



UNIVERSITI PUTRA MALAYSIA

***CAPITAL ADEQUACY, DEFAULT RISK AND MACROECONOMIC SHOCKS IN
COMMERCIAL BANKS IN EAST ASIAN EMERGING COUNTRIES***

MOHAMMADREZA ALIZADEH JANVISLOO

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By

MOHAMMADREZA ALIZADEH JANVISLOO

**Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in
Fulfillment of the Requirements for the Degree of Doctor of Philosophy**

September 2015

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DEDICATIONS

To my wife, Haleh
My lovely son, Amir
Father and mother
For their support and never-ending
love.



Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Doctor of Philosophy

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September 2015

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Evidence from bank failures due to different types of crises over the past decade has led to banks' capital metrics process to be challenging. One of the most challenging processes is to measure default risk and optimum capital. Market asset value is used to measure default risk and optimum capital to test the health of the banking system. The effect of economic shocks on banks' default risk is the other issue related to the health of banks, which has been strongly considered in developed countries. In the literature related to these topics, there is a gap in East Asian emerging countries.

In this study, the probability of default is primarily estimated based on market information with a Merton's Option Pricing Model for commercial banks in five emerging countries (Malaysia, Singapore, Korea, Thailand, and Indonesia) for the period of 1995-2013. The estimated default risk varies according to economic conditions and increases noticeably in the disaster time. It also consists of asset qualities such as non-performing loans. The default risk in Indonesia and Korea are always more than the other countries while Singapore has the lowest risk.

To meet the second objective, a Global Vector Auto Regressive (GVAR) Model has been used to measure the effects of macroeconomic internal and external shocks on domestic macroeconomic risk factors. The shocks up to 3 standard deviations of variables have been imposed to GVAR Model. Bootstrap median estimation of generalized impulse response functions show that weak exogenous foreign country-specific variables have significant effects on their domestic corresponding variable. Meanwhile the equity price, real GDP, and real exchange rate are the main transmission channel of shocks' effects on the domestic macro risk factors.

Finally, this study estimates the relationship between the probability of default and macroeconomic risk factors using a dynamic panel data model with a Least Square Dummy Variable Bias Correction (LSDVBC) estimator. The empirical outcome shows that the default risk is explained with different combinations of variables in each country. Meanwhile the equity piece, real exchange rate, real output, and oil price are

the most effective variables on the probability of default. The bank size and asset return ratio is the other effectual bank-specific variables on default risk.

Based on the impulse response functions, the default risk has been affected by macroeconomic shocks in Malaysian banks more than the other countries. The banks in Indonesian, Korea, Thailand, and Singapore have less been influenced respectively. The banks' capital conditions is different in these countries and the impact of shocks on the probability of default definitely depends on the initial conditions in terms of capital and market value of their assets as well as their equity volatility, bank size, and asset return ratio.

Banks in Singapore have the best condition as the suggested adequate capital ratio is 18.5 percent, which requires a 14 percent increase in capital. In Indonesia, the banks' capital is not in well status and the capital ratio has to be 24.2 percent due to 51.4 percent increasing in the capital. Korea, Malaysia, and Thailand have relatively been in better and somewhat similar conditions. Hence, they need to improve their adequate capital ratio to 20.6, 20.1, and 21.2 percent while the required capital increase equals 34, 37 and 39.7 percent in average respectively. Therefore following the macro-prudential policy and forward-looking approach, it is suggested that the banks' capital to be strengthened before a sudden shock leads to a financial crisis.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Doktor Falsafah

**NISBAH KECUKUPAN MODAL, KEBARANGKALIAN KEMUNGKIRAN
DAN KEJUTAN EKONOMI MAKRO DI BANK PERDAGANGAN DI
RANTAU NEGARA MEMBANGUN ASIA TIMUR**

Oleh

MOHAMMADREZA ALIZADEH JANVISLOO

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Bukti daripada kegagalan bank disebabkan oleh beberapa jenis krisis sepanjang dekad yang lalu telah membawa kepada proses metrik modal bank yang mencabar. Satu daripada proses yang paling mencabar ialah mengukur risiko kemungkiran dan modal optimum. Nilai pasaran aset digunakan untuk menilai risiko kemungkiran dan modal optimum untuk menguji kesihatan sistem bank. Salah satu isu lain yang berkaitan dengan peringkat kesihatan perbankan, adalah kesan kejutan ekonomi pada risiko kemungkiran bank. Ini telah diberikan pertimbangan yang agak penting di negara-negara maju. Dalam sorotan literatur yang berkaitan dengan topik-topik ini, terdapat jurang di negara-negara baru Asia Timur.

