Does Options Trading Deter Real Activities Manipulation?

MAHMOUD DELSHADI,

Adam Smith Business School, University of Glasgow

ZABIHOLLAH REZAEE

Fogelman College of Business and Economics, The University of Memphis

SEYED MAHMOUD HOSSEINNIAKANI

Norwegian University of Science and Technology (NTNU), NTNU Business School

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Abstract:

We examine whether and how options trading activity curtails real activities manipulation. Using a large sample of US firms that are suspected of earnings manipulation, we document that an active options trading market significantly reduces real activities manipulation. We confirm our findings by using 2SLS analyses and alternative research designs. Our findings are also robust to using alternative proxies for options trading activity. Further, we find that the deterring impact of options trading on real activities manipulation is more pronounced among firms with low institutional ownership, firms in highly competitive industries, and small and young firms. Overall, our findings show that an active options market discourages managers from engaging in real activities manipulation as informed options trading helps stock prices better reflect adverse consequences of real activities manipulation. Our findings highlight the benefits of the options market development in reducing value-destroying activities and thus provide policy, practice, and research implications.

Keywords: Earnings management; Real activities manipulation; Options trading

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1. Introduction

Options market as one of the fastest developing components of the US capital[1] has been the interest of researchers over four decades. Researchers well document that managers' decisions and news about corporate outcomes are reflected in the options market (e.g. Jin, Livnat, Zhang, 2012). Recently, a new line of research explores whether and how the presence of an active options market may influence corporate policies in the first place by enhancing the firms' information environments. This study focuses on the impact of options trading on the overstatement of earnings through real activities manipulation which is a deleterious corporate practice.[2] Mellado-Cid, Jory, and Ngo (2019) document a negative association between the ex-post level of real activities manipulation and the volatility spread and skew in the firms' options. Their findings may suggest that the options market detects real activities manipulation. A natural question arises as to whether an active options trading market influence the ex-ante level of real earning management. In other words, the question is whether managers refrain from taking real economic actions to manipulate earnings as the informed options traders may detect such manipulative actions.

It is not clear a priori whether and how options trading affects the ex-ante level of real activities manipulation. On the one hand, there is substantial evidence that trading by informed options traders conveys information to the capital market, and thus improves stock price efficiency. (Cao et al., 2020a; Ho et al., 1995; Hu, 2018). Hence, options trading helps the stock prices better

[1] The total number of equity options contracts has grown from 174 thousand in 1995 to 7,004 million in 2020. (Retrieved from The Options Clearing Corporation web site: https://www.theocc.com/Market-Data/Market-Data-Reports/Volume-and-Open-Interest/Historical-Volume-Statistics).

[2] Real activities manipulation (or often referred to as real earnings management) refers to the overstatement of earnings by taking real economic actions, such as overproduction and cutting discretionary expenses, that inflate earnings temporarily. Real activities manipulation is associated with adverse impacts on firms' future operations and their cash flow (Roychowdhury, 2006). For instance, a firm's competitive advantage could be adversely affected by reducing R&D investments or cutting advertising expenses.

reflect the outcomes of managers' economic actions (Blanco and Wehrheim, 2017; Cao, Goyal, Ke, and Zhan, 2020a). Thus, through informed options trading the adverse consequences of real activities manipulation are impounded into the stock prices and the capital market can detect real activities manipulation more effectively. Therefore, management may refrain from taking economic actions to overstate earnings as it would be hard to deceive the capital market in the presence of an active options market.

On the other hand, options trading may also have no impact on the ex-ante level of real activities manipulation for two reasons. First, the preponderance of evidence is weighted towards the informational role of options trading (e.g., Hu, 2018; Cao et al., 2020a). However, we note that there are studies that fail to provide evidence in favor of the informational role of the options market (e.g., Hu, 2014; Xing, Zhang, and Zhao, 2010). Second, a high volume of uninformed trading in an active options market (i.e., noise trading) clouds informed trading. Consequently, that makes it difficult for the capital market participants to acquire information from the options market (Roll, Schwartz, and Subrahmanyam, 2010; Hu, 2018). If this is the case, then options trading may have little or no effect on the level of real activities manipulation as capital market participants are unable to learn about earnings manipulation from the options market. Consequently, managers can mislead the capital market by taking real economic actions. Finally, options trading may also lead to more real activities manipulation as management may resort to real activities manipulation because detecting real activities manipulation may be harder for options traders than discovering accounting-based earnings management[3]. These possibilities introduce tension in our research

[3] Financial analysts and short-sellers also reduce information asymmetries in the capital market and contribute to stock price efficiency. In particular, García Lara, García Osma, and Penalva (2013) shows that financial analysts clearly detect real activities manipulation and fully consider its future consequences in their assessments. However, management engages in more real activities manipulation when analyst coverage is high (Irani and Oesch, 2016; Sun and Liu, 2016) and there is an active short selling market (Zhang et al., 2020; Jian et al., 2020). The reason is that

question of whether and how options trading is associated with real activities management. Therefore, ex-ante, given these competing views, the relation between options trading and real activities manipulation is an empirical question.

To examine how options trading relates to real activities manipulation, we focus on overproduction and cutting discretionary expenditures, two main real economic actions that managers take to boost earnings (Graham, Harvey, Rajgopal, 2005; Zang, 2012). Using a large sample of US firms that are listed on options exchanges and are suspected of earnings manipulation, we find that options trading is negatively related to real activities manipulation. We also adopt a two-stage least square (2SLS) approach to mitigate the concern that omitted variables drive our results or reverse causality explains our findings. More specifically, we use moneyness and open interest as instrument variables, which are widely used in the literature on the impact of options trading on corporate policies (e.g. Roll, Schwartz, and Subrahmanyam, 2009; Chen et al. 2021; Blanco and Garcia 2021). The 2SLS analyses also confirm our main findings. In robustness checks, we also find that our findings are robust to the alternative research designs proposed by Chen, Hribar, and Melessa (2018), to alternative proxies for options trading activity, and an alternative definition of moneyness.

To provide further insights into the relation between options trading and real activities manipulation, we also examine several additional hypotheses. First, we posit that options trading impedes real activities manipulation by helping the stock prices better impound the fundamental value of managers' decisions including real activities manipulation. Thus, we expect that the negative impact of options trading will be more prominent where the expected information

managements switches from accounting-based earnings management to real activities manipulation as it is more difficult to detect the latter than the former by financial analysts and short-sellers. The same logic may apply to options traders.

asymmetry between managers and outsiders is high, and thereby the expected price efficiency is low. Consistent with our expectations, we find that the impact of options trading on real activities manipulation is stronger among small and young firms (e.g., where the expected information asymmetry is high and the expected price efficiency is low). Second, prior studies show that institutional ownership deters real activities manipulation (e.g., Bushee, 1998). We explore the interaction between institutional ownership and options trading activity and find that options trading acts as a substitute for institutional ownership in curtailing real activities manipulation. Finally, we explore how industry competition (concentration) influences the relation between options trading and real activities manipulation as prior research (e.g., Shi, Sun, and Zhang, 2018) suggests that the adverse consequences of real activities manipulation are more severe in highly competitive environments. Thus, in highly competitive industries, informed options traders have greater incentives to trade and profit from suboptimal managers' actions. Consistent with our prediction, we find that the impact of options trading on real activities manipulation is stronger in highly competitive industries (i.e., low concentrated industries).

This study contributes to two streams of research and also offers policy implications. First, it contributes to the literature on the determinants of real activities manipulation. While prior studies show that most of the governance mechanisms, such as financial analysts and auditors encourage management to switch from accounting-based earnings management to real activities manipulation. Our study contributes to this line of research on the determinants of real activities manipulation by showing that the options market serves as a corporate governance mechanism as it deters such activities. We further demonstrate how ownership structure, Size/age, and industry competitiveness influence the governance role of the options market in curtailing real activities manipulation.

