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1 Introduction

Information asymmetry is a fundamentally important concept in finance and economics, since it influences most interactions between market participants, especially in cases of adverse selection and moral hazard. It is of particular interest to financial economists, as the fundamental purpose of financial markets is to aggregate dispersed information into market prices. Hence, it is crucial to understand the effects of information asymmetry on trading behavior of investors and as a result, on the outcomes and operation of securities markets.

The presence of foreign investors has increased prominently in recent decades. For instance, according to the NYSE Fact Book, foreign ownership in US stocks has grown from 3% in 1970 to 11% in 2001. As a result, foreign ownership has drawn an interest from researchers and the existing literature provides studies of the effects of foreign investments on productivity, investment and growth of invested firms (Henry, 2000; Bekaert et al., 2005, 2011) and also on stock price properties like liquidity, return volatility and the cost of capital (e.g. Bekaert and Harvey, 2000; Bae et al., 2004; Bekaert et al., 2007). Foreign investors are generally thought to be at an informational disadvantage compared to domestic investors and most of the existing literature finds an inverse relation between asymmetric information and foreign ownership (e.g. Jiang and Kim, 2004; Baik et al., 2013; Batten and Vo, 2015). Furthermore, foreign investors hold stocks that have characteristics associated with low information asymmetry, such as large size and low leverage (Kang and Stulz, 1997; Dahlquist and Robertsson, 2001; Batten and Vo, 2015).

Despite the findings of the relationship between information asymmetry and foreign ownership, there are no previous studies of the causality between these variables with a credible identification strategy. Thus, there are different possible explanations of the causal effects. For instance, in the inverse relationship case, Jiang and Kim (2004) argue that foreign investors are attracted to stocks with low information asymmetry, since they avoid stocks with cross-corporate holdings. In contrast, Choi et al. (2013) argue that the positive relationship of these variables is due to large foreign shareholders' positive contribution to stock price informativeness.

In this thesis, I empirically examine the effect of information asymmetry on foreign ownership in

the US stock markets. I contribute to the existing literature by first testing the general relationship between information asymmetry and foreign ownership, using multiple proxies for asymmetric information instead of just one. Second, I examine the causal effect of information asymmetry on foreign ownership, using the quasi-natural experiment setting of brokerage closures by Kelly and Ljungqvist (2012). Accordingly, I construct a difference-in-differences estimation, using the findings of Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013) that an exogenous decrease in analyst coverage due to these brokerage closures increase the asymmetric information of the covered firms. Third, I test whether the causal effect is emphasized in firms with low analyst coverage and institutional ownership.

Consistent with the main existing literature and my hypothesis, I find strong evidence for a negative relationship between asymmetric information and foreign ownership in fixed effects regression results with a panel data set. When compared to a whole market of investors, stockholdings and the number of foreign institutional investors are strongly negatively correlated with asymmetric information. In addition, when compared to institutional investors, there is a negative, although less pronounced, relation between the aforementioned variables.

Nonetheless, there is no evidence of causality between information asymmetry and foreign ownership. Furthermore, there is no evidence of the emphasized negative causal effect in firms with low analyst coverage and institutional ownership. The results are not altered when conducting several robustness tests such as a subset analysis of foreign institutional investor types, an alternative selection of control group or a use of instrumental variables for information asymmetry.

The structure of this thesis is as follows. I begin by discussing the existing literature in Section 2. Second, I develop the hypotheses in Section 3. Then, I describe and study the sample data in general in Section 4. Section 5 presents the methods used in the study. In Section 6, I present the empirical results of the study. Then, I conduct several robustness tests in Section 7. After that, I discuss the results and their implications in Section 8. Finally, Section 9 concludes.

2 Literature review

To build a theoretical framework of the study, I provide a literature review focusing on first describing information asymmetry and the relation between information asymmetry and analyst coverage. Then, I describe the relation between information asymmetry and foreign ownership.

2.1 Information asymmetry and analyst coverage

Information asymmetry has been perceived to be a typical characteristic of market transactions ever since Akerlof's (1970) classic example of how asymmetric information between the buyer and seller in the market for used cards leads to adverse selection. In the example, sellers have private information while buyers are uninformed market participants. Since the buyers cannot detect high-quality cars from bad-quality cars, they are willing to pay a price that is an average of these two types' values. Now, the sellers are incentivized to sell only low-quality cars, which results in an adverse selection situation that banishes the high-quality cars from the market.

In other settings of information asymmetry, buyers can be better-informed. For instance, the buyer of an insurance knows typically more about her individual risk, which as such leads to adverse selection. In addition to adverse selection, information asymmetry can result in moral hazard. For example, the buyer of an insurance is more likely to act carelessly after the contract has been signed, if the insurer has no efficient means to control for the insuree's actions. Since these asymmetries influence on different parties' incentives and optimal strategies, the topic has encouraged plenty of game theoretical studies. Consequently, some of the suggestions to mitigate information asymmetry are based on game theory. For instance, in games with signaling equilibria, the informed party can signal their type to the uninformed party (Spence, 1973) or in games with screening equilibria, the uninformed party may provoke the other party to reveal their information (Stiglitz, 1975).

Earlier literature of information asymmetry in financial markets studies it by examining the strategic behavior of investors. Kyle (1985) studies the strategic behavior of investors by a market microstructure model in which uninformed trades follow Brownian motion and market makers see only the order imbalance which they fill with matching orders that are crossed at the market-clearing

price. Orders are batched and therefore there are no bid and ask prices. The optimal trading behavior for the single informed investor is to exploit his information on trades gradually. In contrast, Glosten and Milgrom (1985) propose a microstructure model in which uninformed orders arrive as a Poisson process and orders are executed individually by market makers. They argue that due to informed investors, there is a positive bid-ask spread even when the market maker is risk-neutral and makes zero profits.

Several researchers have developed various measures to estimate the magnitude of information asymmetry. Easley et al. (1996) use a market microstructure model inspired by Glosten and Milgrom (1985) in which trade order flows affect the beliefs of market participants. The information of trade order flow is analyzed to estimate the magnitude to which trade order flows convey different information for different securities. As a result, they construct the well-known measure of the probability of informed trading (PIN) of which different researchers have developed various versions (e.g. Brown et al., 2004; Brown and Hillegeist, 2007; Duarte and Young, 2009; Easley et al., 2010). Johnson and So (2017) assume that informed investors trade more in options than uninformed investors. Based on the premise, they construct the multimarket information asymmetry (MIA) measure with daily trading volume data of stocks and options. Lof and van Bommel (2018) propose an easily computed measure of volume coefficient variation (VCV). They argue that orders of uninformed (informed) liquidity seekers are uncorrelated (perfectly correlated) and informed orders need to be matched by market makers. From the distribution of total trading volume, they construct functions of the proportion of informed trade and show that the coefficient of variation (the ratio of standard deviation to the mean) of trading volume increases monotonically in the proportion of informed trade.

A great amount of literature finds that equity research analysts produce relevant and valuable information for investors and firms (e.g., Womack, 1996; Barber et al., 2001; Jegadeesh et al., 2004; Loh and Stulz, 2010). Furthermore, as providers of information of the covered firms, analysts are also monitoring these firms (Moyer et al., 1989; Chung and Jo, 1996) and they help to reduce information asymmetry (Bushman and Smith, 2001; Healy and Palepu, 2001). Accordingly, Kelly and Ljungqvist (2012) find in a quasi-natural experiment setting that an exogenous decrease in analyst

coverage of a firm results in an increase of information asymmetry. Subsequently, many researchers have applied the setting of Kelly and Ljungqvist (2012) to study the effects of exogenous variation in analyst coverage on corporate policies (Derrien and Kecskés, 2013), innovation (He and Tian, 2013) and corporate tax aggressiveness (Allen et al., 2016).

2.2 Foreign ownership and information asymmetry

Foreign investors are generally thought to be less informed of local stock markets than local investors among finance practitioners and academics. Domestic investors are found to have better information and support from regulators. For instance, the home bias, the volatility of capital flows and herding among foreign investors are explained to be due to superior information of domestic investors as well as to regulators' bias against foreign investors (Choe et al., 2005). Although the literature of early 2000s provides some opposite evidence of information asymmetry between domestic and foreign investors (Grinblatt and Keloharju, 2000; Seasholes, 2000), the most recent studies support the traditional view that foreign investors are at an information disadvantage compared to domestic investors (Hau, 2001; Choe et al., 2005; Dvořák, 2005).

Compared to large literature of describing information advantages of domestic and foreign investors, the relationship of foreign ownership and information asymmetry is less studied. Choi et al. (2013) report that high foreign ownership is associated with high information asymmetry in Chinese markets using a bid-ask spread as a proxy for information asymmetry. Similarly, He et al. (2013) use a well-known measure of the probability of informed trading (PIN) and price non-synchronicity as proxies for information asymmetry when examining the connection between foreign ownership and information asymmetry with a cross-sectional data set of firms in 40 markets in 2002. They find, as well, that firms with large foreign ownership typically have more information-intensive stock prices (i.e. high information asymmetry). Based on their theoretical arguments and informal Granger causality test of one-year cross-sectional setting, authors argue that large foreign ownership contributes to information asymmetry.

In contrast to the positive relation between foreign ownership and asymmetric information, Kang and Stulz (1997) find that in Japanese markets foreign investors prefer significantly less smaller

firms than domestic investors, which they argue to be due to larger information asymmetry in small stocks between foreign and domestic investors. Similarly, Dahlquist and Robertsson (2001) find in Swedish markets that foreign investors prefer relatively more firms with comfortable characteristics such as large size due to information asymmetry factors. Furthermore, Jiang and Kim (2004) find evidence of inverse relation between foreign ownership and information asymmetry in Japanese markets. They focus on the relation between the level of foreign shareholdings and a measurable consequence of information asymmetry of which they use the timing and magnitude of intertemporal return-earnings associations. Moreover, they provide evidence that foreign investors tend to avoid stocks with high cross-corporate holdings.

Most recently, Batten and Vo (2015) find evidence of the inverse relation between foreign ownership and asymmetric information in Vietnamese markets. They find similarly as Kang and Stulz (1997) and Dahlquist and Robertsson (2001) supporting evidence of foreign investors holding shares in firms with familiar attributes to overcome information asymmetries. Moreover, Baik et al. (2013) find foreign investors' stronger preference for low information asymmetry stocks in the US markets. They measure information asymmetry based on a firm's size, return volatility, analyst forecast dispersion and R&D intensity of which they construct a single asymmetric information factor by principal component analysis.

I contribute to the existing literature by examining the relationship of foreign ownership and information asymmetry not just with a panel regression but also with a difference-in-differences research setting of brokerage closures (Kelly and Ljungqvist, 2012) which cause an exogenous shock to the analyst coverage of a firm's stock. Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013) argue that an exogenous decrease in analyst coverage causes an increase in information asymmetry of the covered firm. As a result, the research setting of brokerage closures enables me to assess the causal effect between information asymmetry and foreign ownership. Previous studies of information asymmetry and foreign ownership (Jiang and Kim, 2004; Choi et al., 2013; He et al., 2013) do not examine causality profoundly, which makes this thesis a first attempt, to the best of my knowledge, to study the causal effect of information asymmetry on foreign ownership. In addition, I test the general relationship of these two with panel regressions by using various proxies for information

asymmetry such as PIN by various researchers (Brown et al., 2004; Brown and Hillegeist, 2007; Duarte and Young, 2009; Easley et al., 2010), MIA (Johnson and So, 2017) and VCV (Lof and van Bommel, 2018).

3 Hypotheses

In this thesis, I study the effect of information asymmetry on foreign ownership in US stock markets. In particular, I examine how the foreign ownership of US stocks are affected by an exogenous reduction in analyst coverage using a credible quasi-natural experiment of brokerage closures (Kelly and Ljungqvist, 2012). Moreover, I test the general relationship of foreign ownership and information asymmetry with alternative proxy measures for information asymmetry in a panel regression setting. Based on these research settings, I construct the following hypotheses:

H1: Stocks with higher information asymmetry are associated with low foreign ownership

H2: An exogenous increase in information asymmetry of stocks results in a decrease of foreign ownership

H3: The reduction of foreign ownership due to an exogenous information asymmetry shock is emphasized in stocks with low institutional ownership and analyst coverage

The first hypothesis is mainly supported by the existing literature. Kang and Stulz (1997) and Dahlquist and Robertsson (2001) find that foreign investors prefer relatively more firms with characteristics associated with low information asymmetry, such as firm size. Jiang and Kim (2004) find an inverse connection between foreign ownership and information asymmetry using the timing and magnitude of intertemporal return-earnings associations in Japanese markets. Moreover, recent studies by Baik et al. (2013) and Batten and Vo (2015) find inverse relation between the variables in the US and Vietnamese markets, respectively.

Although the existing literature supports the hypothesis of the inverse relation between information asymmetry and foreign ownership, few studies address the causal relationship of these two variables directly as described in the second hypothesis. Based on their overall results, Jiang and

Kim (2004) argue that foreign investors are attracted to firms with low information asymmetry in Japanese markets. He et al. (2013) provide opposing results of positive relation and interpret these results to be due to a view that foreign investors contribute positively to the informativeness of stock prices. However, they point out that the potential reverse causality may drive their results but find it conceptually less likely. They argue that foreign investors could improve corporate governance and disclosure policies of firms of the invested firms. In the spirit of Granger causality test, they run a predictive regression with a one-year lag of dependent variable and find results to be consistent with foreign ownership Granger-causing price informativeness. Batten and Vo (2015) find in Vietnamese markets that foreign investors prefer firms of which characteristics are associated with low information asymmetry, such as large size, low leverage and high book-to-market ratio to overcome the information disadvantage compared to domestic investors. Furthermore, their finding is in line with previous studies of home bias that find foreign investors preferring firms with comfortable characteristics like large size or low leverage (Kang and Stulz, 1997; Dahlquist and Robertsson, 2001).

The existing literature finds that institutional investors can act as active monitors of management by directly intervening in a firm's operations (Shleifer and Vishny, 1986; Gillan and Starks, 2003; Ferreira and Matos, 2008). As a result of monitoring, information asymmetry of a stock is reduced. Accordingly, less uninformed investors like foreign investors consider institutional ownership as a convincing signal that information asymmetry risk of a given stock is mitigated (Luong et al., 2015). Similarly, Lof and van Bommel (2018) argue that an exogenous decrease of analyst coverage is a greater shock for a firm that initially has a low analyst coverage. Hence, the third hypothesis is largely supported by existing literature.

4 Data

In this section, I describe how I select and construct the variables of the baseline sample which is used in examining the general relation between foreign ownership and information asymmetry. In addition, I describe the data processing of quasi-natural experiment sample which is used in testing

the causal effect between the aforementioned variables. I also provide summary statistics of these.

4.1 Sample selection

The baseline sample examined in this study includes US listed firms during the period of 1997-2017. Data for foreign, domestic and institutional shareholdings is retrieved from Thomson Reuters institutional holdings (form 13F) database. To calculate the stock price related control variables, the information asymmetry proxies *BA_SPREAD*, *VCV* as well as foreign and institutional ownership measures, I gather stock price information from the Center for Research in Security Prices (CRSP). Accounting related control variables are collected from COMPUSTAT. The 13F data is merged with CRSP by matching the 8-digit CUSIP identifier from 13F to the 8-digit NCUSIP from CRSP. I use CRSP-COMPUSTAT Merged Database (CCM) to merge CRSP and COMPUSTAT datasets. Firm-year estimates of information asymmetry proxies PIN_{BHL} (Brown et al., 2004), PIN_{BH} (Brown and Hillegeist, 2007), PIN_{EHO} (Easley et al., 2010), PIN_{DY} (Duarte and Young, 2009), PIN_{DY_ADJ}, $PSOS_{DY}$ and firm-day estimates of *MIA* (Johnson and So, 2017) are collected from the cited authors' websites [1]. Information asymmetry measures are merged with the baseline sample by using the CRSP's Permanent Issue Number (PERMNO) as a linking identifier. The baseline sample selection process ends up with firm-year observations.

The quasi-natural experiment sample includes US listed firms during the period of 1997-2010. Similar to baseline setting, I collect institutional ownership data from 13F, stock price related variables from CRSP and accounting related variables from COMPUSTAT. In addition, I use the list of brokerage closures in Appendix A of Kelly and Ljungqvist (2012) and analyst coverage data from Institutional Brokers' Estimate System (IBES) to identify stocks that experience exogenous reductions in analyst coverage due to these brokerage closures. Since the quasi-natural experiment sample does not involve aforementioned information asymmetry measures, the sample selection process ends up with firm-quarter observations.

