions, and consequently, for the losses of outsiders when trading with insiders. Prosecuted insider trades are likely very profitable because this would strengthen the regulator's case that these transactions are indeed based on material and non-public information. In contrast, reported insider trades tend to be less profitable (Eckbo and Smith (1998)). Second, it is unclear how often insider trading occurs because it is unknown what fraction of illegal insider trades is discovered by regulators. This frequency matters because outsiders' expected losses due to insider trading depend both on the profitability of insider trades and on the likelihood of trading with an insider.

In this paper, we study the financial consequences of insider trading for outsiders using a novel hand-collected data set that is not subject to potential sample selection bias. Our sample includes the holdings and transactions of all shareholders of three major British companies traded in the early 18th century London stock market.[3] We further observe the identity of every trader in our sample and various trader characteristics such as occupation and address. Most importantly, we also retrieve information about the composition of the board of directors for each company and are therefore able to classify each trader as either insider or outsider based on board membership.

[1] Augustin, Brenner, and Subrahmanyam (2019) document that the SEC initiated a litigation for only 10% of the takeover deals in their sample with informed option trading activity that is unlikely explained by public sources of information. Blackburne, Kepler, Quinn, and Taylor (2021) report that many SEC investigations are undisclosed.

[2] For example, in the U.S., all trades by company directors, officers, key employees, and principal shareholders owning more than 10% of a company's equity must be reported to the SEC within a few days after the trade.

[3] Koudijs (2015) uses a late 18th century setting to study how private information is incorporated into prices.

These unique features of our data set allow us to answer various important questions. First, because there are no restrictions on insider trading during our sample period, we can measure the price informativeness of insiders' trades in an unregulated setting. Second, because we observe the identity of each trader and the exact timing of their buy and sell transactions in each stock, we can measure trader performance accurately and quantify the return gap between insiders and outsiders. Prior studies only observe a non-random subset of each insider's trades (i.e., detected illegal trades or self-reported trades) and cannot compare the performance of insiders to that of outsiders because they do not observe outsiders' trades and realized returns. Third, because we observe *all* transactions of *all* insiders and outsiders, we can measure the *unconditional* probability that an outsider trades with an insider and the expected loss for outsiders due to insider trading.

We first examine the value of access to private information from the perspective of an insider. Consistent with prior work, we find that insider trading activity has strong predictive power for future stock returns, both at a one-week and one-month horizon. Importantly, our data set allows us to exploit variation in a trader's insider status over time and across companies to better identify the relation between board membership and trade informativeness. In particular, because of changes in board composition, a trader can be a corporate insider in one year and an outsider in another year. Moreover, in a given year, a trader can be an insider for one company and an outsider for another. We find that directors' predictive power vanishes when they no longer serve on the board. In addition, their trades do not predict returns on other companies. This evidence suggests that board membership improves a trader's access to valuable private information.

Next, we analyze if insiders outperform outsiders by exploiting their private information.[4] We account for trader fixed effects to rule out that any return differences between insiders and outsiders are driven by unobserved trader characteristics such as IQ, education, and investment skill. We find that due to their superior timing ability, insiders outperform outsiders by 7% per year on average when investing in the company on whose board they sit.[5] However, in the years before and after a trader's board membership, we do not observe any return gap between insiders and

[4]The significant predictive power of insider trades does not necessarily imply that insiders realize higher returns than outsiders because trading gains also depend on the moment a position is closed.

[5]We show that the outperformance of insiders is not confined to a specific company or to a period with extreme volatility (the South Sea bubble) that created unique opportunities for insiders to gain at the expense of outsiders.

outsiders. Insiders also do not outperform outsiders when investing in other companies in which they do not hold a board position. These results imply that directors' information advantages are company-specific and disappear when they are no longer a member of the board.

We then turn to the consequences of insider trading for outsiders. An outsider's unconditional expected loss from insider trading depends on the probability of trading with an insider and the profitability of the insider's trade. We find that the likelihood of trading with an insider is low, because the number of outsiders far exceeds the number of insiders. In fact, 90% of outsiders never trade with an insider during our sample period and 5% encounter an insider only once. The unconditional probability of an outsider selling (buying) stocks to (from) an insider is 1.72% (1.53%) per trade. Even though post-trade returns on stocks sold to insiders are higher than those on stocks sold to outsiders, the unconditional expected loss from selling to an insider instead of an outsider is only 0.93 bps (4.54 bps) over the one-week (one-month) period after the trade due to the low probability of trading with an insider. Expected losses are even smaller for outsider buys, ranging from 0.03 bps over a one-week period to 0.29 bps over a one-month horizon.

It is reasonable to expect that not all insider trades in our sample are based on private information because insiders may also trade for liquidity and diversification reasons. Because uninformed insider trades are likely less profitable, we also estimate outsiders' expected losses due to *informed* trades. Determining whether an insider's trade is informed or uninformed is challenging because we cannot observe an insider's complete information set. However, because we do observe all trades of every insider in our data set, we can classify each insider trade as informed or uninformed based on ex-post trade returns. In particular, we consider an insider's purchase (sale) informed if the stock return over the next week or next month exceeds (is below) a prespecified threshold value. By raising the bar (in absolute value) we select the most profitable insider transactions for which it is most plausible that they are based on private information. At the same time however, increasing the threshold return reduces the number of insider trades that are classified as informed and therefore lowers the estimated probability of trading with an informed insider.

We find that outsiders' expected losses decrease with the threshold because the decrease in the probability of trading with an informed insider at higher thresholds more than offsets the

increase in the profitability of insider trades. When classifying all insider buys (sells) followed by a positive (negative) one-week return as informed, expected one-week losses range from 3.32 bps for outsider sells to 2.48 bps for outsider buys. Expected losses are somewhat larger over a one-month post-trade period (9.14 bps for outsider sells and 4.30 bps for outsider buys) but remain negligible relative to the typical brokerage fee during our sample period (25 bps per transaction). Moreover, we view these losses as upper bounds on the actual expected losses due to informed trading because some trades classified as informed likely turned out to be profitable for insiders ex post merely due to luck rather than due to having access to private information.

In robustness tests, we examine several extensions of our default insider definition that expand the set of insiders beyond board members. We consider as potential insiders traders who live in the same area as board members, traders whose transactions are repeatedly in the same direction as the most profitable directors' trades, politicians, brokers, and traders with the highest realized returns over the sample period. By definition, expanding the group of insiders increases the unconditional probability that an outsider trades with an insider. However, if the additional trades labeled as insider trades are not truly based on inside information, the average profitability of insider trades goes down. Because of these opposing effects, we find that outsiders' unconditional expected losses from trading with insiders remain small after broadening the insider definition.

Despite its benefits, the use of eighteenth century data also raises external validity concerns because the financial landscape has changed significantly over the past three centuries. If anything, however, we argue that insider trading is even less harmful for outsiders in today's markets for two reasons. First, the number of outsiders in financial markets has grown exponentially because of improved market access and lower trading costs. In contrast, the number of insiders did not materially change. For instance, Ahern (2017) documents that the size of insider trading networks rarely exceeds six people, which is smaller than the average board size in our sample (25 people). Second, increasingly stricter insider trading laws reduce an insider's opportunities to take advantage of private information. Del Guercio, Odders-White, and Ready (2017) present evidence that illegal insider trading in stock markets has decreased due to more aggressive SEC enforcement. Extremely profitable insider trades are less likely to occur because those are more

likely to be prosecuted (Cohen, Malloy, and Pomorski (2012); Kacperczyk and Pagnotta (2020)). We therefore believe that the expected outsider losses we compute based on historical data serve as an upper bound on the expected losses outsiders incur due to insider trading in modern markets.

Our work is related to a large literature that studies the performance of insiders and the price informativeness of insider trades. Most empirical work in this area uses self-reported insider trades or data on insider trading retrieved from lawsuits initiated by the SEC.[6] Meulbroek (1992) studies data from SEC cases and finds that insider trading moves stock prices prior to the public announcement of takeovers. In contrast, Lakonishok and Lee (2001) find that the stock market hardly reacts when information about reported insider trades is released, despite the fact that aggregate insider trading has predictive power for future stock returns. Cohen, Malloy, and Pomorski (2012) and Ali and Hirshleifer (2017) use reported data on insider transactions and document large heterogeneity in the price informativeness of insider trades. Evidence on the performance of insider trades is mixed. Seyhun (1986) uses a traditional event-study approach in which abnormal stock returns are estimated over a fixed horizon following insider trades and finds evidence of significant abnormal returns following disclosed insider trades. In contrast, using self-reported insider trades in Norway, Eckbo and Smith (1998) find no evidence of positive abnormal performance by insiders when forming portfolios of aggregate insider holdings that reflect the insiders' actual holding periods.

We contribute to this literature in several ways. First, we provide empirical evidence on the consequences of insider trading for outsiders. Our rich data set allows us to measure the unconditional probability that an outsider trades with an insider and the expected loss for outsiders due to insider trading. Second, we exploit variation in a trader's insider status over time and across companies to strengthen the empirical identification of the relation between insiders' information advantages and the price informativeness and performance of their trades. Because we also observe directors' trades in stocks of other firms and their trades before and after sitting on a firm's board, we can control for trader fixed effects to rule out that performance differences between insiders and outsiders are due to unobserved trader characteristics rather than information asymmetry. Third, because we observe all trades of all insiders and outsiders in a firm, our analysis is not prone to

[6] Two sources of self-reported insider trading data are often used. Form 4 filings that disclose insiders' trades in the company's stock and Schedule 13D filings that disclose beneficial ownership of 5% or more.

sample selection biases that pose a major challenge for existing studies on insider trading.

The paper proceeds as follows. Section 2 describes the historical setting and the companies in our sample. Section 3 provides an overview of our data sources and discusses our insider definitions. Section 4 explains the method we use to measure trader performance. Section 5 provides an example of informed insider trading and presents our empirical evidence on the informativeness of insider trades and the expected losses outsiders incur due to insider trading. Section 6 discusses the potential impact of insider trading in derivatives markets on our results. Section 7 concludes.

2 Historical setting

The early eighteenth century London stock market consisted of a few stocks, and newspapers typically quoted daily prices for the largest companies (Bank of England, East India Company, South Sea Company, Million Bank, and Royal African Company).[7] In late 1719 and early 1720, two new insurance company stocks were floated: the Royal Exchange Assurance and London Assurance. These public offerings were followed by a widespread enthusiasm about public equity and share trading. Entrepreneurs proposed more than 100 new companies in the spring of 1720 and the market witnessed a flurry of IPOs. Except for the two insurance companies, all new initiatives were nipped in the bud by the Bubble Act that was passed on 11 June 1720. While the Act was supposed to terminate all speculative endeavours, the summer of 1720 became a textbook example of a bubble that is commonly referred to as the South Sea Bubble. Since the two insurance companies were the only new companies that survived the turbulent year 1720, the post-bubble market consisted of the same shares as the pre-bubble market plus two insurance companies. The three companies for which we were able to collect all share transactions, i.e., the Bank of England, East India Company, and Royal African Company, collectively represented more than 40% of the market in terms of pre-bubble capitalization (see Anderson (1801)).

[7] Scott (1912) documents that there were more publicly traded companies, but these were not traded regularly.

2.1 Trading

Trading typically took place in coffee houses close to the Exchange. Traders also met in the transfer offices of the listed companies where transactions were recorded in the company's ledger books and transfer books. Similar to today's markets, an investor who wanted to buy or sell stocks contacted a broker who in turn contacted another broker or market maker for price quotes. The broker then executed the transaction at the best possible price for the client and charged a fixed 25 bps brokerage fee per transaction.[8] Investors could also authorize others to trade on their behalf by signing a letter of attorney. Mandated trading was common among traders who lived far from the Exchange. Most important for the purpose of this paper, it allowed insiders to take advantage of material, non-public information while concealing their identity to the counterparty.[9]

2.2 South Sea Bubble

The South Sea Bubble plays a prominent role in our sample. It is characterized by extraordinary news events with large price impact and extreme asset price volatility. These ingredients create unique opportunities for insiders to gain at the expense of outsiders. Because the South Sea speculation triggered a simultaneous increase in the share price of other British companies, we need to understand the economic mechanism that played a key role in the bubble formation.[10]

The South Sea Company was a private company that was chartered in 1711 and received the Asiento from the British government in 1713. The Asiento comprised the exclusive right to transport slaves to plantations in South America. However, instead of foreign trade, the company focused on sovereign lending. In particular, it facilitated the conversion of illiquid and often irredeemable government annuities into liquid and easily transferrable South Sea shares.

In the early eighteenth century, the British government had a large amount of high-interest rate debt outstanding. A substantial part of the debt was in the form of annuities that were

[8] The loan book of the Bank of England documents a few loan defaults where the Bank sells collateralized shares to cover the losses on the loan. Each transaction records a 25 basis points brokerage fee.

[9] Historical records indicate whether a transaction was conducted through a mandate and include a reference to the letter of attorney. Using these records, we are able to link all mandated trades to the actual investor.

[10] Neal (1990) provides an in-depth treatment of the South Sea Company's history.

tied to the life expectancy of the annuity holder and therefore hardly tradeable.[11] Due to this market illiquidity and the poor financial condition of the state, the annuities were unattractive for debt holders and traded against sharp discounts. The government itself also disliked the annuities because they offered few opportunities to redeem debt or defer interest and principal payments.

The South Sea Company came to the rescue by offering annuity holders the option to convert their illiquid annuities into liquid South Sea shares. The Company paid the government a fixed fee and received in return the interest payments on the annuities and the right to issue a fixed number of new South Sea shares to investors.[12] The government gained because it paid a lower interest rate to the Company and got the opportunity to defer payments. The profitability of the deal for the South Sea Company relied on both legs of the deal; (i) between the South Sea Company and the government, and (ii) between the South Sea Company and the annuity holders. The profitability of the first leg was not affected by changes in market prices of South Sea shares, while the profitability of the second leg was sharply increasing in share prices. Rising market prices enabled the Company to convert outstanding annuities more cheaply, i.e., using fewer shares. As a result, it had more shares left for secondary offerings as the total number of new shares that the Company was allowed to issue was fixed. Moreover, these new offerings could be sold at higher prices. The Company therefore had strong incentives to boost its share price.

Over the course of 1720, the South Sea Company issued a second, third, and fourth batch of shares. There was such enthusiasm that the price of each new issue exceeded market prices and new offerings were heavily oversubscribed. However, in the late summer of 1720, the Sword Blade Company that acted as the South Sea Company's financier defaulted on its payments and South Sea share prices started to plummet. As a result of the immediate liquidity problems, the South Sea Company had to be bailed out by its main competitor, the Bank of England.