Second, while it is well documented that corporate news (i.e. ex-post corporate policies) influences the options market (e.g. Jin, et al., 2012), an emerging strand of literature investigates how the presence of an active options market shapes corporate policies, such as innovation (Blanco and Wehrheim, 2017) and voluntary disclosure (Chen et al., 2021). Mellado-Cid et al. (2019) report that the ex-post level of real activities manipulation influences the options market. Our study adds to this aforementioned line of research by showing that options trading curtails real activities manipulation in the first place. Our paper provides policy and practice implications for policymakers and regulators, by showing how development in the options market may deter real activities manipulation, which has harmful impacts on firm value.

The remainder of the paper is organized as follows. Section 2 presents the literature review on real activities manipulation, as well as options trading. Section 3 develops the hypothesis. Section 4 describes our sample and our main model. Section 5 reports the descriptive statistics and our main empirical findings. Section 6 examines the robustness of our main findings. Finally, section 7 concludes the paper.

2. Literature review

2.1. Real activities manipulation

Earnings is the most important item in the financial statement and significantly influences investors' investment decisions. Earnings target is a frequent performance measure in compensation contracts (Indjejikian, Matëjka, Merchant, Van der Stede, 2014). Managers' career prospects are also largely affected by their ability to meet or exceed the expected earnings as it is a key driver of investors' perception of managers' ability to convert firms' resources into profit (Graham, Harvey, Rajgopal, 2005; Pae, 2021). As such, managers have strong incentives to overstate earnings to deceive the capital market by portraying a better picture of firms' operations.

The earnings manipulation is achieved by using three different approaches (Dechow and Skinner, 2000). First, fraudulent manipulation of earnings by violating accounting rules and standards. Second, managers can overstate earnings by taking advantage of discretion in recognizing and reporting accruals by selecting accounting policies and practices that enable the achievement of a desired earnings. Third, managers can alter real transactions in a way that boosts the earnings (i.e., real activities manipulation or real earnings management). While accounting-based earnings management has no impact on firms' future cash flow, real activities manipulation is associated with adverse impacts on firms' future operations and their cash flow (Roychowdhury, 2006). For instance, the reduction of discretionary expenses, such as R&D and advertising, boosts earnings temporarily. However, a company that reduces such discretionary expenses may lose the competitiveness of its products and fail to attract or maintain customers. Opportunistic overproduction, a common real activities manipulation, also leads to inventory obsolescence, which might result in inventory write-downs in the future (Gupta, Pevzner, and Seethamraju, 2010)[4].

Despite the detrimental impacts of real activities manipulation on firms' operations, there is substantial evidence that managers widely alter real transactions to boost earnings. For instance, 80% of 400 executives who participated in a survey and interview study conducted by Graham et al. (2005), state that they overstate earnings by taking real economic actions, such as cutting R&D, advertising, and maintenance costs. Archival studies also show that managers engage in real activities manipulation, such as overproduction and cutting discretionary expenses, to meet certain

[4] Opportunistic overproduction allows managers to delay expensing a large proportion of the fixed costs into earnings by allocating it to the ending inventory, which classifies as a current asset. Real activities manipulation through opportunistic overproduction is also associated with the holding costs of excess inventory. (Gupta et al., 2010).

earnings benchmarks (e.g., Roychowdhury, 2006) or mislead the stock market during seasoned equity offerings (Cohen and Zarowin, 2010).

Given the adverse consequences of real activities manipulation on firms' operations and their competitiveness, it is imperative for governance mechanisms to curtail such activities. Nonetheless, under intense scrutiny by regulators and corporate gatekeepers (e.g., financial analysts, auditors) managers switch from accounting-based earnings management to real activities manipulation (e.g., Zang, 2012). Prior studies find that analyst coverage (Irani and Oesch, 2013; Sun and Liu, 2016), short-selling pressure (Zhang, Zhu, He, and Chan, 2020; Jiang et al., 2020), adoption of clawback provisions (Chan, Chen, Chen, Yu. 2015), and auditing by high-quality auditors (Chi, Lisie, and Pevzner 2011) are associated with shifting from accounting-based to real activities management. Prior research suggests that following the implementation of regulations that are intended to increase firms' transparency and protect investors' wealth, managers substitute accounting-based earnings management for real activities manipulation. For example, Cohen et al. (2008) and Ernstberger, Link, Stich, and Vogler. (2017), respectively, report that after the implementation of the Sarbanes-Oxley Act of 2002 (SOX) in the United States and the requirement of interim reporting in Europe, firms resort to more real activities manipulation. Given the unintended consequences of encouraging more real activities manipulation by most of the governance mechanisms as well as regulations, it is important to identify mechanisms that impede such harmful activities.

2.2. Options trading

The options trading literature is vast and spans across four decades; hence, we do not attempt to provide a comprehensive review of its findings and instead we focus on the relevant

strands of the literature. One main relevant strand of the literature provides consistent evidence that the options market leads the stock market and contributes to the price discovery process around corporate news events, such as earnings announcements (e.g., Jennings and Starks 1986; Roll et al. 2010; Truong and Corrado, 2014) and financial analysts' consensus revisions (e.g., Hayunga and Lung, 2014). Overall, this line of research shows that informed traders, who have private information, trade before corporate news events and their trading activity conveys private information to the stock market. Therefore, the prices of underlying stocks adjust to the news announcements more efficiently (Truong and Corrado, 2014). Jin et al. (2012) find that options traders have superior ability in processing public information after unplanned corporate news events, such as executive/board changes, litigations, and M&A announcements.

Apart from the literature that explores the price discovery process, a stream of studies also examines how options trading improves the quality of other aspects of firms' information environments. For instance, Ho, Hassell, and Swidler. (1995) and Yu, Tandon, and Webb (2010) document that information production by options traders leads to an improvement in the accuracy of security analysts' earnings forecasts. Hu (2018) finds that options trading attenuates information asymmetries in the capital market and reduces information risk. Cao et al. (2020a) show that options trading enhances stock price informativeness.

This study belongs to a body of developing literature by investigating how options trading influences various corporate outcomes. A common feature of studies in this line of research is that they all attribute their findings to the enhanced informational efficiency associated with options trading. For instance, Roll et al. (2009) find that options trading enhances firm value as options trading increases investment sensitivity to stock price. Blanco and Wehrheim (2017) argue that informed options traders help stock prices better incorporate the fundamental value of R&D

projects. Hence, options trading motivates managers to invest in innovative projects. Cao, Hertzel, Xu, and Zhan (2020b) find that options trading influences firms' debt structure by improving the information environments, which in turn facilitate financing from public bonds. Chen et al. (2021) find that firms reduce voluntary disclosure as options trading alleviates information asymmetries. Ali et al. (2020) argue that informed options traders, who actively search for information, limit managers' ability to manipulate financial information. Consistent with their argument, they find that options trading is associated with a lower likelihood of accounting restatements and consequently auditors demand lower audit fees when there is an active options market. Delshadi et al. (2021) find that options trading reduces the demand for conditional conservatism by reducing information asymmetry and aligning shareholders-managers interests. This study extends this line of research and highlights the bright side of the options market development by showing the deterring impact of options trading on real activities manipulation.

3. Hypothesis development

Informed options traders skillfully analyze public information and actively search for private information (e.g., Jin, et al., 2012). They trade based on their acquired information and finally, their trading activities convey information to the capital market (e.g., Hu 2018). There is substantial evidence in the literature that supports the role of informed options traders in bringing the information to the capital market (e.g., Jennings and Starks 1986; Ho et al. 1995; Yu et al. 2010; Hu 2018), facilitate price discovery (e.g., Jin et al., 2012; Truong and Corrado 2014), and overall improve price efficiency (e.g., Diamond and Verrecchia, 1987; Cao et al. 2020a). As such, options trading leads the stock prices to better incorporate the fundamental value of managers' decisions (Blanco and Wehrheim 2017). Consequently, as evidence provided by Mellado-Cid et

al. (2020) suggests, informed options traders may understand real activities manipulation [5], help stock prices reflect the detrimental effects of real activities manipulation, and discourage management to largely engage in real activities manipulation to deceive the capital market. Therefore, in the presence of an active options market, management may avoid engaging in taking real economic actions to manipulate earnings.