[1] Firm-year observations of PIN_{BHL}, PIN_{BH}, PIN_{DY}, PIN_{DY_ADJ}, $PSOS_{DY}$ and PIN_{EHO} are made available by Stephen Brown (http://scholar.rhsmith.umd.edu/sbrown/pin-data), Jefferson Duarte (http://www.owlnet.rice.edu/~jd10/) and Søren Hvidkjær (https://sites.google.com/site/hvidkjaer/data), respectively. Daily firm-level observations of *MIA* are made available by Travis Johnson (http://travislakejohnson.com/data.html).

4.2 Constructing the variables

I extract foreign ownership data from Thomson Reuters institutional holdings (form 13F) s34 master file. I define firm-quarter level shareholdings as foreign by taking the sum of all the institutional shareholdings where the institution's country is other than the US. Then, I follow Glushkov et al. (2009) to match the 13F data with CRSP's monthly file and taking into account the adjustments for shares outstanding from CRSP. Similarly, I define institutional ownership variables of CRSP stocks with no 13F data as zero. Finally, I define two variables *FOR_OWN* and *FOR_BREADTH* of which the former is defined as an annual average of the shares of a firm held by foreign institution at the end of each quarter divided by the firm's total shares outstanding (CRSP) at the end of each quarter. The latter is defined as an annual average of the number of distinct foreign institutions holding shares in the firm at the end of each quarter divided the total number of institutions in the 13F database at the end of each quarter (Chen et al., 2002; Lof and van Bommel, 2018). I also construct the variables for total institutional ownership *INST_OWN* and *INST_BREADTH* in a similar manner.

In addition to these market level ownership measures, I define two variables to examine foreign institutional investors' ownership against total institutional investors' ownership. *FOR_TO_INST_OWN* is defined as an annual average of a firm's shares held by foreign institution at the end of each quarter divided by shares held by total institutions at the end of each quarter. *FOR_TO_INST_BREADTH* is defined as an annual average of the number of foreign institutions holding shares in the firm at the end of each quarter divided by the number of total institutions holding shares in the firm at the end of each quarter.

I notice that there are some observations of *INST_OWN* and *FOR_OWN* where the shares held by institutions exceeds shares outstanding. This is a known limitation of the 13F data. Institutional investors are not required to report their short selling positions, which is a plausible explanation for the issue (Lewellen, 2011). To mitigate the problem, I follow Lewellen (2011) and winsorize all the ownership variables at the top to a maximum of 1. In comparison of the firm-year level data set in the baseline research setting, I construct the variables for the quasi-natural research sample similarly but at the firm-quarter level.

I obtain data for information asymmetry measures of annual firm-level PIN (PIN_{BHL}, PIN_{BH}, PIN_{EHO}, PIN_{DY} and PIN_{DY_ADJ}), $PSOS_{DY}$ and daily firm-level *MIA* observations from the cited researchers' publicly available websites and CRSP. I construct the firm-year observations of *MIA* by calculating the annual average of daily observations for each firm. Data for bid-ask spread is collected from CRSP and I define *BA_SPREAD* as the annual average of the daily observations of difference in ask and bid price divided by closing price. Data for proxy measure VCV is retrieved from CRSP daily stock file. Following Lof and van Bommel (2018), I construct the annual firm-level observations of VCV by computing the fraction of the annual standard deviation of daily trading volumes and the annual average of daily trading volumes. I require firms to have at least 200 days with a positive trading volume in a year. Similarly, I calculate the *VCV* using three different measures of trading volume: volume in US dollars (VCV_{USD}), volume market shares (VCV_{MKT}) and turnover (VCV_{TO}).

I gather control variables data from COMPUSTAT quarter fundamentals and CRSP monthly stock files. To make CRSP and COMPUSTAT variables comparable, I convert monthly CRSP data to quarter level by taking the last non-missing estimate for a stock in each quarter of the given variable. Using CRSP, I compute *LOG_MKT_CAP* by multiplying market price of each stock by the shares outstanding at the end of each quarter, converting it to an annual average and taking the logarithm of this measure. Accounting related control variables are gathered from COMPUSTAT. *BM_RATIO* is an annual average of the stock's book value of equity divided by the market value at the end of each quarter. *LEVERAGE* is an annual average of the stock's total debt divided by total assets at the end of each quarter. *ROA* is an annual average of the stock's net income divided by total assets at the end of each quarter. I use two-digit SIC codes from CRSP to capture the corresponding industry for each stock. I report a detailed list of variables and definitions in Table 8 in Appendix A.

4.3 Identification of the quasi-natural experiment

For the quasi-natural experiment, I limit the time period of the baseline sample to 1997-2010 to cover the time period of 22 distinct brokerage closures from June 2000 until November 2007 listed in Appendix A of Kelly and Ljungqvist (2012) plus three years of pre- and post-treatment periods.

I identify stocks that lose an analyst covering the firm because of the brokerage closures which provide a source of exogenous variation for the analyst coverage. The list is matched with an analyst coverage data retrieved from the Institutional Brokers' Estimate System (IBES) detail file.

The identification strategy of the quasi-natural experiment setting by Kelly and Ljungqvist (2012) is based on argument that in addition to genuine financial distress reasons, brokerage firms respond to adverse changes in revenue making by downsizing or closing their research operations. Hence, the decisions to close research department is driven by business strategy rather than by the characteristics of the firms covered by their analysts. Therefore, the brokerage closure events provide a robust quasi-experimental setting of exogenous reductions in analyst coverage. I also rely on the findings of Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013) that an exogenous decrease in analyst coverage causes an increase in information asymmetry of the covered firm. Kelly and Ljungqvist (2012) include also events of the brokerage mergers which require a thorough data processing to eliminate potential endogeneity problems. Dealing with these endogeneity issues is crucial in order to use merger events as a source of exogenous variation. Due to data availability and potential endogeneity issues, I limit my sample of events to include only brokerage closures.

To construct the sample of treated firms, I filter out firms that are not covered by analysts employed in the brokerage houses listed in Appendix A of Kelly and Ljungqvist (2012). Following Derrien and Kecskés (2013), I require for the treated firms to be covered by an analyst at least one year before the disappearance dates to filter out firms that are not actively covered by the analysts. Furthermore, following Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013), I only retain firms for which the analyst has not "stopped" his estimate before the corresponding broker disappearance date to eliminate the potential endogeneity problem. For instance, if an analyst terminates the coverage of firms unrelated to the brokerage closure before the disappearance date (e.g. anticipating changes in corporate policies), the decision is endogenous. I collect the data for stopped estimates from IBES stop file.

I start the identification of control firms by gathering all distinct firms from IBES detail file. To make groups comparable, I require similarly the potential control firms to be covered by an analyst one year before the disappearance dates to keep only actively covered firms. Second, based on the

treatment group, I identify firms that, for a given event, are not affected by the reductions in analyst coverage. Then, I merge IBES data with CRSP, COMPUSTAT and 13F and have a data set of treated and potential control stocks with variables of institutional ownership, stock price and accounting related measures. Moreover, I define the variable *ANALYST_COVERAGE* as the number of distinct analysts covering a firm (source: IBES) in a given quarter.

To construct the final sample of control firms, I follow recent studies (e.g. Allen et al., 2016; Bena et al., 2017) and use propensity score matching (nearest neighbor) to match each treatment firm to three control firms. *TREATED* is a dummy variable that equals one if a firm is affected by a brokerage closure and zero otherwise. For each brokerage closure, I estimate a logistic regression model with *TREATED* as a dependent variable and averages of three-year pre-event measures of the logarithm of market capitalization (*LOG_MKT_CAP*), book-to-market ratio (*BM_RATIO*) and the number of distinct analysts (*ANALYST_COVERAGE*) as explanatory variables.

Since brokerage closures tend to extend over several months, the dates listed by Kelly and Ljungqvist (2012) and corresponding disappearance dates do not coincide completely. Hence, I follow Derrien and Kecskés (2013), He and Tian (2013) and Lof and van Bommel (2018) to construct a three-month gap before and after the event date. As a result, I estimate the dependent variables and explanatory variables for each stock in a given quarter by subtracting (adding) three months from the event date and finding the previous (next) available quarter value for before and after measures, respectively.

4.4 Summary statistics

In this section, I report the summary statistics of sample variables. First, I report the summary statistics of the main variables in baseline setting. Then, I examine the time series development of ownership-specific variables during baseline sample period. Finally, I present the summary statistics of the quasi-natural experiment sample.

Table 1 presents the summary statistics of sample variables used in the baseline setting. I report the mean, standard deviation, minimum, first quartile, median, third quartile and maximum of firm-year

observations of ownership-specific, control and information asymmetry variables.

Table 1: Summary statistics of the baseline sample

This table reports summary statistics of firm-year observations of baseline sample variables. Ownership-specific variables are winsorized at the top to a maximum of 1. Control variables, bid-ask spread (*BA_SPREAD*) and different VCV measures are winsorized at the top and bottom by 1%. Table 8 in Appendix A provides a detailed list of variable definitions. Sample period: 1997-2017. Sources: CRSP, COMPUSTAT, 13F and the cited authors' websites.

Variable	N	Mean	St. Dev.	Min	P25	Median	P75	Max
FOR_OWN	110,819	0.033	0.056	0.000	0.001	0.016	0.043	1.000
FOR_BREADTH	110,819	0.003	0.006	0.000	0.0005	0.001	0.004	0.060
INST_OWN	110,819	0.438	0.316	0.000	0.140	0.409	0.718	1.000
INST_BREADTH	110,819	0.040	0.060	0.000	0.006	0.021	0.049	0.673
FOR_TO_INST_OWN	109,907	0.077	0.122	0.000	0.009	0.043	0.089	1.000
FOR_TO_INST_BREADTH	109,907	0.085	0.089	0.000	0.038	0.067	0.106	1.000
LOG_MKT_CAP	110,819	5.701	2.048	1.301	4.200	5.630	7.108	10.785
BM_RATIO	110,819	0.714	0.612	0.034	0.318	0.563	0.907	3.931
LEVERAGE	110,819	0.529	0.261	0.035	0.316	0.534	0.743	1.140
ROA	110,819	−0.012	0.064	−0.425	−0.010	0.004	0.015	0.105
BA_SPREAD	110,819	0.046	0.030	0.003	0.024	0.037	0.059	0.175
PIN_{BHL}	78,226	0.196	0.118	0.000	0.105	0.197	0.273	1.000
PIN_{BH}	78,335	0.233	0.134	0.000	0.131	0.202	0.304	1.000
PIN_{DY}	15,025	0.203	0.119	0.00000	0.121	0.167	0.244	1.000
PIN_{DY_ADJ}	15,025	0.162	0.086	0.000	0.103	0.140	0.197	0.903
$PSOS_{DY}$	15,025	0.284	0.156	0.000	0.177	0.233	0.346	1.000
PIN_{EHO}	9,498	0.188	0.091	0.000	0.120	0.166	0.234	0.895
MIA	20,813	0.416	0.106	0.014	0.351	0.422	0.477	1.000
VCV_{USD}	94,888	1.305	0.854	0.370	0.704	1.081	1.614	4.986
VCV_{MKT}	94,888	1.282	0.862	0.328	0.675	1.062	1.598	5.021
VCV_{TO}	94,888	1.252	0.792	0.377	0.690	1.039	1.546	4.558

As shown in Table 1, the mean and median of foreign institutional ownership (*FOR_OWN*) are 3.3% and 1.6%, respectively. The corresponding measures for total institutional ownership (*INST_OWN*) are 43.8% and 40.9%. The results are mainly in line with the findings of Baik et al. (2013), who report the mean (median) of 2.62% (2.48%) for foreign ownership and 40.0% (36.5%) for institutional ownership. They use similarly 13F data, but they compute ownership variables with 13F and COMPUSTAT data, compared to 13F and CRSP data in my sample. Moreover, their sample period is 1990-2007 and they report the summary statistics with firm-quarter observations. Hence, our samples are not perfectly comparable. Notably, the minimum (0.0%) and first quartile (14.0%) compared to the third quartile (71.8%) and maximum (100.0%), along with the standard deviation (31.6%), indicate a high variability of institutional ownership. Foreign ownership has similar, but

lower variability between firm-quarter observations.

The summary statistics of information asymmetry are also similar with previous studies. The mean and median of different PIN measures are both approximately 0.20 and the corresponding measures for MIA are 0.416 and 0.422, respectively, which are consistent with the findings of Lof and van Bommel (2018). Moreover, the means (medians) of different VCV measures are approximately 1.3 and 1.1, respectively, which are consistent with their findings. The control variables are in line with the recent studies that use COMPUSTAT or CRSP data with similar variables and definitions (e.g. Baik et al., 2013; Allen et al., 2016; Lof and van Bommel, 2018). It is important to note that there are some outliers such as the winsorized maximum (114.0%) of leverage ratio (*LEVERAGE*), which supports the methodology of winsorizing control variables to mitigate the effect of these outliers in regression analysis.

Next, I examine the time series development of foreign and institutional ownership during the sample period of 1997-2017, by plotting the mean of firm-quarter observations of these variables. Figure 1 presents the results.

As shown in Panel A, the mean of foreign ownership increases from under 2% in 1997 to almost 6% in 2009, which is followed by a steep decline to approximately 3%. After 2009, foreign ownership increases steadily to ca. 5% in 2017. In Panel B, the mean of institutional ownership increases from 30% in 1997 to approximately 55% in 2008, which is followed by a slight downturn. After 2011, institutional ownership increases steadily to over 55%. Interestingly in Panel A, there is an abrupt drop in foreign ownership during the last quarter of 2003 and an immediate bounce back in the next quarter. In Panel B, there is a similar but relatively much smaller drop during the same quarter. This finding, as well as the overall trend, is in line with the results of Glushkov et al. (2009). They present the time series development of the mean of institutional ownership classified into five different size quintiles. The drop in the last quarter of 2003 is more affected in the largest bin of stocks, which is consistent with my findings that foreign investors invest more in larger firms.

Next, I examine the relation between the sample variables used in baseline setting by a correlation matrix. Table 2 reports correlations of annual firm-level estimates between the variables used in baseline setting. Each value is a time-series average of within-year correlations (Pearson), which

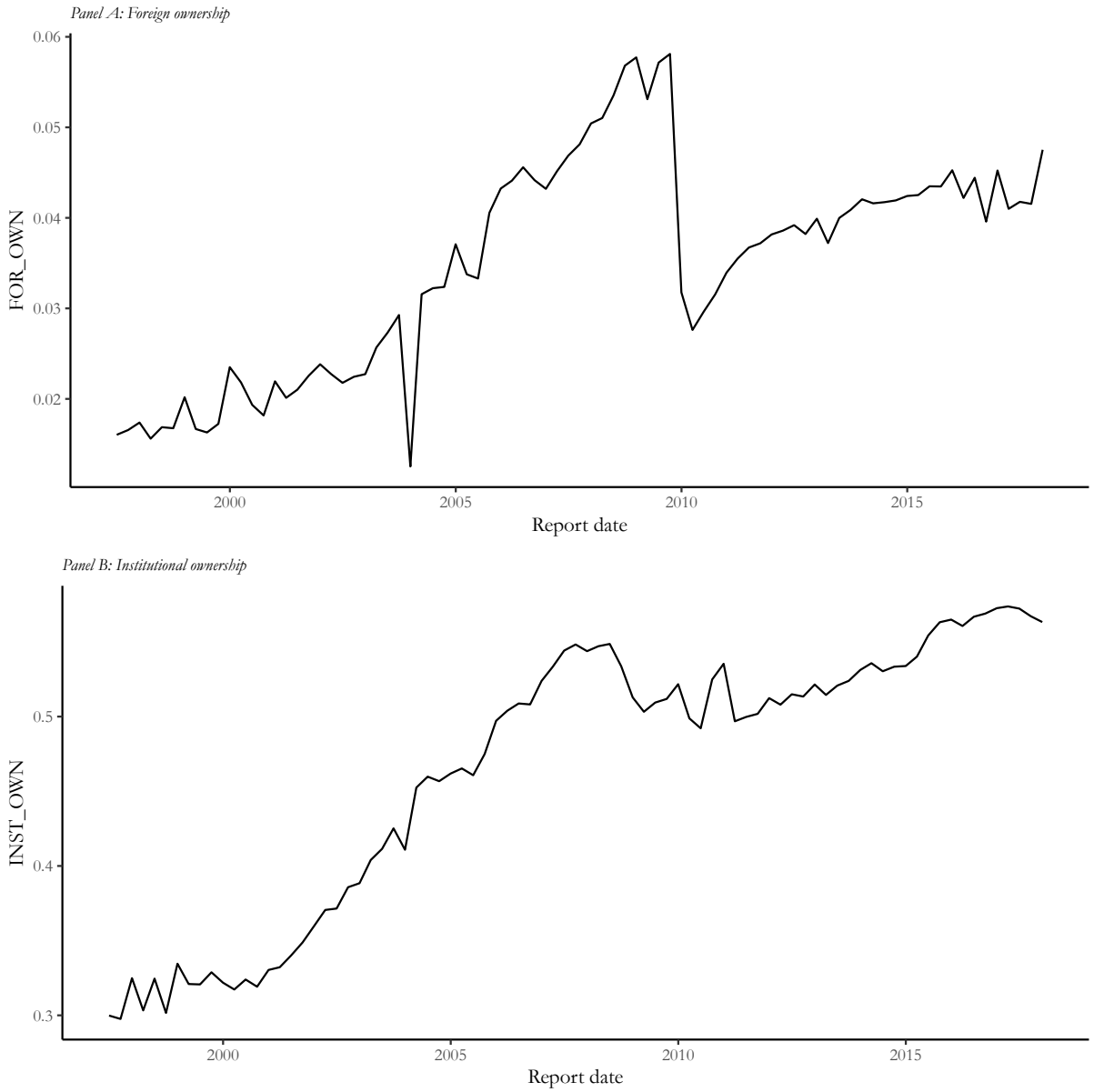

Figure 1: Time series development of foreign and institutional ownership during baseline sample period

This figure presents the evolution of the mean of firm-quarter observations of foreign ownership (*FOR_OWN*) in Panel A and institutional ownership (*INST_OWN*) in Panel B during the baseline sample period of 1997-2017. Firm-quarter observations of these variables are winsorized at the top to a maximum of 1. Sources: CRSP and 13F.

mitigates the effect of potential time series trends between variables. The total sample time period extends from 1997 to 2017. However, this holds true for all variables except PIN_{BH} (1997-2010), PIN_{DY_ADJ} (1997-2004), PIN_{EHO} (1997-2001) and *MIA* (1997-2015).

