The macroeconomic impact of stricter capital requirements in Vietnam

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List of Acronyms

ARG	Vietnam Bank for Agriculture and Rural Development
BCBS	The Basel Committee on Banking Supervision
BIDV	Joint Stock Commercial Bank for Investment and Development of Vietnam
CTG	Vietnam Joint Stock Commercial Bank of Industry and Trade
SBV	The State Bank of Vietnam
VAS	Vietnam Accounting Standards
VCB	Joint Stock Commercial Bank for Foreign Trade of Vietnam
UNDP	United Nations Development Programme

Abstract

Perceiving that a healthy banking system is capable of absorbing market disturbances, thus being a precursor to economic development, the State Bank of Vietnam (SBV) has attempted to adopt Basel Accords after the Asian financial crisis of 1997 with the aims of strengthening financial supervisions and regulations on the banking system. Considered as one of the core provisions in the Basel Accords, bank capital requirements put forth and taken as prerequisite obligations in Vietnam have been stricter and stricter over four phases (1999-2004, 2005-2009, 2010-2016, 2017 and up to now). Hence, the Vietnamese commercial banks have always been under a high pressure to raise their capital adequacy ratio through three options: (1) increasing their capital, (2) cutting down their lending, and (3) reducing risky assets. These responses of the commercial banks would affect the whole economy in different directions and magnitudes. Motivated by the context of Vietnam and the effectiveness of these requirements in Vietnam, the research paper is to explicate the impacts of higher regulatory capital requirements on the banks' behaviours and activities at first through applying Panel-data analysis. Secondly, by using Vector Error Correction Model (VECM), the impulse responses of the credit supply, bank-risk taking, and the output level to a shock of capital adequacy ratio will be investigated, together with looking into long-run relations amongst these factors. It is worth highlighting the findings that the commercial banks are inclined to reduce the incentives towards risky assets in the short run and try to increase their capital, but unlikely to cut down their lending, which leads to a deterioration in the financial stability of the whole banking system.

Keywords

Financial sector, economic development, bank regulations, capital requirements, capital adequacy ratio.

Chapter 1
Introduction

1.1. Background

1.1.1. Financial Sector and Economic Development

Long before the prevailing milestone in theoretical approaches to economic development, the Solow growth model, was introduced in 1956 and 1957, the importance of the financial sector to economic growth had captured the attention of development economists. Indeed, the notion that the financial and banking system has significant and favourable impacts on economic growth had been postulated by Joseph Schumpeter in 1911. He asserted that financial intermediaries provided contributions to a substantial enhancement of the capital accumulation process and technology progress, accelerating economic development. From his theories, the system was considered to take crucial roles in allocating savings, encouraging innovation, and furnishing productive investments with money. More specifically, he argued for the essence of "banking operations" for national wealth against Ricardo' statement and accepted the concept of "vapoury speculations" in John Law's sense (Schumpeter 1911: 98). It is worth emphasising that Schumpeter's theory defined capital as a fund of purchasing power or the sum of means of payments, rather than as "neither the whole nor a part of the means of production - original or produced". From this viewpoint, he took the capital market as the money market, other than accepting the existence of other capital markets, as "in any case the capital market is the same as the phenomenon that practice describes as the money market" (Schumpeter 1911: 98).

Financial intermediation and institutions were first emphasised as precursors to rapid growth in the theory of Gurley and Shaw (1955, 1960). In their theories, although the rise of institutional savers and investors does not affect the equilibriums in social accounting systems (budgetary deficits and surpluses), loanable-funds (purchases and sales), and financial accumulation (assets and liabilities), total debt, including debt purchases and debt issues of intermediaries, would grow "at faster pace relative to income and wealth than when finance is either direct or arranged internally". Hence, institutionalisation of saving and investment would accelerate the growth rate of debt in comparison with the growth rates of income and wealth. They also disagreed with the generally accepted doctrine that banks should be segregated from other financial intermediaries, as they possessed the capability of creating loanable funds, instead of solely transmitting loanable funds like the other intermediaries. From their perspectives, "neither banks nor other intermediaries create loanable funds"; rather, banks, by themselves, are able to create demand deposits and currency (the deposits can be withdrawn on demand) and own "a virtual monopoly of the payment mechanism", while both are capable of creating credits, transmitting loanable funds, and diversifying their portfolios. More significantly, they argued the deficiencies of the Keynesian model or the liquidity-preference model in analysis of economic development because of its short-term characteristic and suggested the interest-income theory allowing

accumulation of debts and the growth of non-bank intermediaries. Provided that investment rises over periods and by change in income, at the state of full-capacity output, the growth rate of income will equate ex-ante saving and investment. At this warranted rate of growth in income, the demand for indirect financial assets, which is generated by the rise in income, as well as its interest rate, must be satisfied. However, "the need for indirect finance to hold interest rates on their optimal trend does not necessarily imply a high rate of growth for banking assets and the money supply in a buoyant economic system". Indeed, in the growth process, final buyers could hold more indirect financial assets with the aim of portfolio diversification, and non-bank intermediaries could obtain "the requisite share of direct debt at the appropriate price". As a result, there is a downward pressure on interest rates at the time when income growth exceeds the money supply. In the long-term, the demand for growth of money supply could be high or low, as well as positive or negative, which is decided by the growth of income, the share of spending financed by long-term securities, the growth in demand for indirect financial assets, and the development of financial intermediaries. In order to keep the interest rate at the presumed irreducible minimum, governments should take monetary policies adjusting the money supply. The guidance monetary controls are expected to prompt the money supply to grow at the same or higher rate of income with the aim of satisfying the rising of demand for liquidity which might originate from gains in income or wealth per capita.

Following the theoretical notion of Gurley and Shaw (1955, 1960), McKinnon (1973) and Shaw (1973) postulate their argument against the notion of financial repression that indicates governmental intervention in the financial intermediaries by regulations, laws, and restrictions with the aim of constraining them to capitalise on their full capacity. They theorise that an efficient financial system would assist its economy to achieve economic growth and development through allocating capital efficiently. Hence, from their perspective, financial repression causes restrictions on competition in the financial sector, which leads to lower rates of return than those in a competitive mart, thus being a discouragement of saving and investment. Emphasised as an important factor in increasing the volume of savings, the financial sector fails to function itself at the full capacity in the governmentally repressed system, thus impeding economic growth. In order to deal with the consequences of repression, Shaw (1973) suggests the removal of controls on interest rates and the promotion of competition between financial institutions. In his opinion, these courses of action, combined with a suitable level of control over the nominal money supply's growth, would be able to invigorate the demand for money. This would in turn help expand the banking system's financial resources. Without price controls, competition among financial institutions would motivate them to become more efficient and also help banish specialised institutions which can only exist thanks to fragmented markets and protection. For less developed countries, Shaw recommends a financial system in which there are many commercial banks competing to sell a finite variety of claims and, at the same time, meeting a wide range of credit needs. On that premise, the job of the Central Bank would be to only make use of the most ordinary methods to ensure the balance between the money supply and the demand for money, which would grow steadily. Provided that this model monetary system is put into use, it would serve as the basis for: firstly, the banking system to mobilise and allocate savings more efficiently, secondly, the financing institutions to evolve appropriately and

sustainably in alignment with the country's development, and thirdly, the fiscal system, as well as its international transactions, to operate efficiently.

Nevertheless, many influential economists either ignored or expressed their scepticism about finance-growth relationship; typically, in a collection of essays entitled "pioneers of development economics", which includes the notions of three Nobel economists, financial factors were not taken into consideration in the theories of development economics (Gerald Meier & Dudley Seers 1984). Only after the emergence of the endogenous growth theory had the roles of financial factors received serious attention and had theoretical literature on them been developed and stratified into five main strands. The first type of finance-growth models focuses on the function of financial markets as a channel resource that takes a responsibility for savings mobilisation and allocation mechanism in which financial intermediaries receive deposits from risk-averse savers and then provide credits for risk-neutral borrowers, thus inducing a transformation from unproductive liquid assets into productive illiquid assets, i.e. from money or risk-free assets into production assets (Bencivenga & Smith 1988; Greenwood & Jovanovic 1990; Pagano 1993). By applying AK endogenous growth model, Pagano (1993) asserted that financial deepening positively affects economic growth through switching savings to investments. Secondly, the assistance of financial markets towards corporations through portfolio diversification improving liquidity and reducing risks, thus stimulating economic growth, was discussed by Levine (1991) and Saint Paul (1992). The third consideration is the capability of financial markets (e.g. equity and debt) to influence incentives for corporate control, affecting economic growth (Jensen & Murphy 1990; Demirguc-Kunt & Levine 1996). Fourthly, the process of specialising in entrepreneurship and the innovation of technologies are promoted by financial markets (Greenwood & Smith 1997). Lastly, an exit mechanism for agents and an improvement in the efficiency of financial intermediation were repercussions of financial development (Rousseau & Wachtel 2000; Arestis, Demetriades & Luintel 2001)

There were empirical studies on the relationship between financial development and economic growth. Most empirical evidence supported the theory that the efficiency of resource allocation, fostering long-term growth, was enhanced by advanced financial markets. Using a 35-country sample, Goldsmith (1969) observed the first evidence for a positive correlation. Considered as an approach of conventional wisdom, the proxies for financial development, used in the majority of successive research, were separated into credit markets and equity markets, in which corporations could find necessary outlays for their investments or business, but with different costs of capitals. The early empirical studies taking into account credit markets, King and Levine (1993b), Berthelemy and Varoudakis (1996), and Levine (1998), indicated bank development to be a crucial determinant of economic growth. Investigating on a sample of 44 advanced and less advanced countries over the period 1975-1993, Levine (1998) observed a strongly meaningful impact of the exogenous statutory component of banking development (legal codes) on physical accumulation, productivity growth, as well as output growth by applying GMM estimates. As would be the case of the former measure, the advance of stock markets was positively correlated with economic growth in different research, e.g. Atje and Jovanovic (1993), Bencivenga et al. (1996), Levine and Zervos (1996), and Cooray (2010). There were studies examining the effects of both markets on economic growth,

which had the same desirable results (Levine & Zervos 1999; Beck and Levine 2004). It is worth highlighting the masterwork of Arestis et al. (2001), as well as Deidda and Fattouh (2008), which concluded a more powerfully positive impact of the banking system than that of the stock markets in prompting economic growth. Through running the estimations for a panel-based VEC model on a ten-developing-countries sample, Christopoulos and Tsionas (2003) provided a consistent result of "unidirectional causality from financial depth to growth", which was against the view that "financial deepening is an outcome of the growth process". Drawing on this result, they also advised policy makers to focus on long-run policies, such as the creations and implementations of modern financial institutions in both banking systems and stock markets, with the aim of promoting economic growth.

Nonetheless, it is of great necessity to acknowledge that these effects could become undesirable or insignificant in some countries because of their own specifics. For instance, there were no evidence for the contributions of financial sectors to growth in the Middle Eastern countries (Narayan & Narayan 2013) or for the dampening effect of financial development on investments in the oil exporting countries (Nili & Rastad 2007). Another case for the disparities of these effects is in low income countries which experienced no contribution of stock markets to their growth, but rather a noticeable positive effect of banking system on capital accumulation (Rioja & Valev 2014). The variances could come from the degree of financial development, which could indicate non-linearity association between finance and growth; more particularly, the effect would be more significant in countries with intermediate financial development than those with well-developed systems (Rioja & Valev 2004), or finance sectors would only be capable of positively impacting growth up to a critical threshold and lose their effect beyond that point (Beck et al. 2014).

To sum up, there is no doubt that the link between finance and growth is tight, as financial sectors play the role of a bridge between risk-averse lenders and risk-neutral borrowers to monitor and control the mechanism of savings mobilisation and allocation, which is a decisive factor for capital accumulation and technical progress driving economic growth in both the short and long run. Deemed one of the two main supplies in the money market, the banking system has an ability to collect deposits and then provide credits for productive investments, thus accelerating growth. However, this has never implied that the efficiency of the banking system would only be determined and improved by perfect competitions amongst banks without governmental interventions and legislations from the perspective of neoclassical economists. There was a set of literature on the finance-growth relationship looking into banking risk management and liquidity of the banking system through taking into account the control or monetary policies of governments, e.g. Bank of England (1999), and Cecchetti (2009). Ultimately, the past economic recessions or slowdowns in economic growth observed from 1980 were originated from deficiencies of banking systems.

1.1.2. Introduction of Basel Accords

In the aftermath of the 1980s banking crisis attributed to the failure of savings and loans (the S&L crisis) and that of large commercial banks, not only were government interventions conducted to bailout and reconstitute the banking sector, but feasible preventions of this development were seriously taken into

consideration and discussed by the central banks' governors and regulatory authorities from the Group of Ten countries (G10) as well. After the meeting, these representatives settled on the foundation of the Basel Committee on Banking Supervision (BCBS) with a commission to enhance financial stability through reinforcing the regulation, supervision and practices of commercial banks at the international scale. Since its inception, the committee has developed a series of policy recommendations on banking regulation and supervision, under the name of Basel Accords.

As the foundation stone of this standardisation, the Basel Capital Accord, known as Basel I and put forth in 1988, mainly focuses on credit risks and classification system of bank assets, and more importantly, requires commercial banks to maintain a minimum capital level. This minimum capital requirement of 8%, measured by the ratio of bank capital to risk-weighted assets, is considered as a coverage of possible risks occurring in banking activities, as it enhances commercial banks' capabilities to overcome losses without the expropriation of depositors. These provisions of Basel I were expected not only to invigorate the stability of each national banking system, as well as that of the international one, but also to increase competitive equality amongst commercial banks by establishing an even and unified supervisory system at the global scale. Prior to being considered as the global standard and adopted in more than 120 countries, this Accord was only obligatorily implemented in the banking systems of the G-10 countries. Although amended to become more effective in preventing risks and ensuring the safety of banks' activities through taking into account market risks in 1996 and aiming to operate twenty-five core principles for banking supervision, Basel I still revealed its deficiencies in assessment of credit risks, consideration of other risks, and instruction of risk mitigation.

Acknowledging the limitations of the first accord, the BCBS eventually released the new capital framework, generally knows as Basel II in 2004, after proposing a new capital adequacy framework in 1999. This set of international banking regulations comprises three main pillars: minimum capital requirements, regulatory supervision, and market discipline. Under the first pillar, the calculation of capital adequacy ratio is altered as it requires not only the coverages of market risk and operational risk, but also a significant modification in the measurement for credit risk. Meanwhile, the second pillar recommends banks to develop internal methods and procedures for evaluating all types of on-going risk and assessing capital, their own targets of capital level above the prescribed minimum one and consistent with their risk portfolios, and early control managements of their banks' capital levels. More strictly, the new framework obliges banks to disclose information about capital structure, profiles of credit, market and operational risks, as well as the evaluation processes for these risks within the scope of the third pillar. Although seemingly staying at the same level of 8% as in Basel I, the regulatory minimum capital ratio in Basel II is in fact more stringent as there are no changes in the calculating method for the total capital but rather for risk-weighted assets. While the alterations, clarified in the first pillar, make the measurement of capital adequacy ratio more complex and harder in implementation because of requiring a variety of methods for measuring each type of risk, they also enhance the accuracy of capital assessment and provide a larger discretion in supervising banking activities.

