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Abstract
A bank generally hold more equity capital than required by their regulators. We hypothesize that stock market has a disciplining role vis-à-vis bank managers that forces them to increase their capital level. For market discipline to be effective, market factors such as changes in firm equity values and returns, would influence bank decision making. We apply the model to annual panel data for publicly traded bank holding companies in three stock markets over a sample period from 2006 to 2015. Using OLS and fixed effect, we find a significantly positive relationship between market discipline and bank capital structure. In addition, we find that market discipline is a more effective to enhance bank capital when bank perform efficiently. Robust tests based on instrumental variable and dynamic GMM evidence of a causal link between market discipline and bank capital structure. The results have certain policy implications for understanding the role of stock market in affecting bank operation that in turn could improve bank prudency and assist the design of an enhanced regulation framework.

Keywords: Market discipline, Informed trading, PIN, Bank capital
JEL Classification: C61, G14, G21.

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1 Introduction

The capital adequacy requirement is one of the appropriate tools for regulator to maintain the stability of banking system. A wealth body of theoretical and empirical banking literature suggests that bank capital level purely reflects regulatory minimum requirements. However, recent banking literature reveal that banks maintain or strengthen their regulatory capital ratios when they face higher illiquidity and want to strengthen their capital structure and thus solvency standards and improve their ability to raise external funds (Distinguin et al., 2013; Berger et al., 2008; Gropp and Heider, 2010).

The challenges in monitoring banks are closely linked to the complexity and information asymmetry problem featuring this unique sector (De Andres and Vallelado, 2008). Informed trading, by incorporating private information into share price, is central to price discovery process and eventually enhances price informativeness in stock markets (Ealey and O'Hara, 2004). Governance via informed trading has recently been recognised potentially as a market discipline mechanism on the management of firms which complement legal and regulatory institutions, thus improving market efficiency (Admati and Pfleiderer, 2009; Edmans 2009; Edmans and Manso, 2011; Edmans et al., 2013; Ferreira et al., 2011; Ferreira and Matos, 2008; Gallagher et al., 2013; Massa et al., 2015). The basic insight is that informed trades drive stock prices to fundamentals, dependent on corporate managerial actions. With stock price more sensitive to these actions, governance through trading credibly rewards (penalizes) the stock-incentivized manager, who ex ante has greater incentive to put in effort by means of costly hidden actions (Holmstrom and Tirole 1993). Ultimately stock-incentivized managers exert more effort on behalf of shareholders (Gallagher et al, 2013; Edmans et al, 2013, 2015; Zhang et al, 2015; Massa et al, 2015).

Despite trading as a widely-recognized market discipline in corporate governance

literature, its role in affecting bank capital structure has been neglected. In this research, we focus on informed trading and investigate how it target banks with different performance and ultimately how it affects bank capital ratio. We argue that informed trading, by actively incorporating superior insight of a bank real fundamental status including its solvency condition into share price, should act as an "invisible" hand to discipline bank managers. It should especially target those "under-performing" bank managers, thus acts as a private enforcement to force managers to strengthen their solvency standards above the mandatory minimum requirement. The effectiveness of trading, as the market discipline, should become more effective if bank managers are more stock-incentivized. Our analysis can enhance our understanding of why banks maintain their capital buffer from a market discipline perspective. It has implications for policy makers on whether and under what conditions market discipline via informed trading can act as an effective private enforcement to strengthen the solvency standards in addition to the public mandatory minimum requirement.

This study focus on banks listed on stock exchanges from Mainland China, HongKong and Taiwan. This is because Mainland China is the largest emerging economy where disclosure quality is poor, and stock option compensation is not allowed in its banking sector. Despite Hong Kong and Taiwai share many similar market and culture characteristics with Mainland China, with economy development and financial systems being increasingly integrated, they have highly stock-incentivized managers in their banking sector. Especially Hong Kong has the highest disclosure quality and most stock-incentivized bank managers among these three. Thus, these three markets represent a good opportunity for us to mitigate different culture related impacts on capital buffer decisions made by bank managers, focus on the impacts of informed trading conducted in similar market structure on different degree stock-incentivized bank managers and their capital buffer decisions.

We employ a three-step procedure to generate the empirical evidence in this study. First, the level of informed trading is estimated using a market microstructure model (PIN) and high frequency trade and bid-ask data. Following recent literature (Flannery and Giacomini, 2015; De Jonghe and Oztekin, 2015; and Lepetit et al., 2015), we measure capital level using the traditional ratio of total capital to total asset. We measure bank performance using bank efficiency estimated by frontier approach. Our main finding is under-performing banks attracts a high level of informed trading, which in turn leads to a lower level of capital buffer held by a bank. Our results are robust in pooled OLS, fixed effect panel-regression, IV-2SLS and dynamic GMM approach panel regression estimations, while controlling for several specific bank financial and macro-economic characteristics.

Our study contributes to the literature in several ways. First, this paper makes the attempt to explore the role of informed trading in banking sector through microstructure perspective. To the best of our knowledge, it is the first paper to link the literature concerned with PIN in the context of market microstructure and the numerous empirical work on bank capital structure. Second, our study sheds light on the bank performing condition which market discipline influences capital structure, which adds a new dimension to the understanding of the relation between market discipline and bank capital decisions. Third, our study also gives empirical analysis on the relationship between bank capital and efficiency using the sample of Great China listed banks, while the existing theory often provides contradictory predictions. Moreover, a single-market study seems appropriate for this type of analysis. However, given the cross-market discrepancy in the development level of capital markets, culture homogeneous samples provide an excellent laboratory for understanding the role of information in banking sector.

The reminder of the paper is organized as follows. The next section discusses the related literature on informed trading as the market discipline force and literature on

the determinants of bank buffer. Drawing on these theoretical insights, we develop hypotheses relating market discipline and bank capital structure, as well as the bank managers as the condition of effectiveness of bank performance to discipline bank managers and affect bank capital decision. We then explain the operationalisation of the dependent and explanatory variables, present and discuss some descriptive statistics, and outline the estimation methodology for the main regression analysis. The empirical results are then presented and discussed, as well as several robustness tests. Finally, we conclude with some comments about the importance and applicability of our analysis and make some suggestions about future work.

2 Literature review and Hypothesis development

2.1 Bank capital

Although the role of capital has varied over time, it remains an important source of funds for banks in all countries. Normally bank capital is finance by shareholder's fund and same as non-financial firms that serve three important functions. First, capital can be a buffer against adverse outcomes. Second, bank capital creates incentive for management to manager risk when inverts in risky assets. High capital implies higher losses for the banks' shareholders in case of default, and hence lower incentives for risk-taking (Hilscher and Raviv, 2014). Besides, regulators may require some additional capital for individual bank that are perceived to pose significant risks. Third, sufficient capital can be a single to different stakeholders suggesting that the bank will not be taken advantage of.

Such adjust is require by regulation

Capital adequacy ratio has played an important role for the regulation as banks have long been subject to explicit or implicit limits on their permissible leverage level. Setting capital requirements is a major policy issue for regulators. The 1988 Basel

Accord[1] and subsequent amendments significantly influence the effectiveness of bank capital structure. A common justification for bank capital regulation is the reduction of bank moral hazard and conflicts between equity holders and debt holders. An under-capitalized bank may take excessive risks for maximizing its shareholder wealth. This incentive is reducing if banks have capital at risk. As the equity capital is costly for bank compare with other types of funds, thus bank managers attempt to economize on the use of this valuable resource.

Although the regulatory constraint is one of factors related to the determinant of capital level, but it is not the most important (Barrios and Blanco, 2003). Gropp and Heider (2008) do not detect a first-order effect of regulation on banks' capital holdings. They find from the similarity of their sample banks and non-financial firms that functioning as a buffer against regulatory distress, conclude that the regulatory requirement is not the major role of bank equity. In addition, despite banks complied with regulatory standards for minimum capital requirement, several financial crises undoubtedly demonstrated that existing capital regulation was inadequate to prevent a panic in the financial sector. The historic system of relying on book capital rules and supervisory (Basel Pillar 2) discretion to maintain adequate capital may need to revise (Flannery and Giacomini, 2015). Benink and Wihlborg (2002) find that supervision alone cannot prevent banks from ‘gaming and manipulation’ of risk-weights.

Banks like to adjust their capital ratio

Both theoretical (Diamond and Rajan, 2000; Mehran and Thakor, 2011; Barrios and Blanco, 2003) and empirical (Miles et al. 2013; Flannery and Rangan, 2008; Berger et al. 2008) literatures imply that banks have a target capital structure, which is different from the regulatory requirement. Barrios and Blanco (2003) developed two theoretical models, the first one for firms not affected by capital adequacy regulation, the second one for firms which are. They demonstrate in both models that the existence of an

[1] The Basel Agreement of 1988 is to ensure the financial institutions have enough capital to meet the obligation, which requires that banks in European countries meet the minimum capital ratios of four percent tier 1 capital and eight percent tier 1 plus tier 2 capital to risk-weighted assets.

optimal capital ratio. In addition, Diamond and Rajan (2000) summary that optimal capital structure for bank trades off three effects of capital, rent absorbed by the banker, against shocks and extracted from borrowers. In addition, banks might target higher capital ratios to mitigate insolvency risk. Given the historically high profitability of banking sector, bank increase the capital ratio because earnings were easily retained. Berger et al. (2008) find that banks actively managed their capital ratio, set target capital levels above regulatory minima, and made rapid adjustments toward their targets. Alternatively, banks might target lower capital ratios to maintain lending relationships and competitive advantage.

Gropp and Heider (2008) conclude that unobserved time-invariant bank fixed-effects are ultimately the most important determinant of banks' capital structures. De Jonghe and Oztekin (2015) find that banks make faster capital structure adjustments in countries with more stringent capital requirements, better supervisory monitoring, more developed capital markets, and high inflation a global sample of 64 countries. Memmel and Raupach (2010) find that large German private commercial banks (neither state-owned nor cooperative) and banks with a high level of proprietary trading are more likely to adjust their capital ratio tightly. Lepetit et al. (2015) find that the internal governance mechanisms affect the way banks adjust to the target capital structure.

Market discipline

To make progress in understanding bank capital structure, it is necessary to consider other different determinants. Market discipline might be an instrument induce banks holding appropriate capital is stronger under the Basel Accord. Because markets have significant resources with numerous investors and analysts having access to both public and private information about banks' operation. For market discipline to be effective, market factors such as changes in equity values and returns, would influence firms' manager decision making. Therefore, market participants can affect

bank behavior. Bliss and Flannery (2002) show that market discipline implies two distinct notions: private investors' ability to understand (monitor) a financial firm's true condition, and their ability to influence managerial actions.

Barrios and Blanco (2003) argue that banks' capital ratios were primarily driven by the pressure of market forces rather than regulatory constraints. Besides, Allen et al. (2011) also claim that market discipline is imposed as the bank's capital used to provide monitoring incentives. Bennett et al. (2015) suggest that market discipline tends to begin far enough in advance to signal to both banks and supervisors that corrective actions can and should be taken. Curry et al. (2008) claim that equity market can provide timely information and add value to bank holding company. Hilscher and Raviv (2014) show that effecting market discipline via introducing contingent capital into banks' capital structures represents a possibility to substantially reduce incentives to increase bank risk and decrease the bank failure rate.

The informational efficiency of prices is a key attribute of capital markets that can have significant implications for the real economy. Thus, information from stock market is a useful mechanism for designing corporate governance and can discipline managers on corporate investment decisions (Gorton et al., 2016; Dow et al., 2015; Faure-Grimaud and Gromb, 2004; Ferreira et al., 2011; Ferreira and Laux, 2007). Indeed, investors can exert governance through affecting stock price. The stock prices generate informative signals that affect how managers run their companies. Gorton et al. (2016) show that there is a fundamental tension between the informativeness of stock prices and the effectiveness of market discipline in corporate governance. Dow et al. (2015) analyze the incentives for financial market trader to produce information about firm's investment opportunities.