[11] The British debt in 1720 amounted to 50 million pounds. Of this, 18.3 million was held by the three largest companies: 3.4 million by the Bank of England, 3.2 million by the East India Company, and 11.7 million by the South Sea company. About 15 million pounds of debt was in the form of irredeemable annuities and the remaining 16.5 million pounds were in the form of redeemable government bonds held privately (Garber (1990)).

[12] Figure A1 in the appendix summarizes the main characteristics of the debt conversion scheme.

2.3 Main companies

2.3.1 Bank of England

The Bank of England (BoE) is known today as the central bank of the United Kingdom. However, in the early eighteenth century it acted as a private bank with strong ties to the government. In January 1720, the BoE pulled the short straw in the bidding war with the South Sea Company to convert government debt into stocks. While the South Sea share price bubbled heavily in 1720, the BoE was considered one of the safer assets in the turbulent bubble market.[13] BoE share prices only doubled in 1720, while some other companies such as the London Assurance witnessed an eightfold increase. Despite its lower share price volatility, the BoE contributed to the bubble by allowing shareholders to borrow money cheaply by collateralizing their BoE shares.

As explained in Section 2.2, the BoE also played an important role in the unwinding of the bubble by bailing out the South Sea Company in late September 1720. As largest private lender in the market, the BoE was probably the only candidate for such a large-scale operation. However, the bailout also jeopardized the BoE as it was forced to call all outstanding loans immediately to raise cash for the bailout, including the loans on collateralized BoE shares. The unexpected call likely induced borrowers to sell their shares in other companies to raise cash for their loan repayments. The credit contraction therefore triggered a negative price-liquidity spiral that spilled over to these other companies. In line with the theoretical predictions in Brunnermeier and Pedersen (2009), investors were confronted with market-wide drops in stock prices and a severe liquidity drought after the loans had been called on 6 October 1720.

2.3.2 East India Company

The East India Company (EIC) was chartered in 1600 and is the oldest company in our sample. It received a monopoly to trade commodities with the East Indies, mainly tea, silver, cotton, indigo, and saltpeter. Although the EIC held a monopoly in Britain, it faced fierce competition from the French Compagnie des Indes and the Dutch East Indies Company. The EIC was responsible for

[13] For example, stockbroker Peter Crellius wrote on 16 January 1720: "the general opinion is that they [shares] will all continue to rise. Bank shares are not mounting as rapidly as the others, but opinion ranks them the safest of all: most of the speculation is falling on the South Seas." (Wilson (1941, p.124))

30% of Britain's import and thus strongly connected to the British government.

2.3.3 Royal African Company

The Royal African Company (RAC) obtained a royal charter in 1672 and received the British monopoly on trade along the coast of West Africa. After being close to bankruptcy in 1712, the company underwent a dramatic reorganisation (Carlos, Moyen, and Hill, 2002). In May 1720 the company undertook another major refinancing operation (Shea, 2011). It quadrupled the book value of its equity capital by issuing new shares, known as "engrafted shares".[14] In July 1720, the company followed the example of the South Sea Company and Bank of England and offered its shareholders the opportunity to borrow cash using RAC shares as collateral. In synchrony with the shares of other companies, prices of RAC shares began to tumble in the late summer of 1720.

3 Data

We retrieve data from three sources. Our primary source are the BoE and EIC ledger books and RAC transfer files that record daily stock holdings and transactions. We collect the BoE ledger books for the period 1 August 1715 to 29 September 1725, EIC ledger books from 24 June 1715 to 25 March 1723, and RAC engrafted share transfer files from 16 May 1720 to 27 October 1720. Our second data source are the board meeting minutes for each company in our sample that contain information about a company's board composition and dividend payments. The third data source is a newspaper called Castaing's Course of the Exchange that publishes daily share prices.

3.1 Stock ledgers and transfer files

The BoE and EIC ledger books record every individual stock transaction and each shareholder's daily holdings in trader-specific accounts. An individual trader may have multiple accounts over the course of time that are all linked to a unique trader-specific ledger index entry showing shareholder characteristics like home address, occupation, and title. We retrieve all buys and sells for

[14] The old and engrafted shares were slightly different because holders of the old shares were entitled to a £10 dividend payment, while holders of engrafted shares were not. Nonetheless, prices of old and engrafted shares were highly correlated (99%) and after the dividend payment newspapers reported only one price.

every account with all transaction details: date, amount traded, and buyer and seller identities. Unfortunately, the RAC ledger books have not survived. However, using the transfer files we are able to reconstruct all transactions and holdings of the engrafted RAC shares issued in 1720.[15]

The main advantages of the ledger and transfer file data are their completeness and high level of detail. We observe *all* daily holdings and buy and sell transactions for *every* shareholder of a company. Because we want to measure the *unconditional* probability that an outsider trades with an insider and the *unconditional* expected loss of trading with an insider, it is crucial to observe the entire universe of transactions with trader identities. Because every BoE and EIC transaction is recorded in multiple places (buyer and seller ledger accounts and transfer file), we are able to cross check each transaction multiple times, which ensures high data quality.[16]

3.1.1 Example ledger account and transfer file

Figure 1 displays an example of a BoE ledger book entry: Sir Joseph Eyles' share sales from 29 September 1720 to 29 September 1725. Eyles is a board member for the BoE from 1717 to 1721. He also serves on the board of the EIC from 1714 to 1717 and in 1721. His ledger book entry shows that he sells for £2,000 nominal to Frances Reynardson on 21 October 1720. The transaction also appears in Reynardson's ledger account as a purchase with the same transaction details. Each transaction is also recorded in a transfer file. Figure 2 shows the transfer file of the transaction between Eyles and Reynardson, in which both traders agree to transfer shareholder rights. The transaction was completed when both the buyer and seller had signed the transfer file.

[Figure 1 about here.]

[Figure 2 about here.]

3.1.2 Shareholder characteristics

We retrieve shareholder characteristics from the ledger indexes in which background information is recorded in an unsystematic manner. Most likely, company clerks did not systematically doc-

[15] Using the transfer files only, it is not possible to reconstruct the trader-specific holdings of the existing "old" shares. However, the number of newly issued engrafted shares dwarfed the number of outstanding old shares.

[16] For the RAC we cannot cross check transactions due to the missing ledger books.

ument titles, home addresses, and occupations of shareholders because the characteristics served to uniquely identify a shareholder. As a result, we typically observe many details for John Smith (e.g., "woollen draper from Lombard Street in London"), while we know little about Baron Philip van Borselle because there is only one such baron. Table A1 gives an overview of the most common trader characteristics in our sample. We find that many traders live close to the stock exchange: in Westminster, St. James', Holborn, or the city of London. Among the foreign traders, the Dutch and Swiss are the largest groups with 810 traders from Holland and 145 from Switzerland. The table further shows that merchant, draper, and goldsmith are the most popular occupations among shareholders. Temin and Voth (2004) point out that goldsmiths often acted as early eighteenth century bankers. It is therefore not surprising that they are heavily involved in stock trading. Approximately 2% of the traders carry a title, most commonly Baronet, Knight, and Earl, but higher nobility is also active in the London stock market (Dukes, Viscounts, and Marquises).

3.2 Insider definition

We classify board members of the BoE, EIC, and RAC as insiders for the period in which they serve on the board of their respective companies. A trader can thus be an insider for a company in one year and an outsider for that company in another year. Similarly, in a given year, a trader can be an insider for one company and an outsider for another. Each company appoints directors once per year. For example, the BoE installs a new board on 25 March. We retrieve director names from the BoE's minutes of the board meetings.[17] For the EIC we use Prinsep (1885)'s overview of EIC director names and for the RAC we extract director names from the board meeting minutes.[18]

Table 1 presents descriptive statistics on investor trades and holdings. Our sample consists of 14,239 shareholders, split into 14,116 outsiders and 123 insiders. The BoE has 53 different board members over our sample period and the EIC has 51 directors. For the RAC we have 25 directors because the sample period is much shorter and only includes one board. We observe in the data that board members often enter and leave the board multiple times during our sample period.

[17]The BoE board meetings minutes (so-called Court of Director meetings) are available on the BoE website: https://www.bankofengland.co.uk/about/people/court-of-directors

[18]Treasury Papers, Class T70, National Archives, Kew, UK: The Minute Book of the Royal African Company Court of Assistants (T70/90) and Minute Book of the General Court (T70/101).

The total number of unique board members (123) is smaller than the sum across companies (129) because some individuals hold directorships in multiple companies (e.g., Joseph Eyles). Some traders even hold board positions in multiple companies in the same year (e.g., Matthew Decker).

Table 1 further shows that the total number of trades over the sample period is 54,140 for outsiders and 3,350 for insiders. For days with positive trading volume, the average total transaction volume per day is £34,540 for the group of outsiders and £5,373 for the group of insiders. Interestingly, average holdings per trader are much larger for insiders (£13,381) than for outsiders (£2,639), which indicates that insiders tend to hold larger portfolios than outsiders.

[Table 1 about here.]

A key advantage of our data set is the ability to observe each investor's trades in different companies. Figure 3 shows that 2,727 investors hold shares in two companies and 227 traders hold shares in all three companies. As a result, we can compare a trader's performance when investing in the company in which he holds a board position to the return he earns on investments in other companies. This allows us to rule out that an insider's outperformance is driven by time-invariant trader characteristics or company-specific investment skill rather than information asymmetry.

[Figure 3 about here.]

3.2.1 Alternative insider classifications

Our default definition labeled *Board* classifies traders as insiders for a company during the years they serve on its board. We also consider various broader definitions. Our first alternative definition *Board + Pre&Post Board* classifies board members as insiders for a company over our entire sample period, including the years they do not serve on the board of that firm. This generalization captures potentially valuable information flows from current directors to past and future directors.

Our second alternative definition *Board + Other Board* classifies traders as insiders for all three companies during the years they serve on the board of at least one of those companies. This extension allows for the possibility that material and non-public information is shared across companies among a small inner circle of highly placed individuals in British society. As a result, insiders' information advantages may extend beyond the firm in which they hold a board position.

In robustness tests, we examine several other extensions of our default insider definition that expand the set of insiders beyond board members. We consider as potential insiders traders who live in the same area as directors, traders whose transactions are repeatedly in the same direction as the most profitable directors' trades, politicians, brokers, and traders with the highest realized returns over the sample period. $Board + Neighbours$ broadens the group of insiders with all traders who live in the same ward as a company's board member and trade in the same direction (buy or sell) on the day after the board member's trade.[19] Compared to the default definition, this yields 66 extra insiders: 35 for the BoE, 21 for the EIC, and 10 for the RAC.

$Board + Friends$ expands the set of insiders with potential friends or relatives who repeatedly trade in a similar fashion as a director, irrespective of whether they live in the same ward as the director. To capture potentially *informed* trades by friends, we first sort all board member trades on profitability, measured as the one-week stock return after the trade. We then select the 20% most profitable board member trades in our sample and assume that friends copy the director's trading strategy. We therefore consider all investors who trade on the next day in the same direction (buy or sell) as the profitable board member trades as potential new insiders. Subsequently, for each board member with a transaction among the 20% most profitable trades, we compute the Euclidean trading distance with respect to all potential new insiders.[20] For each director, we reclassify the outsiders with the smallest Euclidean trading distance as insiders.[21] This definition yields 83 additional insiders: 35 for the BoE, 30 for the EIC, and 18 for the RAC.

We further allow for the possibility that politicians have inside information because the companies in our sample have strong government ties. $Board + Politicians$ augments the group of insiders with all members of the British parliament.[22] This yields 444 extra insiders: 245 for the BoE, 134 for the EIC, and 65 for the RAC. Next, we allow for the possibility that brokers may infer non-public information from the trades they execute on behalf of board members. $Board + Brokers$

[19] Ahern (2017) shows that inside traders live close to each other and are connected through social relationships.

[20] We follow Frehen, Goetzmann, and Rouwenhorst (2013) and convert days with positive (negative) net buying volume into a 1 (-1) and compute Euclidean distances between each pair of directors and potentially new insiders. We use only trades the director makes while serving on the board and thus having access to private information.

[21] If more than six outsiders have the smallest Euclidean distance to a given director, we define no new insiders because Ahern (2017) shows that few insiders pass valuable information to more than six friends or relatives.

[22] We retrieve names of all members of the 5th parliament elected in 1715 and the 6th parliament elected in 1722.

broadens our default definition by including brokers trading for their own account.[23] This results in 131 extra insiders: 68 for the BoE, 40 for the EIC, and 23 for the RAC. Finally, we consider the most successful investors in each company as potential insiders. $Board + Outperformers$ adds for each firm the 25 traders with the highest average weekly holding period return over the sample. Clearly, by selecting traders with the highest realized returns, it is likely that many of these successful traders were simply lucky rather than truly possessing valuable inside information. Our results for this definition therefore serve as an upper bound on the profitability of insider trades.

3.3 Prices and dividends

We obtain stock price data from the newspaper Castaing's Course of the Exchange and retrieve dividend payments from the minutes of the board meetings to compute total returns.[24] Figure 4 plots the evolution through time of share prices for the BoE, EIC, and RAC, normalized by dividing by the first observation for each company in our sample. The figure highlights the impact of the South Sea Bubble in 1720 when prices rose rapidly by a factor of two (BoE) to four (RAC) before suddenly collapsing a few months later when the bubble burst.

[Figure 4 about here.]

4 Performance measurement

We measure trader-specific holding period returns using the money-weighted (MW) return method of Dietz (1966) that attaches more weight to returns in periods with more money invested.[25] The MW measure approximates an investor's rate of return by dividing realized trading gains by average holdings and accounts for intermediate cash flows. Specifically, the MW realized return

[23] We only consider the trades that brokers perform for their own account as these are more likely to be informed.

[24] Following Pastor and Veronesi (2009), we linearly interpolate gaps in the stock price series. These gaps arise because there is no stock trading during the closure of a company's ledger and transfer books. Twice per year, a company closes its books for approximately two weeks to compute each shareholder's dividend claim.