Table 2: Correlations between baseline sample variables

This table reports the correlations between different ownership-specific, information asymmetry and firm-characteristic control variables of the baseline sample. Each correlation estimate is the annual average of the within-year of (Pearson) correlations. Of the information asymmetry measures, I include PIN_{BH}, PIN_{DY_ADJ}, PIN_{EHO}, MIA and VCV_{USD}. Ownership-specific variables are winsorized at the top to a maximum of 1 and control variables are winsorized at the top and bottom 1%. Table 8 in Appendix A provides a detailed list of variable definitions. Sample period: 1997-2017. Sources: CRSP, COMPUSTAT, 13F and the cited authors' websites.

	FOR_OWN	FOR_TO_INST_OWN	FOR_BREADTH	FOR_TO_INST_BREADTH	INST_OWN	INST_BREADTH	LOG_MKT_CAP	BM_RATIO	LEVERAGE	ROA	BA_SPREAD	PIN_{BH}	PIN_{DY_ADJ}	PIN_{EHO}	MIA	VCV_{USD}
FOR_OWN	1															
FOR_TO_INST_OWN	0.55	1														
FOR_BREADTH	0.39	0.18	1													
FOR_TO_INST_BREADTH	0.33	0.7	0.21	1												
INST_OWN	0.41	-0.04	0.45	0.01	1											
INST_BREADTH	0.27	0.06	0.93	0.05	0.46	1										
LOG_MKT_CAP	0.35	0.15	0.76	0.16	0.59	0.74	1									
BM_RATIO	-0.09	-0.05	-0.17	-0.04	-0.17	-0.17	-0.33	1								
LEVERAGE	0	-0.02	0.09	-0.03	0.01	0.1	0.1	0.08	1							
ROA	0.13	0.01	0.19	0.02	0.27	0.2	0.32	0.03	0.11	1						
BA_SPREAD	-0.19	-0.03	-0.3	-0.05	-0.36	-0.31	-0.49	0.12	-0.22	-0.52	1					
PIN_{BH}	-0.28	-0.07	-0.49	0	-0.53	-0.5	-0.66	0.28	0.13	-0.08	0.04	1				
PIN_{DY_ADJ}	-0.46	-0.06	-0.52	0.14	-0.51	-0.53	-0.67	0.26	-0.07	-0.08	0.11	0.74	1			
PIN_{EHO}	-0.46	0.05	-0.54	0.27	-0.54	-0.57	-0.73	0.26	-0.08	-0.12	0.25	0.74	0.69	1		
MIA	-0.09	-0.08	-0.41	-0.05	0.03	-0.42	-0.39	0.13	0.04	-0.14	0.02	0.42	0.29	0.14	1	
VCV_{USD}	-0.24	-0.09	-0.4	-0.1	-0.42	-0.4	-0.58	0.16	-0.07	-0.27	0.36	0.49	0.55	0.52	0.24	1

Variable *FOR_OWN* is negatively correlated with all information asymmetry measures, which is consistent with the first hypothesis. The negative relation is the strongest with the different probability of informed trading measures and the least strong with *MIA*. Moreover, the correlations of *FOR_OWN* with the control variables of different firm characteristics are intuitive and in line with the existing literature. Foreign investors tend to own firms with larger market capitalizations, greater profitability and smaller book-to-market ratios (i.e. non-value stocks). However, foreign ownership has a positive relation with leverage, implying a preference of more in-debt firms. The relation between foreign ownership and total institutional ownership is positive, indicating that foreign investors have similar stockholdings with institutional investors in general. Accordingly, *FOR_BREADTH* has similar but stronger correlations with other variables than *FOR_OWN*.

Information asymmetry measures are strongly positively correlated with each other, which is consistent and implies that they capture similar explanatory characteristics. All control variables except *LOG_MKT_CAP* have relatively weak correlations with the information asymmetry measures, which enables me to use them as explanatory variables in a regression model with a low risk of multicollinearity. As a result, I choose to exclude *LOG_MKT_CAP* from subsequent regression models due to a potential risk of multicollinearity.

Finally, I present the summary statistics of sample variables used in the quasi-natural experiment. Table 3 presents the summary statistics of sample variables used in the quasi-natural experiment. I report the mean, standard deviation, minimum, first quartile, median, third quartile and maximum of firm-quarter observations of ownership-specific, control and analyst coverage variables for each group of treatment, control and a whole sample of firms.

Table 3: Summary statistics of the quasi-natural experiment sample
This table reports summary statistics of firm-quarter observations of the quasi-natural experiment sample variables. Ownership-specific variables are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom by 1%. Table 8 in Appendix A provides a detailed list of variable definitions. Sample period: 1997-2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

Variable	N	Mean	St. Dev.	Min	P25	Median	P75	Max
Panel A: All firms								
FOR_OWN	231,318	0.047	0.044	0.000	0.020	0.040	0.061	1.000
FOR_BREADTH	231,318	0.007	0.007	0.000	0.002	0.004	0.010	0.054

INST_OWN	231,318	0.613	0.253	0.00000	0.437	0.652	0.812	1.000
INST_BREADTH	231,318	0.099	0.102	0.0003	0.036	0.068	0.124	0.684
FOR_TO_INST_OWN	231,318	0.079	0.075	0.000	0.039	0.065	0.096	1.000
FOR_TO_INST_BREADTH	231,318	0.069	0.046	0.000	0.044	0.061	0.083	1.000
LOG_MKT_CAP	231,318	7.279	1.797	1.301	6.091	7.280	8.518	10.785
BM_RATIO	231,318	0.555	0.485	0.034	0.262	0.441	0.693	3.931
LEVERAGE	231,318	0.530	0.250	0.035	0.330	0.537	0.722	1.000
ROA	231,318	0.001	0.052	−0.425	0.001	0.009	0.021	0.105
ANALYST_COVERAGE	231,318	10.038	8.133	0	4	8	15	50
Panel B: Treated firms								
FOR_OWN	58,634	0.047	0.039	0.000	0.022	0.042	0.062	1.000
FOR_BREADTH	58,634	0.008	0.007	0.000	0.002	0.005	0.013	0.051
INST_OWN	58,634	0.634	0.235	0.00000	0.484	0.672	0.813	1.000
INST_BREADTH	58,634	0.120	0.119	0.0004	0.042	0.080	0.154	0.684
FOR_TO_INST_OWN	58,634	0.075	0.061	0.000	0.041	0.065	0.095	1.000
FOR_TO_INST_BREADTH	58,634	0.068	0.040	0.000	0.045	0.061	0.083	1.000
LOG_MKT_CAP	58,634	7.580	1.865	1.301	6.248	7.562	8.988	10.785
BM_RATIO	58,634	0.551	0.506	0.034	0.248	0.425	0.686	3.931
LEVERAGE	58,634	0.512	0.249	0.035	0.309	0.517	0.698	1.000
ROA	58,634	0.001	0.051	−0.425	0.0002	0.009	0.021	0.105
ANALYST_COVERAGE	58,634	12.224	9.039	0	5	11	18	50
Panel C: Control firms								
FOR_OWN	172,684	0.047	0.046	0.000	0.019	0.039	0.061	1.000
FOR_BREADTH	172,684	0.006	0.006	0.000	0.002	0.004	0.009	0.054
INST_OWN	172,684	0.605	0.259	0.00000	0.419	0.644	0.811	1.000
INST_BREADTH	172,684	0.092	0.094	0.0003	0.035	0.064	0.115	0.684
FOR_TO_INST_OWN	172,684	0.080	0.079	0.000	0.039	0.064	0.097	1.000
FOR_TO_INST_BREADTH	172,684	0.069	0.048	0.000	0.043	0.060	0.083	1.000
LOG_MKT_CAP	172,684	7.176	1.761	1.301	6.032	7.205	8.354	10.785
BM_RATIO	172,684	0.556	0.477	0.034	0.268	0.446	0.695	3.931
LEVERAGE	172,684	0.536	0.250	0.035	0.337	0.544	0.729	1.000
ROA	172,684	0.001	0.052	−0.425	0.001	0.009	0.021	0.105
ANALYST_COVERAGE	172,684	9.296	7.661	0	3	8	14	49

As shown in Panel A of Table 3, the mean and median of foreign institutional ownership (*FOR_OWN*) are 4.7% and 4.0%, respectively. The corresponding measures for total institutional ownership (*INST_OWN*) are 61.3% and 65.2%, respectively. The estimates are notably higher than in the baseline setting. This is largely explained by the fact that the exogenous reductions in analyst coverage are more affected by larger firms which have higher share of foreign ownership. Furthermore, the control firms are matched with a ratio of three by similar firm characteristics. Hence, it is consistent that *LOG_MKT_CAP* has higher mean, *BM_RATIO* lower mean and *ROA* higher mean than in the baseline setting. There is no essential difference in *LEVERAGE* between Tables 1 and 3. *ANALYST_COVERAGE* has a mean of 10.038, with a minimum of 0 and a maximum of 50, indicating large variation between firm-quarter observations.

Based on Panels B and C, there are no large differences in ownership-specific variables between the treatment and control groups. *FOR_OWN* is 4.7% for both groups, although the median is higher for the treatment group (4.2%) than the control group (3.9%). Institutional ownership is slightly higher in the treatment group both in dollar terms (*INST_OWN*) and in numbers (*INST_BREADTH*). Moreover, the differences in control variables between the groups are almost to zero, except the variables *LOG_MKT_CAP* and *ANALYST_COVERAGE*. Although the control group is matched by these covariates and *BM_RATIO*, this finding suggests that treated firms are persistently larger firms and highly covered by analysts.

5 Methodology

To empirically examine the first hypothesis of the thesis, I use a panel regression model for the baseline sample. A difference-in-differences regression model is employed with the quasi-natural experiment sample to test the second and third hypotheses.

5.1 The panel regression model

I test the relation of foreign ownership and information asymmetry by using the following panel regression model (OLS) of firm-year observations with fixed effects:

$$\begin{aligned} FOREIGN_{i,t} = \beta_0 + \beta_1 IA\_MEASURE_{i,t} + \beta_2 BM\_RATIO_{i,t} \\ + \beta_3 LEVERAGE_{i,t} + \beta_4 ROA_{i,t} \\ + YEAR_t + INDUSTRY_n + \varepsilon_{i,t} \end{aligned} \tag{1}$$

where $FOREIGN_{i,t}$ is measured by either of the four ownership-specific variables: *FOR_OWN*, *FOR_BREADTH*, *FOR_TO_INST_OWN* and *FOR_TO_INST_BREADTH*. $IA\_MEASURE_{i,t}$ is, similarly, measured by one of the various proxy variables of information asymmetry: *BA_SPREAD*, PIN_{BHL}, PIN_{BH}, PIN_{EHO}, PIN_{DY}, PIN_{DY_ADJ}, *MIA*, VCV_{USD}, VCV_{MKT} and VCV_{TO}. $BM\_RATIO_{i,t}$, $LEVERAGE_{i,t}$ and $ROA_{i,t}$ are control variables of firm-characteristics. $YEAR_t$ and $INDUSTRY_n$ control for year and industry specific fixed effects and $\varepsilon_{i,t}$ is the residual term. The detailed list of variables and definitions is provided in Table 8 in Appendix A.

Based on the first hypothesis, I want to examine the effect of information asymmetry on foreign ownership. Hence, I include an ownership-specific variable as the dependent variable and an information asymmetry measure as the main explanatory variable. The main challenge in the model specification of the baseline setting is to include control variables that explain variation in foreign ownership, but are not correlated with information asymmetry measures. Following previous studies of foreign and institutional ownership, I first filter the potential group of control variables by selecting only the most commonly used variables that explain variation in foreign or institutional ownership. Kang and Stulz (1997), Dahlquist and Robertsson (2001), Jiang and Kim (2004) and Baik et al. (2013) find in Japanese, Swedish and the US markets that foreign investors prefer firms with large market capitalization and low book-to-market ratio. Furthermore, Kang and Stulz (1997) and Jiang and Kim (2004) find that leverage has a negative effect on foreign ownership, whereas return on assets (ROA) has positive.

Next, based on the correlation results in Table 2, I decide to exclude the logarithm of market capi-

talization (*LOG_MKT_CAP*), as it has approximately over -0.60 correlation between information asymmetry measures. Otherwise, there is a potential risk of multicollinearity, which may result in invalid coefficients of other explanatory variables and large standard errors. Other control variables have relatively small or moderate correlations with information asymmetry measures and are therefore kept in the regression model.

I also include fixed effects for year and industry to control for time variation and firm characteristics unrelated to information asymmetry or control variables. Baik et al. (2013) find that foreign ownership increases substantially in the US markets between 1990 and 2007 and I find similar trend in my data set during 1997-2017. Also Duarte et al. (2017) and Lof and van Bommel (2018) find that information asymmetry decreases over time. Thus, a pooled panel regression model does not capture this time-specific variation and can lead to biased and inconsistent estimators due to omitted variable bias. Following a recent study of foreign ownership by Bena et al. (2017), I include industry fixed effects to control for unobservable firm-specific characteristics.

5.2 The difference-in-differences regression model

I examine the effect of an exogenous increase in information asymmetry on foreign ownership by using the following difference-in-differences regression of firm-quarter observations with fixed effects:

$$\begin{aligned} FOREIGN_{i,t} = \beta_0 &+ \beta_1 TREATED_i + \beta_2 AFTER_t + \beta_3 AFTER \times TREATED_{i,t} \\ &+ \beta_4 LOG\_MKT\_CAP_{i,t} + \beta_5 BM\_RATIO_{i,t} + \beta_6 LEVERAGE_{i,t} \\ &+ \beta_7 ROA_{i,t} + YEAR_t + INDUSTRY_n + \varepsilon_{i,t} \end{aligned} \tag{2}$$

where $FOREIGN_{i,t}$ is, similarly as in Equation 1, measured by either of the four ownership-specific variables: *FOR_OWN*, *FOR_BREADTH*, *FOR_TO_INST_OWN* and *FOR_TO_INST_BREADTH*. *FOR_OWN* and *FOR_BREADTH*. *TREATED* is a dummy variable indicating observations of firms that are in the treatment group. *AFTER* is defined as a dummy variable for observations

that occur after each brokerage closure event. The variable of interest is the interaction term of these two variables $AFTER \times TREATED$ or the difference-in-differences estimator which captures the effect of treatment. I include same control variables of firm-characteristics $BM\_RATIO_{i,t}$, $LEVERAGE_{i,t}$ and $ROA_{i,t}$, as in the baseline setting and the logarithm of market capitalization (*LOG_MKT_CAP*). Since there is no potential risk of multicollinearity due to the model not including an information asymmetry measure as an explanatory variable, I decide to include *LOG_MKT_CAP* to the model. $YEAR_t$ and $INDUSTRY_n$ control for year and industry specific fixed effects and $\varepsilon_{i,t}$ is the residual term. The detailed list of variables and definitions is provided in Table 8 in Appendix A.

Since I want to test the causal effect of information asymmetry in hypotheses 2 and 3, I choose a difference-in-differences approach in the model specification. It ensures that the difference in foreign ownership between treatment and control groups is not due to cross-sectional heterogeneity or time series patterns affecting both groups. Rather, the model enables to examine whether the changes in foreign ownership are caused by exogenous shocks in asymmetric information, if the treatment and control groups are similar before the event. The crucial assumption here is the pre-treatment parallel trend between the groups, which I examine along with the results in Section 6. I also rely on the findings of Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013) that an exogenous decrease in analyst coverage due to the brokerage closures causes an increase in information asymmetry of the covered firm.