Notwithstanding the improvement of Basel II in stabilizing the international financial system, the global financial crisis of 2008 still occurred with the collapse

of Lehman Brothers, one of the five biggest international investment banks in the US, and eventually put the world economy into a deep and prolonged recession. The precursors of this crisis were an abuse of leverage and inadequacy of liquidity buffers in the banking sector lacking effective governance and risk management, as well as proper incentive structures. These problems were indicated by the mispricing of credit and liquidity risks, and the boom of credit, which had taken place before the crisis. In the light of these weaknesses, the BCBS not only issued "Principles for sound liquidity risk management and supervision", but also integrated further amendments, with respect to the management of complicated securitisation positions, off-balance sheet items and trading book exposures, into the Basel II capital framework with the expectation of strengthening the banking regulation and supervision. Going beyond these temporary treatments, from 2010, the reform package relating to capital and liquidity, entitled Basel III, was proposed, generally designed and set out to enhance the three pillars constructed in Basel II, as well as to extend its coverages of risk-based capital requirements, thus to improve credibility of reported risk-weighted capital ratios in the eyes of stakeholders. Considered as responding to the 2007-2008 crisis and reinvigorating the international banking system post-crisis, the reforms of the capital and liquidity framework have been enacted since 2013. This process introduced five main disparities in terms of capital, leverage, and liquidity standards into the new framework compared to Basel II. First of all, Basel III is centred on the capital source in respect to quality, consistency and transparency; more specifically, although keeping the regulatory capital adequacy ratio unchanged, it requires Tier 1 capital comprising common equity and retained earnings to achieve the level of 6%, in which 4.5% must be financed by common shareholders. Secondly, commercial banks must ensure their levels of capital are sufficient to cover incurred counterparty credit risks, banks' equity investments in funds, and non-centrally counterparty derivatives. Thirdly, they are also obligated to raise capital conservation buffer for constraining pay-outs and discretionary counter-cyclical buffer for reducing banks' incentives to involve in systemic credit booms, the maturing of capital buffers in upturn periods supporting anti-cyclicality in downturn periods. Fourthly, under the provisions of Basel III, the risk-based capital requirement is supplemented with a leverage ratio with the intention of controlling leverage in the banking system and proposing safeguards against model risk and measurement error. Finally, an international standard for liquidity, including a requirement for liquidity ratio (Liquidity Coverage Ratio) and longer-term ratio (Net Stable Funding Ratio) is developed to manage an adequate amount of cash which can meet funding needs over a 30-day period of stress and to tackle maturity mismatches in balance sheets.

It is acknowledged that the revolutionary contents over the three Basel Accords have rendered the international standard for the prudential regulation and supervision of banks too complicated and stringent to be contemporaneously and homogenously implemented in all countries, especially in developing countries. Since Basel II, commercial banks are not only obligated to satisfy the minimum level of capital, but also compelled to adopt the variety of risk measurements, thus ensuring the accuracy of capital adequacy ratio. Even when a higher regulatory capital adequacy ratio is not mandated in Basel III, it is still perceivable that the capital requirements are stricter due to the stipulations for capital source and lower leverage ratio. Although the consecutive adjustments were brought about by the existence of deficiencies revealed in the two financial

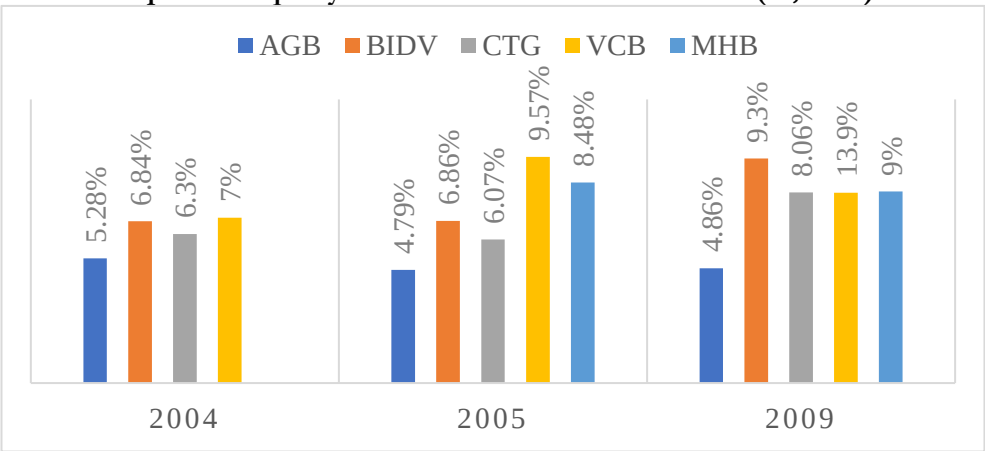
crises of 1992 and 2007, it is irrefutable that Basel Accords have ever been considered as the most effective set of regulations in supervising bank activities, and an accurate benchmark for evaluating risk, which supported the country members to stabilise and recover their banking systems in the post-crisis periods. More than that, thanks to the standard for banking administration, the banking sector can improve its ability to absorb shocks from economic and financial distress, thus reducing repercussions on the entire financial system as well as the economy.

1.1.3. Roadmap of implementing Basel Accords in Vietnam

Although adopting these agreements is not obligatory for all countries, most of them, especially developing countries, are attempting to apply these frameworks in their supervisory system and risk management. Vietnam is not an exception in the process of financial reforms as the Vietnamese government has recently imposed regulations obligating commercial banks to maintain a regulatory capital adequacy ratio (CAR) of 8 per cent, which is based on the Basel II standards from 2020, other than the Circular No. 13/2010/ TT-NHNN, dated May 20, 2010. These new regulations are clarified in Circular No. 41/2016/TT-NHNN, dated December 30, 2016, which is effective from January 1, 2020. Nevertheless, this is not the first time the Vietnamese government puts the commercial banks under an obligation to strengthen their capital adequacy ratio. Together with the new course of regulations, there were three phases on the road map for the implementation of the legislation on capital adequacy ratios in the Vietnam banking system in the past, which is depicted as follows:

The first phase from 1999 to 2004 was the longest period, in which the commercial banks complied with three decisions (Decision No. 296/1999/QĐ-NHNN5, Decision No. 297/1999/QD-NHNN5, Decision No. 381/2003/QD-NHNN) on safety ratios in their activities and tried to satisfy CAR at 8%. Confronting the high level of non-performing loans ratio in the five state-owned commercial banks following the threats of their bankruptcies as well as the collapse of the Vietnamese banking system, the Vietnamese government directly furnished the biggest four of the banks (ARG, BIDV, CTG and VCB) with 12,000 billion VND, in the form of special 20-year government bonds, in order to support raising their levels of capital. By doing so, the safety of the whole system was reinvigorated as the market share of these banks constituted approximately 70% of the whole market (Nguyen 2012). Nevertheless, these four stated-own commercial banks still failed to meet the minimum capital requirement at the end of the period, except for Mekong Housing Bank (MHB) without announced information. (see more details in Figure 1.1.3.1)

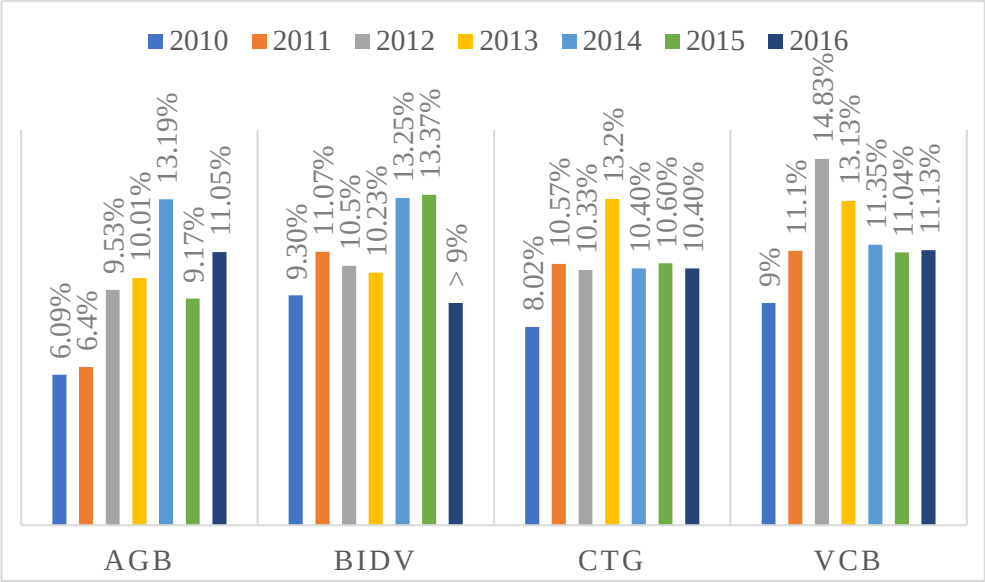
Figure 1.1.3.1:
Capital Adequacy Ratios of the State-Own Banks (%, VAS)



The second phase from 2005 to 2009 was the period of implementing classifications of own capital into Tier 1 and Tier 2 and the regulation of safety assurance ratios, including capital adequacy ratio of 8% in the commercial banks, regulated in the two courses of regulations, Decision No. 457/2005/QD-NHNN and Decision No. 493/2005/QD-NHNN. In addition, according to Decree No. 141/2006/ND-CP, the commercial banks must raise their charter capital to the level of 3,000 billion VND as of the end of 2010. In this phase, most of the commercial banks were capable of satisfying this ratio, albeit unsustainably because of an increase in risky assets as a consequence of the significant credit growth caused by the impacts of stimulus policies and monetary easing in 2008 and 2009. Therefore, their levels of capital adequacy ratio were damaged as the total amounts of risk-weighted assets rose. As can be seen in Figure 1, one of the biggest state-owned commercial banks, ARG (Vietnam Bank for Agriculture and Rural Development), still stayed far from the commitment on the regulatory capital adequacy ratio of 8%.

The third phase from 2010 to 2016 was the period of improving a minimum capital adequacy ratio to 9%, calculated by using the similar approach to Basel I, and applying separated and consolidated capital adequacy ratios in their supervision on capital adequacy ratio, these requirements written down in Circular No. 13/2010/TT-NHNN, and amended in Circular No. 36/2014/TT-NHNN and then in Circular No. 06/2016/TT-NHNN. In 2010, all of the four dominant state-owned commercial banks could not satisfy the new regulatory ratio, except for VCB (Joint Stock Commercial Bank for Foreign Trade of Vietnam) and BIDV (Joint Stock Commercial Bank for Investment and Development of Vietnam) just exactly reaching this level (see more details in Figure 1.1.3.2). Meanwhile, most joint stock commercial banks complemented the capital level of 9% and succeeded in raising their charter capital in 2010, except for some small-scale commercial banks accounting for 36.5% of the entire system's banking capital (Nguyen 2012). Not until 2016 that all state-owned commercial banks completed this requirement.

Figure 1.1.3.2: Capital Adequacy Ratios of the State-Own Banks (%, VAS) from 2010 to 2016



(4) The fourth phase from the end of 2016 has been the period in which the commercial banks are obligated to achieve the regulatory capital ratio of 8% based on the Basel II standards before 2020, according to Circular No. 41/2016/TT-NHNN.

To sum up, since 1999, the commercial banks in Vietnam have been obligated to raise their capital adequacy ratios gradually. Even after all commercial banks satisfied the minimum adequacy ratio of 9% based on Basel I standards in the third phase, they are still facing the challenge of new regulation of capital adequacy ratio of 8% but based on Basel II. Although the new level seems lower than the previous one, this still reflects that the Vietnam banking system is still under stricter capital requirements, which can be perceptive through the differences in calculating capital adequacy ratio between the third and the fourth phases, represented below, together with the summary of the above-mentioned legislations.

There are two differences in calculating capital adequacy ratio between these two phases. Firstly, the weight range for credit risk is wider in phase 4, from 0 to 200%, which makes the RWA larger. Secondly, the formula of capital adequacy ratio in phase 4 integrates the capital requirement for operational risk and market risk in its denominator. These two adjustments in the way to calculate capital adequacy ratio make the current CARs of the commercial banks become insufficient, thus forcing the commercial banks to continue raising their capital level from the end of 2016. More importantly, the formulas reveal that there are three ways, together with the combinations amongst them, for commercial banks to raise their targeted capital adequacy ratio, specifically:

(1) Increasing their capital through issuing more equity

(2) Cutting down their total lending

(3) Reducing risky assets

Notwithstanding how the commercial banks have been responding to the stricter capital requirements in Vietnam, it is necessary to perceive that the changes on these banking factors will have impact at the macroeconomic level.

Table 1.1.3: A Summary of Legislations

Legal Documents	Year of Issuance	Year of Effect	CAR regulations	Formula
Decision No. 457/2005/QD-NHNN	2005	2005	* CAR ≥ 8% * Assets classification under a risk weight system: 0%, 20%, 50%, and 100%	$CAR = \frac{Bank\ owners'capital}{RWA}$
Decision No. 493/2005/QD-NHNN	2005	2005	* Credit classifications into five groups	
Decree No. 141/2006/ND-CP	2006	2010	* Charter capital ≥ 3000 billion VND	
Circular No. 13/2010/TT-NHNN	2010	2010	* CAR ≥ 8% * Assets classification under a risk weight system: 0%, 20% 50%, 100%, 150%, and 250%	
Circular No. 36/2014/TT-NHNN	2014	2015	* CAR ≥ 9% * Assets classification under a risk weight system: 0%, 20% 50%, 100%, and 150%	
Circular No. 06/2016/TT-NHNN	2016	2016	* CAR ≥ 9% * An increase in risk weight for real estate from 150% to 200%	
Circular No. 41/2016/TT-NHNN	2016	2020	* CAR ≥ 8%, covering credit, market and operational risks. * Assets classification under a risk weight system: 0%, 20% 50%, 100%, 150%, and 200%	$CAR = \frac{Bank\ owners'capital}{RWA + 12.5(K_{OR} + K_{MR})}$

1.2. Research Problem

In spite of the fact that obeying the regulations of Basel II would reinforce the stability of the Vietnamese banking system, raise the competence of commercial banks, ensure operational safety, and thus bring about economic benefits, it is of great importance to perceive that imposing the Basel II could cause losses of average output of the whole economy through its effect on the credit market. Motivated by these two opposite directions, the research will aim to achieve an assessment of the macroeconomic impact of the capital adequacy ratio in respect of financial stability, and credit supply,

Bank capital ratio is considered as one of the risk measures at the bank level as it reflects the bank's capability of covering credit, market, and operational risks. An increase in bank capital ratio can be attributed to either an increase in bank owners' equity, or a decrease in bank credit, or a constraint on risky lending, or even combinations of these. Regardless of the method used for reinforcing bank capital ratio, this increase indirectly affects output level through three main channels: financial stability, and credit supply. Indeed, a higher bank capital adequacy ratio can reduce bank risk-taking incentives, thereby enhancing financial stability. Credit supply can dwindle as the tighter capital requirement can render banks unwilling to provide loans. It can also increase lending rates as a result of raising bank cost of equity, which can be compensated by raising lending rates. With the aims of assessing the macroeconomic impacts of a stricter capital requirement in Vietnam, the study will attempt to answer three main questions as follows:

1. How did bank risk-taking behaviour respond to capital adequacy ratio in the Vietnamese banking system?

2. How did capital adequacy ratio affect credit supply of the Vietnamese banking system?

3. How and to what extent was capital adequacy ratio influential in net lending interest ratio of Vietnamese commercial banks?

Finally, the paper will try to investigate impulse responses of the output level to shocks of financial stability and credit supply, movements caused by a higher capital requirement, as well as long-run relationships amongst endogenous variables in the two endogenous systems corresponding to the two transition indicators for financial stability and credit supply. This paper is structured in the following order: Chapter 2 conveys a theorical and empirical reviews of the preceding literature in this field, Chapter 3 illustrates the research methodology in respect of the estimation approach, and data descriptions, while Chapter 4 discusses the results of the estimations before the conclusions are provided in Chapter 5.