[25] Money-weighted returns are known as "dollar-weighted" rates of return in popular textbooks on investments such as Bodie, Kane, and Marcus (2021).

for trader i over the period from day t_0 to day T is given by

$$R^{MW}_{i,t_0+T} = \frac{H_{iT} + \sum_{t\in[t_0,T]} D_{it} - (H_{i0} + \sum_{t\in[t_0,T]} CF_{it})}{H_{i0} + \sum_{t\in[t_0,T]} w_t CF_{it}}, \tag{1}$$

where D_{it} are the dividend payments received by trader i on day t, CF_{it} are intermediate cash flows in and out of the portfolio, and H_{i0} and H_{iT} denote the market value of trader i's beginning- and end-of-period portfolio holdings, respectively:

$$H_{i0} = \sum_{j\in J} P_{j0} Q_{ij0}, \qquad H_{iT} = \sum_{j\in J} P_{jT} Q_{ijT} \tag{2}$$

with P_{jt} the price of share j at the end of day t and Q_{ijt} the number of shares in j trader i holds on day t. Cash flows are the net inflows from contributions (purchases) and withdrawals (sales):

$$CF_{it} = \sum_{j\in J} P_{jt} Buys^N_{ijt} - \sum_{j\in J} P_{jt} Sells^N_{ijt}, \tag{3}$$

where $Buys^N_{ijt}$ and $Sells^N_{ijt}$ denote the number of shares in j bought and sold by trader i on day t.

The numerator in Eq. (1) measures portfolio gains for trader i over the period $[t_0, T]$, taking into account dividends and intermediate deposits and withdrawals. The denominator scales these trading gains by the time-weighted average capital invested, with weights proportional to the time length between each cash flow and the end of the holding period. Specifically, the initial holdings H_{i0} receive a weight of one and subsequent cash flows are weighted by the number of days from the moment the cash flow occurs until day T, divided by the length of the holding period $T - t_0$:

$$w_t = \frac{T - t}{T - t_0}. \tag{4}$$

A simple example illustrates the calculation of money-weighted returns. Suppose that on 1 January, trader i buys 100 shares of company j for £10 per share. On 1 December, trader i purchases an additional 240 shares of firm j for a price of £16 per share. The trader liquidates the entire position on 31 December that year for £14 per share. For simplicity, assume that company

j pays no dividends. In total, the trader has invested £4,840 and realized a loss of £80. The time-weighted average capital invested equals $1 \times (100 \times 10) + \frac{1}{12} \times (240 \times 16) = 1,320$. The MW realized rate of return given by Eq. (1) therefore equals:

$$R^{MW}_{i,t_0+T} = \frac{340 \times 14 - (100 \times 10 + 240 \times 16)}{100 \times 10 + \frac{1}{12} \times 240 \times 16} = -\frac{80}{1,320} = -6.1\%.$$

The example shows the effect of money weighting. The portfolio has a 60% gain over the first 11 months and a 12.5% loss over the last month. Because more money is invested in the last month, the loss in that month receives more weight and the overall MW holding period return is negative.

Panel B of Table 1 provides information on the one-week and one-month holding period returns for insiders and outsiders. Returns are winsorized at the 0.1st and 99.9th percentiles. The average weekly portfolio return of insiders (0.10%) exceeds that of outsiders (-0.14%). For each of the three companies we observe that the company's directors earn higher average returns on their investments than outsiders, which indicates that they have better timing ability. As expected, median returns of both groups are very similar because when insiders and outsiders invest in the same stock during the same period, they should earn the same return. Returns only differ in periods when an insider is invested and an outsider is not, or vice versa. Because insiders tend to be better able to increase their exposure to a stock before a price increase and decrease their exposure before a price decrease, their average returns are higher than those of outsiders. The return gap between insiders and outsiders is widest for investments in the RAC. This is not surprising because our sample for the RAC is confined to the bubble period in which its stock price experienced a rapid and extreme rise and fall (see Figure 4). As a result of these large price swings, any differences in timing ability across traders will result in large differences in returns.[26] We observe similar patterns when looking at the monthly returns of insiders and outsiders.

[26] In our regression analysis, we perform robustness tests in which we exclude the bubble and the RAC from the sample to rule out that our results on the outperformance of insiders are solely driven by the bubble and the RAC.

5 Results

5.1 Example of informed trading

It is notoriously difficult to classify a transaction as *informed* because we have to prove that the trade is based on material and non-public information. Since we typically cannot observe a trader's information set, it remains a challenge to define a transaction as informed with certainty. However, some transactions look so suspicious that it seems reasonable to assume that they are based on material and non-public information. We give an example of such a trade below.

On 10 May 1720, the BoE granted its shareholders the right to borrow cash by collateralizing their Bank shares. For every £100 in *nominal* (par) value, a shareholder could borrow £100 in cash. The loan facility follows the example of the South Sea Company that opened a similar facility on 25 April 1720. Scott (1912, p. 317-318) directly links the South Sea bubble to the South Sea loan program: "The effect of these loans was to bring about a rapid rise in quotations. The increase in the resources available for making purchases added to the demand, while at the same time it was necessary for the borrowers to deposit with the company shares that had a larger market value than the sums lent on them. Thus, while the demand was increased, the supply was artificially restricted." Braggion, Frehen, and Jerphanion (2021) find evidence in line with Scott (1912)'s conjecture by showing that BoE shareholders who collateralized their shares used the borrowed cash to ride the bubble. They show that these loan holders acted as extrapolators of past prices by buying stocks with high past returns and subscribed to highly overvalued new share issues of the South Sea Company and London Assurance Company.

It seems reasonable to assume that Bank directors were aware of the price effects of the loan facility. We examine whether directors traded on this inside information by relating their holdings of BoE shares to the creation of the loan facility. Figure 5 plots total BoE insider holdings against BoE stock prices. We observe a sharp increase in insider holdings shortly before the opening of the loan facility and the run-up in prices. The graph further shows that insiders failed to anticipate the subsequent burst of the bubble because holdings only declined after prices had started to fall.

[Figure 5 about here.]

Next, we formally test whether insider trading activity prior to the public announcement of the loan program can be characterized as unusual. We regress insider and outsider trading activity in BoE shares on a dummy variable that equals one for the month (April 1720) prior to the opening of the loan facility.[27] We consider three measures of monthly trading activity: the number of buy or sell transactions, the buy or sell volume, and the number of traders buying or selling BoE shares.[28]

Table 2 reports the regression results. In panel A we use standardized measures of net trading activity, computed as the net of buy and sell activity divided by the sum of buy and sell activity. We observe that net trading activity by insiders significantly increases in the month prior to the launch of the loan facility. In contrast, net trading activity of outsiders significantly decreases in that month.[29] Panel B shows results for raw measures of insider trading activity, split in buy and sell trades. We find a significant increase in all three measures of insider buy activity in the month prior to the opening of the facility. In particular, we observe 28 insider purchases in April 1720, compared to an average of 3.4 trades in other months. Insiders purchase a total of 347.5 shares, up from an average of 47.5 in other months. The number of BoE insiders buying Bank shares increases from an average of 2.6 in normal times to 13 in April 1720 (i.e., half of the board).

The increase in insider buy activity is not due to an increase in overall trading activity that is characteristic of a bubble, because the right-hand side of panel B shows that insider sell activity in April 1720 is significantly lower than in other months. For outsiders we also observe an increase in buy activity in April 1720 (panel C). However, we find an even larger increase in outsider sell activity, consistent with the drop in net outsider trading activity reported in panel A. In sum, the results in Table 2 are consistent with BoE insiders trading on their private information in anticipation of a price increase following the opening of the BoE loan facility.

[Table 2 about here.]

[27] Results are similar when setting the dummy equal to one for the two months prior to the creation of the facility.

[28] For each measure of trading activity we perform an augmented Dickey-Fuller test and reject the null hypothesis of a unit root at the 1% level.

[29] Because the number of BoE shares outstanding is fixed, the order imbalance of outsiders should offset the order imbalance of insiders. Indeed, when we use *raw* (unstandardized) net volume as dependent variable, the coefficients on the dummy variable in the regressions for insiders and outsiders have the same magnitude but opposite signs.

5.2 Do insider trades predict stock returns?

In this section we test whether insider trades have predictive power for future stock returns. Specifically, we regress one-week- and one-month-ahead returns of stock j on the aggregate weekly buy and sell volume of insiders while they serve on the board of company j.[30] The results in columns 1 and 4 of Table 3 show that insider buy volume strongly predicts future stock returns at both the one-week and one-month horizon. Specifically, an increase in weekly insider buys by 100 shares of company j predicts an increase of more than 1% in the return on stock j over the next week or month. In contrast, an increase in insider sells negatively predicts returns, although the coefficient is only statistically significant for the one-month forecast horizon. Collectively, these results indicate that insider trades contain information about future stock returns.[31]

Because we observe trader identities for every transaction in our sample, we can test whether directors' trades also have predictive power when they do not serve on the board of company j. Insiders who do not serve on the board of company j either serve on the board of another company or serve on the board of company j in another year (past or future). The results in columns 2 and 5 indicate that the buy and sell volume of directors does not have significant predictive power for a company's stock return when they are not on the board of that company. Columns 3 and 6 show that outsiders' buys and sells also do not predict future stock returns. Overall, these findings suggest that board membership improves a trader's access to valuable, non-public information.

[Table 3 about here.]

[30] We include lagged stock returns to capture serial correlation in returns. We also include company fixed effects to control for omitted firm characteristics that might be correlated with future stock returns and insider trading activity. We cluster standard errors by company and by week. Because of the small number of company clusters (3), we compute p-values using the wild bootstrap procedure of Cameron, Gelbach, and Miller (2008).

[31] Existing literature that uses modern data also finds that insider buys tend to have more predictive power for returns than insider sells at short horizons (e.g., Meulbroek (1992); Lakonishok and Lee (2001); and Ahern (2017)). However, Marin and Olivier (2008) show that insiders' sales tend to peak several months prior to a large drop in stock prices, challenging the popular view that insider sales are mostly driven by liquidity and diversification needs. Consistent with our findings, Ali and Hirshleifer (2017) document that both buys and sells of opportunistic insiders strongly predict stock returns at a one-month horizon.

5.3 Do insiders outperform outsiders?

The results in the previous section show that insider trades have predictive power for future returns. However, this does not necessarily imply that insiders realize higher returns than outsiders because trading gains also depend on the moment the position is closed. For example, Figure 5 shows that BoE insiders only closed their positions *after* the burst of the bubble. Because we observe the exact timing of all trades of all insiders and outsiders in a firm, we can measure trader performance accurately and test the conjecture that insiders outperform outsiders by exploiting their private information. In contrast, existing studies do not observe outsiders' trading performance and measure insider trading profitability using only a subset of each insider's trades (i.e., self-reported insider trades and illegal trades uncovered by the SEC). It is not clear whether the profitability of this non-random sample of trades is representative for unobserved insider trades.

We compare the performance of insiders and outsiders by regressing trader- and company-specific returns on various insider dummy variables. We account for trader fixed effects to rule out that any return differences between insiders and outsiders are driven by unobserved time-invariant trader characteristics such as IQ and financial literacy. We further control for time fixed effects to capture market-wide events such as the South Sea bubble.

Panel A in Table 4 presents the results for weekly returns.[32] Column 1 shows that insiders outperform outsiders by 0.14% per week (7% per year) when investing in the company on whose board they sit. This return difference is significant at the 1% level. However, in the years prior and post a trader's board membership, we do not observe any return gap between insiders and outsiders (column 2), consistent with our finding in Table 3 that insider trading volume has no predictive power for future stock returns during the years the insider is not on the board. As a result, the extended insider definition that includes a trader's non-board years (column 3) yields very similar results as the default insider definition in column 1. We further observe that insiders do not outperform outsiders when investing in other companies in which they do not hold a board position (column 4). These results imply that the superior returns of insiders are completely driven by their investments in the company for which they serve as board member.

[32] We record the weekly return on a trader's position in a stock from the moment it is opened until the moment it is closed, accounting for any intermediate purchases and sales as explained in Section 4.

The descriptive statistics in Table 1 indicate that the return gap between insiders and outsiders is widest for investments in the RAC. In column 6 we therefore perform a robustness check by excluding returns on RAC shares from the sample. The performance difference drops to 0.10% per week (5.2% per year), which is still sizeable and significant at the 1% level. Another potential concern is that insiders' gains may be concentrated in periods with extreme events that occur infrequently such as the South Sea bubble. We address this concern by excluding the bubble year 1720 from the sample (column 7). As expected, this reduces the performance gap between insiders and outsiders because the frequent news events and large price volatility during the bubble offer abundant opportunities for insiders to profit from.[33] Nonetheless, the return difference remains substantial, 0.07% per week (3.6% per year), and significant at the 10% level (t-stat = 1.81).

Panel B presents the results for monthly returns. Again, we observe that the outperformance of insiders is limited to their investments in shares of the company in which they hold a board position. Depending on the insider definition, the outperformance ranges from 0.45% to 0.64% per month (5.4% to 7.7% per year) and remains statistically significant after excluding the RAC and bubble period from the sample. This evidence suggests that the information advantages of board members are company-specific and disappear when they are no longer a member of the board.[34]

[Table 4 about here.]

5.4 How often do outsiders trade with insiders?

The evidence presented thus far suggests that insiders capitalize on their information advantage. Due to superior timing ability, the average insider outperforms outsiders by about 7% per year on investments in the firm for which he serves as director. However, this does not imply that the average outsider loses 7% per year because the expected loss for outsiders due to insider trading depends on the probability of trading with an insider. Table 1 shows that the number of outsiders in our sample far exceeds the number of insiders. However, the average number of transactions

[33] Hence, excluding the bubble period likely *reduces* outsiders' expected losses due to trading with insiders.

[34] Another way to show that the performance gains of insiders are realized exclusively during their board years is to include trader-company fixed effects in the baseline regression in column 1. However, doing so effectively excludes the RAC from the analysis because our RAC sample only includes one board year (and thus no change in insider status). Consequently, adding trader-company fixed effects yields results similar to those in column 6.

per insider (27) is much larger than that of outsiders (3). In this section we examine the net effect of these factors on the frequency with which an outsider trades with an insider.

Table 5 reports the fraction of outsiders who trade with an insider zero, one, or two times over the sample period. We compute these statistics for trades in all companies jointly and for trades in each of the three companies separately. The top-left panel shows that more than 90% of outsiders never trade with an insider over the course of our sample.[35] About 5% of outsiders trade with an insider once and fewer than 1% encounter an insider twice. We observe very similar patterns when considering the transactions in each company separately. Even for the BoE for which we have more than 11 years of transaction data most outsiders never trade with an insider. When extending the insider definition to also include a director's non-board years, the frequency of trading with an insider increases by construction. Nonetheless, even with this alternative definition, we find that 9 out of 10 outsiders never trade with an insider.

[Table 5 about here.]