6 Results

In this section, I report the empirical results of the effect of information asymmetry on foreign ownership. First in Section 6.1, I present the results of the general relation between foreign ownership and information asymmetry with the baseline panel regression setting (Hypothesis 1). Second in Section 6.2, I study the causal effect of the exogenous increase in information asymmetry on foreign ownership by difference-in-differences panel regression setting (Hypothesis 2). Finally in Section 6.3, I test the causal effect in cases of low analyst coverage and low institutional ownership

(Hypothesis 3).

6.1 The results of the baseline setting

In this section, I report the results of the baseline setting. First, I examine the effect of information asymmetry on foreign ownership in a panel regression setting. The dependent variable of the regressions in Panel A is foreign institutional ownership *FOR_OWN* and foreign institutional breadth *FOR_BREADTH* in Panel B. Different information asymmetry measures are used separately as explanatory variables. The control variables are different measures of firm characteristics. I also include industry and year fixed effects. Table 4 reports the results.

Similar to the findings of correlations in Table 2, the empirical results of the panel regression models in Table 4 support Hypothesis 1 and the findings by Jiang and Kim (2004), Baik et al. (2013) and Batten and Vo (2015) of the negative relation between foreign ownership and asymmetric information. In Panel A, The regression coefficients of information asymmetry measures are negative and statistically significant at the 1% level in all regression models. Based on column (5), a 1 percentage point increase in information asymmetry (PIN_{DY_ADJ}) leads to a decrease of about 0.10 percentage points in foreign ownership *ceteris paribus*. Based on all models, a 1 percentage point increase in information asymmetry results, on average, in a decrease of about 0.07 percentage points in foreign ownership. Overall, the negative relation is stronger with the probability of informed trading measures than with multimarket information asymmetry or volume coefficient of variation. Based on the results of adjusted R^2, models with different probability of informed trading measures and *MIA* have the best explanatory power.

Table 4: Panel regression analysis of foreign ownership and foreign breadth

This table reports the results of the annual firm-level panel regression models. In Panel A, the dependent variable is foreign ownership (*FOR_OWN*). In Panel B, the dependent variable is foreign breadth (*FOR_BREADTH*). The explanatory variables of main interest are the various annual firm-level estimates of information asymmetry. Other explanatory variables are firm-characteristic control variables. Ownership-specific variables are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom by 1%. Table 8 in Appendix A provides a detailed list of variable definitions. I include industry and year fixed effects in all regressions. Standard errors are clustered by the industry and year level and reported in parentheses. *, ** and *** denote the statistical significance at the 10%, 5% and 1% level, respectively. Sample period: 1997-2017. Sources: CRSP, COMPUSTAT, 13F and the cited authors' websites.

	Dependent variable:										
	FOR_OWN										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A: Foreign ownership											
BA_SPREAD	−0.265***										
	(0.040)										
PIN_{BHL}		−0.077***									
		(0.017)									
PIN_{BH}			−0.079***								
			(0.014)								
PIN_{DY}				−0.074***							
				(0.013)							
PIN_{DY_ADJ}					−0.097***						
					(0.016)						
$PSOS_{DY}$						−0.042***					
						(0.010)					
PIN_{EHO}							−0.089***				
							(0.013)				
MIA								−0.035***			
								(0.007)			
VCV_{USD}									−0.011***		
									(0.001)		
VCV_{MKT}										−0.011***	
										(0.001)	
VCV_{TO}											−0.012***
											(0.001)
BM_RATIO	−0.006***	−0.003***	−0.003***	−0.005***	−0.003***	−0.005***	−0.003***	−0.0001	−0.006***	−0.006***	−0.006***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LEVERAGE	0.005	0.008***	0.008***	0.008***	0.004***	0.003	0.005**	0.011***	0.003	0.003	0.004
	(0.003)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.004)	(0.003)	(0.003)	(0.003)
ROA	0.052***	0.080***	0.082***	0.080***	0.064***	0.074***	0.074***	0.093***	0.079***	0.079***	0.084***
	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)	(0.012)	(0.008)	(0.008)	(0.008)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	109,907	78,009	78,118	15,021	15,021	15,021	9,496	20,717	94,298	94,298	94,298
Adjusted R^2	0.156	0.190	0.199	0.349	0.343	0.312	0.331	0.262	0.177	0.177	0.176

	Dependent variable:										
	FOR_BREADTH										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel B: Foreign breadth											
BA_SPREAD	−0.036***										
	(0.009)										
PIN_{BHL}		−0.013***									
		(0.002)									
PIN_{BH}			−0.013***								
			(0.002)								
PIN_{DY}				−0.014***							
				(0.003)							
PIN_{DY_ADJ}					−0.021***						
					(0.003)						
$PSOS_{DY}$						−0.007***					
						(0.002)					
PIN_{EHO}							−0.018***				
							(0.002)				
MIA								−0.033***			
								(0.003)			
VCV_{USD}									−0.002***		
									(0.0002)		
VCV_{MKT}										−0.002***	
										(0.0002)	
VCV_{TO}											−0.002***
											(0.0002)
BM_RATIO	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.0003***	−0.0003	−0.001***	−0.001***	−0.001***
	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0001)	(0.0001)	(0.0001)	(0.0003)	(0.0001)	(0.0001)	(0.0001)
LEVERAGE	0.003***	0.003***	0.003***	0.003***	0.002***	0.001***	0.002***	0.005***	0.002***	0.002***	0.002***
	(0.0005)	(0.001)	(0.001)	(0.001)	(0.0003)	(0.0002)	(0.0003)	(0.001)	(0.0004)	(0.0004)	(0.0004)
ROA	0.007***	0.013***	0.014***	0.014***	0.009***	0.006***	0.008***	0.022***	0.010***	0.009***	0.010***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.004)	(0.002)	(0.002)	(0.002)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	109,907	78,009	78,118	15,021	15,021	15,021	9,496	20,717	94,298	94,298	94,298
Adjusted R^2	0.267	0.375	0.365	0.406	0.426	0.342	0.449	0.488	0.311	0.313	0.311

The control variables in Panel A are mainly statistically significant and in line with the existing literature. Book-to-market ratio (*BM_RATIO*) is negative and statistically significant at the 1% level in all regression models except in the model with *MIA* as the explanatory variable. This implies that foreign investors hold less stocks with relatively high book-to-market ratio (i.e. value stocks). Book-to-market ratio is used as a measure of risk in many asset pricing models (e.g., Fama and French, 1993; Carhart, 1997; Pástor and Stambaugh, 2003), which, in addition to my results, supports the findings of Ko et al. (2007) and Lin and Shiu (2003) that foreign investors hold less riskier firms with high book-to-market ratios. Moreover, the regression coefficients of *ROA* are positive and statistically significant at the 1% level in all models, implying that foreign investors hold stocks with positive probability. The regression coefficients of leverage are mainly positive. *LEVERAGE* is positive and statistically significant in six out of eleven models and positive and statistically insignificant in five out of eleven models. Hence, an increase in leverage is mostly associated with an increase in foreign ownership. The results mostly contradicts the findings of foreign investors' preference on low debt ratio firms by Kang and Stulz (1997) and Dahlquist and Robertsson (2001).

Panel B reports the results of regressing foreign breadth on information asymmetry measures. The results follow similar pattern with foreign ownership results in Panel A. The regression coefficients of information asymmetry are negative and statistically significant at the 1% level in all models. Based on column (8), a 100 basis point increase in information asymmetry (*MIA*) is associated with a ca. 3 basis point decrease in foreign breadth. In general, a 100 basis point increase in information asymmetry results in 0.2 - 4 basis points decrease of foreign breadth. Based on adjusted R^2, the explanatory power is, in general, better than with models in Panel A. Notably, the model with *MIA* clearly explains variation better than other models, which differs from the results in Panel A.

In addition to information asymmetry measures, the control variables in Panel B follow similar pattern with Panel A. Book-to-market ratio is negative and statistically significant at the 1% level in all models, except with *MIA* as explanatory variable, leverage is positive and statistically significant in all models and return on assets is positive and statistically significant at the 1% level in all models. Similar to Panel A, the results support the findings of Ko et al. (2007) and Lin and Shiu (2003)

that foreign investors hold stocks with comfortable characteristics, except the results of leverage. In general, the results of Table 4 support strongly the first hypothesis of inverse relation between foreign ownership and information asymmetry.

In addition to inspecting general market-level foreign ownership and breadth measures, I extend the analysis by comparing foreign ownership against institutional ownership for a given stock in a given time. In particular, I define a variable *FOR_TO_INST_OWN* which is a measure of the annual average of the firm's shares held by foreign institutions divided by the firm's shares held by total institutions at the end of each quarter. This enables me to examine whether foreign institutional shareholders hold more or less information intensive stocks than institutional shareholders in general. Similarly, I define a variable *FOR_TO_INST_BREADTH* which is a measure of the annual average of the number of the firm's distinct foreign institutional shareholders divided by the number of the firm's of distinct institutional shareholders at the end of each quarter. I test the dependent variables with the same panel regression models as in Table 4. Table 5 reports the results.

In Panel A, the regression coefficients of asymmetric information variables are all negative, except the models with *PIN_DY*, *PSOS_DY* and PIN_{EHO} as explanatory variables. The results are statistically significant at the 1% level in models with *MIA* and all *VCV* variables as explanatory variables. The results give more supporting evidence of the negative relation between foreign ownership and information asymmetry. Based on the results, foreign institutional investors are holding less information intensive stocks than institutional investors on average. Based on column (8), a 1 percentage point increase in information asymmetry is associated with a 0.06 percentage point decrease in ownership of foreign institutions against total institutions. The models with statistically significant results (*MIA* and *VCV*) have the best explanatory power according to the results of adjusted R^2.

Table 5: Panel regression analysis of foreign-to-institution ownership and breadth ratios

This table reports the results of the annual firm-level panel regression models. In Panel A, the dependent variable is foreign-to-institution ownership (*FOR_TO_INST_OWN*). In Panel B, the dependent variable is foreign-to-institution breadth (*FOR_TO_INST_BREADTH*). The explanatory variables of main interest are the various annual firm-level estimates of information asymmetry. Other explanatory variables are firm-characteristic control variables. Ownership-specific variables are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom by 1%. Table 8 in Appendix A provides a detailed list of variable definitions. I include industry and year fixed effects in all regressions. Standard errors are clustered by the industry and year level and reported in parentheses. *, ** and *** denote the statistical significance at the 10%, 5% and 1% level, respectively. Sample period: 1997-2017. Sources: CRSP, COMPUSTAT, 13F and the cited authors' websites.

	Dependent variable:										
	FOR_TO_INST_OWN										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel A: Foreign-to-institution ownership ratio											
BA_SPREAD	−0.024										
	(0.076)										
PIN_{BHL}		−0.023									
		(0.021)									
PIN_{BH}			−0.021								
			(0.030)								
PIN_{DY}				0.001							
				(0.043)							
PIN_{DY_ADJ}					−0.014						
					(0.051)						
$PSOS_{DY}$						0.007					
						(0.022)					
PIN_{EHO}							0.071				
							(0.070)				
MIA								−0.057***			
								(0.012)			
VCV_{USD}									−0.008***		
									(0.002)		
VCV_{MKT}										−0.007***	
										(0.002)	
VCV_{TO}											−0.010***
											(0.002)
BM_RATIO	−0.010***	−0.007***	−0.006**	−0.007**	−0.009***	−0.011***	−0.010***	0.004	−0.010***	−0.010***	−0.009***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
LEVERAGE	−0.002	0.002	0.002	0.002	−0.001	−0.004	−0.003	0.006	−0.004	−0.004	−0.004
	(0.006)	(0.004)	(0.004)	(0.004)	(0.006)	(0.006)	(0.005)	(0.007)	(0.006)	(0.006)	(0.006)
ROA	−0.005	−0.028	−0.029	−0.026	−0.032	−0.053***	−0.054***	−0.030	−0.033	−0.032	−0.033
	(0.020)	(0.036)	(0.037)	(0.037)	(0.049)	(0.018)	(0.017)	(0.034)	(0.025)	(0.025)	(0.025)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	109,907	78,009	78,118	15,021	15,021	15,021	9,496	20,717	94,298	94,298	94,298
Adjusted R^2	0.086	0.087	0.086	0.083	0.083	0.083	0.101	0.209	0.100	0.100	0.101

	Dependent variable:										
	FOR_TO_INST_BREADTH										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Panel B: Foreign-to-institution breadth ratio											
BA_SPREAD	−0.071										
	(0.074)										
PIN_{BHL}		0.020									
		(0.021)									
PIN_{BH}			0.050								
			(0.034)								
PIN_{DY}				0.094**							
				(0.037)							
PIN_{DY_ADJ}					0.105**						
					(0.042)						
$PSOS_{DY}$						0.056***					
						(0.021)					
PIN_{EHO}							0.190***				
							(0.058)				
MIA								−0.025***			
								(0.009)			
VCV_{USD}									−0.006		
									(0.004)		
VCV_{MKT}										−0.005	
										(0.004)	
VCV_{TO}											−0.007*
											(0.004)
BM_RATIO	−0.004*	0.001	0.002	0.003	−0.003	−0.001	−0.003*	0.004**	−0.004**	−0.004**	−0.004**
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LEVERAGE	0.004	0.003	0.003	0.002	−0.002	−0.0004	0.0002	0.013***	0.003	0.003	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.004)	(0.004)	(0.004)
ROA	−0.019	−0.048*	−0.053*	−0.047*	−0.043	−0.060***	−0.054***	−0.0002	−0.027	−0.027	−0.026
	(0.020)	(0.028)	(0.029)	(0.028)	(0.040)	(0.018)	(0.017)	(0.022)	(0.021)	(0.021)	(0.022)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	109,907	78,009	78,118	15,021	15,021	15,021	9,496	20,717	94,298	94,298	94,298
Adjusted R^2	0.095	0.079	0.081	0.110	0.103	0.103	0.164	0.433	0.126	0.126	0.126

The results of the control variable coefficients are mixed. Book-to-market ratio (*BM_RATIO*) is negative and statistically significant at the 1% level in all regression models except with *MIA* as the explanatory variable. The results are mainly in line with the previous results and existing literature, implying that foreign institutional investors hold more non-value stocks compared to institutional investors on average. The coefficients of *LEVERAGE* are mainly statistically insignificant, positive in four out eleven models and negative in seven out of eleven models. Hence, the results of *LEVERAGE* provide nothing conclusive. The results of *ROA* are to some extent surprising. The coefficients are negative in all models and statistically significant at the 1% level in two models. The results imply that foreign institutional investors hold less profitable stocks compared to institutional investors on average.

In Panel B, the regression coefficients of asymmetric information variables provide mixed results. The coefficients are positive and statistically significant with models of PIN_{DY}, PIN_{DY_ADJ}, $PSOS_{DY}$ and PIN_{EHO} and negative and statistically significant with models of *MIA* and VCV_{TO}. Hence, it is difficult to derive solid conclusions of the results. However, according to adjusted R^2, the models with *MIA* and different *VCV* measures as explanatory variables have better explanatory power. In particular, the model with *MIA* has adjusted R^2 of 0.433 which is clearly better than any other model. Moreover, the sample sizes in models with *MIA* and *VCV* are notably larger than with PIN_{DY}, PIN_{DY_ADJ}, $PSOS_{DY}$ and PIN_{EHO}.

Control variables in Panel B provide mixed results. *BM_RATIO* is negative in seven out of eleven models and statistically significant in five out of eleven models. It is positive and statistically significant once. Hence, the results primarily suggests that foreign institutional investors hold less value stocks than institutional investors in general. *LEVERAGE* is positive and statistically significant once and otherwise insignificant, implying that foreign institutional investors hold more levered stocks than institutional investors in general. This is counterintuitive in the light of the results by Kang and Stulz (1997) and Dahlquist and Robertsson (2001) that foreign investors hold more low debt ratio firms. The regression coefficients of *ROA* follow a similar negative and statistically significant pattern than in Panel B. This finding suggests that foreign institutional investors hold relatively less profitable stocks than institutional investors in general.

6.2 The main results of the quasi-natural experiment

In this section, I report the main results of the quasi-natural experiment. First, I examine the evolution of the dependent variables foreign ownership (*FOR_OWN*), foreign breadth (*FOR_BREADTH*), foreign-to-institution ownership (*FOR_TO_INST_OWN*) and foreign-to-institution breadth (*FOR_TO_INST_BREADTH*) between the treatment and control groups in the twelve quarters (i.e. three years) before and after the brokerage closures. The treated firms are firms that lose an analyst due to these brokerage closures. The control firms are selected using propensity score matching that matches each treatment firm to three control firms (nearest neighbor) on multiple covariates (twelve quarters before the event): logarithm of market capitalization, book-to-market ratio and analyst coverage. Figure 2 presents the results.