There are also reasons to expect that options trading may have no effect on real activities manipulation. First, while overall literature suggests that the options market has information advantage over the stock market and enriches firms' information environments, there are also studies showing that stock markets lead options markets. Therefore, it could be concluded that options trading does not enrich the information environments (e.g., Hu 2014; Manaster and Rendleman 1982; Xing et al. 2010). Second, as pointed out by Roll et al. (2010) and Hu (2018), the trading by uninformed traders (noise traders) makes it hard for the capital market participants to learn information from the trading behavior of informed options traders. As such, although informed options traders may detect real activities manipulation (Mellado-Cid et al. 2019), the capital market may not learn about real activities manipulation.

Options trading may also induce managers to engage in more real activities manipulation. Cohen et al. (2008) and Zang (2012) argued that under intense scrutiny, managers may choose to take more real economic actions as real activities manipulation are substantially more difficult to detect than accounting-based earnings management. Consistent with this argument, Cohen et al. (2008) find that under higher regulatory scrutiny following SOX, firms switch from accounting-based earnings management to real activities manipulation. It could be argued that the presence of short sellers and financial analysts deter managers from manipulating earnings as both capital

[5] We do not argue that an active options market totally deters real earnings management as the decision in taking real economic actions is determined by a host of factors (e.g., auditors, governance mechanism, etc.).

market participants improve firms' information environments. However, prior studies show that while short selling (Zhang et al. 2020; Jiang et al. 2020) and financial analysts (Irani and Oesch, 2013; Sun and Liu 2016) decrease accounting-based earnings management, they encourage real activities manipulation. The reason is that managers switch from accounting-based earnings management to real activities manipulation which is harder to discover by financial analysts and short-sellers. In a similar way, managers may prefer to take more economic actions as it might be harder for options traders to detect real activities manipulation than accounting-based earnings management[6]. As such, it is reasonable to argue that options trading may induce managers to engage in more real activities manipulation as it is harder to discover. Based on the above discussion, we state our first non-directional hypothesis as follows:

H1: Options trading is associated with real activities manipulation.

We argued that options trading reduces information asymmetry and helps stock prices better incorporate the fundamental value of managers' decisions including real activity manipulation. As such, we expect that the impact of options trading on real activities manipulation would be stronger where there is likely more information asymmetry and price inefficiency. It is well documented that size is negatively related to information asymmetry and large firms have a better information environment. The reasons are that large firms are more visible to the capital market (e.g., Atiase 1987; Freeman 1987; Zhang 2006), and information intermediaries (e.g., financial analysts, rating agencies) are less motivated to gather information about small businesses (Cotei and Farhat, 2018). Firm age is negatively associated with opacity in the information

[6] Ali et al. (2020) also find that options trading is negatively related to the likelihood of accounting restatement (a proxy for accounting-based earnings management). In untabulated results, using Jones's (1991) model of accrual-based earnings management, we also find that options trading is negatively related with accrual-based earnings management.

environment (Zhang, 2006) as it is easier to predict the future performance of firms with long trading histories (Lu, Chen, Liao, 2010). As such, size and age are suitable proxies for the expected information asymmetry. It is reasonable to expect an active options market to play a more influential role in incorporating adverse consequences of real activities manipulation in stock prices among small and young firms (i.e., where the expected information asymmetry and price inefficiency is high). Hence, we state the following hypothesis:

H2: The association between options trading and real activities manipulation is more pronounced among small and young firms.

Institutional investors have superior ability in collecting and processing information (O'Brien and Bhushan, 1990), and have the incentive to attempt to improve firms' operations as they have significant ownership stakes (Shleifer and Vishny, 1986). Institutional investors can influence corporate governance mechanisms by having necessary resources, such as direct contact with management, to closely monitor and discipline managers (McCahery, Sautner, and Starks, 2016). Prior studies document that institutional ownership limits real activities manipulation (e.g., Bushee 1998, Roychowdhury 2006, Zang 2012). It is not clear ex-ante how an active options market and institutional ownership, as corporate governance mechanisms, operate interactively in impeding real activities manipulation. On the one hand, institutional investors may act as a powerful governance mechanism in deterring real activities manipulation and thus an active options trading market may play a negligible role when institutional ownership is high. On the other hand, options trading and institutional ownership may complement each other in deterring real activities manipulation. Therefore, we state our third hypothesis as follows:

H3: Institutional ownership moderates the relationship between options trading and real activities manipulation.

Under greater competition pressure, the negative economic consequences of real activities manipulation are more severe (Shi et al. 2018). The reason is that if a firm with many rivals deviates from optimal operational policies, it can easily lose its competitive advantage. For instance, in a highly competitive environment, a firm that reduces its R&D and advertising expenses to overstate earnings, will be quickly outperformed by competitors that maintain or even increase their R&D and advertising expenses.[7] Accordingly, informed options traders, who understand the severe adverse impact of cutting R&D and advertising expenses in a highly competitive industry, buy out put options or sell call options to take advantage of an upcoming sales decline which may lead to the stock price drop. As such, deviation from optimal operational policies provides more profitable trading opportunities for informed options traders. The stock market may learn the upcoming adverse impacts of real activities manipulation on firm value from informed options traders. Therefore, in a more competitive environment, an active options market has a greater discouraging impact on managers' decisions to engage in real activities manipulation. Hence, it is reasonable to expect that the negative impact of options trading on real activities manipulation would be higher in highly competitive industries. This leads to our last hypothesis:

H4: The association between options trading and real activities manipulation is more pronounced in highly competitive industries.

4. Research Design

4.1. Data sources and sample selection

[7] The excess inventory associated with opportunistic overproduction may also quickly be obsolete in highly competitive markets.

Our sample period spans the period from 1997 to 2019 and is a compilation of data from Compustat and OptionMetrics. More specifically, financial information data are extracted from Compustat and options-related data obtained from OptionMetrics. Financial industry firms are excluded from the sample (SIC code 6000-6799). The sample includes only US firms that are listed on options exchanges. Our real activities manipulation proxy may capture not only opportunistic real earnings management, but also abnormal activities that are related to the factors, such as mismanagement and adopting unique strategies (e.g., Roychowdhury 2006, Zang 2012, Sohn 2016). Hence, to reduce measurement error in capturing real activities manipulation, following previous studies (e.g., Chi et al., 2011), we focus on the sample of firm years observations that are suspected of the management of earnings. More specifically, following Chi et al. (2011), we constrain our sample to firm years that meet at least one of these criteria: (1) their net income deflated by total assets at the beginning of the year is greater or equal to zero and less than 0.005 (i.e. just beating zero earnings benchmarks), (2) changes in net income (from year t-1 to year t) deflated by total assets at the beginning of the year is greater or equal to zero and less than 0.005 (i.e. just beating past year earnings benchmarks), (3) actual earnings per share (EPS) minus the analysts' consensus forecast of EPS is equal or less than one cent, (4) they issued seasoned equity offering[8]. We removed firm years with missing values for all variables included in our regression models. To estimate real activities manipulation, we require at least 15 firms in each industry (2 digits SIC) and each year. Finally, we end up with a sample of 24,046 firm-years observations. We obtain analyst coverage data from IBES and institutional data from Thomson Institutional Holdings. The institutional investor classification data are taken from Professor Brian Bushee's

[8] Following Chi et al. (2011) and Gubta et al. (2010), we consider a firm issued seasoned equity offering if Compustat report nonzero data item 108 (SSTK).

personal website.[9] All continuous variables are further winsorized at the top and bottom one percent.