Chapter 2
Literature Review

2.1. Introduction

Basel II brings with its stricter capital requirements, involving the capital coverage for operational risks and market risks, though still demanding banks to maintain a minimum regulatory capital ratio of 8%. Although the aim of this heightened requirement is to help banks become more resilient to future financial slumps, whether it is truly beneficial to the economy in general is still a topic in debate. This paper attempts to bring about a review of the current literature regarding this issue, which shows that a direct link between capital regulation and economy growth is only supported by limited evidence. Instead, the majority of research concentrates on the indirect effects, which are dependent on the choices that banks make as regards the options to meet capital requirements: increasing equity, contracting lending, and decreasing asset risk. To conclude, studies evaluating how higher capital requirements affect economic growth in the long term will also be mentioned.

2.2. Improved Financial Stability

In supporting Basel Accords, the most common argument is increased financial stability, which is brought about by the reduction in the chance of banks facing financial troubles, and also in the losses caused by defaults, both of which will be discussed in this section.

Although banks are encouraged to take risks since their shareholders benefit from upside returns but are immune from downside risks (Kane 1989; Cole et al. 1995), they are less incentivised in risk-taking when capital requirements are heightened, since this renders shareholders more vulnerable to downside risks (Furlong & Keeley 1989; Rochet 1992). On a more macroeconomic scale, Martinez-Miera and Suarez (2014) prove that systemic risk-taking can be reduced with the help of capital requirements, which leads to reductions in the cost of systemic crises and also the frequency of them happening.

Nevertheless, opposite arguments stating that stricter capital regulation may lead to more risk-taking from banks are also present. Firstly, such regulation can result in lower profits, which may ultimately reduce banks' shareholder value, and thus instigate more risk-taking and sabotage the expected primary effect of capital regulation (Hellman et al. 2000; Repullo 2004). Second, risk-taking activities can also be stimulated by expectations of incoming capital regulation, according to Blum and Hellwig (1995).

Empirical research regarding this topic mostly shows that lower riskiness of bank assets is a result of higher bank capital. More specifically, Kashyap et al. (2010) find out that bank leverage is positively correlated with equity risk, while De Jonghe (2010) proves that bank's exposure to systemic risk is reduced by higher capital. In addition, Miles et al. (2012) report that higher capital makes banking crises less likely, and according to Baker and Wurgler (2013), banks with more capital have less systematic and idiosyncratic risk.

Concerning risk-taking of banks, although empirical research by De Haan and Klomp in 2012 and 2015 reports that 'capital and asset risk' of banks are reduced by capital regulation, most studies show no strong relationship between bank risk and capital requirements. For example, Barth et al. (2004) and Demirgüç-Kunt and Detragiache (2011) found no robust association between these two factors in their studies using data from 107 and 86 countries, respectively, although using different indicators for bank risk: non-performing loans and Z-score, respectively

In short, a concrete relationship between higher capital requirements and lower banks' risk-taking is not yet reached by both theoretical and empirical approaches of research.

As regards the second proposed benefit leading to enhanced financial stability, it comes from the notion of bank capital acting as a buffer, absorbing the losses in the case of the assets' values falling tremendously. Thus, the frequency and cost of bank failure can be reduced by high capital (Dewatripont & Tirole 1994).

There are many studies in literature capturing the fact that undercapitalised banks reduce more of their lending activities compared to banks with more sufficient capital. Some examples of such studies are Bernanke and Lown (1991), Woo (2003), and Buch and Prieto (2014), covering data in US between 1990 and 1991, Japan in 1997, and Germany between 1965 and 2009, respectively. It is worth highlighting the empirical study in Germany as it observed that the effect of bank capital ratio on bank loans was only negative if the ratio exceeded the threshold of 33%, and below that, one percent permanent increase in the ratio would lead to an increase in bank loans by 0.23%. Besides, banks having stronger balance sheets were more capable of sustaining their lending in the last financial crisis, which is studied and proved by Albertazzi and Marchetti (2010) and Kapan and Minoiu (2013). To conclude, all the aforementioned studies indicate that despite economic crises, higher capital helps banks have more secure and solid credit provision.

Another benefit of higher bank capital is that it gives them more endurance against financial shocks. According to Ashcraft (2001), banks' capacity in raising non-insured debt can be increased thanks to bank capital, which in turn can lead to an increase in the banks' power to shield lending from drops in deposits. Gambacorta and Mistrulli (2004) report similar findings, using data of Italian banks in the period from 1992 to 2001. In addition, banks with more capital are also capable of maintaining their lending under the impact of monetary shocks, since non-insured funding is more accessible to well-capitalised banks than the others. Concerning this notion, Kishan and Opiela (2000) find proofs that banks with high leverage levels have loan growth more sensitive to monetary policy than the others. Regarding the effect of this involving interest rates, Jimenez et al. (2012) report that highly leveraged banks reduce their lending by 3.9 percent more, compared to their better-capitalised counterparts, given a one percentage point increase in interest rate.

Consequently, higher level of bank capital plays an important role in minimizing banks' financial vulnerability (Diamond & Rajan 2010) and survivability in financial crises (Beltratti & Stulz 2012). Also, another benefit from having reduced bank risk and buffered protection again losses is that they make banks' funding of uninsured debt less sensitive regarding information (Admati et al. 2010), which reduces the likelihood of bank runs (Diamond & Rajan 2000;

Admati et al. 2010). Nonetheless, since studies regarding advanced economies' banks in the 2008 crisis usually have contradicting findings, Huang and Ratnovski (2009) use OECD data and come up with no relationship between bank capital before the crisis and bank performance in the crisis.

To conclude, despite the common notion that higher capital increases banks' endurance and decreases losses in case of a crisis, concrete evidence or backing of such a claim has not yet been reached by empirical research in the area.

2.3. Likely drawbacks of more stringent capital regulation

2.3.1. Reducing total lending

The fact that banks decrease their credit supply while trying to meet tightened capital requirements is well documented in literature. According to the BCBS (1999), pressures from bank capital may have restricted bank lending in the US and Japan in cyclical downturns, while a structural dynamic model by Furfine (2000) predicts that when capital requirement increases by one percentage point, loan growth decreases by 5.5%. Focusing on the crisis of 2007-2009, Albertazzi and Marchetti (2010) find out that Italian banks with lower level of capitalisation reduced their lending by two percentage points more than better-capitalised banks. Similarly, Puri et al. (2011) conclude that the number of loans rejected by banks affected by the crisis is 11% higher than that of the others.

Using bank data in the UK from the 1990s and 2000s, Francis and Osborne (2009) find that when capital requirements increase by one percentage point, lending in 2002 would be reduced by 1.2%. Similarly, Aiyar et al. (2014b, 2014c) report that a one percentage point increase in capital requirement entails a drop by 6.5 to 7.2 percentage points of credit growth and a decrease by 4.6 percentage points of growth rate in actual lending. Cross-border credit is also affected: a reduction of 5.5 percentage points accompanies an increase by one percentage point of capital requirement (Aiyar et al. 2014a). Noss and Toffano (2014) give an estimation of 4.5% reduction in lending for each increase of capital requirement by one percentage point.

Outside the UK, BIS MAG (2010) uses data from 15 different countries and reaches the conclusion that the volume of lending declines by 1.4% for each increase of one percentage point in capital requirement. Using data of 250 banks in the euro region, Messonier and Monks (2014) report that credit growth of these banks declines by 1.2 percentage points for every one percentage point increase in their Core Tier 1 ratio.

To sum up, the majority of empirical evidence points out that a one percentage point increase regarding capital requirement results in short-term lending cuts by 1.2 to 4.5% or reduction of credit growth by 1.2 to 4.6%.

However, these studies still have trouble separating the effects of credit demand and credit supply, since the reduction in lending may be caused by either of these. As there are several studies (Bernanke & Lown 1991; Berger & Udell 1994) that report capital having no clear effect on macroeconomic variables and also not being linked to employment growth and asset ratios, it is likely that reduced

credit demand is the primary element leading to economic slumps, rather than credit supply.

In conclusion, while most of the evidence from studies points to the fact that tightened capital requirements result in decreased bank lending, and thus reduced economic growth, studies in literature still struggle in discerning clear-cut effects from credit supply, which stem from banks' capital pressures.

2.3.2. Limiting lending to risky borrowers:

Alternatively, in an effect called flight to quality, banks can also choose to cut down their lending only to borrowers that carry the highest level of risks and dependence on banks (Peek & Rosengren 1995; Albertrazzi & Marchetti 2010). Similar findings are shown in US banks in the early 1990s in the study of Berger and Udell (1994).

More specifically, Popov and Udell (2012) show that smaller firms which depend heavily on banks to get credit will face more difficulties getting one, and thus suffer financially, when banks are being constrained regarding capital requirements. These borrowers receiving less credit from banks can consequently affect economic growth, as stated by Hancock and Wilcox (1998).

Another category of loans that may be cut down by banks facing tight capital regulation is lending related to real estate. Peek and Rosengren (2000) find links between the banking crisis in Japan and the construction activity of real estate markets in the US. Doing a similar study but with UK banks instead, Bridges et al. (2014) reveal that an increase in capital requirements of one percentage point reduces 8 percentage points of real estate loan with commercial purposes given out by these banks.

In general, evidence from empirical studies links the reduction in lending concerning tighter capital regulation discussed above plays a role in the decline of economic activity (Peek & Rosengren 2000).

2.3.3. Raising external equity:

As an alternative to reducing lending, banks can also choose to issue more equity to deal with tighter capital regulation. Regarding this, the popular notion is that as equity is expensive, banks are not willing to raise it. However, the basic theory by Modigliani and Miller (1958) states that equity is not expensive, and a higher capital requirement leads to reduction in funding cost, as higher capital raises safety in both equity and debt funding.

There are also other theories claiming that equity is costly and come up with explanations for this. Firstly, Myers (1977) explains that as extra equity brings more downside risks to shareholders of banks, equity may be expensive. More equity decreases the existing equity's value and increases debtholders' claim value, which makes current shareholders think twice before issuing more equity. Second, as insiders like shareholders have more information about the banks' outlook than outside investors, issuing more equity is required to have higher equity premium (Myers & Majluf 1984). Following these, Bolton and Freixas (2006) bring about an argument that external equity is costly and equity capital requirements restrict lending from banks, which will become even more tough during crises.

Miles et al. (2012) note that the Modigliani-Miller theorem stated above may not stand because of the tax advantages accompanying debt issuing and the underpriced guarantees for debt. Also, there is another argument that even without these guarantees, high leverage can still bring benefits to banks because of the debt' disciplining role (Calomiris & Kahn 1991; Diamond & Rajan 2001). Admati et al. (2010) claim that these arguments favoring lower equity ratio lack empirical evidence.

Nevertheless, there are many empirical studies proving that equity is more expensive, and borrowers will be passed on any increase in equity cost (BCBS 2010). The reason for this is that a higher capital requirement lowers the return on equity (ROE), which may lead to increased lending rates if banks want to keep unchanged (King 2010). Following this, it is concerned that higher lending rates may lead to less lending, which in turn may reduce economic activity.

This impact of tightened capital requirements on lending rates have been evaluated by multiple studies, which are different from each other regarding their acceptance of the Modigliani-Miller theorem and the data they used. For example, BCBS (2010) uses data from 13 OECD countries and shows that each increase of capital ratio by one percentage point heightens loan spreads by 13 basis points. Kashyap et al. (2010) show that in the long run, the effect of capital requirement on lending rates is modest, with the latter increasing by 2.5 to 4.5 basis points for each increase of one percentage point of the former. More important, this paper results in the negative relationship between equity beta (equity risk) and capital adequacy ratio, and a smaller magnitude of the coefficient on capital adequacy ratio (-0.045). In detail, with the median capital ratio of 7% and the median equity beta of 0.9, if capital adequacy ratio was required to be doubled, required return should decrease by 0.45; however, the results showed equity beta would be decreased by 0.32 (0.045*7) less than 0.45 in the case of full M-M effect. An increase in lending spread because of a higher capital requirement from the study by Slovik and Cornede (2011), which uses data from 3 OECD countries from 2004 to 2006, is 14.4 basis points on average.

The concern regarding this effect is that increased lending rates may lead to reduced credit demand (Thakor & Furlong 1995) and entice lower quality borrowers (Stiglitz & Weiss 1981). Consequently, as banks opt for raising equity to deal with tighter capital requirements, lending may go down and loan risk may go up, the latter of which may have a bad effect on financial stability.

2.4. Overall evaluation of capital regulation's impact

While higher capital requirements may lower credit supply, they may also decrease the chance and seriousness of financial crises. However, their direct effect of on economic growth are examined by only few studies. Among these, the BCBS (2010) evaluates the costs and benefits of higher capital by comparing two states of with and without the proposed tighter regulation. Its results indicate that net benefits are positive for a wide range of capital to risk-weighted assets ratios and that with a capital requirement of around 13%, maximum net benefits will be achieved. Miles et al. (2012) use UK data to examine benefits and costs in the long run in terms of GDP and report that the decrease in bank assets' value is often proportionate to the GDP's decline during financial crises.

According to this study, maximum net benefits correspond to the level of capital requirement about 18 to 20%.

In another note, Martinez-Miera and Suarez (2013) argue that while higher capital requirements bring down systemic risk taking, they also decrease credit and output in non-crisis periods. This study also estimates the optimal level for capital requirement to be 14%, much higher than Basel III's requirement of core Tier 1 capital, which is close to 7%.

To recap, all studies involving in overall assessment of capital requirements' effect on economic growth have a mutual conclusion that capital ratios are currently too low and that imposing a stricter capital regulation can bring about an increase of GDP in the long term.

2.5. Conclusions

While there is not much in the terms of concrete evidence regarding the direct effect of higher bank capital requirements on economic growth, three indirect effects have been taken into consideration in literature. First, higher requirements of bank capital may lead to reduced lending from banks, which may in turn lead to lower economic growth. The second effect of higher capital requirements is higher cost of equity, which can result in higher lending rates, thus lower the demand for credit and therefore affect economic growth negatively. Lastly, banks having higher capital are induced to take less risks and are also better buffered against losses, which may result in lower credit volatility and enhanced financial stability. The scarce studies attempting to measure the net costs and benefits of tightened capital regulation mutually agree that raising the current capital requirements can improve economic growth in the long term.

Motivated by opposite effects of bank capital requirements on economic growth, my research paper will attempt to contribute an empirical evidence of these effects in the Vietnamese banking system and to assess the macroeconomic impacts of stricter capital requirements in Vietnam through three channels, financial stability, credit supply and net lending interest.

Table 2.5: Conceptual Framework

Stringent capital requirements	(1) Increasing bank capital	➔ ↓ Credit demand	➔ ↓ Economic growth	Efficiency market
		➔ ↑ Credit supply	➔ ↑ Economic growth	Credit growth
	(2) Cutting down bank lending	➔ ↓ Credit supply	➔ ↓ Economic growth	
	(3) Reducing risky assets	➔ ↑ Financial stability	➔ ↑ Economic growth	Stability

Chapter 3
Research Methodology

3.1. Quantitative research approach

With the aim of uncovering the effects of persistently stringent capital requirements from 2002 to 2017 on risk-taking behaviour and banking activities of the Vietnamese commercial banks, this research will apply panel-data analysis including fixed-effect and random-effect methods, at first. The significant difference between these two models is about taking the individual-specific effect as time-invariant factor or randomly time-variant factor; hence, it is necessary to call for a test for consistence of estimators of these two models, with the purpose of selecting the efficient one by the most prevailing test, Hausman specification test. In addition to controlling the individual-specific effect, it is of great importance to take unobserved period effects into consideration as the legislation on bank supervisions and regulations which were put forth in Vietnam from 2002-2017 not only was consecutively amended and replaced but also allowed a time lag between active date and effective date (see more details in Section 1.3). The statutory requirements were divided into the four phases, which will be taken as period dummy variables in the estimate specifications. These dummies are expected to have significant influences on the impacts of capital requirements on the banking activities and risk-taking behaviour, since the Vietnamese commercial banks confronted different pressures and targets which are defined for different phases.