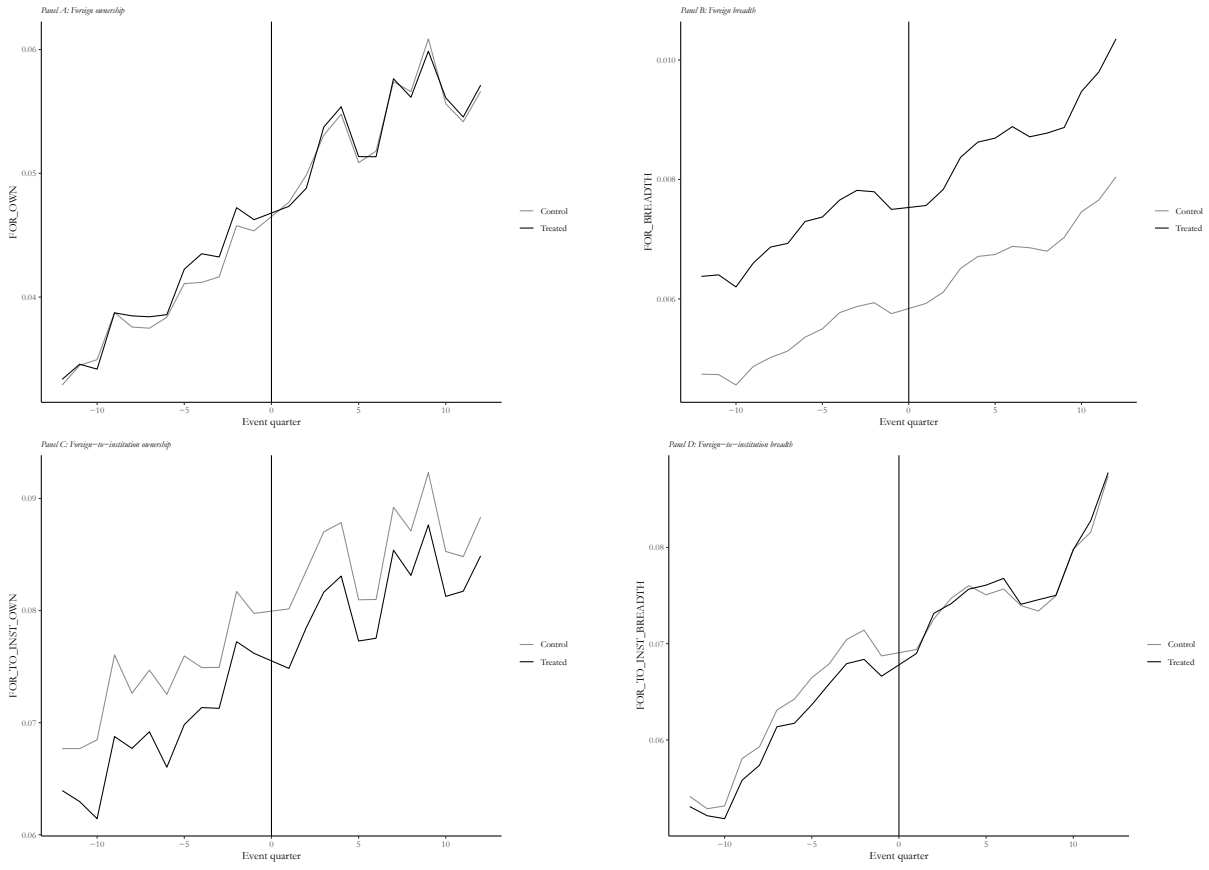

Figure 2: Foreign ownership-specific variables between the treatment and control groups around brokerage closures

This figure presents the evolution of the mean of firm-quarter observations of ownership-specific variables during the twelve quarters (i.e. three years) before and after an exogenous decrease in analyst coverage due to the 22 distinct brokerage closures listed by Kelly and Ljungqvist (2012). I impose a three-month gap over the events so that foreign ownership estimates are from quarters [-12,-1] and [1,12], with the brokerage closure occurring in the quarter 0. Control firms are matched using propensity score matching (nearest neighbor) that matches each treatment firm to three control firms by multiple covariates (twelve quarters before the event): logarithm of market capitalization (*LOG_MKT_CAP*), book-to-market ratio (*BM_RATIO*) and number of distinct analysts covering the firm (*ANALYST_COVERAGE*). Table 8 in Appendix A provides a detailed list of variable definitions. Sample period: 1997-2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

As shown in Panel A, foreign ownership between the treatment and control groups follow an increasing but parallel trend before the event. This validates the assumption of pre-treatment parallel trend between treatment and control groups. Foreign ownership of the control group increases quite prominently during the event occurring quarter and surpasses that of the treatment group after the event whereas the treatment group stays put during the event occurring quarter. However, there is no significant persistent decline in foreign ownership for the treatment group after the event. Hence, there is no robust evidence of a significant post-treatment difference in mean between the two groups. Foreign ownership of both groups continue increasing and are approximately at the same level constantly after the event. Abrupt changes in foreign ownership during the event quarters 5 and 10 are largely caused by changes in foreign ownership during the last quarter of 2003. These changes are further illustrated in Figure 3 in Appendix B with event-specific plots.

Panel B provides the results of the evolution of foreign breadth between the treatment and control groups. Similar to Panel A, foreign breadth follows an increasing but parallel trend between the groups before the event, which validates the assumption of pre-treatment parallel trend. The increasing and parallel trend follows also after the event and there is a slightly larger decrease in foreign ownership for the treatment group, but the decrease is not significantly larger compared to the control group.

Panels C and D provide evidence of the development of foreign institutional investors' ownership (*FOR_TO_INST_OWN*) and breadth (*FOR_TO_INST_BREADTH*) against total institutional investors between treatment and control groups. In both panels, the pre-treatment parallel trend is mostly satisfied. In Panel C, there is a slight drop in ownership ratio in the treatment group after the quarter 0, but the decrease is not significantly larger compared to the control group. On the other hand, in Panel D, the breadth ratio of the treatment group increases more after the event compared to the control group. Based on overall results, the results of Figure 2 do not give strong support for the second hypothesis that an exogenous increase in information asymmetry results in a decrease of foreign ownership.

I extend the analysis of the quasi-experimental setting by implementing a difference-in-differences regression analysis of foreign ownership and foreign breadth. Compared to results in Figure 2,

this enables me to control for other variables and include year and industry fixed effects. Similar to Figure 2, I identify treatment group as stocks that lose an analyst covering the firm due to the brokerage closures and control firms are matched using the propensity score matching. In addition, I impose a three-month gap before and after the event and therefore I calculate averages of the dependent and control variables over the quarters [-4,-1] and [1,4], [-8,-1] and [1,8] and [-12,-1] and [1,12], with the brokerage closure occurring in the quarter 0. When computing the averages, I require for each stock to have at least one observation of the dependent and control variables before and after each event. The explanatory variables are dummy variables indicating observations in the post-closure period (*AFTER*), in the treatment group (*TREATED*) and their interaction term (*AFTER×TREATED*). Table 6 reports the results.

In Panel A, the difference-in-differences regression results of foreign ownership (*FOR_OWN*) for the one-year, two-year and three-year pre- and post-closure period are reported in columns (1)-(3), respectively. The regression coefficients of *AFTER* are positive and statistically significant in all three columns. In addition, the coefficient is the largest in the three-year window and the smallest in the one-year window. Although the regression models contain year fixed effects, these findings are consistent with the increasing trend of foreign ownership for both groups in Figure 2, as the foreign ownership has an increasing pattern even within-year period. Moreover, the coefficients of *TREATED* are negative but close to zero and statistically insignificant in all three columns, indicating that there is no significant difference of foreign ownership between treatment and control firms. The coefficients of the variable of main interest *AFTER×TREATED* are negative in columns (1)-(2) and statistically insignificant. In column (3), the coefficient is positive and statistically insignificant. Hence, the results do not provide support for the second hypothesis that an exogenous increase in information asymmetry causes a decline in foreign ownership. The control variables have similar results as in the baseline setting, with notably positive and statistically significant results for *ROA*. Compared to baseline setting, the additional control variable *LOG_MKT_CAP* is positive and statistically significant in all three columns, which is intuitive and in line with the correlation matrix results in Table 2. Based on adjusted R^2, the models explain variation relatively well compared to the baseline results.

Table 6: Difference-in-differences regression analysis of foreign ownership-specific variables

This table reports the results of the difference-in-differences regression analysis of ownership-specific variables. In Panel A, the dependent variables are foreign ownership (*FOR_OWN*) and foreign breadth (*FOR_BREADTH*). In Panel B, the dependent variables are foreign-to-institution ownership (*FOR_TO_INST_OWN*) and foreign-to-institution breadth (*FOR_TO_INST_BREADTH*). The treatment group is determined as stocks that lose a covering analyst due to 22 distinct brokerage closures listed by Kelly and Ljungqvist (2012). Control firms are matched using propensity score matching (nearest neighbor) that matches each treatment firm to three control firms by multiple covariates (twelve quarters before the event): logarithm of market capitalization (*LOG_MKT_CAP*), book-to-market ratio (*BM_RATIO*) and number of distinct analysts covering the firm (*ANALYST_COVERAGE*). For all stocks, I compute averages of the dependent variables and control variables in columns (1) and (4) over the quarters [-4,-1] and over the quarters [1,4], with the brokerage closure occurring in quarter 0. In columns (2) and (5) the dependent variables are computed over the quarters [-8,-1] and [1,8] and in columns (3) and (6) over the quarters [-12,-1] and [1,12]. The explanatory variables are dummy variables indicating the treatment group (*TREATED*), the post-event period (*AFTER*) and their interaction (*AFTER×TREATED*). The control variables are book-to-market ratio (*BM_RATIO*), leverage (*LEVERAGE*) and return on assets (*ROA*). I include industry and year fixed effects in all regressions. Standard errors are clustered by the industry and year level and reported in parentheses. *FOR_OWN* and *FOR_BREADTH* are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom 1%. Table 8 in Appendix A provides a detailed list of variable definitions. *, ** and *** denote the statistical significance at the 10%, 5% and 1% level, respectively. Sample period: 1997-2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

	Dependent variable:					
	FOR_OWN			FOR_BREADTH		
	[-1,1] years	[-2,2] years	[-3,3] years	[-1,1] years	[-2,2] years	[-3,3] years
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: Foreign ownership and breadth						
AFTER	0.008***	0.011***	0.014***	0.001***	0.001***	0.001***
	(0.003)	(0.004)	(0.003)	(0.0002)	(0.0001)	(0.0001)
TREATED	−0.001	−0.002	−0.002	0.0004	0.0004	0.0003
	(0.001)	(0.001)	(0.001)	(0.0004)	(0.0004)	(0.0004)
AFTER×TREATED	−0.001	−0.0002	0.0004	0.00004	0.0002	0.0004*
	(0.001)	(0.002)	(0.002)	(0.0001)	(0.0002)	(0.0002)
LOG_MKT_CAP	0.005***	0.005***	0.005***	0.003***	0.003***	0.003***
	(0.001)	(0.001)	(0.001)	(0.0003)	(0.0003)	(0.0003)
BM_RATIO	0.001	0.002	0.001	0.001***	0.001***	0.001***
	(0.002)	(0.002)	(0.002)	(0.0003)	(0.0002)	(0.0002)
LEVERAGE	0.001	0.002	0.002	0.001*	0.001**	0.001**
	(0.003)	(0.002)	(0.002)	(0.001)	(0.0004)	(0.0004)
ROA	0.064***	0.082***	0.086***	−0.010***	−0.009***	−0.010***
	(0.012)	(0.013)	(0.009)	(0.003)	(0.003)	(0.003)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Treated firm obs.	5,424	5,444	5,470	5,424	5,444	5,470
Control firm obs.	16,176	16,318	16,410	16,176	16,318	16,410
Distinct treated firms	1,651	1,657	1,658	1,651	1,657	1,658
Distinct control firms	3,558	3,577	3,590	3,558	3,577	3,590
Observations	21,600	21,762	21,880	21,600	21,762	21,880
Adjusted R^2	0.179	0.199	0.209	0.727	0.733	0.734
	Dependent variable:					
	FOR_TO_INST_OWN			FOR_TO_INST_BREADTH		
	[-1,1] years	[-2,2] years	[-3,3] years	[-1,1] years	[-2,2] years	[-3,3] years
	(1)	(2)	(3)	(4)	(5)	(6)
Panel B: Foreign-to-institution ownership and breadth						
AFTER	0.007*	0.008	0.011***	0.003	0.006	0.011***
	(0.004)	(0.006)	(0.004)	(0.004)	(0.004)	(0.004)
TREATED	−0.005***	−0.006***	−0.007***	−0.004***	−0.004***	−0.004***
	(0.001)	(0.002)	(0.002)	(0.001)	(0.001)	(0.001)
AFTER×TREATED	0.0001	0.002	0.002	0.003***	0.004**	0.004**
	(0.001)	(0.003)	(0.002)	(0.001)	(0.001)	(0.001)
LOG_MKT_CAP	0.004***	0.004***	0.004***	0.0004	0.001	0.001
	(0.001)	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
BM_RATIO	0.0001	−0.0002	−0.002	0.003	0.002	0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LEVERAGE	−0.002	−0.003	−0.002	−0.002	−0.003	−0.003

	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)
ROA	−0.047**	−0.042	−0.042	−0.043**	−0.045***	−0.045**
	(0.022)	(0.026)	(0.029)	(0.017)	(0.017)	(0.019)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Treated firm obs.	5,424	5,444	5,470	5,424	5,444	5,470
Control firm obs.	16,176	16,318	16,410	16,176	16,318	16,410
Distinct treated firms	1,651	1,657	1,658	1,651	1,657	1,658
Distinct control firms	3,558	3,577	3,590	3,558	3,577	3,590
Observations	21,600	21,762	21,880	21,600	21,762	21,880
Adjusted R^2	0.098	0.108	0.105	0.127	0.144	0.151

The results of foreign breadth (*FOR_BREADTH*) in Panel A are similarly reported in columns (4)-(6). The regression coefficients of *AFTER* are similarly positive and statistically significant in columns (1)-(3), although with slightly smaller estimates. The coefficients of *TREATED* are, on the contrary, positive and statistically insignificant. The coefficients of *AFTER×TREATED* are positive and statistically insignificant in all three columns. Hence, the results of foreign breadth do neither provide evidence for the second hypothesis. Interestingly, the coefficients of control variables are somewhat inconsistent with the previous results. *LOG_MKT_CAP* and *LEVERAGE* are still positive and statistically significant in all three columns, but *BM_RATIO* is positive and statistically significant and *ROA* is negative and statistically significant. Adjusted R^2 is, on average, 0.73, implying relatively high explanatory power of the models and notably higher than in the case of foreign ownership.

In Panel B, the regression coefficients of *AFTER* are positive for both *FOR_TO_INST_OWN* and *FOR_TO_INST_BREADTH* in all six columns and statistically significant in columns (1), (3) and (6), which implies an increasing trend in the dollar amount and number of foreign institutional investors, compared to all institutional investors. On the other hand, *TREATED* is negative and statistically significant in all six columns, implying that treated firms have relatively low dollar amount and number of foreign institutional investors compared to all institutionals. *AFTER×TREATED* is positive in all six columns, statistically insignificant in columns (1)-(3) and statistically significant in columns (4)-(6). Hence, the results do not provide support for the second hypothesis in columns (1)-(3) and in columns (4)-(6) the results provide even opposing results. Nonetheless, these opposing results are to some extent downgraded in Figure 2, in which the treatment group slightly catches

the control group, but there is no clear drop in breadth measure for either groups. The control variables are mainly statistically insignificant, with the exception of statistically significant negative coefficients of *ROA*. Adjusted R^2 is ca. 0.12 and hence models do not explain a lot of variation compared to Panel A.

Overall, the results of Table 6 give no evidence of the negative causal effect of information asymmetry on foreign ownership. In fact, the results provide even some opposing evidence of positive causal effect of information asymmetry on the number of foreign institutional investors compared to all institutional investors. Nonetheless, I do not find opposing results significant enough, when compared to the results in Panel A and of Figure 2.

6.3 The results of the quasi-natural experiment by institutional ownership and analyst coverage

In this section, I test the causal effect of asymmetric information on foreign ownership in a subset analysis. As hypothesized in Hypothesis 3, I state that the negative causal effect should be stronger in firms with low institutional ownership or low analyst coverage. I test this with the similar model as in Section 6.2, but sample divided to the lowest and highest quartiles of analyst coverage and institutional ownership. Table 7 reports the results of foreign ownership (*FOR_OWN*) and breadth (*FOR_BREADTH*).