4.2. Empirical model

Following the literature (e.g., Huang, Roychowdhury, and Sletten. 2020; Zhang et al. 2020; Zang 2012), we focus on abnormal discretionary expenses ($Dis\_DISX_{i,t}$) and abnormal production costs ($Dis\_PROD_{i,t}$), two main real activities manipulation[10]. We also, following Huang et al. (2018), aggregate these two proxies to calculate an overall real activities manipulation as follows:

$$REM_{i,t} = Dis\_PROD_{i,t} - Dis\_DISX_{i,t} \quad (1)$$

To estimate abnormal discretionary expenses ($Dis\_DISX_{i,t}$) and abnormal production costs ($Dis\_PROD_{i,t}$), we run regressions 2 and 3 for firms in the same industry (2 digits SIC code) in a given year[11]. The residuals from equations 2 and 3, respectively capture $Dis_DISX_{i,t}$and $Dis\_PROD_{i,t}$.

$$(DISX_{i,t}/AT_{i,t-1}) = k_1(1/AT_{i,t-1}) + k_2(SALES_{i,t-1}/AT_{i,t-1}) + \varepsilon_{i,t} \quad (2)$$

$$(PROD_{i,t}/AT_{i,t-1}) = k_1(1/AT_{i,t-1}) + k_2(SALES_{i,t-1}/AT_{i,t-1}) + k_1(\Delta SALES_{i,t}/AT_{i,t-1}) + k_1(\Delta SALES_{i,t-1}/AT_{i,t-1}) + \varepsilon_{i,t} \quad (3)$$

Where $DISX_{i,t}$ is the sum of R&D expenses, advertising expenses, and SG&A expenses (#XAD+#XRD+#XSGA) for firm i in year t, $PROD_{i,t}$ is the sum of the cost of goods sold and

[9] https://accounting-faculty.wharton.upenn.edu/bushee/

[10] Following the literature (e.g. Huang et al. 2020; Zhang et al. 2020; Zang 2012), we do not examine abnormal cash flow from operation because different real earnings management practices have opposite impacts on cash (Haung et al. 2020; Roychowdhury, 2006). For instance, reducing R&D, advertising and SG&A expenses saves cash, and sales manipulation increases cash inflow as well. However, overproduction may increase cash outflows as firms purchase more materials and labor costs also increase with the level of production.

[11] We estimate equations 2 and 3 using sample of all firms on Compustat, including both firms that are listed on OptionMetrics database and those that have no history in OptionMetrics database.

change in inventory (#COGS+Δ#INVT) for firm i in year t. $SALES_{i,t-1}$ is total sales (#SALE) for firm i in year t-1. $AT_{i,t-1}$ is total assets (#AT) for firm i in year t-1.

To investigate the impact of options trading on real activities manipulation (H1), we estimate the following regressions:

$$Dis\_DISX_{i,t} = \beta_0 + \beta_1 Volume_{i,t} + \beta_i \times Control\ Variables + \varepsilon \quad (4a)$$

$$Dis\_PROD_{i,t} = \beta_0 + \beta_1 Volume_{i,t} + \beta_i \times Control\ Variables + \varepsilon \quad (4b)$$

$$REM_{i,t} = \beta_0 + \beta_1 Volume_{i,t} + \beta_i \times Control\ Variables + \varepsilon \quad (4c)$$

$Volume_{i,t}$ is the natural logarithm of 1 plus the aggregated annual options trading volume (in $10,000) for firm i and the fiscal year t. Following prior studies (e.g., Anagnostopoulou, Trigeorgis, and Tsekrekos. 2021; Chen et al. 2021; Blanco and Wehrheim, 2017), we use the volume of options trading as a proxy for an active options market. The rationale is that, as explained by Truong and Corrado (2014), an active options market provides an opportunity for informed options traders to trade based on their information and reveal their information to the capital market.[12] Following prior literature (e.g., Huang et al. 2020; Cohen et al.2008; Zang 2012), we also control for firm characteristics that may determine the degree of real activities manipulation, including size (*Size*), market to book value (*MB*), leverage (*LEV*), financial performance (*ROA*), firm age (*Age*), tangibility (*FASSET*), a dummy variable for big N auditors (*BigN*), capital intensity (*Capital_Int*), and the length of the operating cycle (*Opcycle*). To reduce the risk of misspecification and biased estimates, we control for firm and year fixed effects (Amir,

[12] As discussed by Truong and Corrado (2014), when options trading volume is low, there are not many trading opportunities for informed options traders. Hence, low options trading volume limits informed options traders' ability to trade based on their information. Therefore, the impacts of options trading on information environments depend on volume of options trading. Truong and Corrado (2014) recommend researchers use options trading volume instead of using a binary variable (0 & 1) for options listing as the informational role of options trading hinges on options trading volume. Moreover, the volume of options trading tends to be low in initial years after listing on options exchanges. Following their recommendation, we use options trading volume as a proxy for an active options market rather than a binary variable for options listing.

Carabias, Jona, and Livne, 2016) and cluster standard errors at the firm level (Petersen 2009). Variable definitions are provided in the Appendix.

Endogeneity is the main concern in our study since unobservable omitted variables might drive both options trading volume and the level of real activities manipulation. The association between options trading and real activities manipulation is also subject to reverse causality as options traders may avoid firms that engage in real activities manipulation. To address the potential endogeneity in our analysis, we adopt a two-stage least square (2SLS) approach. More specifically, following the literature on the impact of options trading on corporate outcomes (e.g., Roll et al. 2009; Chen et al. 2021; Ali et al. 2020; Blanco and Garcia 2021; Cao et al. 2020a), we use moneyness and open interest as our two instrumental variables. Moneyness is the annual average of the absolute difference between the option's strike price and the stock's price at the end of the day. Open interest is the natural logarithm of one plus the annual average of open option contracts. As fully discussed by Roll et al. (2009), these two variables are directly related to options trading volume (the relevance condition). There is also no reason to expect that open interest and moneyness will affect the level of real activities manipulation directly or through a channel other than options trading volume (the exclusion condition)[13]. Therefore, both moneyness and open interest are appropriate instrumental variables as they satisfy both the relevance and the exclusion conditions of a suitable instrumental variable.

To test the second hypothesis, we first divide the sample into two sub-samples of small and large, as well as young and old age firms. Then, we re-run regression model 4c for each sample. We apply this approach to examine the third and fourth hypotheses. More specifically, we divide

[13] Moneyness should be exogenous to the corporate policies as exchanges regularly add new options with strike prices close to the recent market price of the underlying stock (Roll et al. 2009).

the sample into the subsamples of firms with low and high institutional ownership, as well as the subsamples of firms in high and low competitive industries.

5. Descriptive statistics and empirical results

5.1. Descriptive statistics

Table 1 Panel A presents descriptive statistics for variables employed in our main regressions (equation 4a, 4b& 4c). The average (median) value of options trading volume is 2.443 (1.997). The average (median) value of *Dis_PROD* and *Dis_DISX* are -0.060 (-0.058) and 0.076 (0.025), respectively. The average (median) value of *RE*, our aggregate measure of real activities manipulation, is -0.136 (-0.094). The standard deviation of *RE* is 0.486, which is almost three times its average of standard deviations (-0.136), indicating high variability in using real activities manipulation by firms. The median and mean of *Size* are very close (6.910 and 6.990, respectively), suggesting that the distribution of *Size* is not skewed. The average of *BigN* is 0.884, indicating that over 88% of firms in our sample are audited by Big N auditors. Table 1 Panel B displays the Pearson correlation among main variables. Consistent with our prediction, *RE*, *Dis_DISX,* and *Dis_PROD* are negatively, positively, and negatively correlated with *Volume*.

Insert Table 1 Here

5.2. Empirical results

5.2.1. First hypothesis: main results

Table 2 reports results for Equations 4 (a, b, and c). The coefficient on *Volume* is negative and significant (-0.005, P<0.01) in column 1, indicating that a negative association between options trading volume and real activities manipulation through overproduction. The coefficient on *Volume* is positive and significant (0.009, P<0.01) in column 2, suggesting a negative

association between options trading activity and real activities manipulation through cutting discretionary costs. The negative and significant coefficient on *Volume* (-0.014, P<0.01) in column 3, indicates that options trading is negatively related to our comprehensive proxy of real activities manipulation.