What is more, the research aims to investigate the impacts of stricter capital requirements on the output level in Vietnam when the requirements preliminarily affect the entire banking system, which holds the essential roles in economic development (as discussed in Section 1.1). Hence, it is of great necessity to call for time-series analysis, which not only supports estimating relations amongst endogenous variables by observing impulse responses of components in an endogenous system when there is a shock in one of the components, but also allows scrutinising permanent impacts and long-run relationships in the system. There are two popular models for time-series estimates, Vector Autoregression (VAR) and Vector Error Correction (VECM); thus, it is crucial to select an appropriate time-series model by conducting the following steps:

(1) Checking endogenous relationship amongst variables in a system by Granger causality test
(2) Determining whether the variables are stationary or non-stationary by Dickey-Fuller test
(3) Testing cointegrating relationship amongst the variables in a system if there is non-stationary variable in the system; otherwise, applying VAR model after making the non-stationary variable become stationary by taking difference
(4) Using VECM model if the third step results in the presence of cointegration

3.1.1. Financial Stability and Capital Adequacy Ratio

Although financial stability is a broad concept which is defined in a variety of aspects, from its capability of promoting economic process to that of being self-resilient, the most prevailing aspect in financial stability is the ability of financial institutions to manage risks. In this aspect, the degree of bank risk will be a significant indicator in assessing financial stability. Though there are several measures of bank risk, in the scope of this study, the Z-score measures will be taken as an indicator of bank risk. The reason for this preference is not only that Z-score proxies can reflect a bank's capability of absorbing volatility in returns by capital with the aim of avoiding insolvency, but also that they are common indicators of bank risk-taking.

This study will use a basic Z-score, mathematically expressed as follows:

$$Z - score = \frac{ROA + (\frac{Equity}{Asset})}{\sigma(ROA)}$$

Where:

- $\sigma(ROA)$: the standard deviation of return on assets
- $\sigma(R_{it})$: the standard deviation of annual returns

The basic Z-score is determined by three factors, the return on assets (ROA), equity to assets ratio, and the standard deviation of ROA. This measure will be computed for all commercial banks. Additionally, the research will also consider non-performing loans (NPLs) as another proxy for banks' risk-taking behaviours. The study also suspects that the level of capital adequacy ratio in the previous year plays a significant role in the incentives to take risks in the given year; hence, the empirical models will be represented as follows:

Equation 1:

$$Z - score_{it} = \alpha + \beta_1 CAR_{it} + \beta_2 CAR_{it-1} + \beta_3 X_{it} + \beta_4 M_{it} + \beta_5 PERIOD_{1-4} + \beta_6 PERIOD_{1-4} * CAR_{it} + a_i + u_{it}$$

Equation 2:

$$NPLs_{it} = \gamma + \gamma_1 CAR_{it} + \gamma_2 CAR_{it-1} + \gamma_3 X_{it} + \gamma_4 M_{it} + \gamma_5 PERIOD_{1-4} + \gamma_6 PERIOD_{1-4} * CAR_{it} + \gamma_7 NPL_{it-1} + a_i + o_{it}$$

Where:

- X_{it} is a vector of regressors including observed variables at the bank level
- M_{it} is a vector of regressors at the macroeconomic level
- $PERIOD_{1-4}$ is dummies variables for the four phases of implementing Basel Accords in Vietnam.
- a_i is time-invariant effect error term.
- u_{it} and o_{it} are idiosyncratic error terms.

3.1.2. Credit Supply and Capital Adequacy Ratio

In order to satisfy the requirement of capital adequacy ratio, banks can reduce their asset size through adjusting their supply of credit. Following Francis and Osborne (2009) in which the growth in loan is affected by the change in capital ratio to meet the targeted capital ratio, this study will investigate the impact of capital adequacy ratio over one year on loan growth. The empirical model will be represented as follows:

Equation 3:

$$Loan\ growth_{it} = \theta_0 + \theta_1 CAR_{it} + \theta_2 CAR_{it-1} + \theta_3 Z_{it} + \theta_4 M_{it} + \theta_5 PERIOD_{1-4} + \theta_6 PERIOD_{1-4} * CAR_{it} + a_i + \varepsilon_{it}$$

Where:

- Z_{it} is a vector of regressors including observed variables at the bank level
- M_{it} is a vector of regressors at the macroeconomic level
- $PERIOD_{1-4}$ is dummies variables for the four phases of implementing Basel Accords in Vietnam
- a_i and ε_{it} are time-invariant effect and idiosyncratic error terms, respectively.

3.1.3. Net Lending Interest Ratio and Capital Adequacy Ratio

In addition, banks can opt for issuing equity to raise their capital adequacy ratio. From the perspective of the Modigliani and Miller theory (1958), higher capital requirement does not make the cost of equity increase as the variability of the return on equity will fall and the safety of debt will rise. However, there are other theories postulating that raising equity may be costly as bank shareholders will expose themselves to more downside risks; thus, it can require more return on equity through increasing lending rates or net lending rates.

In the scope of this study, it is important to examine whether a stricter capital ratio would affect net lending interest ratio as a compensation for the increase in cost of equity in the context of Vietnam. The empirical model will be formulated as follows:

$$NLIR_{it} = \rho + \rho_1 CAR_{it} + \rho_2 CAR_{it-1} + \rho_3 ROE_{it} CAR_{it} + \rho_4 W_{it} + \rho_5 M_{it} + \rho_6 PERIOD_{1-4} + \theta_7 PERIOD_{1-4} * CAR_{it} + a_i + v_{it}$$

Where:

- The net lending interest ratio (NLIR) is calculated by the difference between the interest income ratio and the interest expense ratio.
- W_{it} is a vector of regressors including observed variables at the bank level
- M_{it} is a vector of regressors at the macroeconomic level
- $PERIOD_{1-4}$ is dummies variables for the four phases of implementing Basel Accords in Vietnam
- a_i and v_{it} are time-invariant effect and idiosyncratic error terms, respectively.

With the expectation that a tighter capital requirement's effect on bank risk level will hamper an increase in the net lending interest ratio caused by higher required returns, the coefficient of the interaction term between return on equity (ROE) and capital adequacy ratio (CAR) is expected to be negative.

3.1.4. Impulse Responses Function

Last but not least, this section will suggest the specifications to estimate impulse responses of the output level to an upward shock of capital adequacy ratio by changing the banks' behaviours in risk-taking and providing credits, indicated by the natural logarithm of Z-score, and the natural logarithm of total loans, in the

scale of the whole banking system[1]. By using time-series models, the two endogenous equation systems, corresponding to each transition variable, will be regressed to estimate how much the output level will change if there is a one-percentage-point increase in capital adequacy ratio of the banking system through each channel.

After conducting the necessary statistical tests (illustrated in Appendixes 1.A to 1.D), it is recommendable to implement VEC model in this research as the test results reveal that all variables are non-stationary at the significant level of 10% and there is one cointegrating relationship in each system. The specification of the VEC models, supported by VAR lag order and Johansen cointegration tests, involves the optimal lag length of 2 (one less than VAR lag order denoted by p) and rank of 1 for all endogenous systems, as well as agreeing to the restricted time trend option (consisting of intercepts in both cointegration equation (CE) and VAR part, and linear trend in CE) for these two systems. The overall VECM model is illustrated, as follows.

$$VECM\ specification: \Delta Z_t = \alpha(\beta' Z_{t-p} + \mu + \rho t) + \sum_{i=1}^{p-1} A_i \Delta Z_{t-i} + \gamma + \epsilon_t$$

In which Z_t is the vector of endogenous variables and ΔZ_t is the vector of stationary differences of the variables; α stands for the adjustment coefficients; β' is the matrix consisting of long-run coefficients matrices having dimensions of $k * r$, with k being the number of variables in the endogenous variables' system, while r denoting the number of cointegrating relationships in the model; Z_{t-p} is the vector of lags of the variables; A_i is the matrix having order $k \times k$ of coefficients ; ΔZ_{t-i} is the vector of lag differences of these variables and ε_t is the error term; μ is the constant term in the cointegration part; ρ is a coefficient of trend.

Additionally, the paper decides to go with the generalised impulse responses method, rather than the orthogonalised one, not only because it is less sensitive to the ordering of variables, but also because it is capable of providing more robust results and meaningful interpretation of the response of each variable to innovations of the other variables. These potentials were mentioned by Ewing (2003). Going beyond that, the long-run relationships of components in each system will be investigated by normalising on the transition variables, with the intention of verifying validity of the panel-data estimates' conclusion on the related-to-period effects on risk-taking behaviours and credit supply activities of the Vietnamese commercial banks. With the aim of ensuring no heteroscedasticity problem and serial correlation, the VECM estimates will also be checked for stability and white noise of residuals, the results of these tests will be shown in Appendix 3.

[1] In accordance with panel-data results indicating there are no period effect of a higher capital adequacy ratio on the other two transition variables, non-performing loans ratio and net lending interest ratio, the VECM estimates show an insignificance in CAR and NLIR equations.

3.2. Descriptive statistics

3.2.1. The description of the dataset at the bank level

The unbalanced panel data comprises 28 commercial banks over the period from 2002 to 2017. The dataset is significantly representative of the banking system as it observed 28 out 35 commercial banks, these banks accounting for 93% of total assets of the banking system and providing 94% of total loans of the whole system (estimated in 2013). The information on CAR was collected from annual reports of the banks, while the other figures were either extracted from audited consolidated financial statements or constructed from the information in these statements. Meanwhile, the macroeconomic variables were derived from World Bank database.

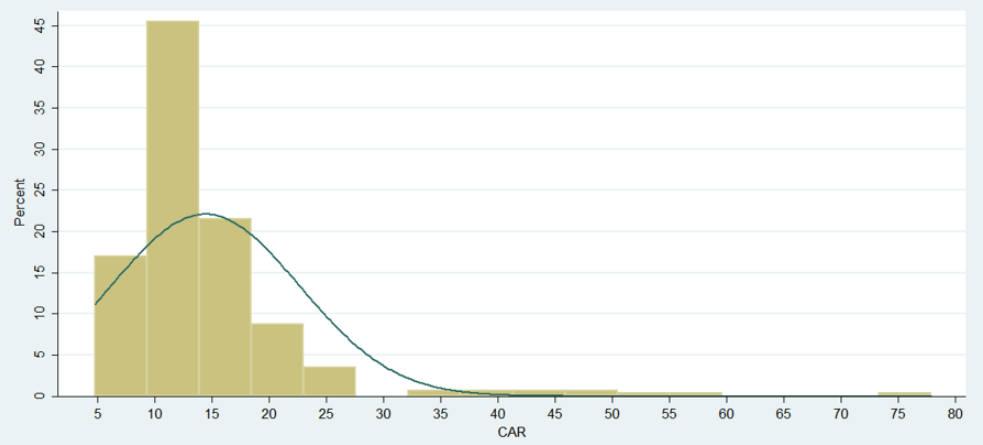
Drawing on the previous section regarding the estimate specifications, it is more precise when the variables in the models are stratified into four groups: dependent variables, independent variables, bank-specific factors, and macroeconomic factors. Looking preliminarily at the regressands in Table 3.1, it is noticeable that the natural logarithm of Z-score, a proxy for bank-risk taking behaviour or for banks' financial stability, has a wide range from -1.96 to 4.6 with a mean of 3. The only negative value for one of the state-owned commercial banks (AGR) in 2002 not only simply indicates a loss or a negative return on assets, but also reveals the inadequacy of equity to absorb the loss. The higher Z-score is, the stronger capability of loss absorption is, or the more financial stability is, or the less bank-risk taking is. Another proxy for bank-risk taking, the ratio of non-performing loans over total loans, considered more concise in measuring the banks incentives towards risky credits or assets, has a mean of 2.46%, a minimum of 0.018% and a maximum of 33%. The indicator for credit supply is the natural logarithm of total loans, having a narrow range from 11 to 20.6, corresponding the smallest amount of bank credits of 63,589 million Vietnamese Dongs to 880,411 billion Vietnamese Dongs. For the last dependent variable, net lending interest ratio, its range spreads from the negative value of -12.7% to 65.79%, with a mean of 6%. The negative values of net lending interest ratio imply that interest expenses ratio exceeds interest income ratio, the excess came from the disparities between deposit and lending interest rates as well as between deposit and lending volumes. The central explanatory variable in this study, which is capital adequacy ratio, a nexus for capital requirements in Vietnam, is distributed from 4.79% to 77.9%, with an average value of 14.42%. As can be seen in Figure 3.1, the distribution of CAR below 20% accounts for 88.5%, while the excessive levels of CAR above 30%, which are observed in four commercial banks EIB, KLB, TPB and VCBP, constitute 3.8% (see the full names in Appendix 4)

Table 3.2.1: Data Description (the bank level)					
	Obs.	Mean	Std. Deviation	Min	Max
Dependent Variables					
The natural logarithm of Z-score	382	3.0079	0.6680	-1.9586	4.6414
Non-performing loan (%, of total loans)	335	2.4611	3.0752	0.0183	33.1350
The natural logarithm of total loans	385	16.9050	1.7503	11.0602	20.5959
Net lending interest ratio (%)	384	6.0099	5.6284	-12.7040	65.7902
Independent variable					
Capital adequacy ratio (CAR, %)	288	14.4174	8.2504	4.79	77.9
Bank-specific factors					
Leverage (LEV = LIABILITY/ASSETS, %)	385	88.5603	9.4490	28.7945	100.4043
The natural logarithm of total assets (SIZE)	385	17.5541	1.7040	11.8835	20.9075
The natural logarithm of equity (LEQUITY)	384	15.1592	1.4328	10.0904	17.9707
Return on Assets (ROA, %)	384	0.9366	0.8151	-5.5117	4.6882
Return on Equity (ROE, %)	384	8.1987	50.3905	-882.4117	391.5988
Off balance sheet ratio (OBR, % of total assets)	375	12.5539	17.3443	0.0049	163.8843
Liquidity (LIQ = LOANS/DEPOSITS, %)	385	97.8628	40.5822	23.5094	384.7141
Macroeconomic factors					
The natural logarithm of real GDP (LRGDP)	385	21.4988	0.2375	20.9740	21.9058
Money base (M2, % of GDP)	385	107.3096	25.4492	53.0356	155.2222
Government Expenditure (GE, % of GDP)	385	5.9811	0.3385	5.4652	6.5095

Considering controllable variables, at both bank level and macroeconomic level, there are seven bank-specific regressors and three macroeconomic regressors, which are taken into account in the estimate specifications. Firstly, the paper aims to control the effect of bank size and that of bank equity usage level through two indicators, the natural logarithm of total assets and that of equity, respectively. These indicators respectively record average values of 17.55 and 15.16 on the logarithmic scale, corresponding to 42,038 billion Vietnamese Dong and 3,833 billion Vietnamese Dong. Although considered as common gauges for bank profitability, ROA and ROE express different views on profitability, one from the entire bank's perspective, the other from the owners' perspectives. This is also a reason for not only significantly larger values of ROE, compared to those of ROA, but also understandably wider variance because of differences in capital structures amongst the commercial banks. Indeed, ROE spans from -882% to 391.6% with an average ratio of 8.2%, whereas the range of ROA is from -5.5% to 4.7% with a mean value of 0.94%. It is necessary to clarify that the maximum and minimum of ROE are the extreme values recorded in AGR. Just mentioned before, the capital structure or leverage is measured by the ratio of liabilities to assets, described with an average ratio of 88%, and a

range from 28.8% to 100%. Meanwhile, liquidity is indicated by the ratio of loans to deposits, which implies that the higher the ratio is, the lower the liquidity is, because the bank attempts to capitalise on deposit fund to provide more loans, thus the amount of cash would be decreased. The last bank-specific factor, integrated into the specifications, is off-balance sheet ratio, a representative of incognito risks.