More specifically, number of literatures argues that the stock trading can be an effective mechanism of market discipline in corporate governance (Admati and

Pfleiderer, 2009; Edmans, 2009; Ferreira et al., 2011). By trading on information, market participate move the stock price toward fundamental value and closely reflect the effort exerted by managers. Faure-Grimaud and Gromb (2004) claim that public trading results in the formation of a stock price that is informative about the large shareholder's incentives to engage in value-increasing activity. Edams (2009) find that institutional trading enhances the informational efficiency of the firm's equity, which lead myopic managers to make better financing decisions. Massa et al. (2015) suggest that short selling functions as an external governance mechanism to discipline managers.

Market discipline can be a source from information asymmetry, which arise from differential information between informed and non-informed traders. Informed traders normally are large shareholders, financial analysts and managers. Informed traders use superior knowledge on such private information to obtain private benefit. Managerial private benefits commonly represent as shirking, managerial career concerns, and perquisites in previous studies. John et al. (2000) recognize that managerial compensation schemes may directly affect bank risk taking preference. In addition, Barakat et al. (2014) find that the increase in information asymmetry is higher for internal fraud-related events. Dell'Ariccia (2001) suggest that informational asymmetries are important determinants of the industry structure and of banks' strategic behavior.

Allen et al. (2011) show that market discipline affects the level of banks capital level when credit markets are competitive by encouraging monitoring. A large body of evidence in banking sector suggests that markets monitor banks effectively and promptly. For instance, Flannery and Rangan (2008) demonstrate that market investors can influence bank behavior in terms of capital decision. Barrios and Blanco (2003) conclude that the pressure of market discipline is the main determinant of banks capital requirements. Nier and Baumann (2006) suggest that market discipline

is effective in providing incentives for banks to limit their risk of default by holding capital buffers.

Hypothesis development

Positive relation

Positive relation - Regulator prospective

Supervisors require that banks maintain minimal equity capital as protection for depositors and other stakeholders. Normally, banks are willing to hold higher level of capital which is well above the regulatory requirement (Berger et al., 2008). Although supervisory pressure may contribute to the capital buildup, but it also creates the environment that made market discipline more relevant to banks. The Third Pillar of Basel III specifies rules for expanded information disclosure to enhance the market disciplines on banks' risk taking. Both Estrella (2004) and Benink and Wihlborg (2002) suggest that the supervision and market discipline are emphasized as necessary supplements to capital requirement.

Regulators have assumed that a federal safety net distorts bank incentives to limit leverage, which indicates that supervisory capital standards will encourage bank to operate in high capital ratio. In addition, the increasing complexity of large banking organizations makes regulators difficult to monitor and control using traditional tools. But markets can recognize and influence a banks' complex activity and can assess true condition. Therefore, market discipline can thus play an important role in bank supervision.

Memmel and Raupach (2010) analyze the capital ratios using monthly regulatory data of large German banks and obtain the best fit to the optimal capital ratio of just above the regulatory minimum of 8%. Miles et al. (2013) find that the amount of equity capital that is likely to be desirable for banks to use is very much larger than banks

have used, and it also higher than targets agreed under the Basel III requirement in UK banks for the period from 1992 to 2010. In United States, Flannery and Rangan (2008) find that banks' capital ratios increased substantially during the 1990s, with banks holding capital levels that were 75% more than the regulatory minimums in the early 2000s. Berger et al. (2008) also find the similar evidence in US bank holding companies from 1992 to 2006.

Positive relation - risk prospective

There is general agreement that the risk classification determining bank capital requirement. Markets can recognize and influence bank default risk. Thus, bank capital ratios might reliably positively relate to portfolio risk exposures. Flannery and Giacomini (2015) demonstrating that large European banks' reported regulatory capital measures often far exceeded their loss-absorbing capacity during 1997–2011. Bank risk exposures increase when banks are permitted to enter new, riskier lines of business. Risk aversion investors are likely requiring bank to adjust upward the capital ratio base on the risk level. Nier and Baumann (2006) find that while competition leads to greater risk taking incentives, market discipline is more effective in curbing these incentives. Curry et al. (2008) conclude that equity markets provide an economically substantive degree of independent assessment of banking company risk, thereby establishing the conditions for market discipline to be effective. Allen et al. (2014) conclude that bank hold a positive amount of equity capital as a way to reduce bankruptcy costs.

Positive relation – market discipline improve governance, improve bank value, improve bank capital

Large shareholders are potentially able to trade on private information that may help discipline management and improve corporate governance (Admati and Pfeiderer,

2009; Edmans et al., 2013). Traditional view is that large shareholder governs by influencing firms' operation. Edmans et al. (2013) and Edmans and Manso (2009) show that governance from trading by blockholders leads to positive announcement returns and improvements in operating performance. Ferreira et al. (2011) claim that external market discipline and internal board monitoring are substitutes. Anginer et al. (2016) show that executive options and stock wealth invested in the bank is generally associated with better capitalization.

Mehran and Thakor (2011) find that total bank value and bank's equity capital are positively correlated in the cross-section.

Positive relation – banking environment

Capital buildup might be a rational response by market participants to changes in the banking environment. Lepetit et al. (2015) find that banks are likely to boost their capital ratios by issue equity without cutting lending when control and cash flow rights are identical from the sample of 341 European commercial banks during the 2002 – 2010 period. Allen et al. (2011) claim that the market discipline is one of the forces that induces banks to hold positive capital because it allows higher borrower surplus. Allen et al. (2011) explain that borrowers prefer lower interest rates and higher capital as they do not bear the cost of the capital. Even there is deposit insurance, banks' incentives to monitor are reduced, but the market discipline still entail high capital level.

Nier and Baumann (2006) find that stronger market discipline resulting from uninsured liabilities and disclosure creates larger capital buffers.

Based on above arguments, market disciplinary forces can be the explanations contribute to the capital buildup. To sum up, there are several reasons why a bank that

is disciplined by the capital market should keep its capital ratio within a narrow high range. Therefore, it is proposed that:

Hypothesis 1: The level of market discipline is positively associated with the level of bank capital.

Negative relation

The previous literature also provides rational explanations for low capital ratios. First, the pecking order hypothesis (Myers and Majluf, 1984) states that information asymmetries between bank managers and outside investors induce a preference order from internal capital through debt to equity financing. Information asymmetries about banks' financial health can be relieved market monitoring. Strong external market discipline enables market participants to assess bank capital adequacy more efficiently. Therefore, this form of monitoring should be associated with lower external financing costs, thus increase the leverage.

Second, bankers normally argue that an excessively high equity capital level has negative effect on their ability to compete. An increase in bank competition erodes the present value of the banks' future rents, which lead to reducing the incentives to behave prudently.

Third, liquidity production is a central function of banks. Greater bank capital reduces the probability of financial distress but also reduces liquidity creation (Diamond and Rajan, 2000). Distinguin et al. (2013) find that banks decrease their capital ratios when they face higher illiquidity. DeAngelo and Stulz (2015) claim that high leverage is optimal for banks in a model that has just enough frictions for banks to have a meaningful role in liquid claim production. Allen et al. (2014) show that equity capital is costly relative to deposit to provide liquidity.

Fourth, raising equity by issuing new shares may entail significant share price reductions and transaction cost. De Jonghe and Oztekin (2015) suggest that external governance has opposite effect on bank capital structure adjustments.

Based on above arguments, market disciplinary forces can be the explanations contribute to the capital decrease. Therefore, it is proposed that:
Hypothesis 2: The level of market discipline is negatively associated with the level of bank capital.

Interaction between pin and eff

Bank performance might contribute to the effect of market discipline on capital structure stronger. General investors have limited knowledge and skills that cannot become privately informed about every bank, thus they choose to trade banks that information is the most profitable. Management may respond to market assessments of company performance and changes capital strategies. If markets are efficient, it leads to changing equity market valuations reflecting market attitudes and expectations of bank profitability. Thus, better performed banks respond to stock prices as a source of information for monitoring management. Uninformed investors are likely to access an asset pool that has been cream-skimmed by informed investors (Bolton et al., 2016).

Short selling can be an avenue that contributes to market discipline when bank underperforming. Large shareholders are more likely to sell their stake in a under-performing bank rather than bear the cost of intervening to fix. Such sales not only drive down the stock price, but also reducing the manager's equity compensation and thus punishing them ex post. Anginer et al. (2016) show that executive options and stock wealth invested in the bank is generally associated with better capitalization. Manager is more sensitive to the short selling as their wealth is closely tied to the

stock price. Although market participates could be motivated purely to maximize their trading profits, but such actions have a social benefit by disciplining the manager. A bulk of the literature focuses on empirically testing the effect of short selling behavior from investors on company reaction. For instance, Admati and Pfleiderer (2009) argue that, when the larger shareholders observe managers underperforming, they will exit early before the information becomes public. Dasgupta and Piacentino (2015) claim that the efficacy of exit as a governance mechanism by equity blockholders can be an effective market discipline. Fang et al. (2016) find that short selling or its prospects helps detect fraud and improves price efficiency. Massa et al. (2015) document a significantly negative relationship between the treat of short selling and earning management. Edmans et al. (2013) also provide evidence consistent with exit theories suggesting that trading by institutions is an effective governance mechanism.

Bank performance has an important role to play in shaping the relation between market discipline and bank capital structure. When banks are undeforming, their capital ratio would difficult to adjust upwards. The idea is simply that banks with lower earnings can be expected to face higher costs of issuing equity and have less financial slack. Under-performed banks would adjust downwards their capital level in response to exogenous changes in market discipline by informed trading. In such situation, these banks cannot obtain a better price when issue new equity (De Jonghe and Oztekin (2015). In addition, managers are more likely to engage risky investment when bank underperforming. Curry et al. (2008) find that equity market information can improve bank supervision by adding value to forecast banks' risk ratings.

Therefore, it is proposed that:

Hypothesis 3: Market discipline can reduce the capital ratio when bank underperforming.

3 Methodology

3.1 Bank Capital

The economist's view of bank capital is the amount of equity that is financed by itself with. The regulatory view is similar but broader in that as regulatory capital typically includes other sources of financing such as preferred stock. As the variety of regulatory definitions of capital all assign a central role to equity, we will refer to bank capital simply as common equity (paid-in capital plus retained earnings) in the bank. Therefore, the ratio of equity to total assets (ETA) represents the bank capital and it is calculated by the equity position as a fraction to total asset of a bank. The ETA is commonly used to measure the level of bank capital in literature, such as Flannery and Giacomini (2015), De Jonghe and Oztekin (2015), and Lepetit et al. (2015). ETA is to capture the capital structure and risk preference across banks in terms of their equity requirement.

In addition, we include an alternative measure for the bank capital, which is regulatory capital ratio. Normally banks need to hold more capital than the required regulatory minimum in order to reduce the likelihood of liquidation. So the regulatory capital is the amount of capital needed for a bank to be regarded as continues operation by depositors and other stakeholders. Following Lepetit et al. (2015) and Memmel and Raupach (2010), the regulatory capital ratio is defined as the bank's core capital divided by the weighted average assets.

3.2 Market discipline

To measure market discipline level, the market microstructure model of Easley, Kiefer, and O'Hara (1996; 1997a; 1997b) is used to generate the PIN. The PIN is a measure of market disciplinary that exists from stock market. It reflects a firm-specific estimate of the probability that investors trade from privately information; hence, it directly captures the extent of information among investors in the capital market. In addition, the model focuses on the mechanism through which the market participants observe updated trading and draw inferences about the true value of an asset. If the

private information is being reflected on relevant transactions and the market participant updates their beliefs, then the trading price will be affected. In continuous time, the full information converges into the process of trading, learning and pricing.