5.5 How much do outsiders lose due to insider trading?

Although most outsiders rarely trade with an insider, insider trading could still be harmful for outsiders if insiders realize large trading gains. In this section, we quantify how much an outsider is expected to lose due to insider trading. Specifically, we express an outsider's unconditional expected loss per transaction from trading with an insider instead of with another outsider as:

$$E(L_B) = -\pi_B^{ins}[E(R_B^{ins}) - E(R_B^{out})] \tag{5}$$

for outsider buys, and

$$E(L_S) = \pi_S^{ins}[E(R_S^{ins}) - E(R_S^{out})] \tag{6}$$

[35] These statistics are computed conditional on outsiders trading at least once during the sample period, i.e., the low frequency of trading with an insider is not due to outsiders being inactive.

for outsider sells, where π_B^{ins} (π_S^{ins}) denotes the unconditional probability of buying from (selling to) an insider, $E(R_B^{ins})$ ($E(R_S^{ins})$) the expected return on stocks bought from (sold to) an insider, and $E(R_B^{out})$ ($E(R_S^{out})$) the expected return on stocks bought from (sold to) an outsider.

We compute π_B^{ins} (π_S^{ins}) as the number of buys (sells) by outsiders from (to) insiders divided by the total number of outsider buy (sell) transactions in our sample.[36] We approximate $E(R_B^{ins})$ ($E(R_S^{ins})$) by the average of all one-week or one-month stock returns after each outsider buy (sell) trade with an insider. Similarly, $E(R_B^{out})$ ($E(R_S^{out})$) is measured as the average of all one-week or one-month returns after each outsider buy (sell) trade with another outsider. By picking a horizon of one week or month, we assume that an outsider who buys a share holds it for that period. For an outsider who sells we assume that the alternative would have been to keep the share for that period. We use the expected return on stocks traded with other outsiders as benchmark for computing losses rather than a return of zero because average returns in our sample are nonzero.[37]

Panel A of Table 6 reports the results for our default insider definition. The unconditional probability of selling stocks to an insider is 1.72% per trade and the average one-week stock return after the sell transaction is 0.99%. In contrast, the one-week return on stocks sold to another outsider is only 0.45%, in line with our finding in Table 3 that insider buys positively predict future returns, whereas outsider buys do not have predictive power. Column 3 reports an outsider's expected one-week return from trading with insiders or outsiders, computed as the product of the probability of trading with an insider or outsider and the average one-week stock return after that trade. Even though post-trade returns on stocks sold to insiders are higher than those on stocks sold to outsiders, the expected return from selling to insiders (-1.69 bps) is much smaller than the expected return from selling to outsiders (-43.92 bps) due to the low probability of trading with an insider.[38] Most importantly, column 4 shows that the expected loss from selling

[36] Note the difference between π_B^{ins} and π_S^{ins} that are computed at the *transaction* level and the analysis in the previous section that is at the *trader* level. Specifically, π_B^{ins} (π_S^{ins}) measures for each outsider's buy (sell) trade the unconditional probability that the counterparty is an insider, implicitly giving more weight in the calculation to outsiders who trade more frequently. In Section 5.4 we compute the fraction of outsiders who trade x times with an insider, giving equal weight to all outsiders regardless of their trading frequency. Hence, our finding that 10% of outsiders trade with an insider at least once does not imply that the probability of trading with an insider is 10%.

[37] For example, if average post-trade stock returns are positive, using a return benchmark of zero instead of $E(R_S^{out})$ would overestimate the expected loss outsiders incur from selling to insiders.

[38] The expected trading result is negative in both cases because the benchmark in column 3 is holding the position. When the stock return after the trade is positive, the outsider would have been better off by keeping the stock.

to an insider instead of an outsider is only 0.93 bps over the one-week period after the trade.[39]

Turning to outsider buys, we find that the probability of trading with an insider is 1.53%. Because the average one-week stock return after buying from an insider is very similar to the return after buying from an outsider, the expected loss from buying from an insider instead of an outsider is close to zero (0.03 bps). Expected losses for outsiders are somewhat larger over a one-month horizon but remain limited: 4.54 bps for sales and 0.29 bps for purchases.

Panel B shows that when we extend the insider definition to include a director's non-board years, the probability of trading with an insider increases. However, the average post-trade return on stocks sold to insiders is lower than in panel A, consistent with the result in Table 3 that directors' trades do not have significant predictive power for a company's return when they are not sitting on its board. Because of these offsetting effects, the expected loss from selling to insiders is only marginally higher than in panel A and remains small, both for the one-week and the one-month horizon. For outsider buys we find that the average return on stocks bought from insiders is higher than in panel A, in line with the observation in Table 3 that insiders' sell volume is not informative about future returns when insiders are not on a company's board. In fact, panel B shows that stocks bought from insiders even have slightly higher one-week and one-month returns than those purchased from outsiders. As a result, with this extended definition, expected losses from buying from insiders are negative, corresponding to small expected gains.

[Table 6 about here.]

Table 7 repeats the analysis in Table 6 for the alternative insider classifications introduced in Section 3.2.1.[40] As expected, broadening the insider definition increases the unconditional probability that an outsider trades with an insider. However, if the additional trades labeled as insider trades are not truly based on inside information, post-trade returns on stocks sold to insiders will be lower than under the default insider definition, whereas post-trade returns on stocks bought from insiders will be higher. This is indeed the general pattern we observe in Table

[39] This is equivalent to computing the difference between an outsider's total one-week expected return from selling to insiders and outsiders, $-1.69 + -43.92 = -45.61$ bps, and the expected return in the absence of insiders, -44.69 bps. This yields a loss of 0.92 bps. The difference with the 0.93 bps reported in column 4 is due to rounding.

[40] For additional robustness, we construct each of these alternative insider classifications in multiple ways. Table A2 in the Appendix shows that in each case we obtain similar results to those reported in Table 7.

7. As a result, we find that broadening the insider definition with neighbours (panel A), friends (panel B), politicians (panel C), brokers (panel D), and outperformers (panel E) has little impact on outsiders' expected losses from trading with insiders. Expected losses from selling to insiders range from 1 to 2 bps over a one-week period and from 5 to 8 bps over a one-month horizon. Expected losses when outsiders buy shares from insiders are close to zero and often even negative.

[Table 7 about here.]

5.6 Expected outsider losses due to informed insider trading

The results presented thus far indicate that the expected losses outsiders incur due to insider trading are small, mainly due to the low unconditional probability of trading with insiders. However, it is reasonable to expect that not all insider trades in our sample are based on private information because insiders may also trade for liquidity and diversification reasons. Because uninformed insider trades are likely less profitable, a potential concern with the analysis in the previous section is that we underestimate outsiders' expected losses by including these uninformed trades.[41] In this section we therefore estimate outsiders' expected losses due to *informed* insider trades.

Determining whether an insider's trade is informed or uninformed is challenging because we cannot observe an insider's complete information set. However, because we do observe all trades of every insider, we can classify each insider trade as informed or uninformed based on ex-post trade returns. In particular, we consider an insider's purchase (sale) informed if the stock return over the next week or next month exceeds (is below) a prespecified threshold value R^{th}.

We define an outsider's expected loss per transaction from trading with an informed insider instead of with another outsider as:

$$E(L_B^{inf}) = -\pi_B^{ins}\pi_B^{inf}[E(R_B^{inf}) - E(R_B^{out})] \tag{7}$$

[41] Cohen, Malloy, and Pomorski (2012) show that the abnormal returns associated with routine (and hence uninformative) insider traders are close to zero, whereas a portfolio strategy that focuses on the remaining opportunistic insider trades yields value-weighted abnormal returns of 82 bps per month. Ali and Hirshleifer (2017) find that both buy and sell trades of opportunistic insiders are much more profitable than those of non-opportunistic insiders.

for outsider buys, and

$$E(L_S^{inf}) = \pi_S^{ins}\pi_S^{inf}[E(R_S^{inf}) - E(R_S^{out})] \tag{8}$$

for outsider sells, where π_B^{ins} (π_S^{ins}) denotes the unconditional probability of buying from (selling to) an insider, π_B^{inf} (π_S^{inf}) the probability that the insider who is the counterparty in the buy (sell) transaction is trading based on private information, $E(R_B^{inf})$ ($E(R_S^{inf})$) the expected holding period return on stocks bought from (sold to) an informed insider, and $E(R_B^{out})$ ($E(R_S^{out})$) the expected return on stocks bought from (sold to) an outsider.

The product $\pi_B^{ins}\pi_B^{inf}$ ($\pi_S^{ins}\pi_S^{inf}$) is the probability that an outsider buys from (sells to) an informed insider, with π_B^{ins} and π_S^{ins} computed as in Section 5.5. We proxy π_B^{inf} (π_S^{inf}) by the number of outsider buys from (sells to) insiders that are followed by a stock return that is below (exceeds) the threshold return R^{th} divided by the total number of outsider buys from (sells to) insiders in our sample. We measure $E(R_B^{inf})$ ($E(R_S^{inf})$) as the average of all one-week or one-month stock returns after buys from (sells to) insiders that are below (exceed) the threshold R^{th}. $E(R_B^{out})$ and $E(R_S^{out})$ are measured as in Section 5.5.

Table 8 reports an outsider's expected loss from selling to informed insiders. The unconditional probability of selling to insiders in column 1 is taken from Table 6. The probability that an insider's buy is informed depends on the chosen return threshold. We report results for various thresholds ranging from 0% to 15%. By raising the bar we select the most profitable insider transactions for which it is most plausible that they are based on private information. For a threshold equal to 0%, the probability that an insider's trade is classified as informed is roughly 50% (column 2). Increasing the threshold lowers the probability that an insider's buy trade yields a return above the threshold. For example, with a threshold of 6% and a one-week post-trade period, the probability that an insider's trade is considered informed drops to 10%. As a result, the probability that an outsider sells to an informed insider also decreases monotonically with the threshold, from 0.87% for a threshold of 0% to 0.04% for a cutoff of 15% (column 3). The average one-week return on stocks sold to insiders in column 4 increases with the threshold, ranging from 4.28% (R^{th}= 0%) to 31.36% (R^{th} = 15%), because we condition on the stock return exceeding the cutoff value.

Column 5 reports the expected loss from selling to an informed insider instead of an outsider. We observe that expected losses decrease with the threshold level because the decrease in the probability of selling to an informed insider at higher thresholds more than offsets the increase in the post-trade stock return.[42] Specifically, the expected loss over a one-week horizon ranges from 3.32 bps for a threshold of 0% to 1.28 bps for a threshold of 15%. As expected, these losses are larger than the loss reported in Table 6 (0.93 bps) because we restrict the analysis to the insider trades that are most profitable ex post. However, outsiders' expected losses are still economically small due to the low probability of trading with an informed insider.[43] Expected losses are larger over a one-month horizon but below 10 bps for all threshold levels.[44] We observe similar patterns when extending the insider definition to include a director's non-board years (panel B). As in Table 6, extending the definition increases the probability of trading with an insider but slightly reduces post-trade returns. As a result, outsiders' expected losses remain limited.

[Table 8 about here.]

Table 9 reports the expected losses outsiders incur by *buying* from informed insiders. We classify an insider's sell trade as informed if the one-week or one-month stock return after the trade is below the threshold value, which ranges from 0% to -15%. Decreasing the return threshold from 0% to -15% reduces the probability that an insider's sell trade is considered informed from 46% to 3%. As a result, the probability that an outsider buys from an informed insider also goes down, from 0.71% to 0.04%. By construction, the average post-trade return on stocks bought from insiders also decreases when the cutoff is set to more negative values. Lowering the threshold thus makes it more plausible that the insider's sale marked as informed is truly based on private information that predicts a stock price decrease.

Column 5 shows that an outsider's expected loss from buying from an informed insider is 2.48 bps over a one-week period when all insider sales followed by a negative one-week return are

[42] Higher post-trade returns are unfavorable for outsiders selling compared to the alternative of keeping the stock.
[43] For comparison, recall that the brokerage fee during our sample period is 25 bps per transaction.
[44] The probability that an insider buy is classified as informed in column 7 is larger than the probability in column 3 because one-month returns tend to be higher than one-week returns, thereby increasing the likelihood that the post-trade return exceeds the fixed threshold. One-month returns following informed buys are higher than one-week returns because it often takes some time before private information is fully incorporated in stock prices.

classified as informed. Setting the return threshold to negative values further decreases outsiders' expected losses because it lowers the probability of buying from an informed insider. Expected losses are larger when considering a post-trade period of one month but remain below 5 bps. Panel B shows that after extending the insider definition to include non-board years, the expected losses are still limited, regardless of the chosen threshold level and holding period.

In sum, we find that the expected losses outsiders incur due to trading with insiders are small, even if we condition the analysis on the most profitable insider trades that are most likely to be informed. In fact, we consider the losses reported in Tables 8 and 9 as upper bounds on the actual expected losses due to informed trading because they likely include trades that turned out to be profitable for insiders ex post due to luck rather than due to having access to private information.

[Table 9 about here.]

6 Insider trading in derivatives markets

Our empirical evidence shows that outsiders' expected losses due to insider trading in stock markets are limited. One potential explanation for this finding is that informed insiders take advantage of their private information primarily by trading in derivatives markets rather than equity markets.[45] We believe this is unlikely to be the case for several reasons. First, the significant predictive power of insider trades for future stock returns (Table 3) and the strong outperformance of insiders when investing in shares of the company in which they hold a board position (Table 4) suggest that insiders do trade in stock markets to capitalize on their information advantage.

Second, option markets were much less liquid than stock markets during our sample period. Option prices were not regularly quoted in newspapers and empirical evidence of option trading is scarce. It would thus have been difficult for insiders to hide behind noise traders to minimize the price impact of their trades, as suggested by theory (see, e.g., Collin-Dufresne and Fos (2016)). Furthermore, Koudijs (2015) points out that option contracts were not legally enforceable, which limited market access to a small group of well-connected, reputable traders and made option

[45] Augustin, Brenner, and Subrahmanyam (2019) find evidence of abnormal volume in options before takeover announcements and suggest that part of this abnormal activity stems from investors trading on private information.

markets even less attractive for insiders. Temin and Voth (2004, p. 1657) argue that trading in forward markets was also not very prevalent in the early 18th century London financial market. They note that "transfers in England were normally neither particularly time-consuming nor costly; consequently, most trading took place in the spot market, not in the form of forward contracts."[46] Moreover, traders in forward contracts were also exposed to counterparty credit risk, which limited forward trading to a small group of traders and further reduced market liquidity.[47]

Third, because trading in derivatives markets relied on trust among market participants, investors could not trade anonymously. As a result, market makers who usually served as counterparties in these trades would likely adjust their bid and ask prices when an insider wanted to trade derivatives on the stock of the company in which he held a board position. In contrast, insiders could trade anonymously in stock markets through mandates. For these reasons it seems unlikely that insiders predominantly traded in derivatives markets to exploit their private information.