Figure 3.2.1: Distribution of Capital Adequacy Ratio



Additionally, the paper sets out to control the influences of macroeconomic factors in respect of the degree of the economy's expansion, fiscal policies, and monetary policies. The first aspect is represented by the natural logarithm real GDP, which ranges between 20.97 and 21.9 on the natural logarithmic scale. By using the indicators of money base (M2) and government expenditure (shares of GDP), the governmental management of the money supply and the fiscal policy are respectively captured in the estimations of this study.

3.2.2. The description of the dataset at the banking system level

Drawing on the dataset of the Vietnamese commercial banks, the paper set out to construct the dataset representing the Vietnamese banking system as whole by an average weighted methodology. More specifically, capital adequacy ratio and Z-score of the whole system each year are respectively an average of asset-weighted capital adequacy ratios and that of asset-weighted Z-scores of observable commercial banks in the same year. Meanwhile, in order to measure the credit supply of the entire system, this study takes the sum of total loans of the observable commercial banks in each year. All variables at the banking system level are statistically described in Table 3.2.2, together with their graphical descriptions in Figure 3.2.2.1 – Figure 3.2.2.4, as follows.

Table 3.2.2: Data Description (the banking system level)					
	Obs.	Mean	Std. Deviation	Min	Max
Capital adequacy ratio (%)	16	9.9401	2.4172	5.57	12.3685
The natural logarithm of GDP (LGDP)	16	21.3470	0.7573	20.0992	22.3343
Transition Variables					
The natural logarithm of Z-score (LZscore)	16	2.7970	0.2708	2.1408	3.0919
The natural logarithm of total loans (LLoans)	16	20.9356	1.0173	19.1846	22.3413

Figure 3.2.2.1: Captial Adequacy Ratio of the Vietnamese Banking System (%)

Figure 3.2.2.2: Z-score of the Vietnamese Banking System (the logarithmic scale)

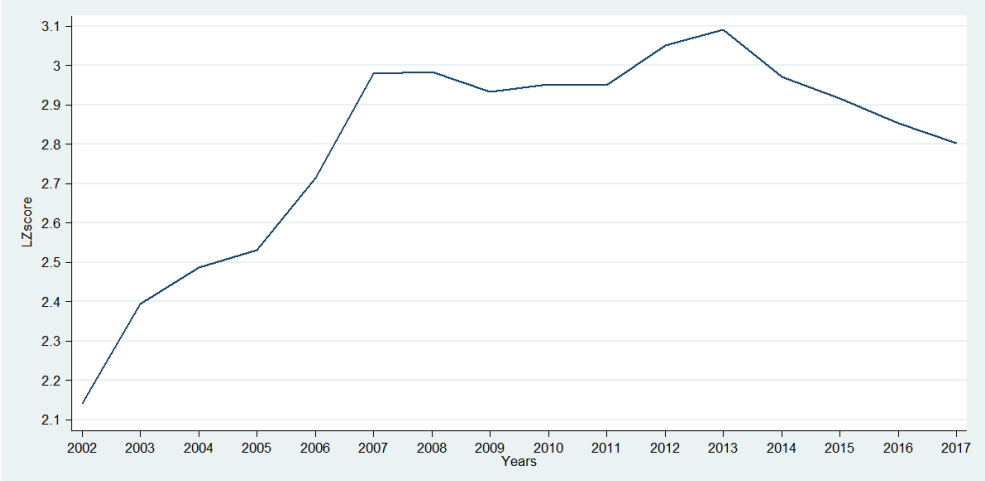


Figure 3.2.2.3: Total Loans of the Vietnamese Banking System (the logarithmic scale)

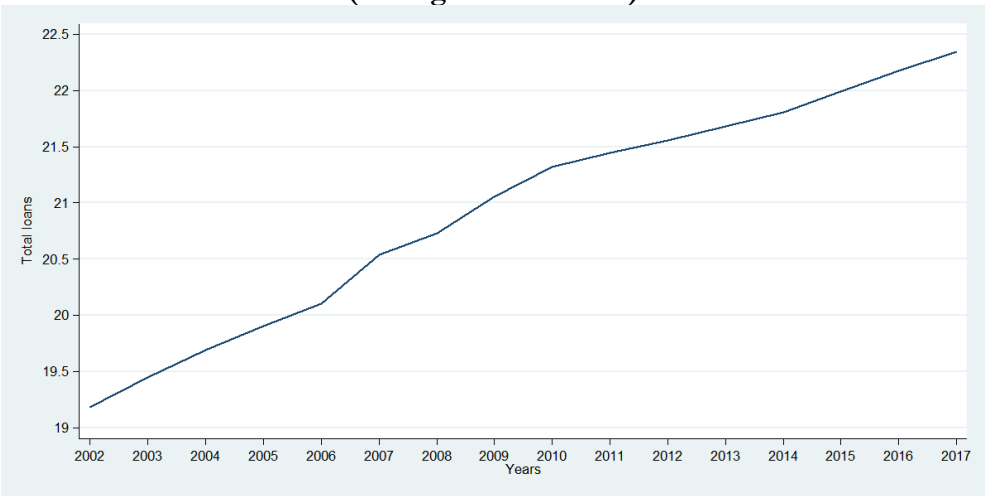
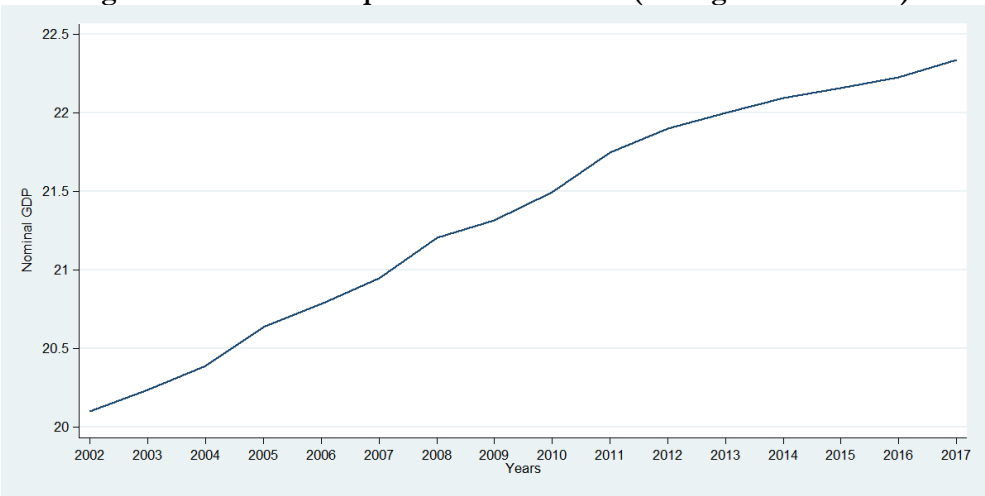


Figure 3.2.2.4: The Output Level in Vietnam (the logarithmic scale)



As shown in Table 3.2.2 and Figure 3.2.2.1, there was an upward, albeit edged, trend in capital adequacy ratio of the banking system from 2002 to 2017, an increase from 5.57 to 12.37%. Sharing similar tendency of the capital adequacy ratio, Z-score was enhanced from the level of 2.14 on the logarithmic scale to a peak of 3.09 in 2013 before being slightly deteriorated afterward (Figure 3.2.2.2). Meanwhile, on the logarithmic scale, GDP and total loans of the banking system were not only appropriately equal to each other, but also parallelly increased gradually over the period from 2002 to 2017 (Figure 3.2.2.3 – 3.2.2.4). It is perceivable that the tendencies of these variables reveal non-stationarity, and more importantly, that the entire banking system has been under the persistent pressure of stringent capital requirements over time, which has forced the banks to change their behaviours and activities to achieve the regulatory capital ratios, and the output level is considered as both a precursor to the banking activities and the influenced by the banking system. It is sensible to suspect that there was a high possibility of a presence of endogenous relationships amongst capital adequacy ratio, each transition variable and GDP, which calls for the application of vector error correction model (VECM) to investigate the dynamic impact of a random disturbance in each endogenous system. It is important to point out that the limitation on capturing the long span of time series is undeniable as the sample size is small.

Chapter 4
Empirical Evidence

4.1. Panel-data estimates

4.1.1. Capital Adequacy Ratio and Bank Risks

Similar to conventional wisdom and previous empirical studies on the impact of regulatory capital ratio on bank risk-taking, which observed either positive or insignificant, albeit weakly, relationship, this current study also found that a stricter capital requirement has a positive direct effect on Z-score in the Vietnamese banking system (Table 4.1.1.1). However, when looking at the negative coefficients of interaction terms between capital adequacy ratio and dummies for the phases of implementing Basel Accords, it is clear that the financial stability of Vietnamese commercial banks has been deteriorated period by period, or that risk-taking behaviour of Vietnamese commercial banks is only reduced by some extent when a higher capital level is required. The reason for that could come from the different significance of each component in Z-score structure across various banking systems. Indeed, the empirical study in the Luxembourg banking system (Giordana & Schumacher 2017) pointed out that although Z-score was positively and significantly associated with both return on assets (ROA) and capital adequacy ratio (CAR), the explosive dynamics of Z-score were relayed from ROA (a one-percentage-point increase in ROA and that in CAR respectively increases the logarithm of Z-score by 2.236 and 0.704). From this point, it is reasonable to suggest that Z-scores of Vietnamese commercial banks are mainly channelled by their capital ratio levels, as the empirical result in Table 4.1.1.1 showed significantly larger direct effects of CAR, total assets and equity on Z-score, rather than ROA's. More than that, the negative effect of a one percent increase in bank assets (-0.9119) is bigger than the positive effect of a one percent increase in equity (0.896) on Z-score, the excess indicates the vulnerability of the banks' financial stability to credit expansion, even in the case of keeping equity growth equal to asset growth. Hence, all explanations support the fact that with the aims of achieving regulatory capital requirements, Vietnamese commercial banks are more likely to raise their capital and reduce their incentives towards providing risky credits, but unlikely to cut down their total lending, i.e. the possible lending structure strategy is keeping their growth of credit supply (decreasing the ratio of equity to assets and improving or maintaining their equity return) but being more concerned about riskiness (increasing the ratio of capital to risk-weighted assets). One more evidence for this strategy is the coefficients on period effects showing that Z-scores of the second, third, and fourth periods have been higher than the first one's. This could imply a persistent enhancement in financial stability of the Vietnamese commercial banks through more profitability because of less bad debt damage, and higher equity level over time. From these pieces of evidence, again it is reasonable to conclude that the commercial banks' incentives to take risks (or supply more credits) were not eliminated, but stricter capital requirements still yielded favourable effects on the financial stability of the Vietnamese commercial banks through less financing of risky investments by the banks. Finally, it is of great importance to point out that macroeconomic

factors, representatives to economic boom, fiscal policy and monetary policy, do not show any direct effects on risk-taking behaviours or financial stability of the Vietnamese commercial banks, while discretionary policies, indicated by period terms, have a strong impact on Z-score.

Although some theoretical and empirical research, typically those by Boudriga et al. (2009a, 2009b) and Fiordelisi et al. (2010) concluded an ambiguous relationship between risk and capital ratio, in the regressions with the risk indicator for non-performing loans (Table 4.1.1.2), it is sensible to be certain that the commercial banks in Vietnam tend to reduce risky lending to achieve capital ratio requirement, as there are some evidence showing that a higher capital adequacy ratio would reduce non-performing loans ratio. More particularly, as shown in the standard-error-robustness estimate, a 1 percentage-point increase in the capital ratio would cause a 0.05 percentage-point reduction in non-performing loans ratio. This result is aligned with the current research's expectation and those of preceding empirical studies, e.g. Marki et al. (2014) studied the case of Eurozone and observed that a risky loan portfolio measured by non-performing loans ratio would be reduced by 0.114 percentage point as there was a reinforcement in bank capital ratio of one previous year, or Salas and Saurina (2002) investigated the case of Spain and found that the Spanish commercial banks with higher solvency levels (measured by capital ratios) would implement more conservative credit policies (indicated by problem loan ratios). In addition, the estimate results represent a consistently and meaningfully positive association of non-performing loans ratio in a given year with itself in the previous year, implying the persistence of bad debts in the Vietnamese banking system, analogous to the evidence in Eurozone. However, the annual cumulative degree of non-performing loans ratio in Eurozone is still lower than that in Vietnam, corresponding to the respective amounts of 0.262 percentage point and 0.6955 percentage point. It is reasonable to perceive that the problem of bad debts in developing countries is more severe than that in developed countries, as banking financing or financial deepening is more prevailing in developing countries because of a higher demand for credits financing investments to drive economic growth, and a lack of concern for the risk level of these investments. The second reason can be explained by a negative correlation between return on assets and non-performing loans, revealing a deterioration of profitability ratio going hand-in-hand with a rise in non-performing loans ratio, and the risk-taking behaviour of banks aligning with the general idea: high risk, high return. This negative association can also be blamed on bad management leading to riskier activities and poor performance (principal-agent problems).

Table 4.1.1.1: Z-score and CAR

**Note: the first three columns are fixed effect estimates, the fourth one is random effect estimate on the full-variable specification. After using Hausman test for the third and the fourth ones, the result supports for the random effect model which will be standard deviation robusted and recorded in the fifth column.*

Dependent Variables:	(1)	(2)	(3)	(4)	(5)
the natural logarithm of Z-score	FE1a	FE1b	FE1c	RE1c	RE1d
Capital adequacy ratio	-0.0017	-0.0011	0.3860***	0.3898***	0.3898***
(CAR, %)	(0.002)	(0.002)	(0.036)	(0.038)	(0.088)
Lag of CAR	0.0004	0.0003	0.0003	0.0001	0.0001
(%)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Bank specific factors					
Leverage	0.0095**	0.0096**	-0.0023	-0.0013	-0.0013
(%)	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
The natural logarithm of total assets	-1.0813***	-1.0772***	-0.9188***	-0.9119***	-0.9119***
(SIZE)	(0.034)	(0.034)	(0.031)	(0.033)	(0.040)
The natural logarithm of equity	1.0182***	1.0200***	0.8910***	0.8960***	0.8960***
(LEQUITY)	(0.031)	(0.032)	(0.029)	(0.030)	(0.056)
Return on Assets	0.1778***	0.1775***	0.1730***	0.1726***	0.1726***
(ROA, %)	(0.011)	(0.011)	(0.009)	(0.010)	(0.060)
Off balance sheet ratio	-0.0010	-0.0007	-0.0008	-0.0007	-0.0007
(OBR, % of total assets)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Liquidity ratio	-0.0004	-0.0003	-0.0003	-0.0002	-0.0002
(LIQ, %)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Macroeconomic factors					
The natural logarithm of real GDP	0.4212***	0.2023	0.1717	0.1261	0.1261
(LRGDP)	(0.140)	(0.190)	(0.153)	(0.161)	(0.202)
Money base	0.0014	-0.0002	0.0001	-0.0001	-0.0001
(M2, % of GDP)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Government expenditure	-0.1831***	0.0609	0.0308	0.0496	0.0496
(GE, % of GDP)	(0.046)	(0.138)	(0.111)	(0.117)	(0.075)
Period effects (with the base for the first period (before 2005)					
2005-2009		0.2994**	3.0896***	3.1250***	3.1250***
		(0.150)	(0.283)	(0.299)	(0.697)
2010-2016		0.2805**	3.0553***	3.0905***	3.0905***
		(0.138)	(0.280)	(0.296)	(0.694)
2017		0.2725*	2.8714***	2.9071***	2.9071***
		(0.151)	(0.297)	(0.314)	(0.691)
Interaction term (with the base for the first period (before 2005)					
(2005-2009)#c.CAR			-0.3876***	-0.3907***	-0.3907***
			(0.036)	(0.038)	(0.089)
(2010-2016)#c.CAR			-0.3865***	-0.3900***	-0.3900***
			(0.036)	(0.038)	(0.088)
(2017)#c.CAR			-0.3738***	-0.3773***	-0.3773***
			(0.036)	(0.038)	(0.087)
F	400.9584	318.2370	414.3354		
R-squared	0.9541	0.9552	0.9716		
N	251	251	251	251	251