In Easley, Kiefer, and O'Hara' model (EKO), it is assumed that news event[2] occurs independently with probability α. When an information event occurs, it is either bad or good news, the probability are δ and 1 – δ respectively. Therefore the bad news event occurs at probability $\alpha\delta$, and good news event occurs with probability $\alpha(1-\delta)$. During each trading day, orders from market participants are assumed to arrive according the Poisson process. The informed traders arrive at rate μ regardless whether good or bad news[3]. Sell and buy orders from uninformed traders would arrive at rate ε_s and ε_b respectively. According to EKO, the likelihood function induced by this simple model of the trade process for a single trade day is given as follow:

$$L\ (\theta\ \mid B,S) = (1-\alpha)\cdot e^{-\varepsilon_b}\frac{\varepsilon_b^B}{B!}\cdot e^{-\varepsilon_s}\frac{\varepsilon_s^S}{S!} + \alpha\delta\cdot e^{-\varepsilon_b}\frac{\varepsilon_b^B}{B!}\cdot e^{-(\mu+\varepsilon_s)}\frac{(\mu+\varepsilon_s)^S}{S!} + \alpha(1-\delta) \cdot e^{-(\mu+\varepsilon_b)}\frac{(\mu+\varepsilon_b)^B}{B!}e^{-\varepsilon_s}\frac{\varepsilon_s^S}{S!}$$

(Equation 1)

As the likelihood function is a mixture of distribution, those three elements refer to the likelihood weighted by the probability of a day with "no event day" (1 –α), a "bad news day" (αδ), and a "good news day"($\alpha(1-\delta)$). The (B_i, S_i) is the total number of buys and sells in a single date for period $i \in (1,\ldots.,I)$ and the $\theta = (\alpha,\mu,\varepsilon_b,\varepsilon_s,\delta)$ is the parameter vector. All we needed to generate these parameters is to input the number of buyer-initiated and seller-initiated. However, trade and quote databases do not provide the number of seller-initiated or buyer-initiated in each day. The validity of our study that classifies trades as buyer-initiated and seller-initiated depends on the accuracy of the classification method. Consistent with Lai et al. (2014), the Lee and

[2] The events could relate to private information of which the firm is aware or unknown, such as releasing new competitive product or adverse change legal environment.

[3] The EKO model assumes that either informed buying or selling order occur on the same data.

Ready (1991)[4] trade classification algorithm is being used to identify the trades. Ellis et al. (2000), Lee and Radhakrishna (2000) and Odders-White (2000) examine the validity of Lee and Ready algorithms and find that this method correctly classifies 81.5%, 93% and 85% of the trade, depending of the sample period and market studied.

Assuming sufficient independence conditions are held across a trading day, the likelihood function for the period is

$$V = L\ (\theta\ \mid M) = \prod_{i=1}^{n} L\ (\theta \mid B_i, S_i\ )$$

(Equation 2)

Here $M = \{(B_i, S_i)\}_{i=1}^{I}$ refers to the data set. This maximizing the likelihood will give us the ML estimator for θ, from which we can estimate the probability that the trade is information-based as follows:

$$PIN = \frac{\alpha\mu}{\alpha\mu + \varepsilon_b + \varepsilon_s}$$

(Equation 3)

The denominator $\alpha\mu + \varepsilon_b + \varepsilon_s$ is the arrival rate for all orders which includes the informed and uninformed. The numerator $\alpha\mu$ is the arrival rate for information-based orders. Therefore the PIN equals the fraction of trades in a given day that arise from informed trading. This model interprets normal trading activities as uninformed trades and the abnormal trade as informed trades. There may have two concerns about the model, simplistic and not consider volume factor.

There are several reasons to choose PIN as proxies of market discipline. First, it captures the characteristic of each transaction on the microstructure economic environment. Easely et al. (2002) use PIN in the asset pricing and found that this

[4] The Lee and Ready (1991) method is the classification on each trade by compare the transaction price and the midpoint of the current bid and ask price. A trade would classify as a buy (sell) if the transaction price is closer to the prevailing ask (bid) quote. If the current transaction price equal to the midpoint, the previous transaction price would be used. A trade would classify as a buy (sell) if the transaction price is higher (lower) than the previous price. Next previous transaction price is being used if the current and previous transaction prices are the same.

measure is priced, higher PIN stocks earns higher expected return. Vega (2006) finds that stocks with high PIN are smaller reactions with earnings announcement, which suggest that those stocks likely contain more private information by speculators. Second, full information can converge by the process of trading and learning from trading results in prices (Easley and O'Hara, 1992). Therefore, a high PIN helps the market become more efficient. Third, compare to other proxies of market forces, such as spread-based, abnormal accruals and earnings informativeness, PIN is more accurate for using the decision by all stock investor rather than individual report or analysts. To classify the number of buyer-initiated and seller-initiated trades for listed company is more direct and comprehensive on reflecting the probability of informed trading in a dynamic view of market.

3.3 Bank performance

The most common efficiency estimations in banking are nonparametric techniques, such as data envelopment analysis (DEA), and parametric techniques, such as the distribution-free approach (DFA) and stochastic frontier approach (SFA). The main difference between DEA and SFA is how they separate the measure of efficiency for an individual bank from random errors. DEA has the disadvantage of not allowing for random error associated with luck and other measurement errors. So we use SFA to measure efficiency, which considers measurement errors as well as other random factors in the estimation of efficiency. It was developed by Aigner et al. (1977) and Meeusen et al. (1977). This method has been widely applied to the banking sector to evaluate cost and profit efficiency theoretically and empirically (Altunbas et al., 2001; Berger and Mester, 1997; Berger et al., 2009a; Koutsomanoli-Filippaki and Mamatzakis, 2009; Jiang et al., 2013). SFA has been criticized for the predetermination of functional form and the distributional assumptions for the residual and efficiency score. However, separating the random error and efficiency score would more appropriate in the efficiency literatures in transition economies (Fries and Taci, 2005).

Suppose that total cost for each bank in each time period is given by:

$$TP_{it} = f(P_{it}, Y_{it}, Z_{it}) + \ v_{it} + u_{it}$$

(Equation 4)

where TP denotes observed profit after tax for bank i at year t. P is a vector of input prices, Y is a vector of outputs, and Z stands for a set of control variables (fixed netputs). This approach disentangles the error term in two components. The first (v), corresponds to the random fluctuations, and is assumed to follow a symmetric normal distribution around the frontier, capturing all phenomena beyond the control of management. The second (u), accounts for bank's inefficiency relative to the frontier and is assumed here to follow a truncated normal distribution. Profit efficiency measures the extent to which an individual's profit fall below the profit of the best performance bank under same condition. Profit efficiency is based on a more reasonable economic goal of profit maximization and explains errors on both the output and the input sides (Sun et al. 2013).

For the issue concerns the choice of functional form, translog function form has been commonly applied in the bank efficiency studies (Fu et al., 2014a, Uchida and Satake, 2009 and Beccalli et al., 2006). Another Fourier-flexible form has gained banking literature attention as it offers a better global approximation of the unknown function without misspecification (Vennet, 2002). But Altunbas and Chakravraty (2001) suggest that the problem would with the Fourier-flexible function when dealing with heterogeneous data sets. Berger and Mester (1997) argue that the difference between the translog form and Fourier-flexible form are not cause serious inconsistence. So the translog form has been chosen, the SFA efficiency is based on the following function:

$$\ln TP \ = \alpha_{i0} + \sum_i a_i lnP_i + \sum_i \beta_i lnY_i + \frac{1}{2}\sum_i \sum_j \alpha_{ij} lnP_i lnP_j + \frac{1}{2}\sum_i \sum_j \beta_{ij} lnY_i lnY_j +$$

$$\frac{1}{2}\sum_i \sum_j \delta_{ij} lnP_i lnY_j + \sum_i \emptyset_i lnZ_i + \frac{1}{2}\sum_i \sum_j \emptyset_{ij} lnZ_i lnZ_j + \frac{1}{2}\sum_i \sum_j n_{ij} lnZ_i lnY_j +$$

$$\frac{1}{2}\sum_i \lambda_{ij} lnZ_i lnP_j + \ v_{it} + u_{it}$$

(Equation 5)

where TP is the logarithm of the profit before tax, Pi are input prices, Yi are output quantities. Zi are control variables. For the definition of bank inputs and outputs, the intermediation approach proposed by Sealey and Lindley (1997) is applied. The banks collect fund through labor and physical capital, and transfer to the loans and other earning assets. So there are two inputs, labour and financial capital, and two outputs; loans and other earning assets. These two output variables are commonly used in the previous researches, such as Berger et al. (2009a) and Bonin et al. (2005). Due to unavailable for the personal expense data, we following Jiang et al. (2009) and Fu et al. (2014a), the ratio of operating expenses to average assets is used as the price of labour. The price of financial capital is dividing the total interest expenses by total interest bearing borrowed funds. Greater organizations complexity may be associated with lower efficiency, so two bank-specific control variables are being employed to account for size different associated with banks, which are the amount of total earning assets and fixed assets.

To ensure that the estimated frontier is well behaved, standard homogeneity and symmetry restrictions are imposed. All variables except for input price are normalized by total asset, which imposes linear homogeneity to ensure that the cost-minimizing or profit-maximizing do not changes if all inputs prices are multiplied by the same positive scalar.

Panel (b) in Table (1) presents the summary statistics of the used variables in stochastic frontier approach.

[TABLE 1 HERE]

3.4 Main model specification and variable construction

To disentangle the relationship among capital, information risk and efficiency leads on, the system of equations estimated is as follows:

$$ETA_{it} = \alpha + \beta_1 PIN_{it} + \beta_2 CEFF_{it} + \beta_3 PIN * CEFF_{it} + \beta_4 X'_{it} + \varepsilon_{it}$$

(Equation 6)

where ETA represents the level of capital and calculated by equity to average asset. The PIN is proxy for the market discipline, which calculates by Easley et al. (1997a, b) market microstructure model. CEFF represent bank cost inefficient and proxy for bank performance. The interaction term between PIN and CEFF is being included to test hypothesis 3. Lastly, X i,t refers to a list of control variables which includes bank specific characteristics and macro market control.

For other control variables, we use a range of bank and market specific variables that are consider being important in explaining the relationship among the market discipline and capital. First, the logarithm of total asset (LNTA) is being used to control the firm size. Larger banks are holding more diversify asset portfolio and gain the size advantage than smaller bank (Hughes et al., 2001). Yet Berger et al. (1987) provide evidence that very large bank often encounter scale inefficiencies. We expect this variable to negatively impact the variation in the capital level because larger bank experienced lower expected costs of raising new equity and enjoy conjectural government guarantees. In addition, banks with high earnings may choose maintain higher equity capital ratios. This motive is likely to be amplified by the degree of risk aversion among bank management. However, high earning indicates that bank will be easy to raise new capital in future. Therefore, higher earnings would be associated with a lower capital ratio. We use earning per share (EPS) to control the impact from fluctuation of earnings on capital. Third, the ratio of total deposits to total loans (DEPTOL) assesses the degree to which customer loans are financed by customer deposits, and is related to the bank's liquidity. DEPTOL is expected to be positive with capital, since holding more liquid assets is usually accompanies with higher risk, therefore lead higher level of capital.

Two market specific variables are also including for controlling the macroeconomic development characteristic of the Mainland China, Hongkong and Taiwan. The impact

of macroeconomic environment may be more important for financial institutions than for non-financial firms because banks' exposure to business cycle fluctuations obviously. These variables are commonly used in the banking literature (De Jonghe and Oztekin, 2015). First, inflation (INF) also uses to capture market characteristics. Bank fee on customer would increase in high-inflation environment, but due loans may accumulated and lead to higher risk. Athanasoglou et al. (2008) found that the inflation can determine the bank performance in Greek market. In addition, lending interest rate (LINT) uses to capture the differences of regulatory regime and monetary policy in these three markets. Third, a dummy variable (PCRISIS) of financial crisis (years 2008–2015) to capture the impact of the global financial crisis.

[TABLE 2 HERE]

4 Data

4.1 Data sources

In this study, we examine a region sample of banks over the 2006–2015 period. The sample cover the listed banks[5] in three capital markets, Mainland China, Hongkong and Taiwan. The financial data regarding income statement and balance sheet information on individual banks is from Bankscope (Fitch's International Bank Database). Given that our focus on listed commercial banks in stock exchanges of Mainland China, Hongkong and Taiwan market, we start by excluding central banks, investment banks, policy banks, securities houses, multilateral government banks, non-banking credit institutions, and specialized government financial institutions. For estimate efficiency, we exclude banks that have the following features: (1) missing values for profit before tax, (2) missing, negative or zero value for inputs and outputs, and (3) missing value for control variables (total assets and fixed assets). In addition, duplicate information is being eliminated. If Bankscope shows both unconsolidated and consolidated financial statements, we use consolidated statement to analysis

[5] As PIN needs to be calculated from daily trading data, so the unlisted banks are excluded.