Table 3 reports results for 2SLS regressions. The coefficient on *Volume* is negative and significant (-0.022, P<0.01; -0.009 P<0.01), suggesting the negative impact of options trading on real activities manipulation (as proxied by REM).[14] For both model specifications, the significant Kleibergen-Paap rk LM statistic indicates that there is no under-identification problem. The Kleibergen-Paap F test statistic is significant in both specifications, indicating that the instrument variables are not weakly identified. The Cragg-Donald Wald F statistic is well above 10 in both specifications, confirming that the instrument variables are not weakly identified (Staiger and Stock 1997). In both models, the Cragg-Donald Wald F statistic is also far greater than all critical values tabulated by Stock and Yogo (2005), suggesting the absence of weak-instrument problems. The Anderson-Rubin F test and the Stock-Wright LM S statistic verify the relevance of the instrument variables and provide further assurance that instrument variables are not weak. Hansen J-statistic rejects under-identification and weak identification of instrument variables. Collectively, diagnostic tests indicate that both models are correctly identified.

Insert Tables 2 and 3 Here

5.2.2. Second hypothesis: firm size and age

Table 4 Panel A reports results for the subsamples of small and big firms that are below and above the median of size, respectively. The coefficient of options trading volume is negative and significant for both subsamples (-0.019, P<0.01 for the subsample of small firms; -0.005,

[14] We also find similar results when we used $Dis\_DISX_{i,t}$ and $Dis\_Prod_{i,t}$ as dependent variable in 2SLS regressions (untabulated).

P<0.05 for the subsample of big firms). However, the coefficient of interest in the subsample of small firms (-0.019) is almost three times the size of the coefficient found for the subsample of big firms (-0.006), and the difference of the two coefficients is significant (P<0.01). This is consistent with findings of prior studies that the impact of options trading is more prominent among small firms (e.g., Cao et al. 2020 a&b).

Table 4 Panel B shows results for the subsamples of young and old firms which are above and below the median of age, respectively. The coefficient of options trading volume, -0.018, is significant for the subsample of young firms (P<0.01). However, the coefficient of interest, -0.006, is marginally significant for the subsample of old firms (P<0.1). The value of the coefficient of options trading volume is more negative for the subsample of young firms and the difference between the coefficients in both subsamples is statistically significant (0.018>0.006; P<0.01). These results indicate that the negative impact of options trading is stronger among younger firms. Collectively, our results show that options trading prominently influences real activities manipulation when there is a high likelihood of information asymmetries (i.e., small and young firms). This is consistent with the argument that options trading deters real activities manipulation by reducing information asymmetries and thus facilitating stock prices to better reflect the fundamental value of real activities manipulation.

Insert Table 4 Here

5.2.3. Third hypothesis: institutional ownership

To investigate our third hypothesis that whether an active options market works as a complement or substitute for institutional ownership, we use two proxies of institutional ownership: the percentage of shares owned by all institutional investors and the percentage of shares owned by dedicated and quasi-indexer institutional investors. We split the sample at the

median of our proxies for institutional ownership, yielding subsamples of firms with high and low institutional ownership. The results of subsample analyses are presented in Table 5 Panel A and Panel B. The coefficient of options trading volume is negative and significant in both subsamples of firms with low institutional ownership (-0.016, P<0.001; -0.017, P<0.01). However, the coefficient of interest is not statistically significant in both subsamples of firms with high institutional ownership (-0.005, P=0.109; -0.004, P=0.150). In sum, our findings suggest that an active options market acts as a substitute for institutional ownership in curtailing real activities manipulation.

Insert Table 5 Here

5.2.4. Forth hypothesis: industry competition

To examine the impact of industry competition on the association between options trading and real activities manipulation (H4), we employ the Herfindahl Hirschman Index (HHI), which has been widely applied to measure industry competition (or concentration). We partition the sample into the subsamples of high HHI (i.e., low competitive industries) and low HHI (i.e., highly competitive industries) above and below the median of HHI. Table 6 shows that the coefficient on options trading volume is negative and significant (-0.024, P<0.01) in the subsample of highly competitive industries (i.e., low HHI). However, the coefficient of interest is insignificant (-0.001, P=0.820) in the subsample of low competitive industries (i.e., high HHI). Collectively, these results indicate that the negative impact of options trading on real activities manipulation is more pronounced among firms in highly competitive industries.

Insert Table 6 Here

6. Robustness tests

6.1. Alternative research design

Chen et al. (2018) raise a concern about using the common two-step regression procedure in accounting and finance research. They warn researchers that using residuals, which are estimated in the first regression, as the dependent variable in the second regression, may lead to biased estimates of the treatment effect and may result in Type I and Type II errors. They recommend researchers estimate their model in a single regression to avoid incorrect inferences. In this section, following Chen et al. (2018), we re-estimate regressions 2 and 4a, as well as regressions 3 and 4b in single regressions. More specifically, we included all independent variables from the first and second regressions in single regressions. We also include industry and year indicator variables and their interactions with the first regression independent variables (i.e., independent variables in models 2 and 3) (Chen et al. 2018 P 782).

Table 7 reports results for our re-estimation of models 2 and 4a in a single model which includes all regressors from models 3 and 4b. The negative and significant coefficient of *volume* in column 1 (-0.021, P<0.01) is consistent with our main results and suggests that options trading deters managers from real activities manipulation through overproduction. Consistent with our main results, in column 2 the coefficient of *volume* is positive and significant (0.034, P<0.01), indicating that options trading limits real activities manipulation through discretionary expenditures.[15]. Taken together, Table 7 shows that our findings are robust to an alternative specification and are not artifacts of biased estimations.

Insert Table 7 Here

6.2. Alternative proxies of options trading activity

[15] We also apply our 2SLS approach in estimating the single-model procedure that is proposed by Chen et al. (2018) and find a negative association between estimated options trading volume and earnings management through overproduction and discretionary expenditures (untabulated).

To corroborate our findings, we re-estimate our main results using alternative proxies for options trading activity. First, we use the natural logarithm of 1 plus the annual number of traded options (*LogNum_Options*), as an alternative measure of options trading volume. Then, we measure options trading activity by using the O/S ratio, which is developed by Roll et al. (2010). This variable is calculated by dividing the total options volume (i.e., the annual number of traded options) by the total stock volume (i.e., annual number of traded stocks). The O/S ratio reflects the liquidity (or depth) in the options market relative to the liquidity (or depth) in the underlying stock market (Zhang 2017, Du 2019). When the O/S ratio is high, the options market is more attractive to the informed traders as a high O/S ratio indicates a higher depth of the options market (Du 2019). Roll et al. (2010) find that the O/S ratio is associated with the presence of informed traders. We argue that in the presence of informed options traders, it would be harder for managers to deceive the capital market by using real activities manipulation. Therefore, we expect that the O/S ratio would be negatively related to real activities manipulation.

Table 8 displays results for the re-estimation of our main findings using alternative measures of options trading activity. Consistent with our main findings, the coefficients of the logarithm of the number of traded options plus 1 and the O/S ratios are negative and significant (-0.007, $P<0.01$ & -0.002, $P<0.01$ respectively).

Insert Table 8 Here

6.3. Other robustness tests

As recommended by Chen et al. (2018) an alternative way to reduce estimations errors is to include the regressors from the first regression in the second regression as additional control variables. Hence, in untabulated tests, we include independent variables from models 2 and 3 in estimating models 4a and 4b, respectively, and find qualitatively similar results to those reported

in table 2. Following Roll et al. (2009), we also used a volume-weighted annual moneyness measure as an instrumental variable and obtain similar results to those in Table 3.