7 Conclusion

This paper studies the financial consequences of insider trading for outsiders using a unique hand-collected data set that contains the holdings and transactions of all shareholders of three British companies traded in the London stock market in the early eighteenth century. Because we observe the identity of every trader and the composition of the board of directors for every company, we can classify each trader as either corporate insider or outsider based on board membership. Due to the completeness and granularity of our sample, our analysis is not affected by sample selection biases that pose a challenge for existing studies on the profitability and prevalence of insider trading that rely on self-reported insider trades or on data obtained from SEC investigations. Moreover, because we also observe directors' trades in shares of other companies and their trades before and after sitting on a firm's board, we can better identify the value of having access to private information. In addition, our paper is the first to measure the unconditional probability that an outsider trades with an insider and the outsider's expected loss due to insider trading.

[46] Kleer (2015) reports that only 2.9% of South Sea shares bought by Company officials were for future delivery.
[47] Cope (1978) provides a concise overview of the market in securities in London in the 18th century.

We find that insider trading activity has strong predictive power for future stock returns. However, directors' predictive ability is no longer significant when they step down from the company's board. Furthermore, their buy and sell volume does not predict returns on other companies. We further show that insiders outperform outsiders by 7% per year when investing in the company in which they hold a board position. Directors do not outperform outsiders when investing in other companies and in the years before and after their board membership. These results indicate that directors' superior trading performance is due to informational advantages that are company-specific and disappear when they no longer hold a board position.

Even though insider trades are highly profitable on average, we find that outsiders' unconditional expected losses due to insider trading are small. This is due to the fact that the number of outsiders far exceeds the number of insiders, which makes it unlikely that an outsider encounters an insider in the market. Specifically, the unconditional probability that an outsider's counterparty is an insider is less than 2% per trade. As a result, outsiders' expected losses from selling to an insider instead of to another outsider are less than 1 bp (5 bps) per transaction over the one-week (one-month) period after the trade. Expected losses are even smaller for outsider purchases.

Because not all insider trades in our sample are likely based on private information, we also separately estimate outsiders' expected losses due to *informed* insider trading. We show that even after conditioning the analysis on the most profitable insider trades that are most likely to be informed, outsiders' expected losses due to insider trading remain limited. Broadening the group of potential insiders with politicians, brokers, or traders that live in the same area or repeatedly trade in the same direction as directors also does not change our conclusions.

We argue that the expected losses that we report based on historical data serve as an upper bound on the expected losses outsiders face due to insider trading in modern stock markets. First, the number of outsiders in financial markets has grown exponentially because of improved market access. In contrast, evidence provided by Ahern (2017) suggests that the number of inside traders has not changed materially. Second, whereas in our historical sample insider trading was completely unrestricted, in today's markets insiders' opportunities to trade on private information are limited by increasingly stricter insider trading laws and more aggressive regulatory enforcement.

Although our evidence shows that outsiders' expected losses due to insider trading are small, we do not claim that informed insider trading is innocuous and does not need to be regulated. For instance, illegal insider trading can be harmful for companies and investors by reducing market liquidity and by undermining investors' confidence in the fairness of financial markets.

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Figure 1: **Bank of England ledger account Sir Joseph Eyles**

This figure shows an excerpt from the Bank of England ledger books and displays Sir Joseph Eyles' sell transactions between 29 September 1720 and 29 September 1725. The first column shows the transaction date followed by a transaction ID (column 2) and the counterparty's name (column 3). The fourth column reports the transaction number which links the ledger account to the transfer file of the transaction (see Figure 2). Column five displays the nominal transaction amount and the final column shows the page in the ledger book where the counterparty's ledger account is recorded. This file was extracted from the Bank of England archives: AC27\435\6497

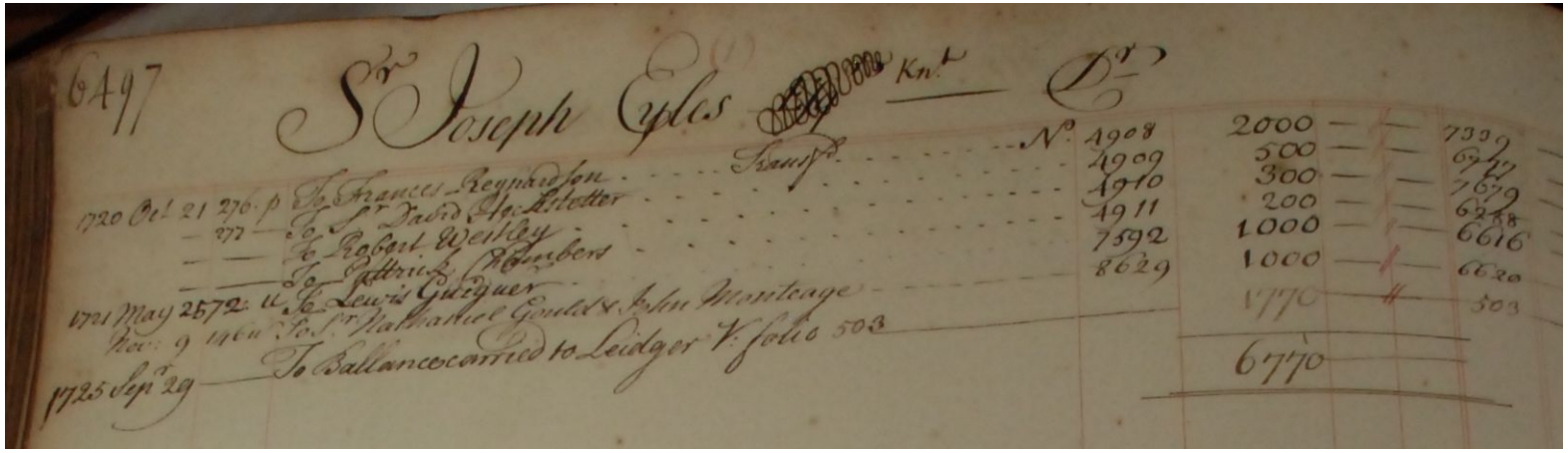

Figure 2: **Bank of England transfer file Sir Joseph Eyles - Frances Reynardson**

This figure shows a copy of the transfer file of a transaction in Bank of England shares between Sir Joseph Eyles (seller) and Frances Reynardson (buyer). Eyles's ledger account is recorded on page 6497 of the ledger book and Reynardson's account on page 7339 of the ledger book. In line with Eyles's ledger account entry in Figure 1, the transaction takes place on 21 October 1720 for a nominal amount of £2,000 with transaction number 4908. This file was extracted from the Bank of England archives: AC28\1542-1558\276

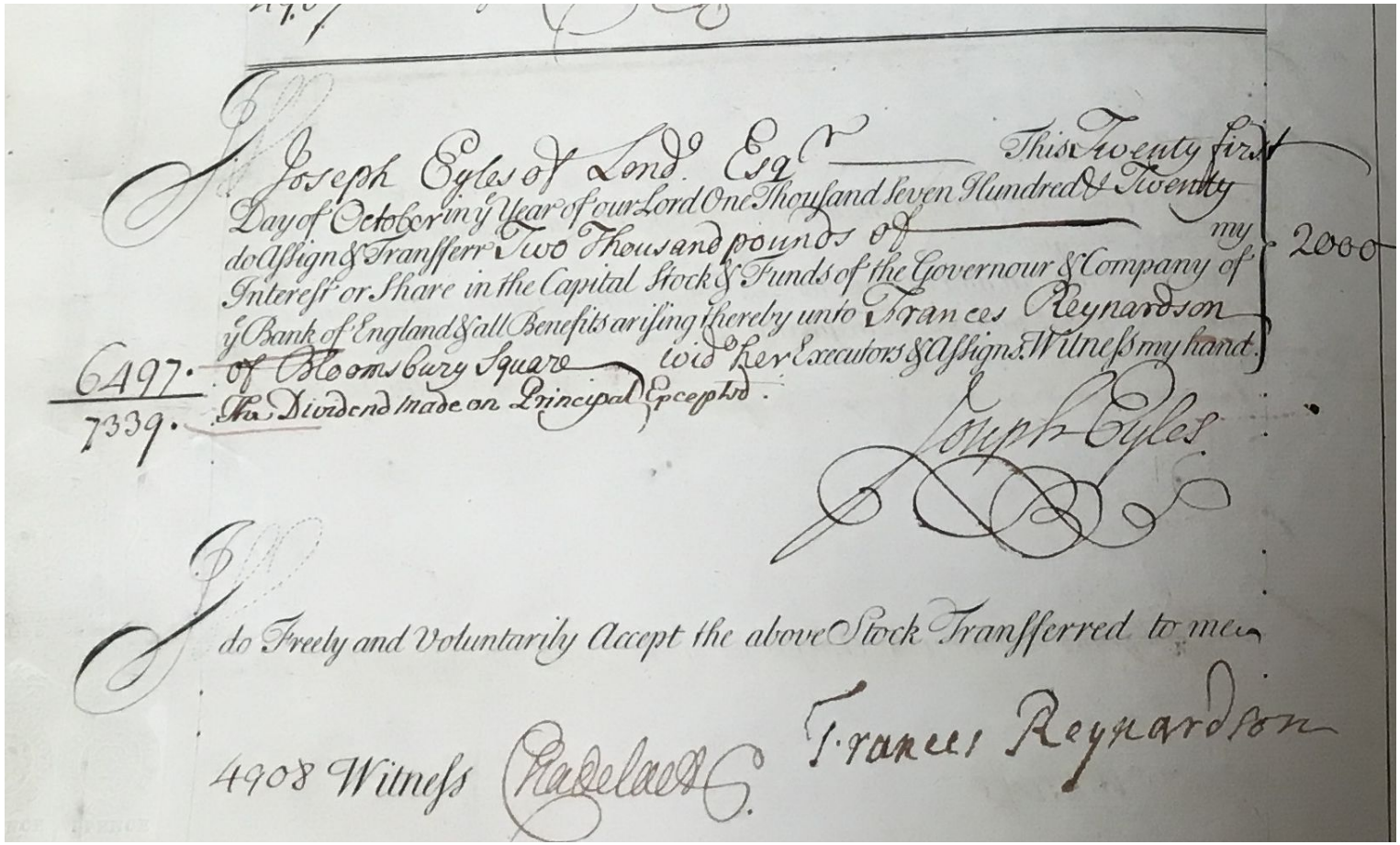

Figure 3: **Number of active traders per company**

This figure shows the number of active traders (i.e., trade at least once) in each of the companies in our sample, with overlapping areas indicating that traders are active in more than one company.

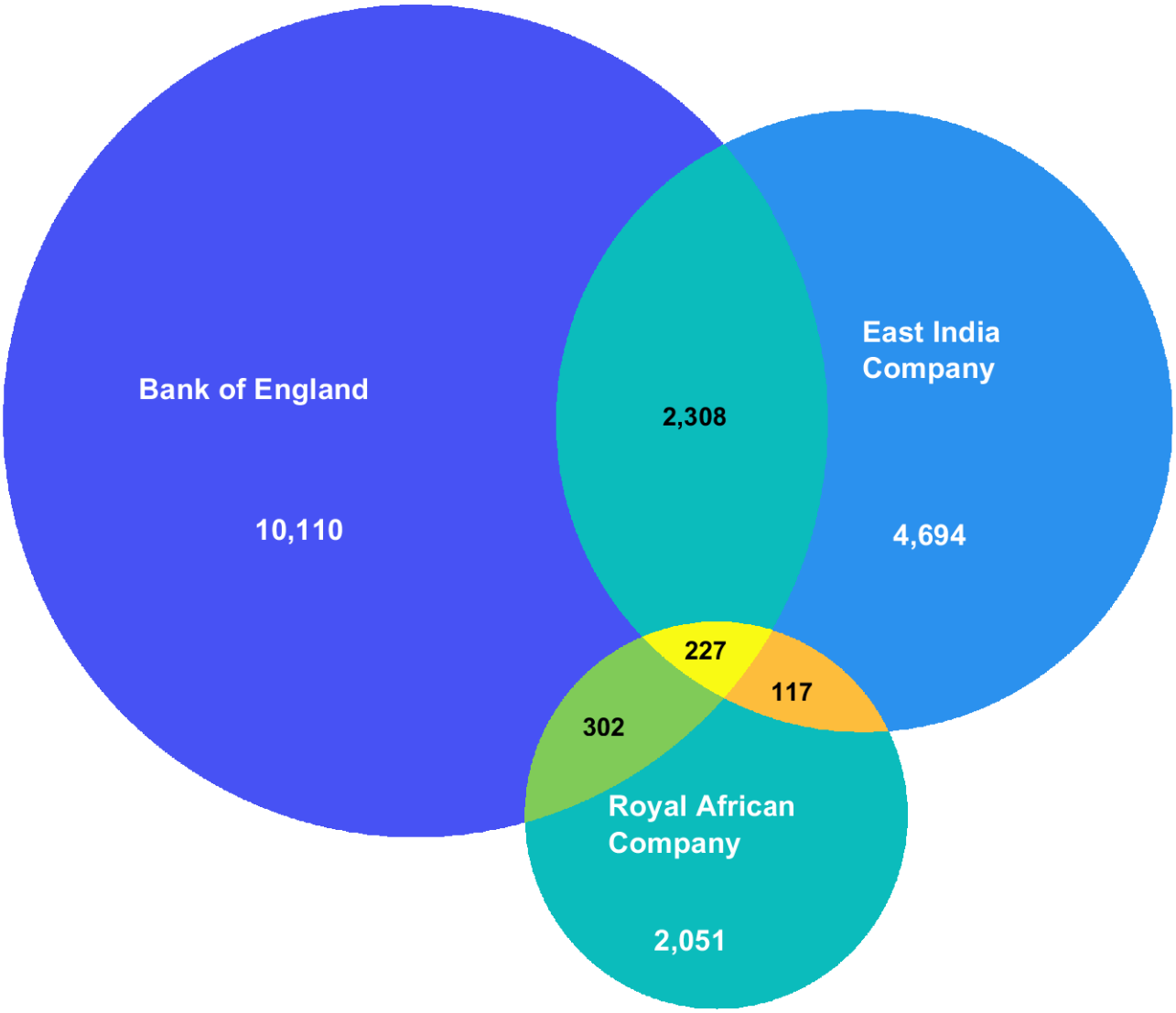

Figure 4: **Normalized share prices**

This figure shows normalized share prices for the Bank of England (BoE), East India Company (EIC), and Royal African Company (RAC). Each company's share price series is normalized by dividing by its first observation. Daily prices of BoE and EIC shares are plotted on the left axis and prices of RAC shares are on the right axis. Share price data is available for the BoE from 1 August 1715 to 29 September 1725, for the EIC from 24 June 1715 to 25 March 1723, and for the RAC from 16 May 1720 to 27 October 1720.