(except, of course, for banks that do not consolidate their data and do not belong to a consolidated group), because as capital requirements are imposed at the consolidated group level. The scope of the risks contained in consolidated statement is broader, as information about those banking subsidiaries operating outside Great China is included. Furthermore, most of the banks in Mainland China previous follow the International Accounting Standards (IAS) while some banks, including the joint ventures and banks listed in the stock market, also prepared annual reports based on the Chinese Accounting Standards (CAS). However, the CAS was developed following the principles of IAS starting in 2006. Therefore, we compare the financial statements of the same bank in Mainland China which reports under both the CAS and IAS and do not find a major difference. The quality of data in China is often questioned and criticism, so data from multiple sources have been checked carefully.

Another problem we faced in this sample of bank-level is that Bankscope reports financial statement data at the aggregated level. The impact of bank mergers during the period has also to be taken into account, especially in Taiwan market. The aggregated statements are combining a group of affiliated banks that have merged or expect to merge. These banks are neither having financial links nor form a legal entity. Therefore, a given bank might be presented several times in Bankscope. Micco et al. (2007) proposed two methods to deal with banks that have aggregated statements. The first is using the aggregated statement and drop the observation for the individual banks. The second is using individual banks up to the time of merger, and then starting from the year of merger, with the new bank. Following Dietrich and Wanzenried (2011), we use first method and work with the aggregated statements. In addition, a similar problem arises for banks which, having belonged at t-1 to a consolidated group, leave such group at t. To calculate both the averages of certain variables, the figure at t-1 is obtained from their individually reported financial statements.

In order to calculate PIN, our sample is restricted to publicly-listed banks because we require high-frequency transaction data from stock market. The high-frequency data represents trades and quotes submitted during the regular trading hours of each listed bank. The high-frequency transaction data for banks in Mainland China are from the GTA Information Technology Company Limited. GTA Information Technology Company Limited is a local data provider that collects all the Chinese listed company transaction data. The transaction data for banks in Hongkong are from Hong Kong Exchanges and Clearing Limited (HKEx). HKEx is a leading global operator of exchanges and clearing houses based in Hongkong. The transaction data for banks in Taiwan are from Taiwan Economic Journal (TEJ). TEJ is a financial data collection and content processing company which focuses mainly on Taiwan stock exchange. Our transaction data include all trades and quotes submitted to the stock exchanges of three markets from January 2006 through December 2015. Those three data sources provide information on trade qualifiers. Besides, trades identified as irregular trades or with negative trading prices are excluded.

In our study, three markets of stock exchanges have implemented automated electronic trading system during our sample period from January 2006 to December 2015. In this manner, a full business cycle of the Great China economy is included, a point of particular importance given that the aim of this paper is to analysis whether there is a relationship between the market discipline driven from stock market and the capital held by financial institutions.

In addition to the bank-specific data and stock market information, we use two macroeconomic variables to control for a country's macroeconomic environment and overall level of economic development. These are the rate of inflation of consumer prices and lending interest rate. These data are obtained from Datastream, which is managed by Thompson Financial Limited.

The initial sample contained 468 bank level observations for PIN measure. We merge these observations with efficiency data calculated by using SFA. For those observations that cannot be matched by efficiency, we manually matched by firm names. Therefore, our panel is incomplete since new listed banks have started to operate during the period considered while others have ceased to exist.

As shown in Table (3), some years have more observations than others due to new IPO, delisted, or acquisition during the sample period. Next, we apply the filters for firm specific information and macroeconomic information. After filtering, the dimension of the data set is 385 observations and 46 banks for the period of 2006-2012. The number of banks and the number of bank-year observations are the highest from Taiwan market, with 23 banks and 198 observations (making up 51.42% of the number of observation). Mainland China market is ranked second with 16 banks and 129 observations (making up 33.51% of the number of observation). Remaining Hongkong market has 7 banks and 58 observations. The observations are distributed relatively evenly over years 2010–2014 in the sample, but years 2006–2009 have fewer observations. Table (3) reports the distribution for our sample.

Using panel data methodology is not only controls for individual heterogeneity, but also reduces concerns associated with multicollinearity and estimation bias, and specifies the time-varying relation between dependent and independent variables (Baltagi, 2008). Thus, our study employs a panel data methodology and an F-test is used to determine whether the fixed-effects model outperforms the pooled OLS. In addition, the appropriateness of the random-effects model relative to the pooled OLS model is examined with the Breusche and Pagan Lagrange multiplier (LM) test. Finally, Hausman's test is used to compare the fixed-effects model with the random-effects model.

[TABLE 3 HERE]

4.2 Descriptive statistics and correlations

Table (4) presents the descriptive statistics for the variables used in our analyses. The key variables in our analysis are the proxies for the bank capital structure and market discipline.

For the full sample, as banks are highly leveraged; the mean (median) capital asset ratio (ETA) is 9.56% (9.2%) with a standard deviation of 2.9%. The mean of regulatory capital (REG) is 9.6%, comfortably above the minimum Basel requirement of 8%, with a standard deviation of 3.9%. There is much greater variation in the ratio of equity to average assets. The pattern is similar as the study of Williams (2004) who examines the relationship between bank risk and efficiency for European banks. These two measures of banks' capital level represent different capital structure dynamics and one should be cautious in interpreting and generalizing results obtained with each measure.

Our estimated PIN variable has a mean of 0.17 and ranges from 0.05 to 0.65. This mean of PIN is comparable to previous studies. Easley et al. (2002) find that the mean of PIN is 0.19 in New York Stock Exchange. More recently, Lai et al. (2014) use a larger dataset from 47 countries worldwide to exam the pricing effect of PIN, they estimate that the mean of PIN in Mainland China, Hongkong and Taiwan are 0.10, 0.20 and 0.23 respectively. As the participants of Chinese equity markets are 99.5% by individual investor investors (Ng and Wu, 2006), so it is plausible for the lower PIN in these markets because individual investors have less information advantage compare to institution investors. While the PIN estimates are in the same order of magnitude, the frustrating in the PIN estimate probably reflects the increasing financial transparency of Mainland China markets and the implementation of an automated trading system.

Besides, the mean of cost inefficiency is 0.07, which same as the cost efficiency in Sun et al. (2013) study. The sample of Sun (2013) covers 8 years' period 2002-2010 in Mainland China. For other control variables, the asset size is highly skewed to the right as banks in the top quartile are several times bigger than median size banks. Therefore, we use the natural logarithm of total assets (LNTA) to measure bank size to reduce the effect of skewness on our results. The average natural logarithm of the total assets is 18.27. The deposit to loan ratio (DEPTOL) ranges from 0.77 to 1.87, with an average of 1.23. The median DEPTOL ratio is 1.21, with a lower degree of variation across banks. The earing per share ratio (EPS) ranges from -0.52 to 1.85, with an average of 0.12. All these various checks reinforce our level of confidence in the accuracy of our estimated variables.

[TABLE 4 HERE]

The correlation matrix of correlations between the variables is shows on Table (5). The correlation between market discipline (PIN) and capital ratio (ETA) is 0.147 and significant at 5% level, which suggests that banks with intensive market disciplinary are likely buildup their capital. Besides, the correlation between the regulatory ratio (REG) and PIN is 0.1845 and significant in 5% level, while correlation between the REG and ETA is negative and insignificant. The bank inefficiency (CEFF) and ETA variables have a correlation of -0.190 and not significant, while the CEFF and REG variables have a correlation of 0.1845 and significant at 5% level. This suggests that the inefficient bank may hold higher level of bank capital. The correlation between CEFF and PIN is not very higher, only -0.099, in absolute value not more than 9%.

[TABLE 5 HERE]

Table (5) further shows that the correlation between the ETA and bank size (LNTA) is negative at -0.193 and significant, while correlation between the REG and LNTA is positive and insignificant. This suggests that the economic impact of bank size on capital level may be opposite. In addition, the negative relation between PIN and bank

size (LNTA) is consistent with previous empirical studies, such as Vega (2006), which use PIN as an informed trading measure.

Overall, most of the value drivers considered exhibit a statistically significant correlation, so there are no strong correlations between the variables forming our models and the risk of multicollinearity is very low.

5 Empirical results

5.1 Market discipline affects bank capital

Table (5) contains estimation results for the baseline model for the full sample using ETA as dependent variable from Equation (6). It presents results of regressions of proxies for market discipline over bank capital variables, and a set of bank-level and country-level control variables. All columns of Table (5) report include year effect except column (1). In addition, those results are estimated with robust standard errors clustered at the firm level.

To start with, column (1) of Table (5) includes market discipline variable only. The coefficient of market discipline (PIN) is positively significant at the 1% level, the termed slope shifter is 0.040. More specifically, an increase of one percentage point in market discipline by informed trading (of 0.10 from Table 4) increases the long-term relative capital ratio by around 0.4% (0.040 * 0.10). Regarding the significance and sign of the coefficient of market discipline, we find that, after controlling for other determinants, there is a clearly significant (at 1%) positive relationship between the capital ratio and the market discipline. Accordingly, in the case of Great China, capital structure barely sensitive to the stock market have translated into relatively bank capital buildup.

Then, we include variables capturing bank specific characteristics without bank

inefficiency and interaction term in column (2) of Table (5). The coefficient of PIN is still positive, while only 10% significant level and the termed slope shifter is 0.018. This suggests that an increase of one percentage point in market discipline by informed trading increases the capital ratio by around 0.18% (0.018 * 0.10).

Furthermore, we further include bank inefficiency and interaction term in column (3) of Table (5). The coefficient of PIN is still positive and significant at 10% level, and the termed slope shifter is 0.058. This suggests that an increase of one percentage point in market discipline increases the capital ratio by around 0.58% (0.058 * 0.10).

Finally, we present the full model with the bank specific and macroeconomic development variables in column (4) of Table (5). Again, the coefficient of PIN is still positive and significant at 10% level, and the termed slope shifter is 0.070. This suggests that an increase of one percentage point in market discipline increases the capital ratio by around 0.70% (0.070 * 0.10). Results show that controlling for other market characteristics does not change the effect qualitatively. As mentioned above, changes in macroeconomic development variables are controlled with inflation rate (INF), lending interest rate (LINT) and post crisis dummy (POSTD).

[TABLE 6 HERE]

Overall, the coefficients of PIN from column (1) to (4) of Table (5) are positively and statistically at the 1% or 5% significance level. This positive relation shows that a higher (lower) market discipline may lead to a high (low) bank capital. This finding supports our hypothesis (1). Our finding consistent with the conjecture that bank managers under market pressure would make proactive efforts to converge to their target capital ratio.

This positive relation between market discipline and capital level can be explained by

several reasons. First, since the market discipline can affect a firm's corporate governance through trading, firm with strong governance are associated with better performance and high profitability of informed trading. The trading brings new information on the true value of a stock to discipline bank managers. Thus, the effectiveness of banking firm governance also could be affected by information environment from stock market. Ferreira and Laux (2007) suggest that the openness to the market for corporate control leads to strong market discipline, which is more informative stock prices by encouraging collection of and trading on private information. Banks clearly appear to have different governance structures than non-financial institutions, which not only intensive regulation but also higher leverage. As suggest by Bhagat and Bolton (2008), better corporate governance have positive impact on bank profitability. Mehran and Thakor (2011) claim that a positive relation between bank value and capital. Therefore, the increase in capitalization simply reflect a retained earnings of bank profitability. Bank have a more conservative profile tend to hold higher capital to meet potential adverse shocks. Besides, manager is less willing to pay dividends, capital ratios thus have risen ''passively''. Indeed, higher capital is associated with higher lending, higher liquidity creation, higher bank values, and higher probabilities of surviving crises (Thakor, 2014).