7. Conclusion

We examine whether and how options trading relates to real activities manipulation. Prior studies document that options trading enhances stock price efficiency by helping the stock prices better reflect the fundamental value of managers' actions. Hence, managers cannot deceive the capital market by overstating earnings as informed options trading reveals the managers' manipulation to the capital market participants. Consistent with our argument, we find that options trading is negatively associated with real activities manipulation through overproduction and cutting discretionary expenditures. We also find similar results, when we adopt alternative research designs and use alternative proxies for options trading activity. In addition, we find that the deterring impact of options trading on real activities manipulation is more prominent among small and young firms, where there is more likelihood of stock price inefficiency. We find that options trading acts as a substitute for institutional ownership in impeding real activities manipulation. Finally, we observe that the negative impact of options trading on real activities manipulation is stronger in highly competitive industries, where the adverse consequences of overproduction and cutting discretionary expenses are greater.

Our study is subject to certain caveats. First, our proxies for abnormal overproduction and abnormal discretionary expenses may also capture firms' specific strategies or mismanagement. To address this concern, we focused on the sample of firms that are suspected of earnings manipulation. In addition to the year fixed effect, we also control for the firm fixed effects, to reduce the likelihood of model misspecification. Second, the association between options trading

and real activities manipulation is subject to reverse casualty and the omitted variables problems. To mitigate the concern that endogeneity explains our findings, we employ the 2SLS approach by using two different instrumental variables that have been used in the literature on the impact of options trading on corporate policies. Despite these limitations, our study shows that options trading is one of the few governance mechanisms that limit managers' ability to engage in real activities manipulation. Our findings carry important insights for policymakers by highlighting an important benefit of the options market development in curtailing real activities manipulation.

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Appendix
Variable definition

Variable	Definition
Real activities manipulation variables	
$REM_{i,t}$	Real activities manipulation proxy calculated as abnormal production costs + (-1* abnormal discretionary expenses) ($REM_{i,t} = Dis\_PROD_{i,t} - Dis\_DISX_{i,t}$)
$Dis\_PROD_{i,t}$	Abnormal production costs proxy computed by estimation of the residuals of the following model (Roychowdhury,2006): $(PROD_{i,t}/AT_{i,t-1}) = k_1(1/AT_{i,t-1}) + k_2(SALES_{i,t-1}/AT_{i,t-1}) + k_1(\Delta SALES_{i,t}/AT_{i,t-1}) + k_1(\Delta SALES_{i,t-1}/AT_{i,t-1}) + \varepsilon_{i,t}$
$Dis\_DISX_{i,t}$	Abnormal discretionary expenses proxy is calculated as the residuals of the following model (Roychowdhury,2006): $(DISX_{i,t}/AT_{i,t-1}) = k_1(1/AT_{i,t-1}) + k_2(SALES_{i,t-1}/AT_{i,t-1}) + \varepsilon_{i,t}$
$PROD_{i,t}$	is the sum of the cost of goods sold and change in inventory (#COGS+Δ#INVT) for firm i in year t
$DISX_{i,t}$	Discretionary expenses is the sum of R&D expenses, advertising expenses, and SG&A expenses (#XAD+#XRD+#XSGA) for firm i in year t
$SALES_{i,t-1}$	is total sales (#SALE) for firm i in year t-1.
$AT_{i,t-1}$	is total assets (#AT) for firm i in year t-1
Options trading related variables	
$Volume_{i,t}$	Options trading volume is the natural logarithm of 1 plus the aggregated annual options trading volume (in $10,000) for firm i and the fiscal year t
$Money_{i,t}$	Moneyness is the annual average of the absolute deviation of the option's strike price from the stock's market price ($\left\lvert \ln\left(\frac{stock\ price}{strike\ price}\right)\right\rvert$) at the end of day
$Open_{i,t}$	Open interest is the natural logarithm of 1 plus the annual average of open option contracts
$LogNum\_Options_{i,t}$	is the natural logarithm of 1 plus the annual number of traded options
O/S	O/S ratio is calculated by dividing the total options volume (i.e., the annual number of traded options) by the total stock volume (i.e. annual number of traded stocks)
Control variables	
$Size_{i,t}$	Size is the natural logarithm of the total assets at the end of the year (#AT)
$LEV_{i,t}$	Leverage is the sum of long-term debt (#DLTT) and current debt (#DLC) scaled by total assets at the beginning of the year (#AT)
$MB_{i,t}$	Market-to-book value is measured as the market value of equity (#CSHO×#PRCC_F) divided by the book value of equity at the end of the year (#CEQ)

$ROA_{i,t}$	Financial performance is pretax income (#PI) divided by total assets at the beginning of the year (#AT)
$FASSET_{i,t}$	Tangibility (or ratio of fixed assets) Property, Plant and Equipment - Total (gross) (#PPEGT) scaled by total assets at the beginning of the year (#AT)
$Capital\_Int_{i,t}$	Capital intensity is Property, Plant and Equipment - Total (Net) (#PPENT) divided by total assets at the beginning of the year (#AT)
$Opcycle_{i,t}$	The length of the operation cycle is the sum of the receivables cycle (calculated as sales (#SALES) divided by 360 and divided by average receivables (#RECT)) and inventory cycle (calculated as the cost of goods sold divided by 360 and divided by average inventory (#INV)).
$Sales\_Growth_{i,t}$	Sales growth for firm i from year t-1 to year t, measured as the percentage of growth in total sales (#SALE) from year t-1 to year t.
$Age_{i,t}$	Firm age is the natural logarithm of 1 plus the number of years that a firm is on Compustat
$Coverage_{i,t}$	Financial analysts coverage is the natural logarithm of 1 plus the number of financial analysts following the firm.
$BigN$	A dummy variable equals 1 if the firm is audited by one of Big N firms, and zero otherwise.

Table 1

Descriptive statistics

Panel A: Summary statistics for key variables

Variable	*N*	*Mean*	*SD*	*Median*	*P5*	*P25*	*P75*	*P95*
RE	24,046	-0.136	0.486	-0.094	-0.920	-0.332	0.091	0.522
Dis_PROD	24,046	-0.060	0.217	-0.058	-0.382	-0.165	0.039	0.267
Dis_DISX	24,046	0.076	0.332	0.025	-0.316	-0.074	0.176	0.611
Volume	24,046	2.443	1.981	1.997	0.084	0.766	3.770	6.310
Size	24,046	6.990	1.708	6.910	4.272	5.785	8.112	10.023
ROA	24,046	0.044	0.192	0.071	-0.313	-0.003	0.140	0.286
FASSET	24,046	0.525	0.395	0.417	0.083	0.225	0.734	1.305
Capital_Intesity	24,046	0.272	0.238	0.196	0.031	0.096	0.373	0.784
LEV	24,046	0.249	0.250	0.205	0.000	0.028	0.368	0.734
BigN	24,046	0.884	0.320	1.000	0.000	1.000	1.000	1.000
MB	24,046	3.357	4.715	2.429	0.560	1.488	4.037	10.39
Opcycle	24,046	0.088	0.141	0.038	0.018	0.027	0.072	0.367
Age	24,046	2.924	0.744	2.944	1.609	2.303	3.555	4.060
Sales_Growth	24,046	0.138	0.334	0.079	-0.259	-0.009	0.205	0.709
Coverage	24,046	2.047	0.792	2.090	0.693	1.576	2.627	3.216