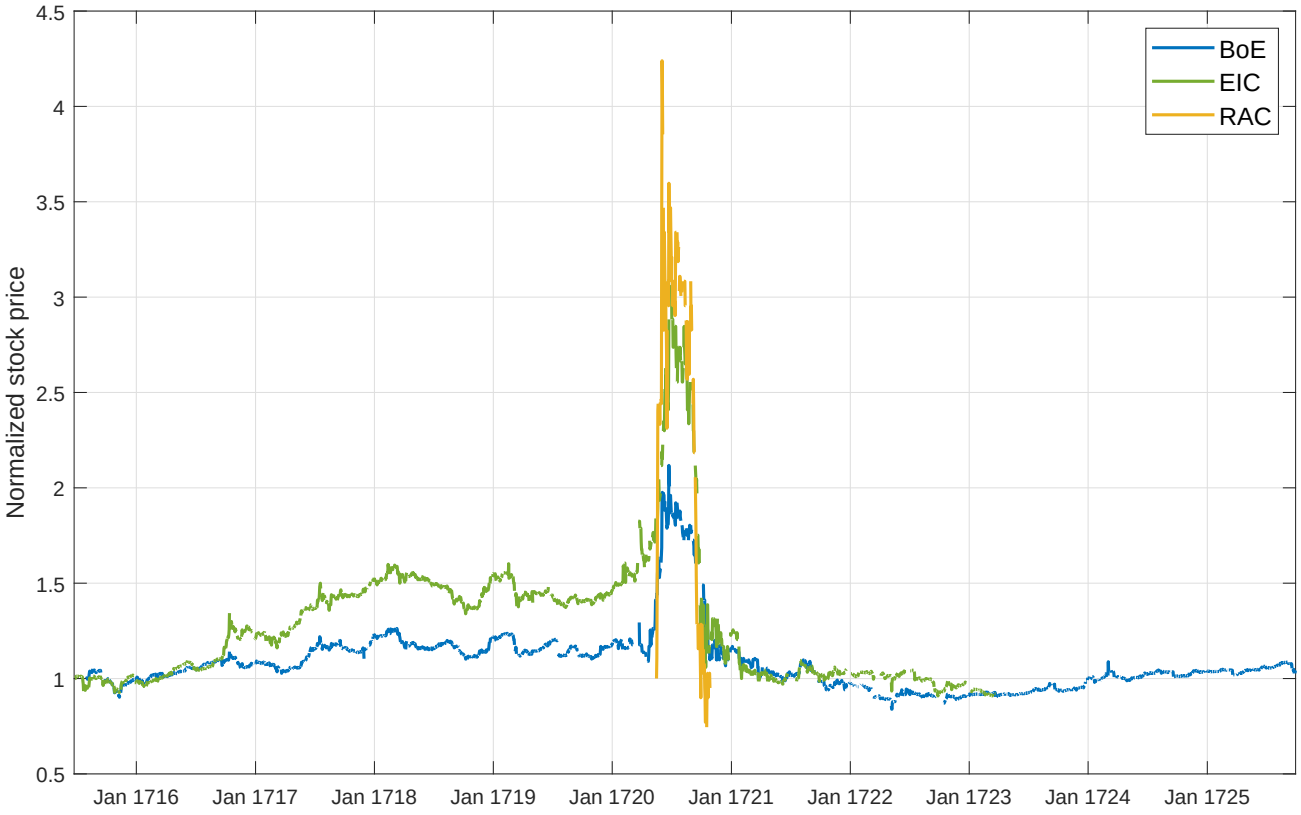

Figure 5: **Bank of England stock price and insider holdings**

This figure shows daily stock prices for the Bank of England (blue line) on the left axis and daily aggregate holdings (number of BoE shares) of all BoE insiders (red line) on the right axis. We classify traders as insiders for the BoE during the period they serve on its board.

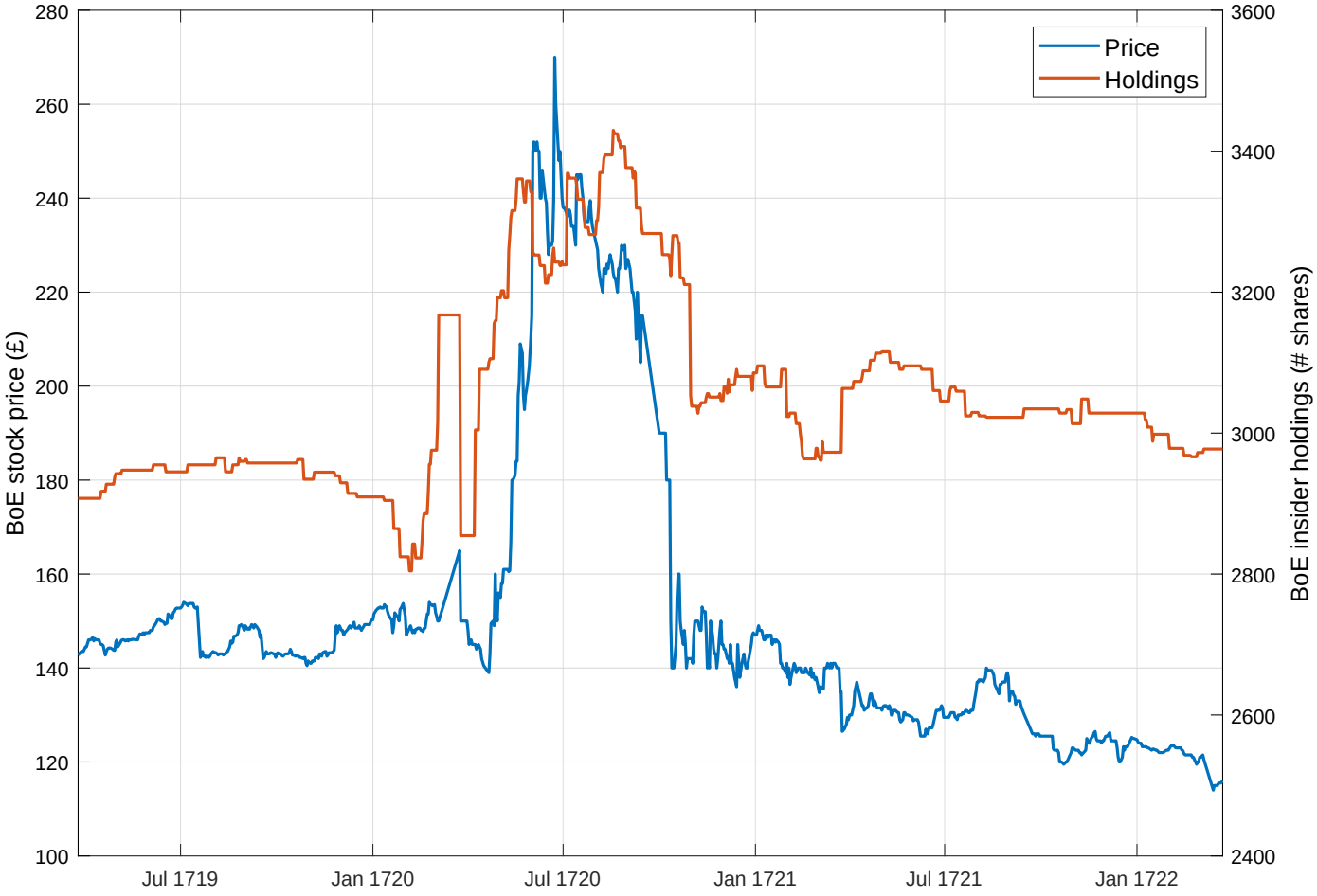

Table 1: **Descriptive statistics on investor trades, holdings, and performance**

This table reports summary statistics for our sample. We collect every stock transaction for the Bank of England (BoE) for the period 1 August 1715 to 1 October 1725, for the East India Company (EIC) for the period 24 June 1715 to 25 March 1723, and for the Royal African Company (RAC) for the period 16 May 1720 to 27 October 1720. We split the sample into outsiders and insiders. A trader is classified as an insider for a company for the years he serves on its board of directors. Total number of traders is defined as the total number of unique shareholders per company (first three columns in each panel) and across all companies (last column in each panel). Total number of transactions reports the total number of transactions for each company over the sample period and across all companies. Mean (Median) number of daily trades is the time-series average (median) of the total number of stock transactions per trading day for each company and across all companies. Mean (Median) daily volume is the time-series average (median) of the total volume per trading day, expressed in number of shares or in pounds. Descriptive statistics for trades and volume are computed conditional on having positive daily volume. Mean (Median) holdings per trader is the average (median) market value of daily holdings across traders, conditional on having positive holdings. Mean (median) weekly (monthly) return is the average (median) one-week (one-month) holding period return, computed over the panel of return observations. Trader returns are winsorized at the 0.1st and 99.9th percentiles. Returns in the column "All" correspond to the total return on an investor's portfolio.

	Outsiders				Insiders			
	BoE	EIC	RAC	All	BoE	EIC	RAC	All
	Panel A: Trading activity and investor holdings							
Total # of traders	10,057	4,643	2,026	14,116	53	51	25	123
Total # of transactions	30,525	19,853	3,762	54,140	1,709	1,390	251	3,350
Mean # of daily trades	17	12	67	22	2	2	2	2
Median # of daily trades	13	8	66	15	1	1	2	1
Mean daily volume (# shares)	156	120	400	210	27	26	20	30
Median daily volume (# shares)	104	72	268	123	10	10	12	13
Mean daily volume (£)	22,597	23,868	42,246	34,540	3,742	5,932	2,183	5,373
Median daily volume (£)	14,151	11,890	25,935	18,266	1,490	2,057	1,260	2,180
Mean holdings/trader (£)	2,188	2,909	1,185	2,639	15,685	10,339	4,000	13,381
Median holdings/trader (£)	949	1,188	510	1,061	8,180	5,954	2,486	7,361
	Panel B: Holding period returns							
Mean weekly return (%)	-0.13	-0.23	-1.05	-0.14	0.05	0.05	6.18	0.10
Median weekly return (%)	0.08	0.05	-5.00	0.05	0.08	0.05	-4.17	0.05
Mean monthly return (%)	-0.89	-1.17	-10.97	-1.02	0.11	0.17	6.25	0.19
Median monthly return (%)	0.09	0.04	-7.76	0.09	0.09	0.09	-3.42	0.27

Table 2: **Example of informed trading: pre-bubble insider trading behavior**

This table reports estimation results for time-series regressions of insider and outsider trading activity in Bank of England (BoE) shares on a constant and a dummy variable that takes a value of one for the month (April 1720) prior to the BoE's creation of a loan facility. A trader is classified as an insider for the BoE for the years he serves on its board of directors. We consider three measures of trading activity: the number of buy or sell transactions in each month, the buy or sell volume in each month expressed in number of shares, and the number of traders buying or selling BoE shares in each month. In panel A we use standardized measures of net trading activity, computed as the net of buy and sell trading activity, divided by the sum of buy and sell trading activity. In panels B and C we use the raw measures of trading activity, split in buy and sell trades. The t-statistics in parentheses are based on Newey and West (1987) standard errors. The sample period is August 1715 to September 1725.

	Panel A: Net trading activity			
	Insiders		Outsiders	
	c	$D_{Apr1720}$	c	$D_{Apr1720}$
Net # trades (std)	-0.02	0.95	0.00	-0.02
	(-0.31)	(15.25)	(0.25)	(-19.95)
Net volume (std)	-0.03	0.97	0.00	-0.03
	(-0.50)	(18.40)	(0.14)	(-19.69)
Net # traders (std)	-0.00	0.86	0.03	-0.12
	(-0.01)	(14.77)	(5.77)	(-21.29)
	Panel B: Insider trading activity			
	Buy		Sell	
	c	$D_{Apr1720}$	c	$D_{Apr1720}$
# Insider trades	3.42	24.58	3.47	-2.47
	(4.24)	(30.49)	(5.37)	(-3.82)
Insider trading volume	47.53	299.97	50.59	-40.59
	(5.30)	(33.46)	(5.13)	(-4.12)
# Insiders trading	2.59	10.41	2.45	-1.45
	(5.01)	(20.18)	(5.63)	(-3.33)
	Panel C: Outsider trading activity			
	Buy		Sell	
	c	$D_{Apr1720}$	c	$D_{Apr1720}$
# Outsider trades	227.42	520.58	227.37	547.63
	(7.62)	(17.45)	(7.58)	(18.26)
Outsider trading volume	1984.94	4575.81	1981.87	4916.38
	(7.23)	(16.66)	(7.19)	(17.83)
# Outsiders trading	189.50	302.50	178.39	409.61
	(8.48)	(13.54)	(8.32)	(19.11)

Table 3: **Do insider trades predict stock returns?**

This table reports estimation results for predictive regressions of future stock returns on aggregate weekly trading volume of insiders and outsiders. Results on the left are for a one-week forecast horizon and those on the right for a one-month horizon. In columns 1 and 4, one-week and one-month ahead returns of the BoE, EIC, and RAC are regressed on the buy and sell volume of insiders while they serve on the board of the respective company. Results in columns 2 and 5 correspond to regressions of future returns of company j on buy and sell volume of insiders when they do not serve on the board of company j. Insiders who do not serve on the board of company j either serve on the board of another company or serve on the board of company j in another board year. The regressions in columns 3 and 6 include the buy and sell volume of outsiders as predictive variables. All volume measures are expressed per 100 shares. In each regression we control for the current one-week or one-month company return R_{jt} and for company fixed effects. The p-values in brackets are computed using the wild bootstrap procedure of Cameron, Gelbach, and Miller (2008) to obtain robust standard errors clustered by company and by week.

Forecast horizon	Week			Month		
	(1)	(2)	(3)	(4)	(5)	(6)
Insider *Buy* volume on board	1.07			1.24		
	[0.07]			[0.05]		
Insider *Sell* volume on board	-0.36			-2.08		
	[0.58]			[0.10]		
Insider *Buy* volume **not** on board		0.35			0.51	
		[0.13]			[0.76]	
Insider *Sell* volume **not** on board		0.34			1.10	
		[0.42]			[0.12]	
Outsider *Buy* volume			-0.01			-0.01
			[0.64]			[0.91]
Outsider *Sell* volume			0.16			0.09
			[0.32]			[0.48]
R_{jt}	0.08	0.08	0.07	0.20	0.20	0.20
	[0.86]	[0.84]	[0.85]	[0.09]	[0.09]	[0.09]
Company FE	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	2.01	1.14	3.24	19.46	18.74	18.65
# Obs.	966	966	966	954	954	954

Table 4: **Do insiders outperform outsiders?**

This table reports estimation results for panel regressions of trader- and company-specific holding period returns on insider dummy variables. The results in panel A correspond to weekly returns and those in panel B to monthly returns. We consider various insider definitions. *Board* classifies a trader as insider for a company during the years he serves on its board. *Pre&Post Board* equals one for the years prior and post a trader's board membership. *Board + Pre&Post Board* classifies board members as insiders for a company over the entire sample period, including the years they do not serve on the board. *Other Board* equals one if a trader is a board member in another company. *Board+Other Board* classifies a trader as insider for all companies during the years he serves on the board of at least one of those companies. Columns 1 to 5 report results for the baseline regression estimated over the full sample period and all companies. Column 6 excludes trader-specific return observations for investments in the Royal African Company (RAC) from the sample. Column 7 excludes the bubble year 1720 from the sample. We control for time fixed effects and trader fixed effects in all regression specifications. The t-statistics in parentheses are computed based on standard errors clustered at the trader level.