Table 7: Difference-in-differences regression analysis of foreign ownership-specific variables by institutional ownership and analyst coverage

This table reports the results of the difference-in-differences regression analysis of ownership-specific variables in subsamples of low (high) institutional ownership and analyst coverage. In Panel A, the dependent variables are foreign ownership (*FOR_OWN*) and foreign breadth (*FOR_BREADTH*). In Panel B, the dependent variables are foreign-to-institution ownership (*FOR_TO_INST_OWN*) and foreign-to-institution breadth (*FOR_TO_INST_BREADTH*). In the first (fifth) and second (sixth) column, the sample is restricted to firms that have in each brokerage closure event institutional ownership below first and third quartile, respectively. Similarly, in the third (seventh) and fourth (eighth) column, the sample is restricted to firms with analyst coverage below first and third quartile, respectively. For all stocks, I compute averages of the dependent variables and control variables in all columns over the quarters [-4,-1] and over the quarters [1,4], with the brokerage closure occurring in quarter 0. The control variables are book-to-market ratio (*BM_RATIO*), leverage (*LEVERAGE*) and return on assets (*ROA*). I include industry and year fixed effects in all regressions. Standard errors are clustered by the industry and year level and reported in parentheses. *FOR_OWN* and *FOR_BREADTH* are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom 1%. Table 8 in Appendix A provides a detailed list of variable definitions. *, ** and *** denote the statistical significance at the 10%, 5% and 1% level, respectively. Sample period: 1997-2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

	Dependent variable:							
	FOR_OWN				FOR_BREADTH			
	IO < $Q_{0.25}$	IO > $Q_{0.75}$	AC < $Q_{0.25}$	AC > $Q_{0.75}$	IO < $Q_{0.25}$	IO > $Q_{0.75}$	AC < $Q_{0.25}$	AC > $Q_{0.75}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: Foreign ownership and breadth								
AFTER	0.005***	0.012***	0.006***	0.011***	0.0003***	0.0004	0.0001	0.001***
	(0.001)	(0.004)	(0.002)	(0.003)	(0.0001)	(0.0004)	(0.0001)	(0.0005)
TREATED	0.001	0.003	−0.003	−0.002	0.00004	0.0004	−0.0002**	0.0004
	(0.001)	(0.002)	(0.003)	(0.002)	(0.0001)	(0.0004)	(0.0001)	(0.0003)
AFTER×TREATED	−0.001	−0.003	−0.0002	−0.004***	0.0001***	0.00003	0.0002***	−0.0002
	(0.001)	(0.003)	(0.001)	(0.001)	(0.00002)	(0.0002)	(0.0001)	(0.0003)
LOG_MKT_CAP	0.004***	0.004**	0.006***	0.001	0.001***	0.004***	0.001***	0.005***
	(0.0005)	(0.002)	(0.002)	(0.001)	(0.0001)	(0.0004)	(0.0002)	(0.0003)
BM_RATIO	0.001	−0.001	−0.002	0.008*	0.001***	0.001**	0.0004***	0.002***
	(0.001)	(0.004)	(0.001)	(0.005)	(0.0001)	(0.001)	(0.0001)	(0.0005)
LEVERAGE	−0.0001	−0.007	0.003	0.002	0.001**	0.0001	0.0004***	0.001
	(0.006)	(0.005)	(0.004)	(0.007)	(0.0004)	(0.0004)	(0.0001)	(0.001)
ROA	0.015**	0.008	0.054***	0.074***	−0.004**	−0.011***	−0.002***	−0.008
	(0.007)	(0.033)	(0.015)	(0.028)	(0.002)	(0.001)	(0.001)	(0.005)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Treated firm obs.	1,050	1,412	878	1,978	1,050	1,412	878	1,978
Control firm obs.	4,350	3,988	4,618	3,360	4,350	3,988	4,618	3,360
Distinct treated firms	443	453	411	433	443	453	411	433
Distinct control firms	1,423	991	1,681	561	1,423	991	1,681	561

Observations	5,400	5,400	5,496	5,338	5,400	5,400	5,496	5,338
Adjusted R^2	0.196	0.141	0.146	0.219	0.612	0.742	0.573	0.790

	Dependent variable:							
	FOR_TO_INST_OWN				FOR_TO_INST_BREADTH			
	$IO < Q_{0.25}$	$IO > Q_{0.75}$	$AC < Q_{0.25}$	$AC > Q_{0.75}$	$IO < Q_{0.25}$	$IO > Q_{0.75}$	$AC < Q_{0.25}$	$AC > Q_{0.75}$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel B: Foreign-to-institution ownership and breadth								
AFTER	0.004	0.010**	0.003	0.012***	−0.005	0.006	−0.006	0.012**
	(0.003)	(0.004)	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)	(0.005)
TREATED	−0.005	0.003	−0.009	−0.005**	−0.008***	0.002	−0.009**	−0.001
	(0.004)	(0.002)	(0.006)	(0.002)	(0.002)	(0.002)	(0.004)	(0.002)
AFTER×TREATED	0.001	−0.002	0.002	−0.005**	0.008***	0.001	0.008***	−0.003*
	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
LOG_MKT_CAP	0.007***	0.006***	0.006***	0.005***	−0.001	0.010***	−0.002	−0.002
	(0.001)	(0.002)	(0.002)	(0.001)	(0.002)	(0.003)	(0.003)	(0.002)
BM_RATIO	−0.002	−0.0002	−0.009**	0.022**	0.003	0.002	0.0003	0.001
	(0.003)	(0.004)	(0.004)	(0.009)	(0.003)	(0.002)	(0.004)	(0.003)
LEVERAGE	0.016	−0.011**	0.004	−0.008	0.001	−0.001	−0.006	−0.006
	(0.015)	(0.005)	(0.011)	(0.014)	(0.008)	(0.004)	(0.005)	(0.007)
ROA	−0.037	−0.006	−0.066	−0.012	0.002	−0.108***	−0.023	−0.076***
	(0.023)	(0.043)	(0.044)	(0.073)	(0.017)	(0.028)	(0.017)	(0.023)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Treated firm obs.	1,050	1,412	878	1,978	1,050	1,412	878	1,978
Control firm obs.	4,350	3,988	4,618	3,360	4,350	3,988	4,618	3,360
Distinct treated firms	443	453	411	433	443	453	411	433
Distinct control firms	1,423	991	1,681	561	1,423	991	1,681	561
Observations	5,400	5,400	5,496	5,338	5,400	5,400	5,496	5,338
Adjusted R^2	0.123	0.150	0.076	0.195	0.109	0.374	0.067	0.404

In Panel A, the regression coefficients of *AFTER* and *TREATED* are similar compared to the main quasi-natural experiment results in Table 6. The coefficients of *AFTER×TREATED* provide opposing results to Hypothesis 3. Both institutional ownership and analyst coverage have lower coefficients in the third quartile than in the first quartile for *FOR_OWN* and *FOR_BREADTH*. The coefficient is negative and statistically significant in column (4), implying that foreign institutional investors are more driven away of the treated stocks that have higher analyst coverage. This is contrary to the hypothesis that the negative effect of the information asymmetry shock should be emphasized in stocks with low analyst coverage, since the loss of even one analyst is crucial to the amount of information. Moreover, the coefficients of foreign breadth with low institutional ownership and analyst coverage are positive and statistically significant, compared to close to zero and insignificant coefficients with high institutional ownership and analyst coverage. The control variables are mainly in line with the main results of quasi-natural experiment. Adjusted R^2 is especially higher in models of high institutional ownership and analyst coverage, although the low sample size somewhat downplays its relevance.

Panel B provides a similar pattern of opposing results. The regression coefficients of *AFTER×TREATED* are smaller with high institutional ownership and analyst coverage in all models. Notably, the dollar amount and number of foreign institutional investors compared to domestic ones are negative and statistically significant, when analyst coverage is high. Overall, the counterintuitive results might be explained by the fact that treated firms are, in general, large firms with high foreign ownership, institutional ownership and analyst coverage. Hence, there is a scope for larger variation in foreign ownership of the treated firms than in samples of low institutional ownership and analyst coverage.

7 Robustness tests

In this section, I conduct several robustness tests for the empirical results of this study. First, I test the credibility of the quasi-natural experiment identification. Second, I examine the quasi-natural experiment by different investor types. Third, I perform an alternative selection of the control group

used in difference-in-differences regression. Finally, as the main results rely on the findings of Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013) that exogenous reductions in analyst coverage results in increased information asymmetry, I examine the difference-in-differences regression analysis with an instrumental variable approach in which information asymmetry measure is used as an instrument variable. I present the findings in Appendix C.

7.1 The credibility of the quasi-natural experiment identification

I test the credibility of the quasi-natural experiment identification by examining the analyst coverage between treatment and control groups around brokerage closures. To keep sample comparable with my previous results and sample size sufficient, the control group is matched with the treatment group by a ratio of 3 and with same covariates. Kelly and Ljungqvist (2012) use a ratio of 5 and Derrien and Kecskés (2013) a ratio of 1 with slightly different covariates, but mostly I find my data processing to replicate their versions. Figure 4 reports the results.

As shown in Figure 4, analyst coverage for both treatment and control groups increases notably before the event. The pre-treatment parallel trend assumption is mostly satisfied, although the number of analysts increases to some extent relatively more in the treatment group. Notably, the treatment group has ca. 2-3.5 more analysts covering than the control group, although the control group is matched with analyst coverage as one covariate. There is a significant drop in analyst coverage during the event quarter for the treatment group. The control group decreases also, but only slightly compared to the treatment group. Moreover, the drop is limited only to three quarters after the event, as the number of analysts stabilizes after three quarters in the treatment group. Hence, I find supporting evidence that my identification of the quasi-natural experiment is consistent with the data processing methods of Derrien and Kecskés (2013) and Kelly and Ljungqvist (2012).

7.2 The quasi-natural experiment by investor type

Since the investment strategies differ between different investor types, the propensity to respond to different stock-related shocks may vary between investors. Hence, as a robustness test, I study

the causal effect of asymmetric information on foreign ownership more in-depth by using different types of foreign institutional investors. I identify informed and non-informed foreign investors by using classifications by Bushee (2001), who define different institutional investors in 13F data as either "dedicated", "transient" or "quasi-indexing" investors. Dedicated investors are the most informed ones of these and prefer large and stable holdings in a small number of firms. Transient investors have highly diversified portfolios and are focused on short-term earnings and therefore their portfolios have high turnover. Quasi-indexing investors have highly diversified and low turnover portfolios, with a passive buy-and-hold strategy.

Based on these classifications, I compute the same foreign-ownership specific variables for classification groups "Quasi", including quasi-indexing foreign investors, and "Non-quasi", including both transient and dedicated foreign investors. Since there are not enough observations for dedicated foreign investors, I include only two classification groups. These classification groups affect only the nominator of these variables. For instance, *FOR_OWN* for dedicated investors is defined as the number of a firm's shares held by foreign dedicated institutions divided by the firm's total shares outstanding (CRSP) at the end of a quarter. With these variables, I compute similar difference-in-differences regression analysis than in the section 6.2, with dependent and control variables calculated for one-year before and after brokerage closures. Table 9 presents the results.

Based on the results of Table 9, the regression coefficients of *AFTER* and *TREATED* are mainly insignificant in the columns of *FOR_OWN* and *FOR_BREADTH*, indicating minor differences between the groups. Interestingly, *LOG_MKT_CAP* is positive and statistically significant for quasi but not non-quasi foreign investors in columns (1) and (2). This is intuitive, as the holdings of quasi-investors are concentrated on large firms due to value-weighted indices. Moreover, quasi investors invest more in profitable firms than non-quasi ones. Nonetheless, there are no significant results for *AFTER*×*TREATED* in columns (1)-(4). Based on Adjusted R^2, explanatory power of the first four models are similar to the main quasi-natural results, but the model of *FOR_OWN* for non-quasi investors is relatively low.

In columns (5)-(8), *TREATED* is negatively associated with *FOR_TO_INST_OWN* for non-quasi investors and on the other hand, negatively associated with *FOR_TO_INST_BREADTH* for quasi

investors. Compared to domestic investors, foreign investors' dollar amount holdings increase relatively more in after brokerage closure period. *AFTER×TREATED* is significantly negative for quasi investors in column (5) and significantly positive for non-quasi investors in column (6). This is counterintuitive to some extent. In general, quasi investors should not react actively to information asymmetry shock of stocks, since their portfolio holdings are fixed to indices. However, index constituents are typically determined based on firm size. As the brokerage closures affect mostly large firms, index rebalancing might be an explanation for quasi investors' negative coefficient. Similar to the main results, *ROA* is significantly negative in columns (5) and (7), and other control variables are mainly in line with the previous findings.

7.3 The quasi-natural experiment with an alternative selection of the control group

As another robustness check, I test the difference-in-differences regression analysis with an alternative selection of the control group. Contrary to the main results of the quasi-natural experiment, I do not match control firms on any covariates with the treatment group. I only require the control firms to be covered one year before the brokerage closure event to keep only actively covered firms. Moreover, control firms must have non-missing observations of dependent and control variables, when merging IBES data set with CRSP, COMPUSTAT and 13F data. Based on this selection, I conduct a similar difference-in-differences regression analysis with observations one year before and after the event. Table 10 presents the results.

Table 10 provides similarly no supporting evidence for the second hypothesis of the negative causal effect between asymmetric information and foreign ownership. In all columns, the regression coefficients of *AFTER×TREATED* are positive but insignificant. Mostly, foreign ownership and breadth when comparing to whole market or only to institutional investors are associated with large market capitalization. When compared to institutional investors, foreign institutional investors invest relatively more in growth, non-levered and less profitable firms. Moreover, foreign institutional investors invest relatively less in the treated firms, when compared to all institutional investors. Overall, the results are mostly in line with the main results and do not change the conclusion of the

difference-in-differences regression results.

7.3 The quasi-natural experiment with instrumental variable approach

As the study relies heavily in the main quasi-natural experiment results on the findings of Kelly and Ljungqvist (2012) and Derrien and Kecskés (2013) that exogenous reductions in analyst coverage leads to increased information asymmetry, I test the causal effect of information asymmetry on foreign ownership with instrumental variable approach. In the first-stage regression, I perform a similar difference-in-differences regression, but with an information asymmetry measure as the dependent variable. For the data availability and sufficient sample size reasons, I select only volume coefficient variation (VCV_{USD}) and bid-ask spread (*BA_SPREAD*) as the dependent variables. I calculate VCV_{USD} and *BA_SPREAD* in a similar manner with the main data processing but as quarter averages. The first-stage difference-in-differences regression of firm-quarter observations is as follows:

$$\begin{aligned} IA\_MEASURE_{i,t} = \beta_0 + \beta_1 TREATED_i + \beta_2 AFTER_t + \beta_3 AFTER \times TREATED_{i,t} \\ + \beta_5 BM\_RATIO_{i,t} + \beta_6 LEVERAGE_{i,t} + \beta_7 ROA_{i,t} \\ + YEAR_t + INDUSTRY_n + u_{i,t} \end{aligned} \tag{3}$$

In the second-state regression, the fitted values of *IA_MEASURE* are used as an explanatory variable with several control variables. Similar to the baseline regression model, I exclude *LOG_MKT_CAP* from control variables in both first-stage and second-stage regressions due to a potential risk of multicollinearity. The second-state regression model is as follows:

$$\begin{aligned} FOREIGN_{i,t} = \beta_0 + \beta_1 IA\_ME\hat{A}SURE_{i,t} + \beta_2 BM\_RATIO_{i,t} \\ + \beta_3 LEVERAGE_{i,t} + \beta_4 ROA_{i,t} \\ + YEAR_t + INDUSTRY_n + \varepsilon_{i,t} \end{aligned} \tag{4}$$

For comparability, I also examine the relationship of information asymmetry and foreign ownership-

specific variables with a similar baseline panel regression (OLS) model but with firm-quarter observations. To test whether instruments *AFTER*, *TREATED* and *AFTER×TREATED* are weak in relation to information asymmetry measures VCV_{USD} and *BA_SPREAD*, I follow Stock and Yogo (2005) to examine the instruments' joint significance with clustered standard errors. As a result, I report the first-stage F-statistics. Table 11 presents the results of the regressions.

In Panel A, volume coefficient variation (VCV_{USD}) is used as the information asymmetry measure. As shown in column (1), the coefficient of *AFTER* is negative and significant, which is consistent with the findings of Lof and van Bommel (2018) that VCV is on average decreasing over time. Similar to Lof and van Bommel (2018), *TREATED* is only slightly negative. Moreover, the variable of main interest *AFTER×TREATED* is positive and statistically significant, indicating that information asymmetry of firms that are exposed to exogenous reductions in analyst coverage increases, which is consistent with Lof and van Bommel (2018). Control variables are mainly in line with my previous results, for instance *LOG_MKT_CAP* and *ROA* are negatively associated with information asymmetry. Based on adjusted R^2, the model explains variation relatively well.