Panel B: Pearson correlation coefficients

Variable	*REM*	*Dis_PROD*	*Dis_DISX*	*Volume*	*Size*	*ROA*	*FASSET*	*Capital_Int*	*LEV*	*Big4*	*MB*	*Opcycle*	*Age*	*Sales_Growth*	*Coverage*
REM	1														
Dis_PROD	0.820***	1													
Dis_DISX	-0.927***	-0.546***	1												
Volume	-0.049***	-0.089***	0.013**	1											
Size	0.269***	0.097***	-0.33***	0.628***	1										
ROA	0.186***	-0.198***	-0.401***	0.173***	0.302***	1									
FASSET	0.117***	0.054***	-0.135***	0.035***	0.147***	0.102***	1								
Capital_Int	0.119***	0.057***	-0.136***	0.088***	0.182***	0.121***	0.895***	1							
LEV	0.066***	0.081***	-0.044***	0.072***	0.295***	-0.079***	0.212***	0.274***	1						
BigN	0.056***	-0.009	-0.088***	0.205***	0.327***	0.136***	0.035***	0.054***	0.075***	1					
MB	-0.167***	-0.14***	0.152***	0.158***	-0.008	0.075***	-0.037***	-0.035***	-0.012*	0.016**	1				
Opcycle	0.057***	0.046***	-0.054***	0.004	0.000	0.06***	0.252***	0.285***	0.042***	0.007	-0.011*	1			
Age	0.200***	0.08***	-0.241***	0.186***	0.463***	0.186***	0.124***	0.022***	0.033***	0.054***	-0.029***	-0.091***	1		
Sales_Growth	-0.240***	-0.056***	0.314***	0.082***	-0.104***	0.008	0.019***	0.101***	0.136***	-0.037***	0.120***	0.034***	-0.222***	1	
Coverage	0.025***	-0.076***	-0.087***	0.587***	0.586***	0.243***	0.059***	0.109***	0.063***	0.293***	0.084***	0.054***	0.145***	-0.008	1

Table 1 displays summary statistics for variables used in the main analysis. The sample period is 1997-2019. ***,**, and * indicate statistical significance at the 1%, 5%, and 10% level. Variable definitions are provided in the Appendix.

Table 2

Options trading volume and real activities manipulation

Dependent Variable	*Dis_PROD*		*Dis_DISX*		*REM*	
	Coefficient	*t-Statistic*	*Coefficient*	*t-Statistic*	*Coefficient*	*t-Statistic*
Volume	-0.005***	-4.14	0.009***	4.66	-0.014***	-5.11
Size	0.023***	5.12	-0.027***	-3.91	0.049***	4.9
ROA	-0.27***	-19.15	-0.406***	-13.65	0.136***	3.69
FASSET	0.013	0.77	0.136***	5.52	-0.123***	-3.29
Capital_Int	-0.024	-0.85	-0.013	-0.34	-0.01	-0.17
LEV	0.021**	2.42	-0.009	-0.55	0.03	1.4
BigN	0.006	0.75	-0.013	-1.02	0.02	1.02
MB	-0.001**	-2.36	0.002***	3.69	-0.002***	-4.09
Opcycle	0.081***	3.6	0.019	0.74	0.062	1.43
Age	-0.005	-0.58	-0.045***	-3.53	0.04**	2.07
Sales_Growth	-0.003	-0.47	0.237***	18.55	-0.24***	-16.38
Coverage	-0.005*	-1.81	0.005	1.05	-0.01	-1.55
Constant	-0.184***	-5.24	0.288***	5.74	-0.472***	-6.2
Firm and year fixed effects	YES		YES		YES	
Observations	24,046		24,046		24,046	
Adj R-squared	0.7745		0.8007		0.8214	

This table presents the results of our baseline regression analysis on the relation between options trading and real activities manipulation. The sample period is 1997-2019. We winsorize all variables at both the 1st and 99th percentiles. Standard errors are clustered by firm. Firm and year fixed effects are included. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in the Appendix.

Table 3

2SLS regressions of options trading volume and total level of real activities manipulation

Panel A: The 2SLS regression estimates with moneyness as the instrument variable

	Estimations With Moneyness as a Instrument for Volume				*Estimations With Open interest as a Instrument for Volume*			
Dependent Variable: REM	*OLS 2SLS (First stage)*		*OLS 2SLS (Second stage)*		*OLS 2SLS (First stage)*		*OLS 2SLS (Second stage)*	
	Volume		*REM*		*Volume*		*REM*	
	Coefficient	*t_Statistics*	*Coefficient*	*t_Statatistcs*	*Coefficient*	*t_Statistics*	*Coefficient*	*t_Statistics*
Moneyness	0.170***	26.96						
Open interest					0.708***	75.14		
Volume			-0.022***	-4.08			-0.009***	-2.65
Size	0.487***	15.39	0.056***	5.58	0.327***	14.33	0.046***	4.49
ROA	0.77***	10.45	0.142***	3.88	0.725***	12.33	0.133***	3.6
FASSET	-0.089	-0.88	-0.122***	-3.28	0.077	1.01	-0.123***	-3.29
Capital_Int	0.176	0.99	-0.010	-0.17	0.116	0.91	-0.01	-0.17
LEV	-0.243***	-4.13	0.027	1.25	-0.248***	-5.35	0.032	1.47
BigN	0.146**	2.56	0.021	1.1	-0.035	-0.88	0.019	0.98
MB	0.02***	9.34	-0.002***	-3.61	0.019***	10.67	-0.003***	-4.24
Opcycle	-0.137	-1.02	0.061	1.41	-0.041	-0.37	0.062	1.43
Age	-0.231***	-3.15	0.035	1.8	-0.357***	-6.66	0.042**	2.18
Sales_Growth	0.24***	10.25	-0.237***	-16.18	0.277***	14.25	-0.241***	-16.44
Coverage	0.388***	15.57	-0.006	-0.93	0.103***	5.61	-0.012*	-1.82
Firm and year fixed effects	YES		YES		YES			
Observations	24046		24046		24046			
Centered R2	0.1296				0.1304			
F test (P-Value)			38.83(0.0000)				38.09(0.0000)	
Kleibergen-Paap rk LM Chi-sq	371.833				894.74			
Kleibergen-Paap rk Wald F	726.748				5646.43			
Cragg-Donald Wald F statistic	8695.472				30634.56			

Stock-Yogo weak ID F testcritical values:		
10% maximal IV size	16.38	16.38
25% maximal IV size	5.53	5.53
Anderson-Rubin Wald test F (P-value)	16.59 (0.000)	7.02 (0.008)
Anderson-Rubin Wald test Chi-sq (P-value)	16.62 (0.000)	7.03 (0.008)
Stock-Wright LM S statistic Chi-sq (P-value)	16.72 (0.000)	7.71 (0.005)
Hansen J statistic	0.000	0.000

This table presents the results of the results of two-stage least squares (2SLS) regressions with moneyness and option interest as the instrumental variables. The sample period is 1997-2019. We winsorize all variables at both the 1st and 99th percentiles. Standard errors are clustered by firm. Firm and year fixed effects are included. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in the Appendix.

Table 4

Cross-sectional analyses: Subsamples of firms with different size and age

Panel A: Subsamples of small and big firms

	Small Firms		**Big Firms**	
Dependent Variable: REM	*Coefficient*	*t-Statistic*	*Coefficient*	*t-Statistic*
Volume	-0.019***	-3.95	-0.005**	-2.03
Size	0.077***	4.49	0.012	0.97
ROA	0.176***	3.71	-0.027	-0.65
FASSET	-0.275***	-4.87	0.020	0.42
Capital_Int	0.085	0.92	-0.132**	-1.97
LEV	0.007	0.17	-0.002	-0.12
BigN	0.024	1.09	-0.005	-0.16
MB	-0.004***	-3.62	-0.001**	-2.47
Opcycle	0.064	0.94	0.042	0.92
Age	0.065*	1.86	-0.018	-0.73
Sales_Growth	-0.269***	-13.35	-0.144***	-10.92
Coverage	-0.032***	-3.00	-0.004	-0.70
Constant	-0.614***	-4.96	0.000	0.00
Firm and year fixed effects	YES		YES	
Observations	11,828		12,005	
Adj-R2	0.8058		0.8648	

Table 4

Cross-sectional analyses: Subsamples of firms with different size and age

Panel B: Subsamples of young and old firms

	Young Firms		Old Firms	
Dependent Variable: REM	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
Volume	-0.018***	-4.43	-0.006*	-1.94
Size	0.063***	4.09	0.031*	1.96
ROA	0.115***	2.76	0.091	1.47
FASSET	-0.234***	-3.21	0.001	0.03
Capital_Int	0.033	0.33	-0.117	-1.57
LEV	0.044	1.27	0.032	1.17
BigN	-0.01	-0.37	0.005	0.29
MB	-0.003***	-3.43	-0.001	-1.25
Opcycle	0.079	1.29	0.055	0.88
Age	0.006	0.14	-0.068	-0.74
Sales_Growth	-0.239***	-14.95	-0.206***	-8.73
Coverage	-0.008	-0.78	-0.009	-1.32
Constant	-0.42***	-3.22	0.007	0.02
Firm and year fixed effects	YES		YES	
Observations	11,708		12,204	
Adj-R2	0.8273		0.8406	

This table presents the results of our regression analysis on the relation between options trading and real activities manipulation in subsamples of small and big firms as well as young and old firms. The sample period is 1997-2019. We winsorize all variables at both the 1st and 99th percentiles. Standard errors are clustered by firm. Firm and year-fixed effects are included. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in the Appendix.