Companies	All	All	All	All	All	No RAC	All
Bubble period	Incl.	Incl.	Incl.	Incl.	Incl.	Incl.	Excl.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Panel A: Weekly returns			
InsDum_{Board}	0.14					0.10	0.07
	(3.73)					(3.01)	(1.81)
$\text{InsDum}_{Pre\&Post\ Board}$		-0.00					
		(-0.09)					
$\text{InsDum}_{Board+Pre\&Post\ Board}$			0.15				
			(3.28)				
$\text{InsDum}_{Other\ Board}$				-0.04			
				(-0.96)			
$\text{InsDum}_{Board+Other\ Board}$					0.13		
					(3.29)		
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trader FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	25.13	25.13	25.13	25.13	25.13	21.77	12.62
# Obs.	2,744,383	2,744,383	2,744,383	2,744,383	2,744,383	2,715,834	2,453,306
				Panel B: Monthly returns			
InsDum_{Board}	0.45					0.39	0.42
	(3.30)					(3.07)	(3.27)
$\text{InsDum}_{Pre\&Post\ Board}$		0.15					
		(0.95)					
$\text{InsDum}_{Board+Pre\&Post\ Board}$			0.64				
			(3.44)				
$\text{InsDum}_{Other\ Board}$				-0.02			
				(-0.15)			
$\text{InsDum}_{Board+Other\ Board}$					0.50		
					(3.36)		
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Trader FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	34.48	34.48	34.48	34.48	34.48	32.46	19.66
# Obs.	643,981	643,981	643,981	643,981	643,981	636,302	573,114

Table 5: **How often do outsiders trade with insiders?**

This table reports the fraction of outsiders who trade a certain number of times with an insider over the sample period. The column *Buy* (*Sell*) shows the percentage of outsiders who buy from (sell to) an insider 0, 1, or 2 times (#). The column *Buy/Sell* reports the percentage of outsiders who trade (buy or sell) with an insider 0, 1, or 2 times. We use the two insider definitions described in the caption of Table 4. We report statistics for trades in shares of all three companies jointly and for trades in BoE shares, EIC shares, and RAC shares separately.

Insider definition		Board			Board+Pre&Post Board		
	#	Buy	Sell	Buy/Sell	Buy	Sell	Buy/Sell
All companies	0	95.61	95.29	92.42	93.64	93.49	89.48
	1	3.11	3.40	5.36	4.37	4.50	7.18
	2	0.50	0.53	0.85	0.66	0.82	1.24
Bank of England	0	96.67	96.47	94.13	94.86	94.78	91.24
	1	2.40	2.61	4.26	3.60	3.86	6.30
	2	0.42	0.42	0.70	0.56	0.58	0.99
East India Company	0	95.27	93.97	91.10	92.27	91.37	87.03
	1	3.30	4.39	6.26	5.43	6.03	8.56
	2	0.62	0.62	0.98	0.79	1.00	1.79
Royal African Company	0	95.81	97.17	93.66	95.81	97.17	93.66
	1	3.46	2.29	5.12	3.46	2.29	5.12
	2	0.24	0.29	0.54	0.24	0.29	0.54

Table 6: **Expected outsider loss from trading with insiders**

This table reports estimates of an outsider's unconditional expected loss per transaction from trading with an insider instead of with another outsider. We use the two insider definitions described in Table 4 and consider one-week and one-month holding periods. Columns 1 and 5 report the unconditional probability that an outsider trades with an insider or with another outsider. The probability of buying from (selling to) an insider π_B^{ins} (π_S^{ins}) is computed as the number of buys (sells) by outsiders from (to) insiders divided by the total number of outsider buy (sell) transactions in our sample. The probability of buying from (selling to) an outsider π_B^{out} (π_S^{out}) is given by the number of buys (sells) by outsiders from (to) outsiders divided by the total number of outsider buy (sell) transactions in our sample. Columns 2 and 6 show the expected holding period return on stocks traded by outsiders. The expected return on stocks bought from (sold to) an insider $E(R_B^{ins})$ ($E(R_S^{ins})$) is approximated by the average of all one-week or one-month stock returns after each outsider buy (sell) trade with an insider. The expected return on stocks bought from (sold to) an outsider $E(R_B^{out})$ ($E(R_S^{out})$) is measured as the average of all one-week or one-month returns after each outsider buy (sell) trade with another outsider. Columns 3 and 7 report an outsider's unconditional expected return when trading with insiders or outsiders. The expected return from buying from insiders and outsiders is computed as $\pi_B^{ins} \times E(R_B^{ins})$ and $\pi_B^{out} \times E(R_B^{out})$, respectively. The expected return from selling to insiders and outsiders is computed as $-\pi_S^{ins} \times E(R_S^{ins})$ and $-\pi_S^{out} \times E(R_S^{out})$, respectively. Columns 4 and 8 present an outsider's expected loss from trading with an insider instead of with another outsider, computed as $E(L_B) = -\pi_B^{ins}[E(R_B^{ins}) - E(R_B^{out})]$ for outsider buys and $E(L_S) = \pi_S^{ins}[E(R_S^{ins}) - E(R_S^{out})]$ for outsider sells.

Holding period	Week				Month			
	π_k^n	$E(R_k^n)$	$\pm\pi_k^n \times E(R_k^n)$	$E(L_k)$	π_k^n	$E(R_k^n)$	$\pm\pi_k^n \times E(R_k^n)$	$E(L_k)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Insider definition: Board								
Sell to insider ($k = S, n = ins$)	1.72%	0.99%	-1.69 bps	0.93 bps	1.72%	3.26%	-5.61 bps	4.54 bps
Sell to outsider ($k = S, n = out$)	98.28%	0.45%	-43.92 bps		98.28%	0.62%	-61.34 bps	
Buy from insider ($k = B, n = ins$)	1.53%	0.43%	0.65 bps	0.03 bps	1.53%	0.43%	0.66 bps	0.29 bps
Buy from outsider ($k = B, n = out$)	98.47%	0.45%	44.01 bps		98.47%	0.62%	61.46 bps	
Panel B: Insider definition: Board+Pre&Post Board								
Sell to insider ($k = S, n = ins$)	2.69%	0.82%	-2.20 bps	1.01 bps	2.69%	3.22%	-8.66 bps	7.07 bps
Sell to outsider ($k = S, n = out$)	97.31%	0.44%	-43.10 bps		97.31%	0.59%	-57.27 bps	
Buy from insider ($k = B, n = ins$)	2.70%	0.55%	1.49 bps	-0.29 bps	2.70%	0.86%	2.33 bps	-0.74 bps
Buy from outsider ($k = B, n = out$)	97.30%	0.44%	43.09 bps		97.30%	0.59%	57.26 bps	

Table 7: **Expected outsider loss from trading with insiders: Alternative insider definitions**

This table reports estimates of an outsider's unconditional expected loss per transaction from trading with an insider instead of with another outsider. We consider five alternative insider definitions. $Board + Neighbours$ expands the group of insiders with all traders who live in the same ward and trade in the same direction as a company's board member. $Board + Friends$ adds the traders whose trades are repeatedly in the same direction as the 20% most profitable board member trades in each company, with profitability measured as the one-week stock return after each trade. $Board + Politicians$ adds all members of the British parliament as insiders. $Board + Brokers$ includes stock brokers trading for their own account as insiders. $Board + Outperformers$ augments the group of insiders with the most successful outsiders per company, defined as the 25 traders with the highest average weekly return over the sample. Columns 1 and 5 report the unconditional probability that an outsider trades with an insider or with another outsider. Columns 2 and 6 show the expected weekly or monthly stock return after an outsider's trade. Columns 3 and 7 report an outsider's unconditional expected return when trading with insiders or outsiders. Columns 4 and 8 present an outsider's expected loss from trading with an insider instead of with another outsider. All numbers are calculated using the same methods as in Table 6.

Holding period	Week				Month			
	π_k^n	$E(R_k^n)$	$\pm\pi_k^n \times E(R_k^n)$	$E(L_k)$	π_k^n	$E(R_k^n)$	$\pm\pi_k^n \times E(R_k^n)$	$E(L_k)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Insider definition: Board+Neighbours								
Sell to insider ($k = S, n = ins$)	3.10%	0.73%	-2.28 bps	0.95 bps	3.10%	2.51%	-7.78 bps	5.91 bps
Sell to outsider ($k = S, n = out$)	96.90%	0.43%	-41.35 bps		96.90%	0.60%	-58.43 bps	
Buy from insider ($k = B, n = ins$)	2.96%	1.07%	3.17 bps	-1.91 bps	2.96%	0.75%	2.22 bps	-0.43 bps
Buy from outsider ($k = B, n = out$)	97.04%	0.43%	41.41 bps		97.04%	0.60%	58.52 bps	
Panel B: Insider definition: Board+Friends								
Sell to insider ($k = S, n = ins$)	2.15%	1.00%	-2.16 bps	1.19 bps	2.15%	3.09%	-6.64 bps	5.32 bps
Sell to outsider ($k = S, n = out$)	97.85%	0.45%	-44.01 bps		97.85%	0.61%	-59.85 bps	
Buy from insider ($k = B, n = ins$)	2.01%	0.14%	0.29 bps	0.61 bps	2.01%	0.69%	1.38 bps	-0.15 bps
Buy from outsider ($k = B, n = out$)	97.99%	0.45%	44.08 bps		97.99%	0.61%	59.94 bps	
Panel C: Insider definition: Board+Politicians								
Sell to insider ($k = S, n = ins$)	3.15%	0.81%	-2.56 bps	1.22 bps	3.15%	2.66%	-8.39 bps	6.53 bps
Sell to outsider ($k = S, n = out$)	96.85%	0.43%	-41.25 bps		96.85%	0.59%	-57.01 bps	
Buy from insider ($k = B, n = ins$)	3.40%	0.91%	3.08 bps	-1.63 bps	3.40%	1.11%	3.78 bps	-1.78 bps
Buy from outsider ($k = B, n = out$)	96.60%	0.43%	41.14 bps		96.60%	0.59%	56.87 bps	
Panel D: Insider definition: Board+Brokers								
Sell to insider ($k = S, n = ins$)	4.86%	0.74%	-3.62 bps	1.45 bps	4.86%	1.88%	-9.13 bps	5.83 bps
Sell to outsider ($k = S, n = out$)	95.14%	0.45%	-42.52 bps		95.14%	0.68%	-64.41 bps	
Buy from insider ($k = B, n = ins$)	5.25%	0.33%	1.75 bps	0.59 bps	5.25%	-0.62%	-3.24 bps	6.80 bps
Buy from outsider ($k = B, n = out$)	94.75%	0.45%	42.35 bps		94.75%	0.68%	64.16 bps	
Panel E: Insider definition: Board+Outperformers								
Sell to insider ($k = S, n = ins$)	3.79%	0.95%	-3.61 bps	2.00 bps	3.79%	2.75%	-10.42 bps	8.29 bps
Sell to outsider ($k = S, n = out$)	96.21%	0.43%	-40.93 bps		96.21%	0.56%	-54.18 bps	
Buy from insider ($k = B, n = ins$)	3.58%	0.72%	2.58 bps	-1.05 bps	3.58%	1.13%	4.06 bps	-2.04 bps
Buy from outsider ($k = B, n = out$)	96.42%	0.43%	41.02 bps		96.42%	0.56%	54.29 bps	

Table 8: **Expected outsider loss from selling to informed insiders**

This table reports estimates of an outsider's unconditional expected loss per transaction from selling shares to an informed insider instead of to another outsider. We use the two insider definitions described in Table 4 and consider one-week and one-month holding periods. We consider an insider's purchase as informed if the stock return over the next week or next month exceeds a prespecified threshold value R^{th}. We approximate the probability that an outsider sells to an informed insider by multiplying the unconditional probability of selling to an insider π_S^{ins} by the probability that the insider is trading based on private information π_S^{inf}. We compute π_S^{ins} in columns 1 and 7 as the number of sells by outsiders to insiders divided by the total number of outsider sell transactions in our sample. We proxy π_S^{inf} in columns 2 and 8 by the number of outsider sells to insiders that are followed by a stock return that exceeds the threshold R^{th} divided by the total number of outsider sells to insiders in our sample. Columns 4 and 9 show the expected holding period return $E(R_S^{inf})$ on stocks sold to informed insiders, measured as the average of all one-week or one-month stock returns after sells to insiders that exceed the threshold R^{th}. Columns 5 and 10 report an outsider's expected loss from selling to an informed insider instead of to another outsider, computed as $E(L_S^{inf}) = \pi_S^{ins}\pi_S^{inf}[E(R_S^{inf}) - E(R_S^{out})]$, where $E(R_S^{out})$ denotes the expected return on stocks sold to outsiders as reported in Table 6.