Second, the effect of ownership could also play an important role in bank capital adjust. Holmstrom and Tirol (1993) claim that a firm's ownership structure influences the value of market monitoring through its effect on market liquidity. If the controlling shareholder is a state or family rather than widely held institution, the incentive for expropriation could be stronger. Those controlling shareholders would injection fund during hard times to avoid their failure with the expectation of extracting benefit in the future. As stock market can play an important role in monitoring management, banks with a strong orientation towards shareholder value are likely to keep the capital ratio in relatively higher level. Although a decrease in the capital ratio seems desirable, as it may increase the ROE, but at it may also cause cost

of rating downgrades and rising debt spreads. Banks with excess control rights were presumably under greater market discipline pressure to adjust their capital ratio upward (Lepetit et al., 2015).

Third, market discipline can influence a bank's risk management function (Barakat et al., 2014). Stronger market discipline should be applied to banks that are at greater risk of failure. Although the senior management and board of directors play an important role in bank risk management, but market discipline is effective in providing incentives for banks to limit their risk of default, by holding capital buffers against adverse outcomes (Nier and Baumann, 2006). The evolution of bank income toward an emphasis on non-interest revenue has also seen a structural change in bank, which may lead to higher risk-taking. Excessive risk taking may led to significant loss during financial crisis period. William (2014) find that external governance and higher capital regulations both act to reduce bank-level risk. Banks can improve risk controls function due the pressure of market discipline when choose to undertake high risk investment. High level of capital would increase a bank's chances of survival and withstanding major negative shocks. In the event of a crisis, the lower the capital ratio is, the higher the probability that a bank will fail to pay back its debts. Miles et al. (2013) conclude that the amount of equity funding that is likely to be desirable for banks to use is very much larger than banks have had in recent years, and it also higher than minimum target requirement set by regulator. As the separation of ownership and control raises question of managers' incentives to take actions in the best interest of shareholders (Jensen and Meckling, 1976), so the managers have incentive to choose disclosure policy which may not fully reflect the risk taking of bank. Regulator may not able to monitor the 'moral hazard' problem and hence cannot fully control banks' risk taking incentive. So, the market force would discipline bank managers, who actively rebalance their capital structure to converge excessive risk taking.

Fourth, Nier and Baumann (2006) find that stronger market discipline from more disclosure increase capital buffers. Regulator should foster disclosure information and private-sector monitoring of banks (Barth et al., 2004). Estrella (2004) also suggest that market discipline through information disclosure can be supplemented with other tools for bank supervision. A bank with higher information asymmetry may indicates that less information being released or selective disclosure. Brown and Hillegeist (2007) suggest that the negative relation between disclosure quality and information asymmetry. A disclosure is a signal that contains information on future investment, future cash flows, and expectation of earnings. However, there is more informative the signal if greater the expenditure on disclosure and leakage of strategic information. Thus, banks may not be willing to disclosure certain information. Besides, those hiding information could represent poor asset quality or high portion of nonperforming loans, in turn raising the bank risk. A failing bank can be seemed as one that has insufficient capital while excess risk taking. The regulation on bank asset restriction has limited effective given the high leverage ratios of banks. In addition, higher information asymmetry may indicate lower quality information disclosure by firms. It creates a potentially constructive role for government interventions to offset the market failures and enhance social cost. Thus, information asymmetry is crucial in determining the possibility of market discipline both at the individual level and the systemic level. Especially for banking sector, information asymmetry prone contagious and socially costly. Base on the information provided by the bank about its level of capital, the authorities should consider whether allow the bank continually operate. Thus, banks should provide more accurate and value-relevant information regarding the risk management function to the regulator and public. Therefore, regulators may focus on the capital adequacy to maintain the stability of financial system by require bank to enhance their capital level.

More importantly, the combination of opaque assets composition and deposit liabilities make banks potentially vague. So, bank may also ‘‘cherry-pick’’ its

information disclosure, for instance, accelerate disclosing the gains on appreciated asset portfolio while postponing recognition of unrealized losses. Berger and Bouwman (2013) suggest that bank with higher level of capital have better chance to survival during a banking crisis. The benefit come because a larger buffer of loss-absorbing capital limit the chance of financial crises as history events. Setting the adequate level of capital is a major policy issue for banking regulators. Therefore, regulator would encourage banks to raise the capital when information asymmetry increase. Regulatory pressure plays an important role in banks' control of the level of capital. The Basel III framework also require banks come to use more equity capital to finance their assets than was required under previous sets of requirement.

The pecking order theory argue that the asymmetric information problem drives the capital structure (Myers, 1984; Myers and Majluf, 1984). Information asymmetries between bank managers and outsider investors induces a preference order from internal capital via debt to equity issuing. Agency costs arise from a conflict of interest between shareholders and managers when shareholders cannot effectively monitor senior management. The cost includes structuring, monitoring and holding a set of contracts among agents with conflicting interests (Fama and Jensen, 1983). In addition, there is some disadvantage for internal capital, which may have the risk of being misused for private benefit of managers. Moreover, bank may have insufficient surplus cash during the crisis. However, the effect of these problems can be partially neutralized by adjust capital. Memmel and Raupach (2010) suggest that banks with a higher level of proprietary trading are more likely to adjust upwards their capital ratio. High information asymmetry costs result in difficulty on external financing, which in turn lead to issue equity capital. In addition, the optimal bank capital trades off three effects, more capital increase the rent, increase the buffer against shocks, and changes the amount that can be extracted from borrowers (Diamond and Rajan, 2000). The cost of intermediation of saving through the banking system might offset the benefit of maintain a larger buffer of capital. That would tend to reduce the level of

investment, which have potentially long-term effects on real economy. Furthermore, the socially efficient capital level may exceed banks' optimal capital levels, market discipline would become germane to minimize the system risk. To sum up, there are several reasons why a bank that is increase capital level when strong market discipline in place.

Our results are consistent with Allen et al. (2011), who argue that an important factor in inducing banks to choose higher capital is market discipline. Besides, Barrios and Blanco (2003) also find that market discipline lead banks to hold higher capital than other factors. Furthermore, Nier and Baumann (2006) conclude that market discipline is more effective to limit bank risk by choosing a larger capital buffer. Curry et al. (2008) also claim that markets can provide useful information to bank supervisors and become a channel for market discipline to be effective in restraining risky behaviors of institutions. A bank has a number of typical choices when raising its capital; it can raise funds from existing shareholders, or issue new shares via the domestic capital market, or alternatively it can source funds via the international capital markets.

Some criticisms for banks to operate with more capital is that banks would be forced to reduce liquidity and lead to impair their competitive advantage. However, the lost liquidity is likely to be significantly lower than the cost to taxpayers of bailing out inadequately-capitalized failing banks. Diamond and Rajan (2001) proposed that the fragility associated with low bank capital is necessary for banks to create liquidity.

Our result is contrast with the finding of Both Petacchi (2015) and Agarwal and O'Hara (2007), which find that strong market discipline from higher information asymmetry have higher leverage and support the pecking order theory. However, there is a major difference between our study, and Petacchi (2015) and Agarwal and O'Hara (2007). The observation of Petacchi (2015) includes not only financial firms, but also non-financial firms, while Agarwal and O'Hara (2007) exclude financial firms.

Both column (3) and (4) of Table (6) include the bank inefficiency (CEFF) the interaction between PIN and CEFF that estimate from stochastic frontier approach. However, both bank inefficiency and interaction term is not statistically significant. In addition, we briefly describing the set of control variables. Bank size (LNTA) is not correlated with capital in first three columns but is negatively correlated with this variable in column (4). This negative relation suggests that larger bank has a relatively lower level of capital. This is consistent with the finding of Berger and DeYoung (1997), larger banks are associated with lower capital level. Lower capital is generally associated with higher bank risk. It is argued that in the developing markets as Mainland China, a higher probability being attached to the likelihood of bailout for larger banks. Thus, large banks find the risk seeking incentives from being too big to fail reinforced. Earning per share (EPS) is not correlated with bank capital in all specifications.

Fixed effect

To formally test how firm fixed effect makes a difference to our results, we use the firm fixed effect estimate to confirm our previous finding. We allow for residuals of the firms to be correlated over time. Bank capital structure can be explained by time invariant firm specific effect i.e. a firm fixed effect (Gropp and Heider, 2010). These fixed effects can be correlated with other observed variables and bias the estimates.

[TABLE 7 HERE]

First, we include market discipline, bank inefficiency, interaction term between PIN and CEFF, and bank specific control variables in column (1) of Table (7). Again, the coefficient of PIN is still positive and significant at 5% level, and the termed slope shifter is 0.063. Increased market discipline results in a context in which managers are less likely to enjoy a quiet life and encourages more bank-specific capital strategies. In addition, the coefficient of CEFF is positive and significant at 10% level, indicating

that bank efficiency has a negative effect on the level of capital. Low profitable, and inefficient banks have higher capital ratios. The result is contrast with the finding De Jonghe and Oztekin (2015). Furthermore, the interaction term is negative and significant at 5% level, which suggest that market discipline may reduce bank capital for those low efficient banks. This is implied by Hypothesis 3. However, the result should be handled with care as it may be driven by covariate: better performing banks tend to have a higher level of market discipline, at the same time, they tend to adjust their capital ratio frequently. The capital market effectively subjects banks to a capital requirement, which brings their preference closer in alignment with those of the authorities, and reduces the level of social losses in event of bank failure.

Then, we present the full model with the bank specific and macroeconomic development variables in column (2) of Table (7). Again, the coefficient of PIN is still positive and significant at 10% level, and the termed slope shifter is 0.045. In addition, the coefficient of CEFF is also positive and significant at 10% level. Furthermore, the coefficient of interaction term is negative and significant at 5% level. These results suggest that market discipline is a more effective to enhance bank capital level when bank perform efficiently.

Finally, we present the full model with year dummy in column (3) of Table (7). Again, the coefficient of PIN is still positive and significant at 1% level, and the termed slope shifter is 0.068. In addition, the coefficient of CEFF is also positive and significant at 10% level. Furthermore, the coefficient of interaction term is negative and significant at 1% level.

Overall, results of Table (7) shows that controlling for firm fixed effect, and other bank and market characteristics does not change the effect qualitatively. The magnitudes of the coefficients are qualitatively unchanged, despite the significance decreased for some variables. All four coefficients of PIN are positively and

statistically at the 5% or 10% significance level. Again, these findings still show that banks with strong market discipline are associated with higher level of capital.

Random effect

First, we include market discipline, bank inefficiency, interaction term between PIN and CEFF, and bank specific control variables in column (1) of Table (8). Again, the coefficient of PIN is still positive and significant at 1% level, and the termed slope shifter is 0.071. However, both the coefficient of CEFF and interaction term are not significant.

[TABLE 8 HERE]

Then, we present the full model with year dummy in column (2) of Table (8). Again, the coefficient of PIN is still positive and significant at 1% level, and the termed slope shifter is 0.068. In addition, we find a negative and statistically significant interaction variable coefficient. Although the coefficient of CEFF is not significant, but the coefficient of PIN negative and significant.

However, the R square values are both not very high. This is not surprising because the existing literature (e.g., Berger and Mester, 1997) shows that many factors, such as organizational forms and the bank's characteristics, may influence the bank capital strategy. Another limitation of our analysis is the measure of market discipline. Due to data availability, we only use PIN as the sole discipline measurement.

6 Robustness test

We perform several regressions to check for the robustness of our results obtained in Sections 5. The causality could also go in the opposite direction from bank capital to market discipline. The share price would go up for the higher level capital and efficient bank compare with counterparties, thus these bank may attracts more attention in the capital market. Therefore, the trading volume would increase when

more investor trade, so the more information would aggregate from trading. This would affect the level of market discipline. Another challenge is unobservable heterogeneity across banks, which definitively exists in these three similar markets.