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 4.1.1.2: Non-performing Loans and CAR

**Note: the first three columns are fixed effect estimates, the fourth one is random effect estimate on the full-variable specification. After using Hausman test for the third and the fourth ones, the result supports for the random effect model which will be standard deviation robusted and recorded in the fifth column.*

Dependent Variables:	(1)	(2)	(3)	(4)	(5)
Non-performing loans	FE2a	FE2b	FE2c	RE2c	RE2d
Lag of Non-performing loans ratio (%)	0.6458***	0.6418***	0.6734***	0.6955***	0.6955***
	(0.046)	(0.046)	(0.047)	(0.039)	(0.032)
Capital adequacy ratio (CAR, %)	0.0391	0.0279	-3.5778***	-3.7502***	-3.7502
	(0.047)	(0.047)	(1.099)	(0.998)	(3.321)
Lag of CAR (%)	-0.0552*	-0.0520*	-0.0505	-0.0503**	-0.0503***
	(0.029)	(0.030)	(0.031)	(0.026)	(0.013)
Bank specific factors					
Leverage (%)	-0.0440	-0.0502	0.0238	0.0307	0.0307
	(0.099)	(0.099)	(0.102)	(0.071)	(0.086)
The natural logarithm of total assets (SIZE)	-0.1693	-0.2337	-1.4222*	-1.1970**	-1.1970
	(0.763)	(0.762)	(0.844)	(0.570)	(1.135)
The natural logarithm of equity (LEQUITY)	0.9048	0.9360	1.7794**	1.3983**	1.3983
	(0.688)	(0.720)	(0.761)	(0.586)	(1.234)
Return on Assets (ROA, %)	-0.4589*	-0.4700*	-0.4172*	-0.3843*	-0.3843*
	(0.241)	(0.242)	(0.240)	(0.207)	(0.228)
Off balance sheet ratio (OBR, % of total assets)	-0.0103	-0.0180	-0.0181	-0.0119	-0.0119
	(0.014)	(0.014)	(0.014)	(0.009)	(0.011)
Liquidity ratio (LIQ, %)	0.0113	0.0086	0.0097	0.0057	0.0057
	(0.009)	(0.009)	(0.010)	(0.006)	(0.004)
Macroeconomic factors					
The natural logarithm of real GDP (LRGDP)	-3.1908	-0.3943	0.5308	1.6922	1.6922
	(3.087)	(4.118)	(4.060)	(3.272)	(3.857)
Money base (M2, % of GDP)	-0.0253	0.0022	0.0035	0.0090	0.0090
	(0.019)	(0.030)	(0.030)	(0.027)	(0.022)
Government expenditure (GE, % of GDP)	1.9440	-2.1091	-2.2831	-3.2831	-3.2831
	(1.180)	(3.165)	(3.104)	(2.723)	(2.382)
Period effects (with the base for the first period (before 2005)					
2005-2009		-5.2436	-29.9149***	-31.7942***	-31.7942
		(3.407)	(8.245)	(7.461)	(24.163)
2010-2016		-4.8056	-29.5029***	-30.8908***	-30.8908
		(3.147)	(8.122)	(7.391)	(24.257)
2017		-4.2118	-29.2885***	-30.2462***	-30.2462
		(3.420)	(8.531)	(7.839)	(23.872)
Interaction term (with the base for the first period (before 2005)					
(2005-2009)#c.CAR			3.5919***	3.7805***	3.7805
			(1.096)	(0.999)	(3.329)
(2010-2016)#c.CAR			3.5990***	3.7709***	3.7709
			(1.096)	(0.998)	(3.323)
(2017)#c.CAR			3.6278***	3.7513***	3.7513
			(1.101)	(1.010)	(3.307)
F	22.6339	18.5105	16.6561		
R-squared	0.5747	0.5837	0.6059		
N	241	241	241	241	241

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.1.2. Capital Adequacy Ratio and Credit Supply

As far as the aforementioned strategy of the Vietnamese commercial banks is concerned, this strategy for satisfying regulatory capital requirements is more reinforced, as the long-term effect of the stricter regulations on credit supply is positive. As illustrated in Table 4.1.2, the empirical results prove that higher capital requirements over the phases would increase loan growth; particularly, a one-percentage-point increase in capital adequacy ratio in the second phase would bring 30% more total loans compared to the first phase. This implies that there was an accumulation of capital over the periods, enhancing the banks' capability of providing credits. This implication is backed up by the notion that regulatory capital ratio could be taken as an anti-cyclical tool. One empirical dynamic research on the Spanish macroeconomy (Jiménez et al. 2017) estimated that a one-percentage-point increase in capital buffers or dynamic provision (measured by tier 2 regulatory capital ratio from 2005 onward) would extend credit supply for firms by 9 percentage points between 2008:Q1 and 2010:Q4 (the crisis period), implying that firms financed by banks having one-percentage point higher in their capital buffers could be furnished with 9 percentage points more in credits than those financed by other banks. This paper also estimated that dynamic provisions increased credit growth by 8 percentage points in the crisis period with one-percentage-point higher in the dynamic provision fund in 2007:Q4. These results contribute to the belief that capital buffers mitigate credit crunch in bad times or capital requirements could switch their roles from a procyclical tool in good times to a countercyclical tool in bad times. Despite acknowledging that this study could not be as meticulous and advanced as the aforementioned research, to some extent, it is capable of explaining the anti-cyclicality of capital regulations in Vietnam as it provides a strong evidence of the positive impacts of capital adequacy ratios on the credit supply throughout the periods. As a matter of fact, in the two recession periods of the Vietnamese macroeconomy, the prudential requirements of capital adequacy ratios forcing the Vietnamese commercial banks raising their capital level, thus helping the accumulation of capital buffers, assists the commercial banks in supplying credits, and alleviating slowdowns in credit growth in the periods of 2006 – 2009 and 2010 – 2016. By looking at the coefficients on the period dummies, it could be noticed that there were period-dependent causes lowering levels of the credit supply in these periods compared with the first one.

On the other hand, the empirical results in Table 4.1.2 also indicate the negative direct effect of capital adequacy ratio on the growth of loans, similar to the conclusions of previous studies. A one percentage point increase in capital adequacy ratio would decrease total loan by 24.33% [(e^-0.2789 -1)*100]. The degree of this effect in Vietnam is remarkably large in comparison with those in developed countries such as the United Kingdom. According to Francis and Osborne (2009), in the UK banking system, a change in capital requirements would lead to 7.25% reductions on the volume of loans in the case a bank's risk-weighted capital ratio was staying at a surplus position compared with the targeted capital ratio. Once again, the evidence of bank capital cushion for loans was found in the UK banking system as the estimate results represented that current risk-weighted capital ratio in excess of one-percentage-point compared with the regulatory ratio at that time would induce banks to provide 6.18% more in credits. In light with this preceding evidence in the UK system, from the empirical findings in the Vietnamese system, when all commercial banks owned

Table 4.1.2: Credit supply and CAR

**Note: the first three columns are fixed effect estimates, the fourth one is random effect estimate on the full-variable specification. After using Hausman test for the third and the fourth ones, the result supports for the fixed effect model which will be standard deviation robusted and recorded in the fifth column.*

Dependent variable:	(1)	(2)	(3)	(4)	(5)
the natural logarithm of loans	FE3a	FE3b	FE3c	RE3c	RE3d
Capital adequacy ratio	-0.0075**	-0.0064*	-0.2789***	-0.2193*	-0.2789**
(CAR, %)	(0.003)	(0.003)	(0.104)	(0.130)	(0.116)
Lag of CAR	-0.0032	-0.0044**	-0.0037*	-0.0081***	-0.0037
(%)	(0.002)	(0.002)	(0.002)	(0.003)	(0.004)
Bank specific factors					
Leverage	-0.0133*	-0.0124*	-0.0106	-0.0204**	-0.0106
(%)	(0.007)	(0.007)	(0.007)	(0.008)	(0.008)
The natural logarithm of total	0.8581***	0.8642***	0.7696***	0.9984***	0.7696***
assets (SIZE)	(0.053)	(0.052)	(0.063)	(0.070)	(0.068)
The natural logarithm of equity	-0.0975**	-0.0840*	-0.0014	0.0237	-0.0014
(LEQUITY)	(0.048)	(0.049)	(0.059)	(0.070)	(0.043)
Return on Assets	0.0475*	0.0493*	-0.0074	-0.0374	-0.0074
(ROA, %)	(0.026)	(0.026)	(0.033)	(0.041)	(0.030)
Off balance sheet ratio	0.0016*	0.0019*	0.0019*	0.0013	0.0019*
(OBR, % of total assets)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Liquidity ratio	0.0028***	0.0031***	0.0033***	0.0050***	0.0033***
(LIQ, %)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Return on Equity	0.0007	0.0007	0.0055**	0.0069**	0.0055**
(ROE, %)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)
Macroeconomic factors					
The natural logarithm of real	1.0811***	1.2861***	1.3218***	0.3553	1.3218***
GDP (LRGDP)	(0.219)	(0.291)	(0.288)	(0.322)	(0.312)
Money base	0.0022	0.0003	0.0004	-0.0033	0.0004
(M2, % of GDP)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Government expenditure	-0.0158	0.0995	0.0939	0.6226**	0.0939
(GE, % of GDP)	(0.075)	(0.211)	(0.209)	(0.252)	(0.160)
Period effects (with the base for the first period (before 2005)					
2005-2009		0.0687	-1.9781**	-1.2017	-1.9781**
		(0.233)	(0.823)	(1.033)	(0.910)
2010-2016		-0.0437	-2.1380***	-1.5487	-2.1380**
		(0.215)	(0.814)	(1.024)	(0.907)
2017		-0.1338	-2.0773**	-1.6840	-2.0773**
		(0.234)	(0.817)	(1.031)	(0.956)
Interaction term (with the base for the first period (before 2005)					
(2005-2009)#c.CAR			0.2693**	0.2118	0.2693**
			(0.104)	(0.130)	(0.117)
(2010-2016)#c.CAR			0.2729***	0.2143*	0.2729**
			(0.103)	(0.130)	(0.116)
(2017)#c.CAR			0.2614**	0.2202*	0.2614**
			(0.102)	(0.129)	(0.120)
F	578.8322	475.4691	407.7509		934.2333
R-squared	0.9705	0.9717	0.9728		0.9728
N	251	251	251	251	251

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

the excessive risk-weighted capital ratios to the minimum requirement in the third phase (based on Vietnamese Accounting Standard), the positive effect of one-percentage-point increase in capital adequacy ratio on the credit supply in the third phase is 72.6% [((e^0.2729*2)-1)*100] more than in the first phase.

4.1.3. Capital Adequacy Ratio and Net Lending Interest Ratio

As regards banks' response to stringent capital requirements by setting their expected lending and deposit interest rates, this paper also attempted to investigate this kind of response in the Vietnamese banking system, in spite of the fact that as described in section 3.1.3, the applied proxy for the expected differentials in interests between providing credits and receiving deposits is different from the common proxy, net lending interest spread in most previous studies. It is undoubted that the nexus in this study takes into account the volumes of deposits and credits, thus being considered as an indicator for bank profitability from related-to-interests activities, other than solely capturing the expected unit price for loans and the expected unit cost for deposits. Due to the incapability of disentangling price-cost component from quantity component, the estimations in Table 4.1.3 with the dependent variable for this proxy result in ambiguous evidence for a positive effect of the tighter capital requirements on the banks' behaviour towards achieving the expected unit return on related-to-interests activities in Vietnam. Meanwhile, most previous studies on this relationship found that a stricter capital requirement would encourage commercial banks to widen the differential between lending interest rate and deposit interest rate with the aim of passing the cost of raising equity to borrowers. Typically, through investigating African economies, Caggiano and Calice (2011) estimated that a one-percentage-point increase in Tier 1 risk-weighted asset ratio and that in return on equity increased lending rate by 0.084 percentage point and 0.066 percentage point, respectively. As would be the case of developing countries, another study in these OECD economies, Solvik and Cornede (2011), also observed that a one-percentage-point increase in capital adequacy ratio would put more burden on lending spreads by 0.144 percentage point.

Going beyond the institution of passing all the costs of raising more equity to borrowers, it is of great importance to argue how equity is costly. Under the Modigliani and Miller (MM) theorem (1985), more equity capital is not necessarily more costly, as it could reduce the volatility of the return on equity and raise the safety of the debt, thus leading to lower required rates of return on both funding sources. However, this is an extreme case. In fact, through empirical evidence, equity is expensive, as higher capital requirements, requiring commercial banks to enhance their equity or charter capital instead of using debt financing or deposit financing, reduces return on equity. By observing 13 OECD countries, King (2013) showed that in order to keep return on equity unchanged, the commercial banks would increase lending spreads by 0.15 percentage point to offset a one-percentage-point in capital adequacy ratio. Nevertheless, some empirical studies believe that there were partial M-M effects which would lessen increases in required return on capital, as well as lending spreads, as there is a higher capital requirement, e.g. Miles et al. (2010) looking into the UK banks. In light with this argument, this study also found that higher capital requirements would help reducing the positive effect of return on equity on net lending

Table 4.1.3: Net Lending Interest Ratio and CAR

**Note: the first three columns are fixed effect estimates, the fourth one is random effect estimate on the full-variable specification. After using Hausman test for the third and the fourth ones, the result supports for the random effect model which will be standard deviation robusted and recorded in the fifth column.*

Dependent variable:	(1)	(2)	(3)	(4)	(5)
Net lending interest ratio	FE4a	FE4b	FE4c	RE4c	RE4d
Capital adequacy ratio	0.1279**	0.1031*	-0.7279	-1.2659	-1.2659
(CAR, %)	(0.056)	(0.055)	(1.864)	(1.876)	(1.729)
Lag of CAR	0.0161	0.0319	0.0225	0.0277	0.0277
(%)	(0.034)	(0.034)	(0.035)	(0.035)	(0.026)
The interaction term	-0.0148***	-0.0152***	-0.0161***	-0.0168***	-0.0168***
ROE * CAR	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Bank specific factors					
Leverage	-0.1304	-0.1378	-0.1137	-0.0835	-0.0835
(%)	(0.115)	(0.114)	(0.120)	(0.113)	(0.092)
The natural logarithm of	2.4605***	2.2956***	2.1442**	1.4366	1.4366*
total assets (SIZE)	(0.852)	(0.838)	(1.036)	(0.958)	(0.845)
The natural logarithm of	-0.8252	-1.2705	-1.0791	-1.3933	-1.3933*
equity (LEQUITY)	(0.786)	(0.801)	(0.956)	(0.936)	(0.807)
Return on Assets	2.3051***	2.2551***	2.2469***	2.3888***	2.3888**
(ROA, %)	(0.595)	(0.588)	(0.619)	(0.614)	(0.932)
Off balance sheet ratio	-0.0014	-0.0049	-0.0034	-0.0034	-0.0034
(OBR, % of total assets)	(0.016)	(0.016)	(0.016)	(0.015)	(0.010)
Liquidity ratio	-0.1290***	-0.1320***	-0.1356***	-0.1471***	-0.1471***
(LIQ, %)	(0.010)	(0.010)	(0.010)	(0.009)	(0.016)
Return on Equity	0.0646**	0.0793**	0.1023*	0.1146**	0.1146***
(ROE, %)	(0.033)	(0.032)	(0.055)	(0.055)	(0.044)
Macroeconomic factors					
The natural logarithm of	6.8428*	14.0361***	13.8431***	18.1961***	18.1961***
real GDP (LRGDP)	(3.549)	(4.697)	(4.742)	(4.325)	(2.842)
Money base	-0.1315***	-0.0530	-0.0551*	-0.0395	-0.0395*
(M2, % of GDP)	(0.022)	(0.032)	(0.033)	(0.033)	(0.023)
Government expenditure	0.1169	-10.1423***	-10.0060***	-12.5191***	-12.5191***
(GE, % of GDP)	(1.209)	(3.372)	(3.387)	(3.330)	(3.139)
Period effects (with the base for the first period (before 2005)					
2005-2009		-11.7134***	-18.4922	-24.8325*	-24.8325**
		(3.718)	(14.874)	(14.948)	(12.567)
2010-2016		-9.8243***	-15.9150	-21.0482	-21.0482*
		(3.434)	(14.702)	(14.805)	(12.618)
2017		-10.0630***	-18.4388	-23.5751	-23.5751*
		(3.746)	(14.772)	(14.909)	(13.193)
Interaction term (with the base for the first period (before 2005)					
(2005-2009)#c.CAR			0.8754	1.4333	1.4333
			(1.874)	(1.886)	(1.740)
(2010-2016)#c.CAR			0.8267	1.3625	1.3625
			(1.868)	(1.880)	(1.742)
(2017)#c.CAR			1.0013	1.5223	1.5223
			(1.853)	(1.867)	(1.798)
F	24.1247	21.0685	17.6891		
R-squared	0.5989	0.6196	0.6223		
N	251	251	251	251	251

interest ratio, a finding being consistent in the Vietnamese banking system. More particularly,

Standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

a one-percentage-point increase in capital adequacy ratio would lower the effect of return on equity on net lending interest ratio by 0.0168 percentage point (1.68 basis points).
Additionally, there is strong evidence supporting that less liquidity by one unit (a one-percentage-point increase in liquidity ratio (Loans/Deposits)) would decrease net lending interest ratio by 0.1471 percentage point, implying that the ability of the commercial banks to provide credits would be deteriorated when providing more loans and receiving less deposits.