Table 5

Subsample of firms with different levels of institutional ownership

Panel A: Subsamples of firms with different levels of total institutional ownership (percentage)

	Firms with low institutional ownership percentage		**Firms with high institutional ownership percentage**	
Dependent Variable: REM	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
Volume	-0.016***	-3.87	-0.005	-1.6
Size	0.054***	4.06	0.046***	3.79
ROA	0.189***	3.95	-0.026	-0.6
FASSET	-0.203***	-4.13	0.016	0.3
Capital_Int	0.070	0.9	-0.148*	-1.69
LEV	0000.	-0.01	0.039*	1.72
BigN	0.050*	1.8	-0.013	-0.7
MB	-0.003***	-3.09	-0.002***	-2.9
Opcycle	0.119*	1.81	0.033	0.6
Age	0.082***	2.95	0.014	0.49
Sales_Growth	-0.265***	-13.09	-0.170***	-11.31
Coverage	-0.012	-1.12	-0.003	-0.51
Constant	-0.620***	-6.37	-0.397***	-3.97
Firm and year fixed effects	YES		YES	
Observations	11,632		11,877	
Adj-R2	0.8013		0.8778	

Table 5

Subsample of firms with different levels of institutional ownership

Panel B: Subsamples of firms with different levels of total institutional ownership (Indexer)

	Firms with low dedicated and quasi-indexer institutional ownership percentage		**Firms with high dedicated and quasi-indexer institutional ownership percentage**	
Dependent Variable: REM	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
Volume	-0.017***	-4.12	-0.004	-1.44
Size	0.056***	4.34	0.040***	3.13
ROA	0.184***	3.88	-0.032	-0.72
FASSET	-0.208***	-4.22	0.02	0.41
Capital_Int	0.085	1.09	-0.147*	-1.94
LEV	-0.002	-0.07	0.041*	1.82
BigN	0.049*	1.79	-0.017	-0.98
MB	-0.002***	-2.68	-0.002***	-2.75
Opcycle	0.13*	1.93	0.036	0.77
Age	0.073***	2.83	0.003	0.12
Sales_Growth	-0.263***	-13.26	-0.167***	-10.28
Coverage	-0.014	-1.57	0.005	0.63
Constant	-0.602***	-6.69	-0.332***	-3.27
Firm and year fixed effects	YES		YES	
Observations	11,555		11,896	
Adj-R2	0.7979		0.8790	

This table presents the results of our regression analysis on the relation between options trading and real activities manipulation in subsamples of firms with low and high total institutional ownership percentage as well as firms with low and high dedicated and quasi-indexer institutional ownership percentage. The sample period is 1997-2019. We winsorize all variables at both the 1st and 99th percentiles. Standard errors are clustered by firm. Firm and year-fixed effects are included. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in the Appendix.

Table 6

Subsample of firms in low and high concentrated industries

	Firms in low concentrated industries		Firms in high concentrated industries	
Dependent Variable: REM	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
Volume	-0.024***	-6.1	-0.001	-0.23
Size	0.064***	4.7	0.034***	2.75
ROA	0.155***	2.93	0.078*	1.82
FASSET	-0.158***	-3.51	-0.071	-1.11
Capital_Int	-0.019	-0.28	-0.007	-0.07
LEV	0.042	1.29	0.007	0.26
BigN	0.019	0.61	0.031	1.43
MB	-0.003***	-3.18	-0.002**	-2.3
Opcycle	0.092*	1.66	0.041	0.54
Age	0.033	1.17	0.045*	1.8
Sales_Growth	-0.257***	-12.05	-0.215	-12.82
Coverage	-0.011	-1.08	-0.01	-1.4
Constant	-0.537***	-4.82	-0.407	-4.34
Firm and year fixed effects	YES		YES	
Observations	11,836		11,918	
Adj-R2	0.8091		0.8560	

This table presents the results of our regression analysis on the relation between options trading and real activities manipulation in subsamples of firms in low and high concentrated industries. The sample period is 1997-2019. We winsorize all variables at both the 1st and 99th percentiles. Standard errors are clustered by firm. Firm and year-fixed effects are included. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in the Appendix.

Table7

Single-step regression procedure

	Dis_PROD		*Dis_DISX*	
Dependent Variable: REM	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
Volume	-0.021***	-9.86	0.034***	12.49
Size	0.056***	14.66	-0.071***	-14.56
ROA	-0.456***	-19.82	-0.401***	-12.91
FASSET	-0.086***	-4.15	0.071***	2.93
Capital_Int	0.210***	5.61	-0.267***	-6.25
LEV	-0.019	-1.5	0.000	0
BigN	-0.025**	-2.5	0.058***	4.49
MB	-0.004***	-6.77	0.006***	7.13
Opcycle	0.019	0.55	-0.034	-0.77
Age	0.003	0.61	-0.011*	-1.75
Sales_Growth	-0.006	-0.39	0.225***	17.32
Coverage	-0.043***	-8.81	0.058***	9.39
Constant	-0.308***	-6.58	0.288***	5.6
Industry-Year indicators and their interactions with the first-step regressors	YES		YES	
Observations	24,046		24,046	
Adj-R2	0.9485		0.6048	

This table presents the results of our baseline regression analysis on the relation between options trading and real activities manipulation by adopting the single-step regression procedure that was proposed by Chen et al., (2018). The sample period is 1997-2019. Firm and year-fixed effects are included. We winsorize all variables at both the 1st and 99th percentiles. Standard errors are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in the Appendix.

Table 8

Alternative proxies for options trading activity and real activities manipulation

	(1)		(2)	
Dependent Variable: REM	*Coefficient*	*t-statistic*	*Coefficient*	*t-statistic*
LogNum_Options	-0.007***	-3.47		
O/S			-0.002***	-3.89
Size	0.044***	4.44	0.040***	4.15
ROA	0.13***	3.53	0.138***	3.67
FASSET	-0.123***	-3.29	-0.123***	-3.25
Capital_Int	-0.011	-0.19	-0.015	-0.25
LEV	0.033	1.52	0.042	1.9
BigN	0.019	0.99	0.02	1.03
MB	-0.003***	-4.42	0.032***	3.92
Opcycle	0.061	1.42	0.057	1.32
Age	0.043**	2.23	0.046**	2.42
Sales_Growth	-0.242***	-16.46	-0.246***	-16.53
Coverage	-0.011*	-1.75	-0.014**	-2.16
Constant	-0.401***	-5.17	-0.467***	-6.15
Firm and year fixed effects	YES		YES	
Observations	24,046		23,935	
Adj-R2	0.8210		0.8204	

This table presents the results of the regression analysis on the relation between options trading and real activities manipulation by using alternative proxies for options trading activity. The sample period is 1997-2019. We winsorize all variables at both the 1st and 99th percentiles. Standard errors are clustered by firm. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. Variable definitions are provided in the Appendix.