The previous results, although favorable to the disciplining hypothesis, may be subject to the same issue of endogeneity. Although FE model addresses endogeneity due to unobserved, time-invariant heterogeneities, but does not take account of the endogeneity problems due to time-varying heterogeneities, simultaneity, or reverse causality. Therefore, we use IV-2SLS and dynamic GMM to further address these econometric challenges.

6.1 IV-2SLS estimation

IV-2SLS is a standard methodology used to address the endogeneity problem in empirical corporate finance research. Under standard identification assumptions, we apply 2SLS methods to isolate the effect of PIN on capital.

A valid instrument must meet two criteria: a strong correlation with the instrumented specific independent variables and orthogonality with the error term. That is, the instrument should be a variable that can be excluded from the original list of control variables without affecting the results. Therefore, we need instruments for PIN: a variable that is correlated with PIN (this assumption can be tested), but uncorrelated with bank capital structure except indirectly through other independent variables.

Following the literature (Ferreira et al., 2011; Easley et al., 2002), we instrument PIN of a specific firm in each year, by using the share turnover and annual stock volatility as instruments. Share turnover is also likely to be strong correlated with PIN, consistent with the intuition that stocks with greater trading activity tend to have more uninformed order flow (Easley et al., 2002). This instrument variable has never been used as explanatory variables of bank capital in previous studies. Another instrument

variable is stock return volatility, that is the standard deviation of the daily returns. As the volatility of stock return corresponds to information arrival to the stock market: the more information arrival, the more volatile a price. A daily return, which is a sum of each intraday return, then depends on the daily number of information arrivals. This indicate that daily volatility is also an increasing function of the number of information arrivals, which represents more strengthening market discipline from stock market. A high volatility reflects intensive arrival of information. This instrument variable has been found to be significantly correlated with PIN. The annualized standard deviation of daily stock returns for a given year has a mean of 0.0190 with a standard deviation of 0.007. This figure is comparable to the figure reported in Bai and Elyasiani, (2013) using U.S. data.

Based on these two instruments, we perform a two-stage IV regression as follows. We regress PIN on two instruments in the first stage and then regress our capital on predicted PIN in the second stage, together with firm-level control variables and year fixed effects.

First stage:

$$PIN_{it} = \alpha + \beta_1 Pricevol_{it} + \beta_2 Shareto_{it} + \beta_3 X'_{it} + \varepsilon_{it}$$

Second stage:

$$ETA_{it} = \alpha + \beta_1 PredictedPIN_{it} + \beta_2 X'_{it} + \varepsilon_{it}$$

(Equation 7)

In first stage regressions, our instruments significantly correlate with PIN at a 1% significance level. In the second stage regressions, the Hansen's over-identification test fails to reject the hypothesis that our instruments are exogenous. As columns (1) and (2) of Table (9) illustrate, the second-stage regressions in table (9) show a strong positive correlation between predicted PIN and ETA. The result also supports our earlier findings that market discipline enhances ban capital in listed banks.

[TABLE 9 HERE]

6.2 Dynamic estimation - GMM

To further confirm our finding and address the correlation and possible endogeneity problems, we consider the difference Generalized Method of Moments (GMM) estimators developed for dynamic panel models by Arellano and Bond (1991). The lagged values of the explanatory variable are used as instruments for the equation in first differences. However, this 'difference estimator' has been found to exacerbate measurement error biases in variables by decreasing the signal-to-noise ratio (Griliches and Hausman, 1986). To reduce the potential biases and imprecision associated with the difference estimator, following Berger et al. (2009b), we employ the system GMM estimator which proposed by Arellano and Bover (1995) and Blundell and Bond (1998). System GMM estimator uses lagged differences of the explanatory variables as instruments in differences and levels equations, as well as lagged values of other regressors which might suffer endogeneity. The system GMM estimator controls for unobserved heterogeneity and for the persistence of the dependent variable. In addition, two-step system GMM estimator with Windmeijer (2005) corrected standard error also been used in our estimation.

Compared to the IV-2SLS methods, dynamic GMM estimator has the advantages of: (1) tackling the endogeneity problem based on internal instruments instead of relying on external instruments, which may not be readily available, and (2) explicitly modeling the dynamic nature of the capital and market discipline relationship by including past capital as one of the independent variable.

To tackle potential serial correlations, we use the first differences of the dependent variables which following the Blundell and Bond (1998). The lags of each independent variable are used as instruments to account for the simultaneity of capital and bank inefficiency. These instrument variables are valid under the assumption that the correlation between the bank-specific effect and the levels of the independent

variables is constant over time. To generate consistent estimations of parameters, both the validity of the assumption in error term and instrument need to be considering. Following De Jonghe and Oztekin (2015), Fu et al. (2014a) and Fiordelisi et al. (2011), we perform two tests of the GMM model. The first test is to examine the assumption of no serial correlation in the error term. The differenced error term is being test for second-order serially correlated. Second test is a Hansen test of over-identifying restriction, which tests the overall validity of the instruments, and the null hypothesis is the instruments are uncorrelated with the residuals.

$$ETA_{it} = \alpha + \beta_1 ETA_{i,t-1} + \beta_2 PIN_{it} + \beta_3 X'_{it} + \varepsilon_{it}$$

(Equation 8)

Table (9) presents the system GMM result. In addition, the first and second order correlation tests, and the Hansen tests of instrument validity, as well as the F test of model statistical significance. The lagged dependent variable for ETA are statically significant across all specifications, indicating a high degree of persistence of bank capital and justifying the use of a dynamic model. Again, we find that ETA is positively and statistically significant linking with PIN. Therefore, we are able to confirm that the market discipline influences the level of capital.

Overall, the system GMM estimates in Table (9) support our previous findings that even after controlling for unobserved heterogeneity, simultaneity and dynamic endogeneity. The diagnostics tests in Table (9) show that the model is well-fitted with statistically insignificant test statistics for both second-order autocorrelation in second differences (AR2) and Hansen J-statistics of over-identifying restrictions. The residuals in the first difference should be serially correlated (AR1) by way of construction but the residuals in the second difference should not be serially correlated (AR2). Accordingly, results show statistically significant AR1 and statistically insignificant AR2 for all bank risk measures. Likewise, the Hansen

statistics of over-identifying restrictions tests the null of instrument validity and the statistically insignificant Hansen J-statistics for all the specifications indicate that the instruments are valid in the respective estimation.

[TABLE 10 HERE]

6.3 Alternative capital structure measure

In this section, we examine whether above results are robust to replacing the capital ratio variables. We use an alternative definition of bank capital. Specifically, we replace the measure of capital structure with the regulatory capital requirement. Table (11) contains estimation results for the baseline model for the full sample using capital buffer (BUF) as dependent variable. The magnitudes of the coefficients are qualitatively unchanged, even the significance raised for some variables. The coefficients of PIN in regressions (1) to (3), which are termed slope shifters, are 0.049, 0.046, and 0.042, respectively. Again, all three coefficients of PIN are positively and statistically at the 1% or 5% significance level, which is even stronger result than ETA as dependent variable in Table (5).

[TABLE 11 HERE]

The estimated equation, on the other hand, passes without any major problem the standard goodness-of-fit tests. Major variables have the expected sign and most of them are significant even at 1%. There is significant negative first-order autocorrelation in the residuals (AR1 statistic) and nil second-order correlation (AR2), as should be the case if the error term (in levels) is white noise. The Hansen test for validity of the instruments used is also fully satisfactory, showing a p-value of 0.26.

7 Conclusions

For banks going public, previous literature focus mainly on the impact of stock price or return on bank performance, while the role of market discipline reflected by stock price and its potential effect on bank capital is a relatively unexplored area. A large body of evidence suggests that markets monitor financial firms effectively and promptly, but specific tests of investor trading have been much more limited. Holding capital is costly due to agency and information costs. Yet banks are required to carry minimum capital to maintain its default value at an acceptable level. This paper attempts to link the literature concerned with market discipline and the numerous empirical works on bank capital, which two to the best of our knowledge, have never been integrated before. Using a large sample of Chinese listed banks between 2006 and 2014, result shows that banks with strong market discipline have higher level of bank capital. In addition, we also find that market discipline is negatively associated with bank capital when bank underperforming. The findings imply that frictions associated with asymmetric information problems in stock market do matter for bank access to external finance. The results shed new light on the understanding of the role of market discipline for the prudential banking industry.

Our work departs from the literature on information structure of corporate securities and bank capital in several respects. First, it fills the gap in the literature and provides for the first time a comprehensive assessment of the causal relationship between market discipline and bank capital structure in Chinese banking. This study is the first paper to predict and find this relation. Second, while previous literature on high frequency data has been dominated by empirical studies in the developed capital markets of US and Europe, our data covers three major Chinese regulatory regimes including Mainland China, Hongkong and Taiwan, an interesting market never been explored in the past. Third, our proxy for market discipline is PIN, which is calculated by high frequency data and bases on the imbalance between buy and sell orders among investors. PIN may validate and strengthen previous studies focusing on accounting data, such as financial ratios and other accounting numbers. Those public

known accounting information is incorporated in the price formation process in an efficient market, but the private information may not be taken into consideration. Fourth, beside the OLS and FE estimators, we also employ the Generalized Method of Moments (GMM) method to account for endogeneity, unobserved heteorogeneity and for the persistence of dependent variables. This estimator yields consistent estimations of parameters compared with OLS estimation, which may lead to inconsistent estimates in this type of study.

The findings highlight several important issues for policymakers in those three markets. First, the governance role of market discipline can complement internal governance mechanism as stock markets performing a monitoring role, which will lead to an improvement of bank performance. This is especially useful for regulator in designing trading regulation to achieve fair competition in stock market. Second, regulators should encourage financial institution monitoring their stock price reaction of disclosure in order to enhance risk management. Third, with the mixed empirical findings on the relation between capital and bank efficiency, we argue that prudential regulation and supervision on capital requirement could affect the bank performance. Our finding extends the understanding of relationship between bank efficiency and stock price in Chinese market.

Our analysis offers a simple fundamentals-based explanation for why banks need to maintain high level of capital. From a methodological viewpoint, both the higher frequency data, compensatory effects between bank specific information and macroeconomic data prove the usefulness of measure the market discipline and bank capital, particularly when banks are investigated.

Our findings indicate a rich set of future research aspects. First, we have focused on market factors associated with financial firms. However, many non-financial firms in emerging economies also face high degree of information asymmetry. Therefore

future research should verify whether our findings can be replicated in non-financial industry. Second, PIN can act as one the external corporate governance to influence bank capital structure. However, some internal corporate governance, such as board composition and the ownership structure, also can affect the level of capital. For example, is better internal governance associated with capital structure? Third, there is little known about the inter-relationship between the external and internal corporate governance. Future research should address these important questions.

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Table 1: Descriptive statistics for PIN and bank inefficiency					
Variable	**N**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Panel A: PIN and its components					
PIN	385	0.180	0.105	0.001	0.800
ALPHA	385	0.648	0.263	0.001	1.000
MU	385	5.174	0.846	2.274	7.597
EPSILON	385	5.522	1.424	0.878	7.600
Panel B: Variables in stochastic frontier approach for efficiency					
Profit before tax (TP)	385	0.108	0.011	0.026	0.142
Output quantities					
Gross loans (Y1)	385	0.539	0.118	0.181	0.776
Other earning assets (Y2)	385	0.396	0.117	0.170	0.695
Input prices					
Price of labour (P1)	385	1.66	1.362	0.300	15.34
Price of capital (P2)	385	0.023	0.042	0.002	0.627
Control variables					
Fixed assets (Z1)	385	0.012	0.007	0.002	0.054
Total earning assets (Z2)	385	0.928	0.052	0.744	0.988

Note: PIN is probability of informed trading. ALPHA is probability of an information event. MU is arrival rate of informed traders. EPSILON is arrival rate of uninformed investors. The summary statistics of MU and EPSILON are based on the natural logarithm of MU and EPSILON. All variables in Panel B are normalized by total asset except for input prices. Price of labor (P1) is the ratio of operating expenses to average assets. Price of capital (P2) is the ratio of total interest expense to total interest bearing borrowed funds. All variables are winsorized at the 1% and 99% levels.