In OLS regressions, the coefficients of VCV_{USD} are negative and significant in columns (2) and (4), negative and insignificant in column (6) and positive in column (8), consistent with the baseline regression results with firm-year observations. Nonetheless, VCV_{USD} is more strongly negatively associated with asymmetric information in the second-stage instrumental variable regressions. Moreover, the first-stage F-statistic of 22.304 is notably above the critical values presented by Stock and Yogo (2005), suggesting that the instruments *AFTER*, *TREATED* and *AFTER×TREATED* for VCV_{USD} are not weak. This finding suggests that foreign institutional investors are driven away (both in dollar terms and in numbers relative to market or all institutions) from stocks that have experienced increase in information asymmetry due to exogenous reductions in analyst coverage. Hence, the result gives supporting evidence for the second hypothesis.

In Panel B, bid-ask spread (*BA_SPREAD*) is used as the information asymmetry measure. In column (1), different from results in Panel A, there is no average decrease of bid-ask spread over time and coefficient of *AFTER×TREATED* is negative and insignificant. Thus, information asymmetry, captured by bid-ask spread, is not increased due to the exogenous reductions in analyst coverage.

However, the coefficients of control variables are intuitive and in line with the previous results.

Similar to Panel A, the coefficients of *BA_SPREAD* are negative in all OLS regressions and statistically significant in all OLS regressions, except with *FOR_TO_INST_BREADTH* as the dependent variable. In contrast to Panel A, the first-stage F-statistic is particularly low, indicating that the instruments are weak. Therefore, the regression coefficients of *BA_SPREAD* in the second-stage instrumental variable regressions have large standard errors, suggesting that the estimates are not reliable. Hence, the instrumental variable approach for bid-ask spread is not valid and the analysis of the potential causal effect is not possible.

Overall, the results of the instrumental variable approach give some supporting evidence for the second hypothesis. Nonetheless, I do not consider it sufficient enough, as the examination with bid-ask spread is not valid and other information asymmetry measures are excluded of this study due to data availability and feasibility reasons.

8 Discussion

In this section, I discuss the results of the study. First, in section 8.1 I provide a summary of the research results. Second, in section 8.2 I discuss the limitations of the study.

8.1 Research summary

The empirical results of this study provide strong supporting evidence of the negative relation between information asymmetry and foreign ownership. Consistent with the first hypothesis and previous literature, foreign institutional investors hold stocks with low information asymmetry, positive profitability and low book-to-market ratio. This result is strong in both dollar amount of foreign institutional holdings and also in the number of foreign institutional investors. Moreover, when comparing foreign institutional investors to domestic institutionals, foreign investors hold less information-intensive stocks in dollar terms. However, the results are mixed for different information asymmetry proxies, when comparing the number of foreign institutional investors to

domestic ones.

Despite the strong evidence in the baseline setting, there is no evidence of the causal effect of information asymmetry on foreign ownership. The positive information asymmetry shock does not lead to a decrease in foreign dollar holdings or in the number of foreign institutional investors, when testing one, two or three years before and after the exogenous information asymmetry shocks. Furthermore, there is no evidence of the causal effect, when examining with different foreign institutional types. Quasi or non-quasi foreign investors do not significantly alter their holdings after the shocks or there is no significant changes in the number of investors. Moreover, this finding is not altered with a different selection of the control group. However, the main results rely on the findings of Derrien and Kecskés (2013) and Kelly and Ljungqvist (2012) that the exogenous reductions in analyst coverage due brokerage closures results in increase of information asymmetry. When testing with instrumental regressions, the results give some evidence that the foreign ownership is decreased relatively more in stocks that have an increase in information asymmetry due to the brokerage closures. Overall, the empirical results do not provide sufficient evidence for the second hypothesis that there is a negative causal effect between asymmetric information and foreign ownership.

According to the third hypothesis, the reduction of foreign ownership due to an information asymmetry shock should be emphasized in stocks with low analyst coverage or institutional ownership. Nonetheless, I fail to find support for this hypothesis. Although mainly insignificant and close to zero, the regression coefficients, in fact, give evidence that foreign ownership and breadth are more decreased in cases of high analyst coverage and institutional ownership. These opposing results may be due to that treated firms have high foreign ownership when analyst coverage and institutional ownership is high and therefore there is a possibility for larger variation.

To sum it up, I find strong negative relation between information asymmetry and foreign ownership, consistent with main existing literature. Compared to the existing literature, I examine the relation more in-depth with multiple information asymmetry proxies and various ownership-specific definitions for dependent variables. I fail to establish a negative causal effect between the aforementioned variables, even with robustness tests and subset analyses of investor types or analyst coverage and

institutional ownership.

8.2 Limitations of the study

The main limitation of the study is not to address the potential reverse causality of the variables. In fact, the presence of foreign investors holding information-intensive stocks may decrease information asymmetry. For instance, the management of a firm might be provoked to disclose information to the public. In addition to direct reverse causality, both variables might be affecting each other simultaneously. In order to test this, the endogeneity of foreign ownership should be dealt with. For example, instrumental variables can be used to capture an exogenous variation. For instance, researchers use stock additions to the MSCI All Country World Index as an instrument for foreign ownership, when examining its effect on corporate governance (Aggarwal et al., 2011) or on long-term investment, employment and innovation (Bena et al., 2017). However, the reverse causality examination is beyond the scope of this study and also the sample size of stock additions might be questionable, since this study is limited only to the US stock markets.

Although I construct four different measures for foreign ownership, namely *FOR_OWN*, *FOR_BREADTH*, *FOR_TO_INST_OWN* and *FOR_TO_INST_BREADTH*, due to data availability reasons the study does not deal with a data set of foreign retail investors. Since the aim of the thesis is to examine foreign ownership as a whole, this is a known limitation. To mitigate the problem, I deliberately examine foreign institutional investors holdings to total shares outstanding and to institutional investors holdings. However, most of the studies considering foreign ownership are similarly limited to foreign institutional ownership data. Hence, the limitation is relatively small and does not downplay the findings of the thesis.

Another limitation is the sample period of 1997-2017 in the baseline setting and the period 1997-2010 in the quasi-natural experiment setting. Although Thomson Reuters Institutional holdings 13F data is available from year 1980 onwards, the country information of institutional investors is only from year 1997 onwards. Moreover, the sample periods of some information asymmetry measures that are gathered from the researchers' websites have limited overlapping period with the sample period of the study. For instance, sample period with PIN_{EHO} is only from year 1997 to

2001. Furthermore, the brokerage closure events in the quasi-natural experiment setting are limited to a period of 2000-2007. Nonetheless, I do not consider the time period limitations to be a major problem of the study or to alter significantly the results.

9 Conclusion

In this thesis, I study the effect of information asymmetry on foreign ownership in the US stock markets. First, I enrich the existing literature of the topic by examining the general relationship between these two variables with multiple proxies for asymmetric information, such as bid-ask spread, probability of informed trading (PIN), multimarket information asymmetry (MIA) and volume coefficient variation (VCV). Second, I test the causal effect of information asymmetry on foreign ownership. Third, I examine the causality in a subset of low analyst coverage and institutional ownership.

Consistent with the main existing literature, I find a negative relationship between asymmetric information and foreign ownership in a panel regression setting. In particular, I find evidence that both stockholdings and number of foreign institutional investors are negatively associated with information asymmetry, when compared to either whole market of investors or to institutional investors.

However, I fail to find support for the negative causal effect of asymmetric information on foreign ownership. I compare firms that are exposed to information asymmetry shocks to firms that are not before and after the shock events. Based on the results, there is no evidence of major changes in foreign ownership for the treatment firms compared to control firms after the events. The finding is not altered, when testing with several robustness tests.

In addition, I examine whether there is an emphasized negative causal effect in samples of low analyst coverage and institutional ownership of firms. I do not find evidence that foreign ownership of firms with low analyst coverage or institutional ownership is more negatively affected due to the information asymmetry shocks. Instead, to some extent the results indicate that this is the case in firms with higher analyst coverage or institutional ownership. However, the opposite results are mostly statistically insignificant.

Overall, the findings of this thesis suggest that foreign institutional investors hold less information-intensive stocks, but they do not respond to adverse information asymmetry stocks. As the existing literature finds the informational disadvantage of foreign investors compared to domestic ones (Hau, 2001; Choe et al., 2005; Dvořák, 2005), the finding of this thesis has interesting economic implications. Domestic investors can exploit the relative weaknesses of foreign investors, which can affect the performance of foreign investors' portfolios. Nonetheless, the limitation of the study is not to address the potential reverse causality. With their financial actions, foreign investors may mitigate information asymmetry or even both variables can affect each other. Due to being out of scope of the thesis, this examination is left to future research.

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Appendices

Appendix A: Variable definitions

Table 8: Variables and Definitions

This table reports the variables used in the study, their definitions and data sources.

Variable	Definition	Source
Panel A: Ownership variables		
FOR_OWN	Number of a firm's shares held by foreign institutions divided by the firm's total shares outstanding (CRSP) at the end of a quarter.	13F and CRSP
FOR_BREADTH	Number of a firm's distinct foreign institutional shareholders divided by the total number of distinct institutional shareholders in 13F database at the end of a quarter.	13F
INST_OWN	Number of a firm's shares held by total institutions divided by the firm's total shares outstanding (CRSP) at the end of a quarter.	13F and CRSP
INST_BREADTH	Number of a firm's distinct institutional shareholders divided by the total number of distinct institutional shareholders in 13F database at the end of a quarter.	13F
FOR_TO_INST_OWN	Number of firm's shares held by foreign institutions divided by the firm's shares held by total institutions at the end of a quarter.	13F
FOR_TO_INST_BREADTH	Number of a firm's distinct foreign institutional shareholders divided by the number of firm's distinct total institutions at the end of a quarter.	13F
Panel B: Control variables		
LOG_MKT_CAP	Logarithm of a firm's market capitalization calculated as market price multiplied by shares outstanding at the end of a quarter.	CRSP
BM_RATIO	Firm's book value of equity divided by market capitalization at the end of a quarter.	COMPUSTAT
LEVERAGE	Firm's total debt divided by total assets at the end of a quarter.	COMPUSTAT
ROA	Firm's net income divided by total assets at the end of a quarter.	COMPUSTAT
Panel C: Information asymmetry variables		
BA_SPREAD	annual average of firm-day observations of bid-ask spreads $\frac{ask_{i,t}-bid_{i,t}}{price_{i,t}}$.	CRSP
PIN_{BHL}	Firm-year observations of probability of informed trading estimated by Brown et al (2004).	author's website [2]
PIN_{BH}	Firm-year observations of probability of informed trading estimated by Brown and Hillegeist (2007).	author's website
PIN_{DY}	Firm-year observations of probability of informed trading estimated by Duarte and Young (2009).	author's website
PIN_{DY_ADJ}	Firm-year observations of probability of informed trading cleaned of illiquidity effects estimated by Duarte and Young (2009).	author's website
$PSOS_{DY}$	Firm-year observations of probability of symmetric order-flow shock (illiquidity measure) estimated by Duarte and Young (2009).	author's website

[2] Firm-year observations of PIN_{BHL}, PIN_{BH}, PIN_{DY}, PIN_{DY_ADJ}, $PSOS_{DY}$ and PIN_{EHO} are made available by Stephen Brown (http://scholar.rhsmith.umd.edu/sbrown/pin-data), Jefferson Duarte (http://www.owlnet.rice.edu/~jd10/) and Søren Hvidkjær (https://sites.google.com/site/hvidkjaer/data), respectively. Daily firm-level observations of *MIA* are made available by Travis Johnson (http://travislakejohnson.com/data.html).

PIN_{EHO}	Firm-year observations of probability of informed trading estimated by Easley et al. (2010).	author's website
MIA	Annual average of firm-day observations of multimarket information asymmetry measure estimated by Johnson and So (2017).	author's website
VCV_{USD}	Fraction of the annual standard deviation of firm-day trading volumes divided by the annual average of firm-day trading volumes. Trading volume is in US dollars. It is defined as a firm's shares traded multiplied by the firm's closing price.	CRSP
VCV_{MKT}	Fraction of the annual standard deviation of firm-day trading volumes divided by the annual average of firm-day trading volumes. Trading volume is a percentage of total market volume. It is defined as a firm's shares traded multiplied by the firm's closing price divided by total sum of trading volumes on the same day.	CRSP
VCV_{TO}	Fraction of the annual standard deviation of firm-day trading volumes divided by the annual average of firm-day trading volumes. Trading volume is a daily turnover. It is defined as a firm's shares traded divided by the firm's shares outstanding.	CRSP
Panel D: Variables of quasi-natural experiment		
AFTER	Dummy variable which equals one for firm-day observations that occur after brokerage closures and zero otherwise.	IBES
TREATED	Dummy variable which equals one for firm-day observations if a firm is affected by the exogenous reduction in analyst coverage due to brokerage closures and zero otherwise.	IBES
AFTER×*TREATED*	Interaction term of the variables *AFTER* and *TREATED*.	IBES
ANALYST_COVERAGE	Number of distinct analysts covering a firm in a given quarter.	IBES

Appendix B: Supplementary figure of the main quasi-natural experiment results

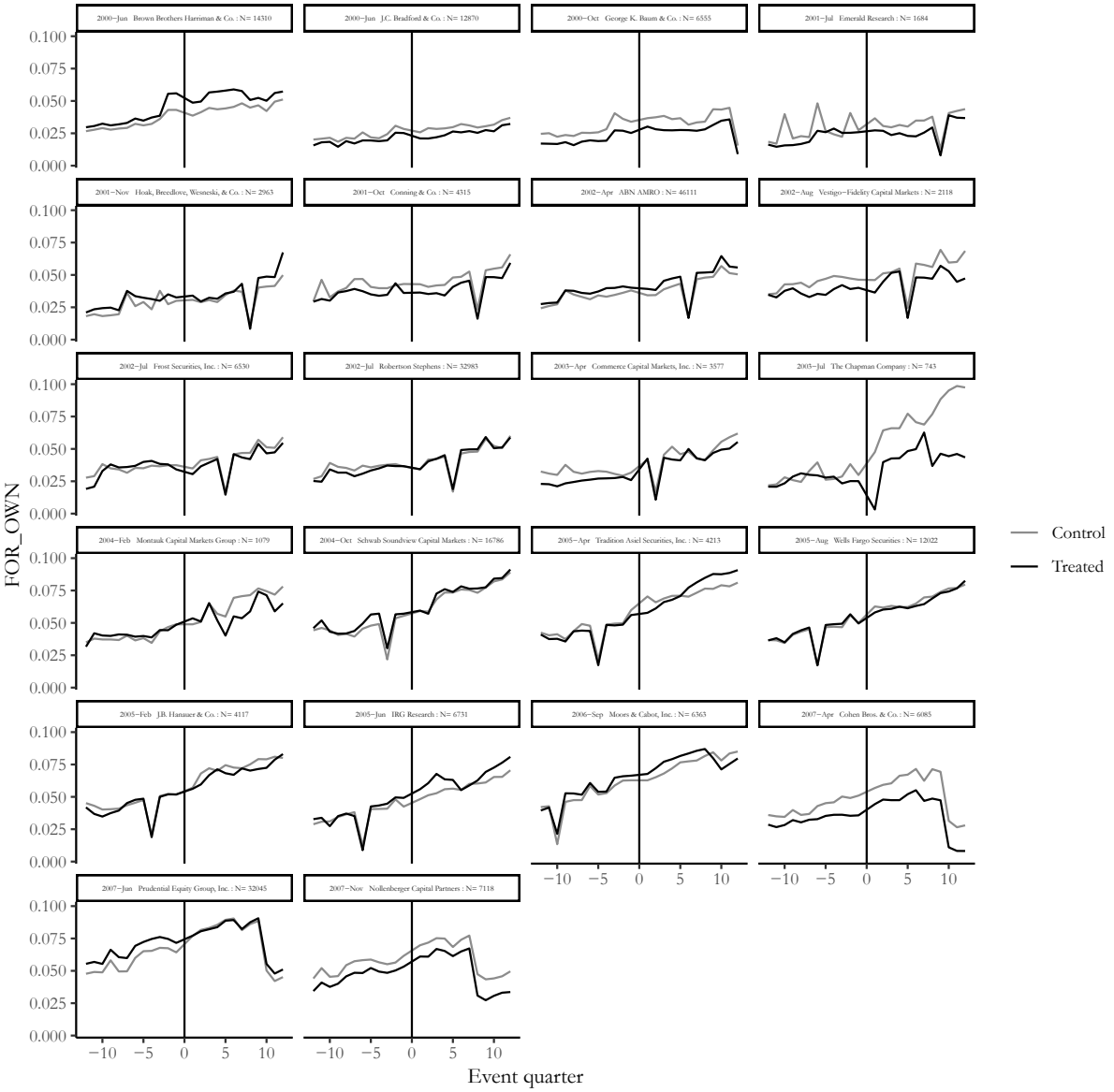

Figure 3: Foreign ownership between the treatment and control groups around each brokerage closure