Dalam kajian ini, kebarangkalian kemungkiran dianggarkan berdasarkan maklumat pasaran Pilihan Model Penentuan Harga Merton untuk bank-bank perdagangan di lima buah negara membangun (Malaysia, Singapura, Korea, Thailand, dan Indonesia) bagi tempoh 1995-2013. Risiko kemungkiran anggaran berbeza-beza mengikut keadaan ekonomi dan terdapat peningkatan yang ketara pada masa bencana. Ia juga terdiri daripada kualiti aset seperti pinjaman tidak dibayar. Risiko kemungkiran di Indonesia dan Korea sentiasa lebih daripada negara-negara lain manakala Singapura mempunyai risiko yang paling rendah. Bagi memenuhi objektif kedua, Global Auto Vektor regresif (GVAR) Model telah digunakan untuk mengukur kesan kejutan dalaman dan luaran makroekonomi di atas faktor-faktor risiko makroekonomi domestik.

Kejutan sehingga 3 sisihan piawai pembolehubah telah dikenakan ke atas GVAR Model. Bootstrap anggaran median umum fungsi tindak balas impuls menunjukkan bahawa pembolehubah negara asing luaran yang lemah, mempunyai kesan yang amat penting dan ketara ke atas pembolehubah domestik mereka. Sementara itu harga ekuiti, KDNK benar dan kadar pertukaran sebenar adalah saluran penghantaran utama kesan kejutan ke atas faktor-faktor risiko makro domestik.

Akhir sekali, kajian ini menganggarkan hubungan antara kebarangkalian lalai dan faktor-faktor risiko makroekonomi dengan menggunakan model data panel dinamik dengan Dataran Dummy Pembetulan Bias ubah (LSDVBC) penganggar yang paling kurang.

Hasil empirikal menunjukkan bahawa risiko mungkir dijelaskan dengan kombinasi pembolehubah yang berbeza di setiap negara. Sementara itu, ekuiti, kadar pertukaran sebenar, pengeluaran sebenar dan harga minyak adalah pembolehubah yang paling berkesan pada kebarangkalian kemungkiran. Saiz bank dan nisbah pulangan aset adalah antara pembolehubah yang berkesan ke atas risiko mungkir. Bank-bank di Singapura mempunyai keadaan yang terbaik Nisbah modal memadai yang mencukupi, berdasarkan nisbah 18.5 peratus, yang memerlukan peningkatan modal sebanyak 14 peratus. Di Indonesia, modal bank tidak berada dalam status yang baik berdasarkan nisbah modalnya yang telah menjadi 24.2 peratus, disebabkan oleh 51.4 peratus peningkatan modal di ibu negara. Korea, Malaysia, dan Thailand berada dalam keadaan yang lebih baik dan agak serupa. Oleh itu, mereka perlu mempertingkatkan nisbah kecukupan modal kepada 20.6, 20.1 dan 21.2 peratus; manakala peningkatan modal yang diperlukan adalah sama dengan 34, 37 dan 39.7 peratus dalam purata masing-masing. Oleh itu, berdasarkan kepada polisi kehematan makro dan bagi pendekatan masa hadapan, adalah dicadangkan supaya modal bank diperkukuhkan sebelum kejutan secara tiba-tiba yang membawa kepada krisis kewangan.

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I certify that a Thesis Examination Committee has met on 14 September 2015 to conduct the final examination of Mohammad Reza Alizadeh Janvisloo on his thesis entitled "Capital Adequacy, Default Risk and Macroeconomic Shocks in Commercial Banks in East Asian Emerging Countries" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Doctor of Philosophy.