Table 2: Definition of variables			
Variables	**Symbol**	**Description**	**Sources**
Capital	**ETA**	The ratio of equity to average asset.	Bankscope
Capital buffer	**BUF**	The bank's capital less its requirement by regulator divided by the requirements	Bankscope
Information asymmetry	**PIN**	The probability of informed trading calculated by equation (3).	Use original trade and quote data from stock exchange to estimate
Profit inefficiency	**PEFF**	The score of profit inefficiency obtained using stochastic frontier approach with translog specifications.	Use original Bankscope data to estimate
Return on average assets	**ROAA**	The ratio of profit on average assets.	Bankscope
Return on average equity	**ROAE**	The ratio of profit on average equity.	Bankscope
Bank size	**LNTA**	The natural logarithm of total assets in thousands of USD.	Bankscope
Non-performance loan	**NPL**	The ratio of non-perform loan to total loans	Bankscope
Net interest margin	**NIM**	Net interest income divided by total assets	Bankscope
Liquidity risk	**LCA**	Liquid assets to short term funding	Bankscope
Credit risk	**CR**	Risk-weighted assets dividend by total assets	Bankscope
GDP growth rate	**GDPG**	The yearly real GDP growth (%).	Datastream
Inflation rate	**INF**	Inflation rate.	Datastream
GDP per-capital	**GDPP**	Domestic GDP (in USD) over the number of inhabitants.	Datastream
Lending interest	**LINT**	Lending interest rate.	Datastream

Table 3: Number of banks in samples used for estimating PIN and efficiency										
	2006	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**Total**
Mainland	7	14	14	14	16	16	16	16	16	129
Hongkong	6	6	6	6	6	7	7	7	7	58
Taiwan	21	21	21	21	23	23	22	22	22	198
	34	41	41	41	45	46	45	45	445	385

Table 4: Descriptive statistics for main model variables					
Variable	**N**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
ETA	385	0.158	0.056	0.021	0.446
BUF	385	0.136	0.039	0.001	0.250
PIN	385	0.180	0.105	0.001	0.659
PEFF	385	0.052	0.107	0.005	1.000
ROAA	385	0.709	0.906	-0.055	0.045
ROAE	385	0.103	0.130	-1.013	0.385
LNTA	385	17.86	1.546	15.30	21.52
NPL	385	1.516	0.929	0.226	4.648
NIM	385	2.002	0.747	0.750	4.230
LAC	385	26.37	14.74	2.340	102.4
CR	385	0.076	0.054	0.022	0.457
GDPG	385	5.599	4.456	-2.459	14.16
INF	385	2.196	1.920	-0.860	5.864
GDPP	385	9.770	4.213	-2.670	13.57
LINT	385	4.527	1.554	2.560	7.900

Note: This table contains means, standard deviations, minimum and maximum values on the variables included in the main model. ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 5: The relationship between information asymmetry and capital			
	(1)	(2)	(3)
	OLS	FE	FE
Dependent variable	**ETA**	**ETA**	**ETA**
PIN	0.024*	0.031**	0.034**
	(1.68)	(2.21)	(2.44)
LNTA	-0.008***	-0.027***	-0.004
	(-3.44)	(-4.08)	(-0.41)
NIM	-0.009*	-0.012**	-0.011**
	(-1.95)	(-2.18)	(-1.97)
LAC	0.001	2.15e-05	6.73e-05
	(1.54)	(0.10)	(0.33)
CR	-0.011***	-0.015***	-0.014***
	(-15.42)	(-16.14)	(-15.19)
NPL	0.604**	0.949***	0.743**
	(2.13)	(3.31)	(2.54)
GDPG	0.001		-0.001
	(1.11)		(-0.16)
INF	-0.001		-0.002
	(-0.89)		(-1.50)
GDPP	-0.038***		-0.077**
	(-5.88)		(-2.56)
LINT	-0.001		-0.002
	(-0.56)		(-0.97)
Constant	0.766***	0.773***	1.129***
	(10.27)	(6.79)	(5.70)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.516	0.528	0.541
Year fixed effect	Y	Y	Y

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 6: The relationship between information asymmetry and capital buffer			
	(1)	**(2)**	**(3)**
	OLS	**FE**	**FE**
Dependent variable	**BUF**	**BUF**	**BUF**
PIN	0.049***	0.046**	0.042**
	(2.58)	(2.42)	(2.19)
LNTA	-0.001	-0.011	-0.020
	(-0.36)	(-1.23)	(-1.44)
NIM	0.002	0.008	0.008
	(0.42)	(1.01)	(1.03)
LAC	0.001	0.001	0.001
	(0.77)	(1.56)	(1.41)
CR	0.003***	0.005***	0.005***
	(4.07)	(4.51)	(4.20)
NPL	-1.393***	-1.654***	-1.508***
	(-3.98)	(-4.31)	(-3.84)
GDPG	-0.001		0.001
	(-0.75)		(0.46)
INF	-0.001		0.001
	(-0.30)		(0.61)
GDPP	-0.0345***		0.014
	(-3.47)		(0.36)
LINT	0.004		0.009**
	(1.37)		(2.42)
Constant	0.463***	0.290*	0.254
	(3.84)	(1.93)	(0.97)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.146	0.155	0.173
Year fixed effect	Y	Y	Y

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 7: The relationship between information asymmetry and bank capital though bank profit inefficiency - OLS

	(1)	(2)	(3)
	OLS	OLS	OLS
	First stage	Second stage	
Dependent variable	**PEFF**	**ETA**	**BUF**
PIN	0.087*		
	(1.68)		
Fitted PEFF		0.398***	0.119
		(2.80)	(0.66)
LNTA	-0.025***	0.002	0.006
	(-5.35)	(0.49)	(1.13)
NIM	0.025**	-0.018***	-0.002
	(2.23)	(-3.25)	(-0.35)
LAC	0.001	0.001	0.001
	(0.69)	(0.95)	(0.56)
CR	-0.001	-0.010***	0.003***
	(-1.17)	(-13.94)	(3.93)
NPL	5.947***	-1.733**	-1.828*
	(6.77)	(-1.97)	(-1.65)
GDPG		0.001	-0.001
		(1.13)	(-0.61)
INF	-0.002	-0.001	-3.1e-05
	(-0.74)	(-0.27)	(-0.03)
GDPP	0.002***	-0.054***	-0.019*
	(3.66)	(-6.33)	(-1.83)
LINT	-0.004	0.001	0.002
	(-0.94)	(0.61)	(1.04)
Constant	0.333***	0.760***	0.209**
	(3.87)	(10.24)	(2.39)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.120	0.500	0.100

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 8: The relationship between information asymmetry and bank capital though bank profit inefficiency - FE

	(1)	(2)	(3)
	FE	FE	FE
	First stage	Second stage	
Dependent variable	**PEFF**	**ETA**	**BUF**
PIN	0.015*		
	(1.67)		
Fitted PEFF		1.843**	2.505**
		(2.10)	(2.03)
LNTA	0.044	-0.098**	-0.123**
	(1.22)	(-2.45)	(-2.20)
NIM	0.021	-0.049**	-0.050*
	(1.00)	(-2.56)	(-1.93)
LAC	0.001*	-0.002**	-0.003*
	(1.76)	(-2.04)	(-1.87)
CR	-0.002	-0.010***	0.010***
	(-0.55)	(-5.31)	(3.64)
NPL	6.083***	-10.29*	-16.62**
	(5.07)	(-1.93)	(-2.21)
GDPG		0.002**	0.002*
		(2.12)	(1.73)
INF	0.001	-0.003**	-0.004**
	(0.44)	(-1.99)	(-2.06)
GDPP	-0.144**	0.240*	0.393**
	(-1.98)	(1.86)	(2.18)
LINT	0.002	-0.006**	-0.001
	(0.33)	(-2.16)	(-0.33)
Constant	0.495	-0.090	-1.257**
	(1.45)	(-0.20)	(-1.97)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.160	0.529	0.128

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 9: The relationship between information asymmetry and capital – Difference GMM				
	(1)	(2)	(3)	(4)
Dependent variable	**ETA**		**BUF**	
Lag.ETA	0.073***	0.082***		
	(14.27)	(2.88)		
Lag.BUF			0.264***	0.199***
			(12.98)	(9.32)
PIN	0.041***	0.073***	0.030***	0.017*
	(4.26)	(2.99)	(6.00)	(1.97)
LNTA	-0.016***	-0.018***	0.003**	-0.010***
	(-6.09)	(-3.89)	(2.47)	(-3.46)
NIM	-0.002	-0.011**	-0.008***	-0.023***
	(-0.55)	(-2.06)	(-4.65)	(-5.80)
LAC	-7.5e-05	-0.001	-0.001***	-0.001***
	(-0.67)	(-1.12)	(-7.57)	(-9.12)
CR	-0.018***	-0.020***	0.006***	0.007***
	(-20.13)	(-9.46)	(11.33)	(15.80)
NPL	0.702***	0.654**	-2.385***	-1.952***
	(4.48)	(2.59)	(-12.87)	(-7.51)
GDPG		0.001***		-0.001***
		(3.68)		(-5.56)
INF		-1.8e-05		0.001
		(-0.07)		(0.75)
GDPP		0.009***		0.029***
		(3.06)		(8.46)
LINT		0.001		0.007***
		(1.43)		(8.23)
Observation	290	290	290	290
F test	0.000	0.000	0.000	0.000
Ar1	0.027	0.011	0.002	0.005
AR2	0.100	0.100	0.100	0.104
Hansan	0.626	0.950	1.000	1.000

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 10: The relationship between information asymmetry and capital – System GMM				
	(1)	(2)	(3)	(4)
Dependent variable	**ETA**		**BUF**	
Lag.ETA	0.592***	0.467***		
	(107.78)	(28.91)		
Lag.BUF			0.679***	0.512***
			(26.02)	(8.92)
PIN	0.019***	0.039***	0.022***	0.030***
	(4.12)	(5.15)	(3.58)	(2.85)
LNTA	-0.001	0.001	0.001	0.005***
	(-1.05)	(1.00)	(0.83)	(3.25)
NIM	-0.007***	-0.009***	0.001	0.010***
	(-9.92)	(-4.29)	(0.74)	(3.19)
LAC	0.001***	0.001***	-0.001**	-9.9E-05
	(29.71)	(15.9)	(-2.09)	(-1.55)
CR	-0.003***	-0.004***	0.001***	0.002***
	(-37.96)	(-17.71)	(5.74)	(6.16)
NPL	0.313***	-0.416***	-0.038	-0.994***
	(10.25)	(-3.24)	(-0.17)	(-3.06)
GDPG		0.001***		-0.001***
		(5.74)		(-2.97)
INF		-0.001***		-0.001*
		(-2.88)		(-1.94)
GDPP		-0.023***		-0.009***
		(-23.20)		(-3.39)
LINT		-0.001***		-0.002**
		(-3.28)		(-2.41)
Constant	0.086***	0.336***	0.015	0.055
	(11.66)	(15.18)	(0.89)	(1.46)
Observation	337	337	337	337
F test	0.000	0.000	0.000	0.000
Ar1	0.037	0.025	0.001	0.001
AR2	0.238	0.278	0.144	0.120
Hansan	1.000	1.000	1.000	1.000

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 11: The relationship between information asymmetry and bank capital though bank profit inefficiency – System GMM