This figure presents the evolution of the mean of firm-quarter observations of foreign ownership (*FOR_OWN*) around each brokerage closure. I impose a three-month gap over the events so that foreign ownership estimates are from quarters [-12,-1] and [1,12], with the brokerage closure occurring in the quarter 0. Control firms are matched using propensity score matching (nearest neighbor) that matches each treatment firm to three control firms by multiple covariates (twelve quarters before the event): logarithm of market capitalization (*LOG_MKT_CAP*), book-to-market ratio (*BM_RATIO*) and number of distinct analysts covering the firm (*ANALYST_COVERAGE*). The firm-quarter observations of foreign ownership are winsorized at the top and bottom 1%. Sample period: 1997- 2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

Appendix C: Robustness tables and figures

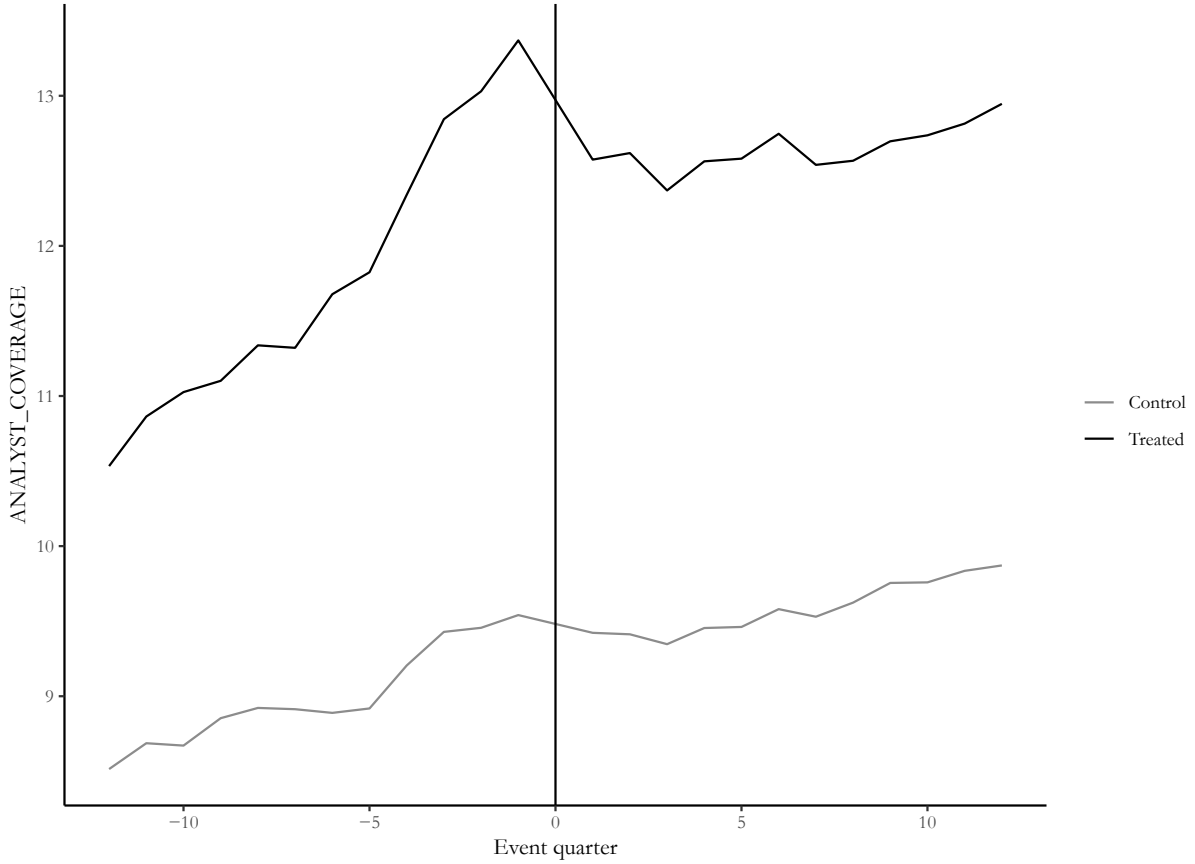

Figure 4: Analyst coverage between the treatment and control groups during brokerage closures
This figure presents the evolution of the mean of firm-quarter observations of analyst coverage (*ANALYST_COVERAGE*) during the twelve quarters (i.e. three years) before and after an exogenous decrease in analyst coverage due to the 22 distinct brokerage closures listed by Kelly and Ljungqvist (2012). I impose a three-month gap over the events so that foreign ownership estimates are from quarters [-12,-1] and [1,12], with the brokerage closure occurring in the quarter 0. Control firms are matched using propensity score matching (nearest neighbor) that matches each treatment firm to three control firms by multiple covariates (twelve quarters before the event): logarithm of market capitalization (*LOG_MKT_CAP*), book-to-market ratio (*BM_RATIO*) and number of distinct analysts covering the firm (*ANALYST_COVERAGE*). The firm-quarter observations of foreign ownership and foreign breadth are winsorized at the top and bottom 1%. Sample period: 1997- 2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

Table 9: Difference-in-differences regression analysis of foreign ownership-specific variables by investor type

This table reports the results of the difference-in-differences regression analysis of ownership-specific variables by different classifications of institutional investor types (Bushee, 2001). The classification group *Quasi* contains quasi-indexing investors and *Non-quasi* transient and dedicated investors. For all stocks, I compute averages of the dependent variables and control variables in all columns over the quarters [-4,-1] and over the quarters [1,4], with the brokerage closure occurring in quarter 0. The control variables are book-to-market ratio (*BM_RATIO*), leverage (*LEVERAGE*) and return on assets (*ROA*). I include industry and year fixed effects in all regressions. Standard errors are clustered by the industry and year level and reported in parentheses. *FOR_OWN* and *FOR_BREADTH* are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom 1%. Table 8 in Appendix provides a detailed list of variable definitions. *, ** and *** denote the statistical significance at the 10%, 5% and 1% level, respectively. Sample period: 1997-2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

	Dependent variable:							
	FOR_OWN		FOR_BREADTH		FOR_TO_INST_OWN		FOR_TO_INST_BREADTH	
	Quasi	Non-quasi	Quasi	Non-quasi	Quasi	Non-quasi	Quasi	Non-quasi
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AFTER	0.008***	0.0001	0.001	−0.0001	0.008**	−0.002	0.005	−0.002
	(0.002)	(0.004)	(0.0005)	(0.0004)	(0.004)	(0.006)	(0.006)	(0.008)
TREATED	−0.0002	−0.001	0.00004	0.0003***	−0.002	−0.003**	−0.002*	−0.002
	(0.001)	(0.001)	(0.0004)	(0.0001)	(0.001)	(0.001)	(0.001)	(0.001)
AFTER×TREATED	−0.001	0.0002	0.0002	−0.0001	−0.002***	0.002*	0.001	0.002
	(0.001)	(0.001)	(0.0002)	(0.0001)	(0.001)	(0.001)	(0.001)	(0.001)
LOG_MKT_CAP	0.004***	0.001	0.001***	0.001***	0.003**	−0.0004	−0.001	0.002***
	(0.001)	(0.0004)	(0.0003)	(0.0001)	(0.001)	(0.001)	(0.002)	(0.001)
BM_RATIO	0.002	−0.001*	0.001***	0.001***	−0.0001	−0.001	0.002	0.001
	(0.002)	(0.001)	(0.0003)	(0.00005)	(0.002)	(0.001)	(0.002)	(0.001)
LEVERAGE	0.004	−0.002	0.001**	0.001***	0.003	−0.009*	0.003	−0.003
	(0.002)	(0.003)	(0.0003)	(0.0003)	(0.004)	(0.005)	(0.002)	(0.002)
ROA	0.044***	0.027***	−0.004**	−0.004***	−0.042***	0.006	−0.031**	−0.007
	(0.012)	(0.004)	(0.002)	(0.001)	(0.013)	(0.015)	(0.013)	(0.008)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Treated firm obs.	5,424	5,424	5,424	5,424	5,424	5,424	5,424	5,424
Control firm obs.	16,176	16,176	16,176	16,176	16,176	16,176	16,176	16,176
Distinct treated firms	1,651	1,651	1,651	1,651	1,651	1,651	1,651	1,651
Distinct control firms	3,558	3,558	3,558	3,558	3,558	3,558	3,558	3,558
Observations	21,600	21,600	21,600	21,600	21,600	21,600	21,600	21,600
Adjusted R^2	0.261	0.083	0.653	0.736	0.166	0.088	0.273	0.155

Table 10: Difference-in-differences regression analysis of foreign ownership-specific variables without control group matching

This table reports the results of the difference-in-differences regression analysis of ownership-specific variables without control group matching. The treatment group is determined as stocks that lose a covering analyst due to 22 distinct brokerage closures listed by Kelly and Ljungqvist (2012). For all stocks, I compute averages of the dependent variables and control variables in all columns over the quarters [-4,-1] and over the quarters [1,4], with the brokerage closure occurring in quarter 0. The explanatory variables are dummy variables indicating the treatment group (*TREATED*), the post-event period (*AFTER*) and their interaction (*AFTER×TREATED*). The control variables are book-to-market ratio (*BM_RATIO*), leverage (*LEVERAGE*) and return on assets (*ROA*). I include industry and year fixed effects in all regressions. Standard errors are clustered by the industry and year level and reported in parentheses. *FOR_OWN* and *FOR_BREADTH* are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom 1%. Table 8 in Appendix provides a detailed list of variable definitions. *, ** and *** denote the statistical significance at the 10%, 5% and 1% level, respectively. Sample period: 1997-2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

	Dependent variable:			
	FOR_OWN	FOR_BREADTH	FOR_TO_INST_OWN	FOR_TO_INST_BREADTH
	(1)	(2)	(3)	(4)
AFTER	0.007***	0.0003***	0.004	0.002
	(0.002)	(0.0001)	(0.003)	(0.005)
TREATED	0.0005	0.001**	−0.005***	−0.002
	(0.001)	(0.0004)	(0.001)	(0.002)
AFTER×TREATED	0.001	0.0001	0.003	0.004
	(0.001)	(0.0002)	(0.002)	(0.002)
LOG_MKT_CAP	0.006***	0.002***	0.005***	0.0002
	(0.001)	(0.0002)	(0.001)	(0.002)
BM_RATIO	0.0004	0.001***	−0.004*	0.001
	(0.002)	(0.0002)	(0.002)	(0.002)
LEVERAGE	0.003	0.002***	−0.012***	−0.001
	(0.002)	(0.0003)	(0.004)	(0.003)
ROA	0.054***	−0.005***	−0.067***	−0.049***
	(0.008)	(0.002)	(0.019)	(0.019)
Industry fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Treated firm obs.	5,424	5,424	5,424	5,424
Control firm obs.	152,298	152,298	152,298	152,298
Distinct treated firms	1,651	1,651	1,651	1,651
Distinct control firms	6,717	6,717	6,717	6,717
Observations	157,722	157,722	157,722	157,722
Adjusted R^2	0.189	0.678	0.111	0.098

Table 11: Difference-in-differences regression analysis of foreign ownership-specific variables with instrumental variable approach

This table reports the results of the difference-in-differences regression analysis of foreign ownership-specific variables with instrumental variable approach. The treatment group is determined as stocks that lose a covering analyst due to 22 distinct brokerage closures listed by Kelly and Ljungqvist (2012). For all stocks, I compute averages of the dependent variables and control variables in all columns over the quarters [-4,-1] and over the quarters [1,4], with the brokerage closure occurring in quarter 0. In the first-stage regression, explanatory variables are dummy variables indicating the treatment group (*TREATED*), the post-event period (*AFTER*) and their interaction (*AFTER×TREATED*). The control variables are book-to-market ratio (*BM_RATIO*), leverage (*LEVERAGE*) and return on assets (*ROA*). In the second-stage instrumental variable regressions, fitted values of information asymmetry measure are used as explanatory variable along with the control variables. I also examine the OLS panel regressions with information asymmetry measure (non-fitted) as explanatory variable along with control variables. I include industry and year fixed effects in all regressions. Standard errors are clustered by the industry and year level and reported in parentheses. I test the weakness of instruments by examining their joint significance and report the first-stage F-statistics. *FOR_OWN* and *FOR_BREADTH* are winsorized at the top to a maximum of 1. Control variables are winsorized at the top and bottom 1%. Table 8 in Appendix provides a detailed list of variable definitions. *, ** and *** denote the statistical significance at the 10%, 5% and 1% level, respectively. Sample period: 1997-2010. Sources: CRSP, COMPUSTAT, 13F and IBES.

	Dependent variable:								
	First stage	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	VCV_{USD}	FOR_OWN		FOR_BREADTH		FOR_TO_INST_OWN		FOR_TO_INST_BREADTH	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A: Volume coefficient variation (VCV_{USD}) as information asymmetry measure									
VCV_{USD}		−0.020***	−0.076*	−0.007***	−0.018***	−0.009	−0.037	0.011*	−0.012
		(0.006)	(0.041)	(0.001)	(0.005)	(0.009)	(0.050)	(0.006)	(0.051)
AFTER	−0.039***								
	(0.005)								
TREATED	−0.074***								
	(0.016)								
AFTER_TREATED	0.035***								
	(0.007)								
BM_RATIO	0.147***	−0.0002	0.007	−0.001***	0.001	−0.002	0.002	0.0003	0.003
	(0.021)	(0.003)	(0.007)	(0.0001)	(0.001)	(0.002)	(0.007)	(0.001)	(0.007)
LEVERAGE	−0.075*	0.005	0.0003	0.002***	0.001**	−0.009	−0.012*	−0.001	−0.003
	(0.043)	(0.005)	(0.003)	(0.001)	(0.001)	(0.007)	(0.007)	(0.004)	(0.005)
ROA	−1.183***	0.083***	0.016	0.010***	−0.004	−0.044**	−0.077	−0.051***	−0.079
	(0.248)	(0.017)	(0.034)	(0.003)	(0.005)	(0.017)	(0.052)	(0.014)	(0.057)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Treated firm obs.	5,298	5,298	5,298	5,298	5,298	5,298	5,298	5,298	5,298
Control firm obs.	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836
Distinct treated firms	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610
Distinct control firms	3,435	3,435	3,435	3,435	3,435	3,435	3,435	3,435	3,435

Observations	21,134	21,134	21,134	21,134	21,134	21,134	21,134	21,134	21,134
First-stage F-statistic	22.304								
Adjusted R^2	0.246	0.224		0.459		0.158		0.222	
	First stage	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	BA_SPREAD	FOR_OWN		FOR_BREADTH		FOR_TO_INST_OWN		FOR_TO_INST_BREADTH	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel B: Bid-ask spread (BA_SPREAD) as information asymmetry measure									
BA_SPREAD		−0.213***	2.516	−0.042***	−0.939	−0.146**	4.820	−0.033	2.844
		(0.051)	(1.990)	(0.012)	(1.199)	(0.064)	(5.588)	(0.046)	(4.013)
AFTER	0.001								
	(0.003)								
TREATED	−0.0004								
	(0.001)								
AFTER_TREATED	−0.001								
	(0.001)								
BM_RATIO	0.009***	−0.001	−0.025	−0.001***	0.006	−0.002	−0.045	0.002**	−0.023
	(0.001)	(0.003)	(0.019)	(0.0002)	(0.011)	(0.001)	(0.051)	(0.001)	(0.034)
LEVERAGE	−0.005	0.006	0.019*	0.003***	−0.002	−0.009	0.015	−0.002	0.012
	(0.004)	(0.005)	(0.011)	(0.001)	(0.003)	(0.007)	(0.020)	(0.004)	(0.018)
ROA	−0.207***	0.063*	0.628	0.009**	−0.177	−0.063**	0.966	−0.071***	0.525
	(0.009)	(0.034)	(0.405)	(0.004)	(0.252)	(0.026)	(1.153)	(0.011)	(0.838)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Treated firm obs.	5,298	5,298	5,298	5,298	5,298	5,298	5,298	5,298	5,298
Control firm obs.	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836	15,836
Distinct treated firms	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610	1,610
Distinct control firms	3,435	3,435	3,435	3,435	3,435	3,435	3,435	3,435	3,435
Observations	21,134	21,134	21,134	21,134	21,134	21,134	21,134	21,134	21,134
First-stage F-statistic	2.107								
Adjusted R^2	0.644	0.212		0.356		0.158		0.217	