4.2. VECM estimates

Not only because of the intention to estimate the effect of an innovation in capital adequacy ratio on endogenous-variable systems, especially the output level, but also because of the attempt to confirm the panel-data estimates' results of the related-to-period effect of stricter capital requirements, the VECM approach will provide impulse response functions and scrutinise further the long-run relations amongst endogenous variables. Based on the previous approach showing the period impact of tighter capital requirements on Z-score and total loans of the commercial banks, it is advisable to suggest that there are two systems which should be looked into, CAR – Z-score – GDP, and CAR – Total loans – GDP. From this approach, the suspicion that the commercial banks in Vietnam still tend to provide more credits when they confront stricter capital requirements is reinforced, as the VECM estimates support that a higher capital adequacy ratio would lead to a permanent deterioration in Z-score, but also to a permanent benefit for the level of credit supply. More importantly, in spite of the limitation on the sample size, this approach still delivers an insight into the macroeconomic impacts of stricter capital adequacy requirements, the findings describing that when there is an innovation in capital adequacy ratio, the output level would be subject to a permanent loss, probably because the commercial banks keep providing more credits at the expropriation of the financial stability, and would benefit from a permanent benefit because the capability of supplying loans is enhanced. However, the overall impact of stricter capital requirements in Vietnam is negative, as the permanent loss exceeds the permanent benefit.

4.2.1. Capital Adequacy Ratio, Z-score, and Nominal Output Level

As illustrated in Table 4.2.1.1, there is an evidence that a higher capital adequacy ratio reduces Z-score in the long run as the parameter of capital adequacy ratio in the cointegrating vector normalised on the natural logarithm of Z-score (LZscore) is negative. This beta coefficient indicates that one-percentage-point change in capital adequacy ratio would associate with a decrease in Z-score by 13.6% [(e^-0.1463 -1)*100]. Considering the adjustment parameters, all are positive and significant, except for the adjustment coefficient in the Z-score equation; hence there is no short-run adjustment in Z-score to correct the equilibrium due to a higher capital adequacy ratio, while capital adequacy ratio is more likely to adjust upwards to match with the new higher level of Z-score with the speed of adjustment at 0.09 percentage point per year. This finding is in accordance with the fact that the banking system ceaselessly reinvigorates their stability and capability to avoid insolvency through increasing the bank equity by profit accumulations and charter capitals over time, thus achieving a higher level

of capital adequacy ratio. As would be the case with capital adequacy ratio, the natural logarithm of GDP has a meaningfully negative β coefficient, which would indicate the negative long-run impact of the output level on the financial stability (one percent increase in the output level would lead to 0.4478 per cent increase in Z-score). In addition, it has a significant adjustment coefficient which illustrates that there is an upward adjustment in the output level to a change in Z-score (each year, 0.918% of the disequilibrium in the output level is adjusted back to the equilibrium). It is worth pointing out the negative impact of Z-score on the output level in the short run, which implies that there might be no choice for the commercial banks to raise their capital ratio level in short-term, rather than decreasing their assets portfolio or cutting down their lending contemporaneously, which could create a shortfall in the output level. Meanwhile, the short-run effect of a higher capital adequacy ratio on the output level is significantly positive, which can indicate that reductions in risky assets in the past in the interest of the capital ratio level would preserve the capability of providing loans in the future, thus being favourable to the output level.

Table 4.2.1.1: VECM estimates – the system of CAR - Z-score - GDP

VARIABLES	(1) ΔCAR	(2) Δ(The natural logarithm of Z-score)	(3) Δ(The natural logarithm of GDP)
L.CE1 (adjustment coefficients)	9.133 (1.95)*	0.120 (0.22)	0.918 (10.38)***
Lag ΔCAR	0.310 (0.58)	-0.001 (0.01)	0.054 (5.42)***
Lag Δ(the natural logarithm of Z-score)	0.157 (0.05)	0.335 (0.82)	-0.120 (1.84)*
Lag Δ(The natural logarithm of GDP)	0.390 (0.08)	0.635 (1.11)	0.168 (1.82)*
Constant	-0.007 (0.01)	-0.087 (1.05)	0.082 (6.16)***
Observations	14	14	14
RMSE	0.8546	0.1002	0.0161
R-squared	0.5795	0.4099	0.9937
Chi-squared	11.0238*	5.557	1256.809***

Cointegration Equation

Beta (β)	Normalisation on the natural logarithm of Z-score
CAR	-0.1463 (-25.32)***
The natural logarithm of Z-score	1
The natural logarithm of GDP	-0.4478 (-6.8)***
Trend	0.09577 (9.34)***
Constant	7.6053
Chi-squared	1315.84

z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Considering the investigation on the dynamic impact of a shock in capital adequacy ratio on the level of Z-score and that of GDP through impulse response functions, the graphical results (presented in Figure 4.2.1) provide negative and persistent responses of Z-score and the output level over 15 years. From the IRF Figure 1 and 2 in Figure 4.2.1, it is clear to observe that these responses are rapid in the first two years and dwindle afterward to settle down at the permanent losses after nine years. As can be represented in Table 4.2.1.2, the contemporaneous impact of a one-percentage-point change in capital adequacy ratio on the natural logarithm of the Z-score and on that of GDP respectively are -0.0214 and -0.0934, corresponding to a decrease in Z-score by 2.113%, and that in GDP by 8.9%. These effects do not die out, but rather converging to the long-run impacts of averagely -0.257 and -0.234 respectively on Z-score and GDP on the logarithmic scale, which implies permanent losses in the Z-score and output level by 29.36% and 20.86%, correspondingly.

Figure 4.2.1: Generalised Impulse Responses of Z-score and GDP in the system CAR – LZ-score - LGDP

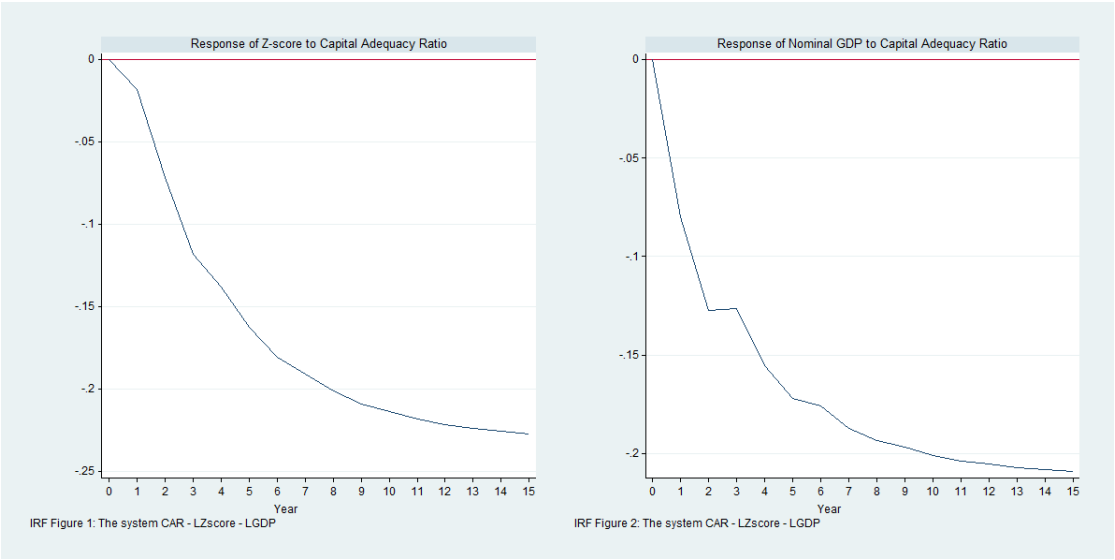


Table 4.2.1.2: Generalised Impulse Responses of Z-score and Nominal GDP to a one-percentage point change in Capital Adequacy Ratio, in percent

	Impulse responses of LZscore to one SD change in CAR	Decreases in LZscore by one percentage point change in CAR	Changes in Z-score (%)
The 1st year	-0.01825	-0.0214	-2.113%
Permanent effect	-0.22	-0.257	-29.36%
	Impulse responses of LGDP to one SD change in CAR	Decreases in LGDP by one percentage point change in CAR	Changes in Nominal GDP (%)
The 1st year	-0.079833	- 0.0934	-8.919%
Permanent effect	-0.2	-0.234	-20.866%

** Note: (1) one standard deviation in CAR is equal to 0.8546 percentage point change in CAR*
(2) $ln(Y_{response}) - ln(Y_{base}) = ln(Y_{response}/Y_{base}) = a$, so $\%\Delta Y = (e^a - 1) * 100\%$
(3) Permanent effects are from the tenth year
(4) The information for these calculations is represented in Appendix 2

4.2.2. Capital Adequacy Ratio, Credit Supply, and Nominal Output Level

As regards the impact of stringent capital adequacy ratio on the output level through influencing the credit supply of the banking system, there is a significant evidence for the countercyclical role of capital adequacy ratio, as a higher capital adequacy ratio would enhance the capability of supplying credit by 12.92% in long-run (Table 4.2.2.1). This positive long-run relationship was also found by Buch and Prieto (2014) in which VECM estimates were implemented and provided the result that 1 per cent increase in the equity capital level would increase the level of business loans by 0.23% in the German banking system. Concerning the short-run relationship, although being insignificant, the coefficient of capital adequacy ratio in the short-run equation of total loans still reveal a negative sign, which implies that the commercial banks in short-term are inclined to reduce their credit supply in the interest of the capital ratio level (Column 2). These findings not only align with the panel-data estimates', but also strengthen the implication of the banks' response to stricter capital requirements from the previous VECM estimation on the system CAR – Z-score - GDP. Additionally, the adjustment coefficient of the natural logarithm of total loan portrays that the credit supply is more likely to adjust upward (76 per cent disequilibrium recovering after one year), due to a higher capital adequacy ratio. Meanwhile, there is a downward adjustment in capital adequacy ratio with the speed of 0.09 percentage point, when a higher level of credit supply at the expense of the bank capital ratio level occurs. In the short run, there is evidence that a higher capital adequacy ratio would be followed by a reduction in the level of credit supply, as the coefficient of lag difference in capital adequacy ratio in the total loans is negative, albeit statistically insignificant. By contrast, a one percent increase in lag of the total loans differential would lead to a 0.196 percentage point increase in the CAR differential, which implies the accumulation of returns on providing credits would reinvigorate the capital ratio level, the effect requiring three years to be achieved.

Table 4.2.2.1: VECM estimates – the system of CAR – Total Loans - GDP

VARIABLES	(1) ΔCAR	(2) Δ(The natural logarithm of Total loans)	(3) Δ(The natural logarithm of GDP)
L.CE1 (adjustment coefficients)	-8.999 (2.47)**	0.760 (2.10)**	0.006 (0.03)
Lag ΔCAR	0.283 (0.84)	-0.023 (0.70)	0.006 (0.33)
Lag Δ(the natural logarithm of Total loans)	19.647 (2.82)***	-1.107 (1.60)	0.539 (1.43)
Lag Δ(The natural logarithm of GDP)	6.922 (1.34)	-0.419 (0.81)	0.253 (0.90)
Constant	0.008 (0.01)	0.100 (1.11)	-0.010 (0.20)
Observations	14	14	14
RMSE	0.8398	0.0834	0.0453
R-squared	0.5939	0.9108	0.95
Chi-squared	11.7**	81.7217***	152.0548***

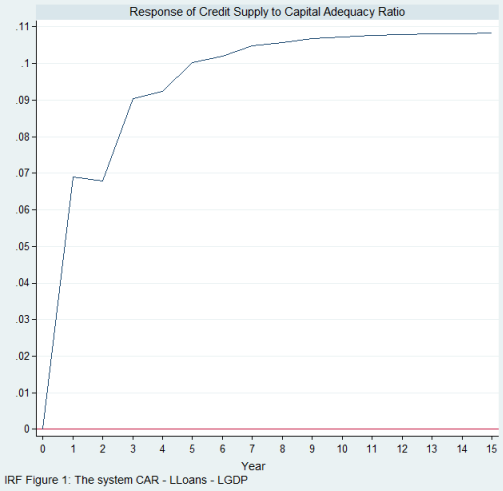
Cointegration Equation

Beta (β)	Normalisation on the natural logarithm of total loans
CAR	0.1215
	(10.12)***
The natural logarithm of total loans	1
The natural logarithm of GDP	-2.1038
	(-16.12)***
Trend	0.0416
	(2.13)**
Constant	23.0405
Chi-squared	261.5283

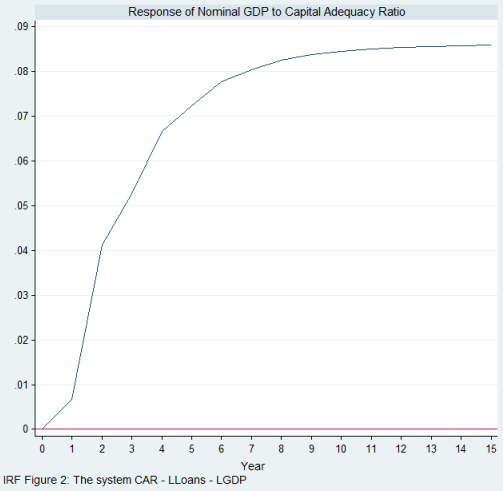
z-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

From the IRF Figure 2 and 3 in Figure 4.2.2, it is manifest that the impacts of an innovation in capital adequacy ratio on credit supply and nominal GDP are positive and permanent. For credit supply, the contemporaneous impact of a one-standard-deviation change in capital adequacy ratio on the natural logarithm of total loans is 0.069, which converges on the long-run impact of approximately 0.108, albeit not being monotonously, from the tenth year. As illustrated in Table 4.2.2.2, this permanent effect is converted to be 0.129 per one-percentage-point increase in capital adequacy ratio, a number which is approximate to the long-run β coefficient (0.1215) in the cointegration equation, and equivalent to 13.724 per cent increase in the level of credit supply. Meanwhile, the impact on the output level experiences a monotonous convergence to the long-run impact of 0.1012 in the same time with the credit supply from the small contemporaneous impact of 0.008. These numbers are equivalent to 10.651 per cent and 0.81 per cent increases in the output level in the permanent state and the contemporaneous state, respectively. The results prove that stricter capital requirements can be taken as a countercyclical tool which forces the Vietnamese commercial banks to create a capital cushion against the downside of the economy through enhancing the capability of providing credits.