	(1)	(2)	(3)
	First stage	Second stage	
Dependent variable	**PEFF**	**ETA**	**BUF**
Lag.PEFF, Lag.ETA, Lag.BUF	0.348***	0.576***	0.574***
	(24.55)	(37.59)	(50.62)
PIN	0.093***		
	(11.75)		
Fitted PEFF		0.101***	0.182***
		(4.19)	(17.80)
LNTA	-0.014***	0.001*	0.004***
	(-11.37)	(1.87)	(7.63)
NIM	0.009***	0.001	0.007***
	(2.81)	(0.09)	(12.10)
LAC	0.001***	0.001***	0.001
	(2.77)	(6.30)	(0.42)
CR	0.001	-0.003***	0.001***
	(0.67)	(-9.20)	(3.24)
NPL	3.150***	-0.526***	-0.589***
	(8.94)	(-3.58)	(-5.57)
GDPG		-0.001	-0.001***
		(-0.11)	(-3.01)
INF	0.001***	-0.001	-0.001
	(8.67)	(-0.99)	(-0.87)
GDPP	0.028***	-0.017***	-0.010***
	(20.76)	(-13.47)	(-8.11)
LINT	0.004***	-0.002***	-0.007***
	(6.55)	(-5.49)	(-6.86)
Constant	-0.106***	0.244***	0.099***
	(-4.92)	(14.62)	(6.18)
Observation	337	291	291
F test	0.000	0.000	0.000
Ar1	0.116	0.000	0.000
AR2	0.129	0.124	0.621
Hansan	0.473	0.376	0.415

Note ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 12: The relationship between information asymmetry and bank capital though ROAE - OLS

	(1)	(2)	(3)
	OLS	OLS	OLS
	First stage	Second stage	
Dependent variable	**ROAE**	**ETA**	**BUF**
PIN	-15.83***		
	(-2.83)		
Fitted PEFF		-0.001*	-0.002**
		(-1.68)	(-2.06)
LNTA	5.007***	-0.001	0.015**
	(9.16)	(-0.08)	(2.34)
NIM	-0.568	-0.009**	0.001
	(-0.44)	(-2.14)	(0.01)
LAC	-0.091	0.001	-0.001
	(-1.64)	(0.68)	(-0.39)
CR	0.469***	-0.010***	0.004***
	(2.77)	(-12.21)	(4.41)
NPL	-5.589***	-0.261	-2.527***
	(-5.81)	(-0.45)	(-3.32)
GDPG		0.001	-0.001
		(1.11)	(-0.19)
INF	0.218	-0.001	0.001
	(0.64)	(-0.48)	(0.16)
GDPP	-4.167**	-0.045***	-0.024***
	(-2.48)	(-6.02)	(-2.76)
LINT	0.781	0.001	0.003*
	(1.40)	(0.11)	(1.66)
Constant	-31.17	0.717***	0.110
	(-1.51)	(8.65)	(1.11)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.167	0.516	0.102

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 13: The relationship between information asymmetry and bank capital though ROAE - FE

	(1)	(2)	(3)
	FE	FE	FE
	First stage	Second stage	
Dependent variable	**ROAE**	**ETA**	**BUF**
PIN	-10.94*		
	(-1.97)		
Fitted PEFF		-0.002**	-0.003**
		(-2.10)	(-2.03)
LNTA	-2.421	-0.022**	-0.020*
	(-0.68)	(-2.45)	(-1.65)
NIM	-6.946***	-0.028***	-0.022
	(-3.31)	(-2.83)	(-1.65)
LAC	-0.268***	-0.001*	-0.0013
	(-3.31)	(-1.72)	(-1.34)
CR	1.107***	-0.011***	0.009***
	(2.94)	(-7.09)	(3.95)
NPL	-5.666***	-0.585	-3.431***
	(-4.83)	(-0.77)	(-3.16)
GDPG		0.001	-0.001
		(0.90)	(-0.04)
INF	0.048	-0.001	-0.001
	(0.15)	(-0.41)	(-0.68)
GDPP	16.03**	0.016	0.089**
	(2.25)	(0.60)	(2.38)
LINT	0.141	-0.001	0.005**
	(0.19)	(-0.55)	(2.20)
Constant	-80.33**	0.608***	-0.307
	(-2.45)	(4.39)	(-1.58)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.268	0.529	0.128

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 14: The relationship between information asymmetry and bank capital though ROAE – System GMM

	(1)	(2)	(3)
	First stage	Second stage	
Dependent variable	**ROAE**	**ETA**	**BUF**
Lag.ROAE, Lag.ETA, Lag.BUF	0.755***	0.602***	0.632***
	(63.46)	(41.17)	(39.54)
PIN	-11.99***		
	(-13.62)		
Fitted PEFF		-0.001***	-0.001***
		(-5.49)	(-10.97)
LNTA	0.704***	0.001	0.001
	(4.10)	(0.61)	(0.51)
NIM	0.924***	0.004**	0.007***
	(3.40)	(2.66)	(6.55)
LAC	-0.081***	0.001***	-0.001
	(-3.42)	(3.30)	(-1.24)
CR	0.210**	-0.002***	0.001***
	(2.25)	(-6.63)	(3.00)
NPL	-81.45***	-0.236*	0.195
	(-2.71)	(-1.79)	(1.13)
GDPG		0.001	0.001*
		(1.31)	(2.01)
INF	-0.603***	-0.001**	-0.002***
	(-7.80)	(-2.24)	(-6.24)
GDPP	-0.213	-0.011***	0.001*
	(-0.46)	(-9.71)	(1.67)
LINT	0.200	-0.001	0.001
	(1.54)	(-1.21)	(1.12)
Constant	-4.371	0.189***	0.022**
	(-0.78)	(11.06)	(2.67)
Observation	337	291	291
F test	0.000	0.000	0.000
Ar1	0.003	0.001	0.000
AR2	0.349	0.167	0.293
Hansan	0.422	0.405	0.458

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 15: The relationship between information asymmetry and bank capital though ROAA - OLS

	(1)	(2)	(3)
	OLS	OLS	OLS
	First stage	Second stage	
Dependent variable	**ROAA**	**ETA**	**BUF**
PIN	-0.880**		
	(-2.19)		
Fitted PEFF		-0.027*	-0.044**
		(-1.68)	(-2.06)
LNTA	0.324***	0.001	0.017**
	(8.59)	(0.14)	(2.33)
NIM	-0.047	-0.010**	-0.001
	(-0.53)	(-2.22)	(-0.11)
LAC	-0.006	0.001	-0.001
	(-1.61)	(0.48)	(-0.58)
CR	0.079***	-0.008***	0.006***
	(6.83)	(-5.68)	(3.46)
NPL	-42.48***	-0.579	-3.039***
	(-6.24)	(-0.77)	(-3.07)
GDPG		0.001	-0.001
		(1.11)	(-0.19)
INF	0.007	-0.001	-0.001
	(0.29)	(-0.65)	(-0.05)
GDPP	-0.179	-0.043***	-0.022***
	(-1.52)	(-6.13)	(-2.66)
LINT	0.083**	0.001	0.005**
	(2.10)	(0.58)	(2.01)
Constant	-3.290**	0.674***	0.040
	(-2.29)	(6.92)	(0.34)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.198	0.516	0.102

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 16: The relationship between information asymmetry and bank capital though ROAA - FE

	(1)	(2)	(3)
	FE	FE	FE
	First stage	Second stage	
Dependent variable	**ROAA**	**ETA**	**BUF**
PIN	-0.475*		
	(-1.65)		
Fitted PEFF		-0.061**	-0.083**
		(-2.10)	(-2.03)
LNTA	0.034	-0.014	-0.008
	(0.13)	(-1.61)	(-0.76)
NIM	-0.298*	-0.028***	-0.021
	(-1.91)	(-2.84)	(-1.64)
LAC	-0.017***	-0.001*	-0.001
	(-2.90)	(-1.88)	(-1.58)
CR	0.153***	-0.005	0.017***
	(5.48)	(-1.19)	(2.80)
NPL	-4.661***	-1.933	-5.262***
	(-5.35)	(-1.40)	(-2.69)
GDPG		0.001	-0.001
		(0.90)	(-0.04)
INF	-0.012	-0.001	-0.001
	(-0.53)	(-1.36)	(-1.57)
GDPP	0.884*	0.028	0.105**
	(1.67)	(0.88)	(2.39)
LINT	0.028	0.001	0.007***
	(0.51)	(0.16)	(2.69)
Constant	-7.977***	0.334	-0.680*
	(-3.27)	(1.30)	(-1.88)
Observation	385	385	385
F test	0.000	0.000	0.000
R	0.265	0.529	0.128

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Table 17: The relationship between information asymmetry and bank capital though ROAA – System GMM

	(1)	(2)	(3)
	First stage	Second stage	
Dependent variable	**ROAA**	**ETA**	**BUF**
Lag.ROAA, Lag.ETA, Lag.BUF	0.750***	0.581***	0.744***
	(58.27)	(42.62)	(37.81)
PIN	-0.794***		
	(-10.64)		
Fitted PEFF		-0.004***	-0.010***
		(-3.37)	(-7.12)
LNTA	0.085***	-0.001	0.001***
	(5.71)	(-0.36)	(3.50)
NIM	0.164***	0.002	0.009***
	(8.23)	(1.54)	(7.51)
LAC	-0.012***	0.001***	-0.001***
	(-6.81)	(4.36)	(-7.91)
CR	0.035***	-0.002***	0.001***
	(5.22)	(-8.46)	(13.78)
NPL	-15.07***	-0.256*	-0.329*
	(-6.11)	(-2.01)	(-1.89)
GDPG		-0.001	0.001*
		(-0.13)	(1.95)
INF	-0.084***	-0.001	-0.003***
	(-11.48)	(-1.60)	(-8.19)
GDPP	-0.012	-0.013***	0.002**
	(-0.92)	(-12.98)	(2.15)
LINT	0.010	-0.001***	0.002***
	(0.87)	(-2.96)	(3.50)
Constant	-0.931***	0.216***	-0.025*
	(-4.11)	(13.99)	(-1.87)
Observation	337	291	291
F test	0.000	0.000	0.000
Ar1	0.079	0.001	0.000
AR2	0.216	0.124	0.253
Hansan	0.140	0.388	0.500

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.

Appendix A: Correlations

	ETA	BUF	PIN	PEFF	ROAA	ROAE	LNTA	NPL	NIM	LAC	CR	GDPG	INF	GDPP	LINT
ETA	1.000														
BUF	-0.289*	1.000													
PIN	-0.146*	0.101	1.000												
PEFF	-0.048	-0.245*	0.115*	1.000											
ROAA	-0.686*	0.219*	0.118*	0.082	1.000										
ROAE	0.227*	0.004	-0.236*	-0.220*	-0.270*	1.000									
LNTA	0.118*	0.001	-0.267*	0.258*	0.043	0.381*	1.000								
NPL	0.216*	-0.059	-0.259*	0.170*	-0.235*	0.421*	0.595*	1.000							
NIM	-0.115*	0.154*	-0.068	-0.013	0.416*	0.263*	0.176*	0.266*	1.000						
LAC	-0.213*	0.234*	-0.184*	-0.763*	0.195*	0.363*	-0.067	0.010	0.228*	1.000					
CR	0.052	0.113*	-0.287*	-0.715*	-0.107*	0.520*	0.036	0.178*	0.141*	0.873*	1.000				
GDPG	0.242*	-0.016	-0.445*	-0.089	-0.160*	0.416*	0.446*	0.487*	0.125*	0.215*	0.329*	1.000			
INF	-0.035	-0.066	-0.166*	-0.059	-0.045	0.276*	0.119*	0.305*	0.158*	0.217*	0.257*	0.336*	1.000		
GDPP	-0.416*	-0.103*	0.337*	0.036	0.197*	-0.439*	-0.681*	-0.518*	-0.09	-0.043	-0.216*	-0.608*	-0.070	1.000	
LINT	0.090	-0.097	-0.372*	-0.076	-0.140*	0.484*	0.318*	0.527*	0.254*	0.314*	0.407*	0.576*	0.580*	-0.303*	1.000

Note: ETA is the ratio of equity to asset. BUF is bank's capital less its requirement by regulator divided by the requirements. PIN is the probability of informed trading given by equation (3). PEFF represents the score of profit efficiency obtained from the stochastic frontier approach with translog specifications. ROAA is the ratio of profit on average assets. ROAE is the ratio of average equity. LNTA is total assets in natural logarithem. NPL is the ratio of non-perform loan to total loans. NIM is the net interest income divided by total assets. LAC is liquid assets to short term funding. CR is the risk-weighted assets dividend by total assets. GDPG is GDP growth rate. GDPP is GDP grow per capital. INF is the inflation rate. LINT is the lending interest rate.