Holding period	Week					Month				
R^{th}	π_S^{ins}	π_S^{inf}	$\pi_S^{ins} \times \pi_S^{inf}$	$E(R_S^{inf})$	$E(L_S^{inf})$	π_S^{ins}	π_S^{inf}	$\pi_S^{ins} \times \pi_S^{inf}$	$E(R_S^{inf})$	$E(L_S^{inf})$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Insider definition: Board										
0%	1.72%	50.29%	0.87%	4.28%	3.32 bps	1.72%	54.63%	0.94%	10.33%	9.14 bps
3%	1.72%	17.83%	0.31%	10.26%	3.02 bps	1.72%	31.66%	0.55%	16.77%	8.81 bps
6%	1.72%	9.94%	0.17%	15.10%	2.51 bps	1.72%	19.66%	0.34%	24.33%	8.03 bps
9%	1.72%	6.29%	0.11%	19.48%	2.06 bps	1.72%	15.77%	0.27%	28.51%	7.58 bps
12%	1.72%	4.23%	0.07%	23.92%	1.71 bps	1.72%	14.17%	0.24%	30.52%	7.31 bps
15%	1.72%	2.40%	0.04%	31.36%	1.28 bps	1.72%	13.26%	0.23%	31.61%	7.08 bps
Panel B: Insider definition: Board+Pre&Post Board										
0%	2.69%	49.30%	1.33%	3.94%	4.64 bps	2.69%	55.00%	1.48%	9.90%	13.79 bps
3%	2.69%	17.27%	0.46%	9.47%	4.20 bps	2.69%	31.13%	0.84%	16.35%	13.20 bps
6%	2.69%	9.04%	0.24%	14.41%	3.40 bps	2.69%	19.42%	0.52%	23.58%	12.02 bps
9%	2.69%	5.71%	0.15%	18.49%	2.77 bps	2.69%	15.05%	0.41%	28.28%	11.22 bps
12%	2.69%	3.78%	0.10%	22.48%	2.24 bps	2.69%	13.12%	0.35%	30.86%	10.69 bps
15%	2.69%	2.37%	0.06%	27.43%	1.72 bps	2.69%	12.23%	0.33%	32.05%	10.36 bps

Table 9: **Expected outsider loss from buying from informed insiders**

This table reports estimates of an outsider's unconditional expected loss per transaction from buying shares from an informed insider instead of from another outsider. We use the two insider definitions described in Table 4 and consider one-week and one-month holding periods. We consider an insider's sale as informed if the stock return over the next week or next month is below a prespecified threshold value R^{th}. We approximate the probability that an outsider buys from an informed insider by multiplying the unconditional probability of buying from an insider π_B^{ins} by the probability that the insider is trading based on private information π_B^{inf}. We compute π_B^{ins} in columns 1 and 7 as the number of buys by outsiders from insiders divided by the total number of outsider buy transactions in our sample. We proxy π_B^{inf} in columns 2 and 8 by the number of outsider buys from insiders that are followed by a stock return that is below the threshold R^{th} divided by the total number of outsider buys from insiders in our sample. Columns 4 and 9 show the expected holding period return $E(R_B^{inf})$ on stocks bought from informed insiders, measured as the average of all one-week or one-month stock returns after buys from insiders that are below the threshold R^{th}. Columns 5 and 10 report an outsider's expected loss from buying from an informed insider instead of from another outsider, computed as $E(L_B^{inf}) = -\pi_B^{ins}\pi_B^{inf}[E(R_B^{inf}) - E(R_B^{out})]$, where $E(R_B^{out})$ denotes the expected return on stocks bought from outsiders as reported in Table 6.

Holding period	Week					Month				
R^{th}	π_B^{ins}	π_B^{inf}	$\pi_B^{ins} \times \pi_B^{inf}$	$E(R_B^{inf})$	$E(L_B^{inf})$	π_B^{ins}	π_B^{inf}	$\pi_B^{ins} \times \pi_B^{inf}$	$E(R_B^{inf})$	$E(L_B^{inf})$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Panel A: Insider definition: Board										
0%	1.53%	46.18%	0.71%	-3.07%	2.48 bps	1.53%	39.33%	0.60%	-6.54%	4.30 bps
-3%	1.53%	13.45%	0.21%	-8.22%	1.78 bps	1.53%	20.44%	0.31%	-11.32%	3.73 bps
-6%	1.53%	4.40%	0.07%	-16.05%	1.11 bps	1.53%	10.35%	0.16%	-17.93%	2.93 bps
-9%	1.53%	3.49%	0.05%	-18.37%	1.00 bps	1.53%	7.63%	0.12%	-21.74%	2.61 bps
-12%	1.53%	2.85%	0.04%	-20.26%	0.90 bps	1.53%	5.05%	0.08%	-27.19%	2.14 bps
-15%	1.53%	2.72%	0.04%	-20.56%	0.87 bps	1.53%	3.10%	0.05%	-36.24%	1.75 bps
Panel B: Insider definition: Board+Pre&Post Board										
0%	2.70%	46.63%	1.26%	-2.58%	3.80 bps	2.70%	40.86%	1.10%	-6.12%	7.39 bps
-3%	2.70%	10.95%	0.30%	-7.73%	2.41 bps	2.70%	19.91%	0.54%	-11.16%	6.31 bps
-6%	2.70%	3.70%	0.10%	-14.33%	1.48 bps	2.70%	9.77%	0.26%	-18.05%	4.92 bps
-9%	2.70%	2.66%	0.07%	-17.20%	1.27 bps	2.70%	7.62%	0.21%	-21.08%	4.46 bps
-12%	2.70%	1.92%	0.05%	-19.85%	1.05 bps	2.70%	5.40%	0.15%	-25.19%	3.76 bps
-15%	2.70%	1.70%	0.05%	-20.63%	0.97 bps	2.70%	3.03%	0.08%	-34.90%	2.91 bps

Figure A1: **South Sea debt conversion scheme**

This figure summarizes the main characteristics of the South Sea debt conversion scheme. The top of the figure (blue arrows) illustrates the situation before 1720 when the government had issued irredeemable annuities with high and fixed interest rates and the annuity holders had lent money to the government. The bottom part of the figure (yellow arrows) illustrates the role of the South Sea Company. It pays a fixed fee to the government and obtains the right to issue a fixed number of new shares and convert outstanding annuities into shares. The annuity holders receive South Sea shares in exchange for the annuities.

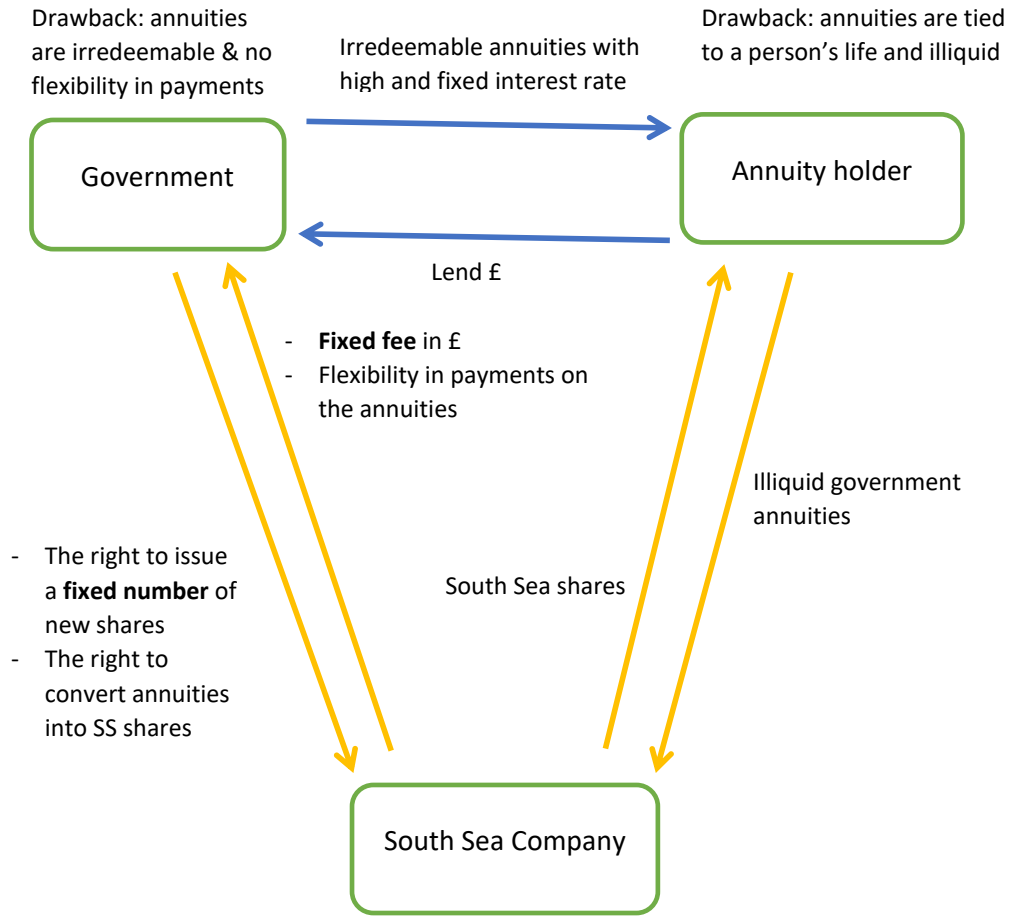

Table A1: **Trader characteristics**

This table reports characteristics for traders in our sample. Column one shows trader addresses and column two the number of times that the address in column one is part of a trader's home address. Column three shows the number of times a trader's home address exactly matches the address in column one. Column four shows trader occupations and column five the number of times a trader reports the occupation in column as one of her occupations. Column six shows the number of times a trader reports the occupation in column four as her only occupation. Column seven displays titles and column eight the number of times that a trader reports the title in column seven as one of her titles. Column nine lists the number of times a trader's title exactly matches the title in column seven. The three trader characteristics are sorted in descending order on columns two, five, and eight, respectively.

Address	**Contains**	**Exact**	**Occupation**	**Contains**	**Exact**	**Title**	**Contains**	**Exact**
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
London	4669	857	Merchant	1776	1616	Baron	204	2
Westminster	1686	50	Draper	249	52	Baronet	155	141
Holland, Netherlands	810	2	Goldsmith	187	171	Knight	130	109
St. James'	582	28	Linen Draper	139	123	Earl	44	1
Holborn	568	22	Mercer	121	99	Dowager	30	1
Amsterdam, Holland, Netherlands	550	550	Clerk	120	110	Viscount	26	1
St. James', Westminster	509	150	Haberdasher	111	94	Duke	14	1
St. Martin-in-the-Fields, Westminster	489	89	Apothecary	107	105	Baronet / Knight	11	11
St. Andrew's, Holborn	425	68	Grocer	101	91	Baroness	9	1
Surrey	359	2	Surgeon	74	57	Baron of the Exchequer	4	1
Kent	319	2	Broker	74	47	Councillor of State	3	3
St. Clement Danes, Westminster	276	26	Mariner	71	71	Knight of the Bath	3	3
Essex	224	1	Taylor	64	22	Chief Baron of the Exchequer	3	2
Inner Temple, London	151	150	Doctor	58	2	Viscount Lonsdale	2	2
St. Margaret's, Westminster	150	60	Distiller	57	56	Baron Brereton of Leighlin	2	2
Switzerland	145	3	Stationer	56	49	Earl of Litchfield	2	2
Southwark	136	38	Brewer	55	54	Earl of Halifax	2	2
Cornhill, London	132	103	Doctor in Physick	53	51	Viscount Fermanagh	2	1
Middle Temple, London	131	129	Salter	52	41	Prince	2	1
Hackney, Middlesex	128	120	Weaver	49	47	Marquess of Winchester	1	1

Table A2: **Expected outsider loss from trading with insiders: Alternative insider definitions (Robustness)**

This table reports estimates of an outsider's unconditional expected loss per transaction from trading with an insider instead of with another outsider. We consider four variations of the insider definitions in Table 7. *Board + Neighbours* expands the group of insiders with all traders who live in the same ward and trade in the same direction as the board members with the 20% most profitable trades, with profitability measured as the one-week (panel A) or one-month (panel B) stock return after each trade. *Board + Friends* adds the traders whose trades are repeatedly in the same direction as the 20% most profitable board member trades in each company, with profitability measured as the one-month stock return after each trade. *Board + Outperformers* augments the group of insiders with the most successful outsiders per company, defined as the 25 traders with the highest average monthly holding period return over the sample. Columns 1 and 5 report the unconditional probability that an outsider trades with an insider or with another outsider. Columns 2 and 6 show the expected weekly or monthly stock return after an outsider's trade. Columns 3 and 7 report an outsider's unconditional expected return when trading with insiders or outsiders. Columns 4 and 8 present an outsider's expected loss from trading with an insider instead of with another outsider. All numbers are calculated using the same methods as in Table 6.

Holding period	Week				Month			
	π_k^n	$E(R_k^n)$	$\pm\pi_k^n \times E(R_k^n)$	$E(L_k)$	π_k^n	$E(R_k^n)$	$\pm\pi_k^n \times E(R_k^n)$	$E(L_k)$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Panel A: Insider definition: Board+Neighbours (informed board trades, weekly return)							
Sell to insider ($k = S, n = ins$)	1.98%	0.85%	-1.69 bps	0.81 bps	1.98%	3.01%	-5.96 bps	4.74 bps
Sell to outsider ($k = S, n = out$)	98.02%	0.44%	-43.55 bps		98.02%	0.62%	-60.28 bps	
Buy from insider ($k = B, n = ins$)	1.80%	0.64%	1.16 bps	-0.36 bps	1.80%	0.86%	1.55 bps	-0.44 bps
Buy from outsider ($k = B, n = out$)	98.20%	0.44%	43.63 bps		98.20%	0.62%	60.39 bps	
	Panel B: Insider definition: Board+Neighbours (informed board trades, monthly return)							
Sell to insider ($k = S, n = ins$)	1.97%	1.02%	-2.01 bps	1.13 bps	1.97%	3.21%	-6.33 bps	5.11 bps
Sell to outsider ($k = S, n = out$)	98.03%	0.45%	-43.63 bps		98.03%	0.62%	-60.74 bps	
Buy from insider ($k = B, n = ins$)	1.75%	0.42%	0.73 bps	0.05 bps	1.75%	0.40%	0.70 bps	0.38 bps
Buy from outsider ($k = B, n = out$)	98.25%	0.45%	43.73 bps		98.25%	0.62%	60.88 bps	
	Panel C: Insider definition: Board+Friends (informed board trades, monthly return)							
Sell to insider ($k = S, n = ins$)	2.18%	0.84%	-1.84 bps	0.86 bps	2.18%	3.06%	-6.67 bps	5.32 bps
Sell to outsider ($k = S, n = out$)	97.82%	0.45%	-44.09 bps		97.82%	0.62%	-60.59 bps	
Buy from insider ($k = B, n = ins$)	2.00%	0.25%	0.50 bps	0.40 bps	2.00%	0.28%	0.55 bps	0.69 bps
Buy from outsider ($k = B, n = out$)	98.00%	0.45%	44.17 bps		98.00%	0.62%	60.70 bps	
	Panel D: Insider definition: Board+Outperformers (top outsiders, average monthly return)							
Sell to insider ($k = S, n = ins$)	2.90%	0.84%	-2.44 bps	1.15 bps	2.90%	2.61%	-7.57 bps	5.79 bps
Sell to outsider ($k = S, n = out$)	97.10%	0.44%	-43.17 bps		97.10%	0.61%	-59.60 bps	
Buy from insider ($k = B, n = ins$)	2.91%	0.45%	1.30 bps	-0.01 bps	2.91%	0.45%	1.31 bps	0.48 bps
Buy from outsider ($k = B, n = out$)	97.09%	0.44%	43.17 bps		97.09%	0.61%	59.59 bps	