Figure 4.2.2: Generalised Impulse Responses of Credit Supply and GDP in the system CAR – LLoans - LGDP



IRF Figure 1: The system CAR - LLoans - LGDP



IRF Figure 2: The system CAR - LLoans - LGDP

Table 4.2.2.2: Generalised Impulse Responses of Total Credits and Nominal GDP to a one-percentage point change in Capital Adequacy Ratio, in percent

	Impulse responses of LLoans to one SD change in CAR	Increases in LLoans by one percentage point change in CAR	Changes in Total Loans (%)
The 1st year	0.06901	0.0822	8.565%
Permanent effect	0.108	0.129	13.724%
	Impulse responses of LGDP to one SD change in CAR	Increases in LGDP by one percentage point change in CAR	Changes in Nominal GDP (%)
The 1st quarter	0.006767	0.0008	0.81%
Permanent effect	0.085	0.1012	10.651%

** Note: (1) one standard deviation in CAR is equal to 0.8398 percentage point change in CAR*
(2) $ln(Y_{response}) - ln(Y_{base}) = ln(Y_{response}/Y_{base}) = a$, so $\%\Delta Y = (e^a - 1) * 100\%$
(3) Permanent effect is from the tenth year
(4) The information for these calculations is represented in Appendix 2

It is worth noting that the result of the impulse responses of credit supply to an increase in capital adequacy ratio in the case of Vietnam is in accord with that in the case of Philippine (Parcon-Santos & Bernabe 2012), in which by applying VAR estimates on the time-series of 16 quarters, a 1 per cent increase in the capital ratio requirements leads to a 4.7 per cent increase in the volume of loans in the first four quarters, and which only reveals a temporarily positive effect on the real GDP growth by 0.01% in the second year.

4.3. Policy implication

In light of the findings in these two approaches, it is sensible to conclude that in the short term, the commercial banks in Vietnam are inclined to follow the strategy in which they still maintain or improve their credit supply, albeit more concerned to reduce their risky assets portfolio, and attempt to raise their capital, when they have been obligated to achieve the stricter capital requirements. However, in the long term, the constraints of these requirements on taking risky assets are not effective, while the stimulating effect of these requirements on the credit supply or the incentives towards providing credits still exists. Hence, the higher requirements on minimum regulatory capital ratio cause a permanent loss larger than the permanent gain, which can be explained that such requirements force the commercial banks to provide credits to increase their capital level through profit accumulation, this intention considered as the precursor of the banks' losses, and thus the fragility of financial stability. This explanation is in accordance with Kanzari and Fayçal (2017) investigating the case of Tunisian banks and showing that the stricter minimum capital requirements (from 5% in 1996 to 8% in 1999, to 9% at the end of 2013 and to 10% at the end of 2014) reduces by 55% the Z-score of these banks. Standing at this viewpoint, it is perceivable that the minimum capital requirements alone are not sufficient to monitor and supervise the banking system, and thus to guarantee the reinforcement of financial stability, since they do not convey any guidance for the commercial banks to perceive risky assets and manage their loans portfolios. Therefore, they do require to be complemented by other dimensions of regulation and supervision on the structure of bank loan portfolios. In addition,

it is of great necessity for the State Bank of Vietnam (SBV) to strictly regulate and orientate risk managements in the commercial banks in their legislations, with the aims of encouraging the commercial banks improving their risk control.

Chapter 5
Conclusion

With the aim of stabilising, recovering, and strengthening the banking system, the stricter capital adequacy requirements in Vietnam, in accordance with Basel Accords, have been consecutively put forth since 1999, and could be divided into four phases (1999-2004, 2005-2009, 2010-2016, 2017 and up to now). Under the provisions of these requirements, the Vietnamese commercial banks can select three overall alternatives, together with the combinations amongst them, to satisfy the regulatory capital adequacy ratio. These options consist of increasing their capital, contracting lending, and cutting down risky assets, which are expected to yield different impacts, with different directions, on the output level when the commercial banks take actions. Indeed, considered as an important factor of economic development, the financial sector is responsible of allocating savings and furnishing productive investments with money; hence, any regulation influencing the financial sector and forcing it to change its behaviours would indirectly affect economic growth and development.

Inspired by the State Bank of Vietnam's attempt to reform the banking system through stringent supervisions and regulations, and the theoretical and empirical repercussions of stricter requirements on bank capital level for banking systems and economies, this paper would try to explicate the impact of a higher regulatory capital adequacy ratio on the banking system firstly at the bank-individual level through panel-data analysis, and secondly at the entire system through VECM estimates. Additionally, the VECM approach enables the research to estimate the impulse responses of the output level to a higher level of regulatory capital ratio in the two endogenous systems with the two transition variables, respectively Z-score (an indicator for financial stability) and the natural logarithm of total loans (an indicator for credit supply). More importantly, through this approach, not only the short-run dynamic relationship between the endogenous variables, but also the long-run relationship, is estimated.

From the panel-data approach, there is an implication that the commercial banks are inclined to reduce their incentives towards providing risky credits in the short term and to reinvigorate their capital, thus unlikely to contract their lending, as they have been confronted by the stricter capital requirements. More particularly, a higher capital ratio would enhance Z-score, but only to some extent, as there is a deterioration on Z-score by the increase in capital ratio over the phases. By taking non-performing loans as an indicator of bank risk-taking, this research found that the incentives toward risky assets would be constrained when a higher regulatory capital ratio was required; nonetheless, there is no evidence that this effect occurs over the periods. In contrast, the credit supply would be decreased by an increase in capital adequacy ratio, but this impact becomes positive over the periods. Meanwhile, there are no direct effects of capital ratio requirements on net lending interest ratio; however, it is possible to observe that the positive effect of return on equity on this ratio is lowered by an increase in capital adequacy ratio, probably because this increase could reduce the equity risk and raise the bank safety, thus lessening required rates of return.

In the VECM estimates, the strategy of the commercial banks for satisfying tighter capital requirements is more coherently explained as the results embodied

that a higher capital adequacy ratio would cause a permanent deterioration in Z-score, but generate a permanent benefit for the credit supply. Notwithstanding that the time-series is short, this approach still provides the findings that an innovation in capital adequacy ratio would yield a permanent loss due to the sacrifice of the financial stability for the credit supply and a permanent benefit due to the enhancement in the capability of supplying credits. However, the larger magnitude of the permanent loss renders the overall impact of stricter capital requirements in Vietnam negative. Nevertheless, this does not mean that the regulations on capital adequacy ratio are undesirable to economic development, but rather that they are not sufficient to constraint the incentives towards risky assets, causing a fragile banking system. It is advisable to suggest other dimensions of regulations and supervisions on the banking systems, which focus on regulating and constraining the structure of bank loan portfolios, as well as guiding and improving the ability of risk management in the commercial banks.

Albeit acknowledging that the limitation on the time-series data could bias the VECM findings, this research is expected to make a moderate contribution by providing an analytical insight into the macroeconomic impact of stringent capital requirements in Vietnam.

Appendix 1.A Granger Causality Test

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
CAR	LZscore	41.309	3	0.000
CAR	LGDP	26.268	3	0.000
CAR	ALL	68.409	6	0.000
LZscore	CAR	6.9872	3	0.072
LZscore	LGDP	4.1014	3	0.251
LZscore	ALL	58.661	6	0.000
LGDP	CAR	58.096	3	0.000
LGDP	LZscore	92.422	3	0.000
LGDP	ALL	121.99	6	0.000

Granger causality Wald tests

Equation	Excluded	chi2	df	Prob > chi2
CAR	LLoans	23.522	3	0.000
CAR	LGDP	5.188	3	0.159
CAR	ALL	41.747	6	0.000
LLoans	CAR	26.942	3	0.000
LLoans	LGDP	91.453	3	0.000
LLoans	ALL	130.62	6	0.000
LGDP	CAR	32.033	3	0.000
LGDP	LLoans	133.97	3	0.000
LGDP	ALL	175.2	6	0.000

Appendix 1.B Unit Root Tests (DF-GLS)

	DF-GLS tau Test Statistic					
Lags	Non-performing loans ratio	The natural logarithm of Z-score	The natural logarithm of Total loans	Capital adequacy ratio	The natural logarithm of GDP	10% Critical Value
4	-3.007	-1.195	-2.561	-1.152	-1.684	-2.368
3	-2.950	-1.218	-2.793	-1.193	-2.825	-2.474
2	-1.946	-0.795	-1.808	-1.877	-1.208	-2.692
1	-2.258	-1.243	-1.101	-1.630	-1.091	-2.932

** Note: if DF-GLS tau is larger than Critical Value at the significant of 10%, the null hypothesis cannot be rejected.*

Appendix 1.C VAR Lag Selection-Order Criteria

The system: CAR-LZscore-LGDP

Lags	LL	LR	FPE	AIC	HQIC	HQ
0	-7.63109		0.001182	1.77185	1.72697	1.89308
1	30.3517	75.966	0.00001	-3.05862	-3.23815	-2.57372
2	41.2772	21.851*	0.000011	-3.37954	-3.69372	-2.53095
3	.	.	-6.3e-23*	.	.	.
4	1099.43	.	.	-177.238*	-177.777*	-175.783*

** Note: * indicates preferred statistics.*

The system: CAR-LLoans-LGDP

Lags	LL	LR	FPE	AIC	HQIC	HQ
0	-9.45722		0.001602	2.0762	2.03132	2.19743
1	37.1092	93.133	3.3e-06	-4.18486	-4.36439	-3.69995
2	55.2079	36.197*	1.1e-06	-5.70131	-6.01549	-4.85273
3	.	.	-5.0e-23*	.	.	.
4	1038.97	.	.	-167.161*	-167.699*	165.706*

** Note: * indicates preferred statistics.*

Appendix 1.D Number of Cointegrating Equations classified by the Three Specifications

The system: CAR-LZscore-LGDP

VAR Models	No intercept No trend		Intercept No Trend		Intercept No Trend	
Rank or No. of CEs	Intercept No Trend		Intercept No Trend		Intercept Trend	
	Trace statistic	5% Critical Value	Trace statistic	5% Critical Value	Trace statistic	5% Critical Value
0	38.0771	34.91	32.9893	29.68	64.0095	42.44
1	17.4935*	19.96	14.6729*	15.41	16.3412*	25.32
2	6.9304	9.42	4.3454	3.76	5.9543	12.25

** Note: if Trace statistic is smaller than Critical Value at the significant of 5%, the null hypothesis cannot be rejected*

The system: CAR-LLoans-LGDP

VAR Models	No intercept No trend		Intercept No Trend		Intercept No Trend	
Rank or No. of CEs	Intercept No Trend		Intercept No Trend		Intercept Trend	
	Trace statistic	5% Critical Value	Trace statistic	5% Critical Value	Trace statistic	5% Critical Value
0	51.3073	34.91	48.2670	29.68	59.2831	42.44
1	16.3421*	19.96	15.0351*	15.41	21.5520*	25.32
2	6.2844	9.42	5.5154	3.76	5.5198	12.25

** Note: if Trace statistic is smaller than Critical Value at the significant of 5%, the null hypothesis cannot be rejected*

Appendix 2 Generalised Impulse Responses

Results from vec

step	(1) irf	(2) irf
0	0	0
1	.06901	.006767
2	.06785	.041301
3	.090364	.052645
4	.092388	.066653
5	.100323	.072317
6	.101949	.077809
7	.104861	.080403
8	.105763	.082592
9	.106868	.083741
10	.107307	.084627
11	.107738	.085126
12	.10794	.085488
13	.108111	.085702
14	.108201	.085852
15	.10827	.085943

(1) irfname = vec, impulse = CAR, and response = LLoans
(2) irfname = vec, impulse = CAR, and response = LGDP

Results from vec

step	(1) irf	(2) irf
0	0	0
1	-.01825	-.079833
2	-.071818	-.127303
3	-.118365	-.126343
4	-.138173	-.155393
5	-.162285	-.17195
6	-.180862	-.175909
7	-.191021	-.187242
8	-.201397	-.193643
9	-.209081	-.19657
10	-.213948	-.201071
11	-.218409	-.20371
12	-.221671	-.205309
13	-.22392	-.207134
14	-.225843	-.208265
15	-.227251	-.209048

(1) irfname = vec, impulse = CAR, and response = LZscore
(2) irfname = vec, impulse = CAR, and response = LGDP

Appendix 3 Stability and White-noise Residuals Tests

The system: CAR – LZscore - LGDP

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	6.0976	9	0.73011
2	7.8109	9	0.55331

H0: no autocorrelation at lag order

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
.7598417	.759842
-.3492125 + .5441879i	.646599
-.3492125 - .5441879i	.646599
.1242507	.124251

The VECM specification imposes 2 unit moduli.

The system: CAR – LLoans – LGDP

Lagrange-multiplier test

lag	chi2	df	Prob > chi2
1	5.2575	9	0.81131
2	10.4646	9	0.31420

H0: no autocorrelation at lag order

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
.6475979	.647598
-.5292292	.529229
-.1919324	.191932
.1557345	.155735

The VECM specification imposes 2 unit moduli.

Appendix 4 List of Commercial Banks

ABB	An Binh Commercial Joint Stock Bank
ACB	Asia Commercial Joint Stock Bank
AGR	Vietnam Bank for Agriculture and Rural Development
BIDV	Joint Stock Commercial Bank for Investment and Development of Vietnam
CTG	Vietnam Joint Stock Commercial Bank of Industry and Trade
DAB	DongA Joint Stock Commercial Bank
EIB	Vietnam Export Import Commercial Joint Stock Bank
FCB	First Joint Stock Commercial Bank
GAB	Great Asia Commercial Joint Stock Bank
HBB	Hanoi Building Commercial Joint Stock Bank
HDB	Ho Chi Minh City Development Joint Stock Commercial Bank
KLB	Kienlong Commercial Joint Stock Bank
MB	Military Commercial Joint Stock Bank
MDB	Mekong Development Joint Stock Commercial Bank
MHB	Mekong Housing Bank
MSB	Vietnam Maritime Commercial Joint Stock Bank
NAB	Nam A Commercial Joint Stock Bank
NCB	National Citizen Bank
OB	Ocean Commercial One Member Limited Liability Bank
PGB	Petrolimex Group Commercial Joint Stock Bank
SCB	Saigon Commercial Bank
SEAB	South East Asia Joint Stock Commercial Bank
SGB	Saigon Bank for Industry & Trade
SHB	Saigon – Hanoi Commercial Joint Stock Bank
STB	Saigon Thuong Tin Commercial Joint Stock Bank
TCB	Vietnam Technological and Commercial Joint Stock Bank
TNB	Vietnam Tin Nghia Commercial Joint Stock Bank
TPB	Tien Phong Commercial Joint Stock Bank
VCB	Joint Stock Commercial Bank for Foreign Trade of Vietnam
VCPB	Viet Capital Commercial Joint Stock Bank
VIB	Vietnam International Commercial Joint Stock Bank
VPB	Vietnam Commercial Joint Stock Bank for Private Enterprise

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