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LIST OF ABBREVIATIONS

ACI	Akaike Information Criterion
ADB	Asian Development Bank
ADF	Augmented Dickey–Fuller
APW	Andrews and Ploberger (1994) Wald
AR	Auto Regressive
BCBS	Basel Committee of Banking Supervisors
BSM	<u>B</u> lack & <u>S</u> chole (1973) and <u>M</u> erton (1974)
CPI	Consumer Price Index
CRD	Capital Requirements Directive
Cs	Five important factors, including <u>C</u> haracter, <u>C</u> apital, <u>C</u> apacity, <u>C</u> ollateral and <u>C</u> ycle condition
CUSUM	cumulative sum
CV	Covariance Estimator
DD	Distance to Default
DSGE	Dynamic Stochastic General Equilibrium
DWB	Data base of World Bank
EaD	Exposure at Default
EDF	Expected Default Frequencies
EDG	Ratio of External Debt to GDP
EL	Expected Loss
EMEAP	Executives’ Meeting of East Asia Pacific Central Banks
FAVAR	Factor Augmented Vector Autoregressive
FLFA	Ratio of Foreign Liability to Foreign Asset
FR	Ratio of Foreign Reserve to GDP
FSAP	Financial Sector Assessment Program
GDP	Gross Domestic Production
GIRF	Generalized Impulse-response function
GMM	Generalized Method of Moments
GVAR	Global Vector Auto Regressive
I(1)	Integrated with order one
IDR	Indonesian Rupie
IFS	International Financial Statistics
IMF	International Monetary Fund
IRB	Internal Rating Based
IRF	Impulse Response function
IV	Instrument Variables
KMV	Model has been developed by <u>K</u> ealhofer, John Andrew <u>M</u> cQuown, and Oldrich <u>V</u> asicek in 1989
KRW	Korean Wang

LGD	Loss Given Default
Ln	Logarithm of Neperiaan
LSDV	Least-Squares Dummy Variables
LSDVC	bias corrected Least Square Dummy Variable
MR	Malaysian Ringet
MSCI	Morgan Stanley Capital International
<i>MTM</i>	<i>Mark-to-Market</i>
MVC	Market Value Capital
MW	Mean Wald
NAIC	National Association of Insurance Commissioners
NPL	Non-Performing Loans
OCC	Office of Comptroller of the Currency
OLS	Ordinary Least Square
PCA	Principal Component Analysis
PD	Probability of Default
PKms	Ploberger and Krämer's (1992) Mean Square
PKsup	Ploberger and Krämer's (1992) maximal OLS cumulative sum
PMG	Pooled Mean Groups
PPP	Purchasing Power Parity
QLR	Quandt's (1960) likelihood ratio
QR	quintile regression
RBC	Risk Based Capital
RNDP	Risk Neutral Default Probability
SBC	Schwartz Bayesian Criterion
SD	Standard Deviation
SEDR	Ratio of Short-term External Debt to Reserves
SG\$	Singapore Dalorer
SMEs	Small size Entrepreneurs
SMM	Small Macroeconomic Model
SRM	Systematic Risk Monitor
THB	Thai Bath
UL	Unexpected Loss anism
VaR	Value at Risk
VAR	Vector Auto Regressive
VECM	Vector Error Correction Model
WS	Weighted Symmetric

CHAPTER 1

INTRODUCTION

1.1 Background of the study

Banking industry is one of the most effective and important sectors in each economy. Strong and stable banking sector can play an important role in a implementation of fiscal and monetary policies. On the other hand, the weak and shaky banking systems could lead to recession and even financial deterioration in distress conditions like what occurred in Asian 1997 financial crisis. The latter was more important for economists due to the heavy costs imposed on the economies. Because of this dual feature of banks, the health and safety of the banking system has become one of the topics of interest to economists. One of the main criterions for assessing the health of banks is the accurate measurement of adequate capital to deal with bankruptcy in critical conditions.

For almost a decade, most banks have used the Basel II standards in order to measure the adequate capital. However, well capitalized banks failed due to the recent global financial crises in Europe and the U.S.A. This event led to the widespread criticism of the Basel II, and many central banks focused on the other new methods for measuring the bank's capital. The findings of these empirical studies resulted in the statement of Basel III. According to Basel III, the minimum total capital adequacy ratio in banks has to increase from 8% to 10.25%. In addition, based on economic conditions, each bank can keep more capital according to internal risk models in order to prevent bankruptcy. Hence, in order to measure the optimum capital, it was suggested to do the stress tests on the banks periodically.

Default risk is one of the most important indexes to regulate banks' portfolios and determine the adequate capital. Whenever the bank is unable to fulfill its obligations, it will be faced with default risk. Since deposits are the main sources of financing in a bank, the main obligations of the bank are the financial security of deposits. On the other hand, the bank's ability to make the repayment of its obligations depends on its asset value. Loans are the major parts of assets which their values are always affected by credit risk. Hence the default risk is directly related to the quality and combination of assets and liabilities in a bank and focusing on particular sectors of the economy cause the banks' credit to concentrate on these sectors. In such a condition, sudden diverse financial and macroeconomic shocks can lead to high credit risk in banks, and the losses arising from bank loans lead to a decline in the asset values and consequently an increase in the probability of default.

This feature can be seen in the banking system of Southeast Asian emerging countries. The emerging markets were initially defined by Antoine W. van Agtmael in 1981 to identify economics with rapid economic growth and industrialization. The other criterions to classify the emerging market by the IMF are the share of foreign income, external financial sources, and the degree of debt services. The emerging markets always have been changed from close to open economy and the structure of financial and capital market have been changed due to this transmission. These countries are the

high return investment opportunity for foreign investment. However the risk for investors is higher than others developed countries. Economy Watch has shown the multiple arrangements of these countries by various organizations, beside the IMF's classification of emerging economies.¹

After the Asian crisis, the structure of financial system changed significantly in suffered countries.² This restructuring in financial systems led to fundamental changes in commercial banks' *position in the financial sector* and their liabilities and asset portfolios. Over one decade after the implementation of these policies, a significant portion of banks' assets has moved to the non-industrial sector, households and small and medium size entrepreneurs (SMEs), and the share of corporate loans has been reduced. Table and figures in appendix A.1.a show some information about SMEs and households in studied countries. An increase in the leverage ratio in these sectors leads to high vulnerability against economic shocks. It can become a serious threat to the bankruptcy of commercial banks in crisis.

The openness of economies and development of international financial markets have exacerbated this vulnerability. Thus, it is necessary to ensure the health of banking system in the face of adverse economic shocks. The bankruptcy experience in significant proportion of banks during the costly financial crisis of 1997 made it more important to pay attention to this issue in East Asian emerging countries. Reviewing the existing literature revealed that there were some gaps regarding this issue in these countries. This research was an attempt to measure the commercial banks' default risk in selected East Asian emerging countries (including Malaysia, Singapore, Korea, Thailand, and Indonesia)³, and it estimated the sensitivity of the probability of default to macroeconomic shocks. Then, the amount of required capital has been forecasted to deal with the default risks raised from economic shocks.

Before addressing the problem concerning the studied countries, it is necessary to have a brief reference to the concept of risk and its components. Understanding the origin of default risk and its relationship with banks' assets and liabilities makes it easy to understand the vulnerability of banks against economic shocks.

1.2 Default Risk, Capital and Health of the Banking System

According to Cihk and Schaeck (2007); Demirgüç-Kunt and Detragiache (1998); and Navajas and Thegeya (2013), capital adequacy is one of the most important financial sound indicators in banks. Because of funding with deposits, banks often face high

¹¹ See: http://www.economywatch.com/world_economy/emerging-markets

² The most important parts of this mutation are the implementation of Financial Sector Assessment Program (FSAP) and development of new financial markets such as stock and bond markets. The recapitalization of damaged banks, bank mergers and the participation of foreign banks in domestic banking sectors were the other supportive programs to revive the banking system (See, Domanski, 2005; Jeon et al. 2011; Santos, 2009).

³ It is noticeable that South Korea is assumed the emerging country according to MSCI Barra's , The Economist's, and the Next Eleven classification lists. The Singapore also is the emerging country based on The Economist's list. The other three countries are emerging country based on IMF and some other classification organization. See http://www.economywatch.com/world_economy/emerging-markets.

leverage ratio (the ratio of deposit to asset). This feature makes banks extremely vulnerable to any macroeconomic shocks in a way they face the risk of bankruptcy. This is one of the reasons that forces banks to keep a minimum capital. In addition, the capital of a bank plays a fundamental role as a buffer against the loss risen from loans and an instrument to decrease the probability of default.

The related literature (see section 2.2.3) also shows that calculating banks' optimal capital has shifted over time toward the credit risk-based methods. Focal points of these studies such as Altman and Saunders (2001), Herring (2005), Jarrow (2007) and Kashyap and Stein (2004) are related to the criticism on Basel II standard risk-based methods such as procyclical effects of banks' capital limitation. It has also been pointed out that Basel II fails to adjust the weights of assets (assigned based on risk) due to the changes in economic conditions (Kashyap & Stein, 2004). And finally, the role of market information has been emphasized for determining and controlling banks' capital (Bliss & Flannery, 2001; Flannery, 1998; Flannery, 2001; Krainer & Lopez, 2004). Therefore, using leverage ratio based on market value of asset and liability has taken more attention than accounting based on this ratio. Forgoing will be more apparent with a brief reference to the effects of market value on credit risk in bank loan portfolios.

1.3 Credit Risk and Banks Loan Portfolio

According to the classification made by Delamaire (2012), risks in banks are classified into four major groups including financial risks, operational risks, business risks, and events risks. As the most important business of commercial banks is funding (borrowing) and lending financial resources; hence, the credit risk is the original source of financial risk in banks. The definition of credit risk makes this dominant feature clearer. Credit risk is indeed the loss due to unwillingness or inability of one party in a financial contract to fulfill the obligation at the time of commitment that damages the opposite party.

The credit risk is comprised of three main components: Probability of Default (PD)⁴ that is probability of failure to perform the obligation by the debtor due to the contract; Exposure at Default (EaD) which is the amount of the debt that borrower is unable to pay at the time of default, and Loss Given Default (LGD) that is the amount of final loss after the deduction of covered loss (recovery rate or RR) by creditor from EaD (Saunders & Allen, 2002).

Based on the regulatory definition of risk, multiplication of PD and LGD is the Expected Loss (EL) that is anticipated to incur under normal market conditions. In other words, EL is the loss rate or price of particular exposure at the beginning of the contract. The volatility from EL (difference between whole loss and EL at default time) is in fact the risk or Unexpected Loss (UL) in relation to one individual credit. The

⁴ Note that there are different concepts about probability default in relation to bank and bank's borrowers. In the case of bank borrowers, it means the failure to repay the loans. However, the bank's probability of default refers to bank's inability to repay its obligation (funds to depositors).

main objective of risk management is, on the one hand, to minimize the unexpected loss, and on the other hand, to keep the adequate capital to prevent bankruptcy.

To access the bank's total portfolio credit risk, the individual portfolio credit risks are combined together based on a credit risk model. Figure 1.1 shows a simple shape of the modeling of the portfolio risk in bank. Based on the frequency of EL, the probability of default can be estimated.

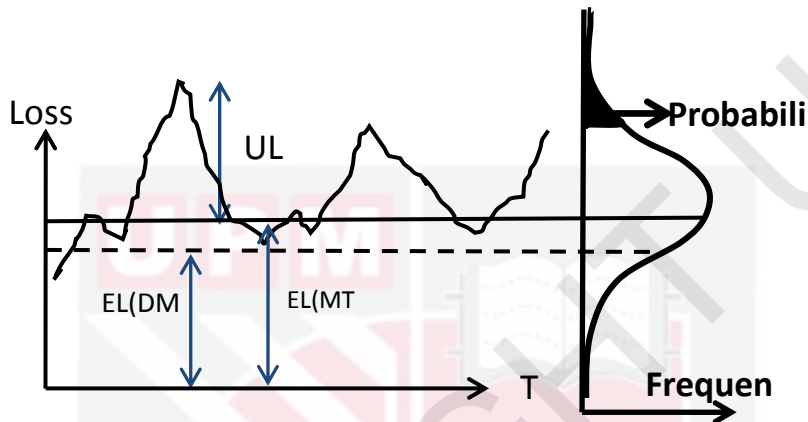


Figure 1.1. Portfolio Risk (expected (EL) and unexpected (UL) loss)

Source: Designed by the author based on figure included in BIS (2004).

Note: DM and MTM refer to two different approaches: Default mode and Mark-to-Market model

In this regard, two different attitudes are expressed: the first one which is called default mode or DM model is that the calculation of the expected loss is confined just to the economic value of the loan in default. In the next approach, the loss arising from changes in credit rate or market value of loans (due to increased default) is also taken into account in measuring loan loss. This is called mark-to-market or MTM models (Saunders & Allen, 2002). This simple example shows the relationship between the market value of loan and probability of default for creditors.

The distinction between these two approaches is the main factor of difference between traditional and structural risk models. In the traditional models as discussed in Bank for International Settlements (2004), the loss rate or EL does not change during the maturity time; in other words, unlike the structural models, the volatility of real market value of remaining exposure at default time is not considered in calculating the actual amount of expected loss. This issue has been widely argued among risk analysts after the recent global financial crisis, which showed most of the well capitalized banks experienced failure based on Basel II regulation. Due to the essential weakness of the Basel II in measuring capital regulatory, the analysts have concentrated on two fundamental points; first, the approach to credit risk models based on the market value of assets (loans), and the second, the impact of business cycle and macroeconomic shocks on the assets market value.

As mentioned earlier, the credit risk as a source of default risk is affected by market value of assets and has a significant role in specifying the amount of the required capital based on the risk. The market value of assets is not easily available and can be

measured as a function of equity price and amount of liability based on option pricing model. This is the foundation of structural models that links the assets value to liability in the process of estimating the probability of default. The relationship between probability of default and market value of assets is an appropriate tool to calculate the capital requirement consisting of each level of the probability of default (Chacko et al., 2006; Imerman, 2011).

The countries studied in this thesis have attempted to implement the financial restructuring policies after the Asian financial crisis. This restructuring in financial systems has led to a change in the combination of commercial banks' liabilities and assets. Now, after over one decade of the implementation of these policies, a review of the current status of commercial banks will present a clearer picture of the credit risk exposure of banks loan portfolio and the probability of default.

%DQNV\$VVHWDQG/LDELOLW\$IWHU&ULVLV

Up until 1997, almost the main part of banks' credit was held by big firms and corporations. The concentration of banks' credits on this sector beside the weaknesses in risk management led to the bankruptcy of a large number of banks following the financial crisis. The development of new financial markets such as stock and bond markets was one of the policies after the crisis in East Asian emerging countries. The main objective of this policy was to provide a convenient tool to obtain long-run capital for investors and reduce the mismatch between the banks' short-term deposits and long-term loans.⁵

The expansion of these markets has affected the performance of banks. Some of banks' credit customers have moved to these markets and banks encountered a gradual accumulation of funds; therefore, in order to maintain their profitability, non-industrial sectors including SMEs and households have been targeted as new credit customers. It has to be noted that the structural weakness in Indonesia and Thailand has led to less development of bond market. So, in these two countries, in addition to an increase in household debt, the banks still are the important sources to the finance of a corporate. As is shown in Figure 1.2, over the last decade, the share of credit for personal uses and non-industrial purposes has increased substantially and almost tripled compared with the previous decade.

The household debts to GDP ratio for Korea, Malaysia, Singapore, and Indonesia reached to 85%, 79%, 75%, and 68% respectively by the end of 2012 (Mann et al., 2013). Also based on a study done by Shinozaki (2012), SMEs were less affected by 1997 crisis than those big firms because of their independence from bank loans and reliance on their own capitals.

⁵ For more information about the performance of these markets, see Appendix 1. Also you can directly visit some information in Asian Bond Market website.

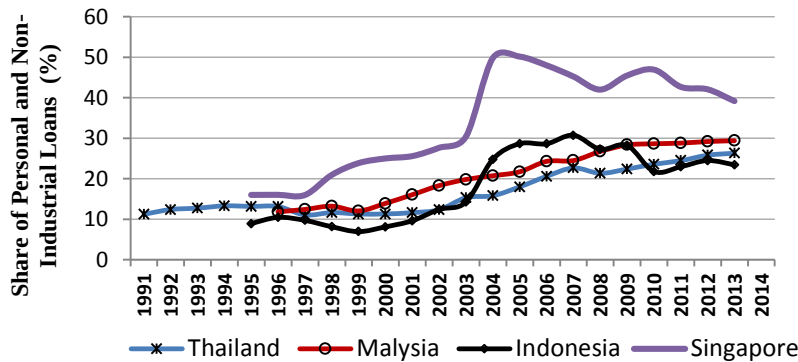


Figure 1.2. The Share of Personal and Non-Industrial Loans in Commercial Bank (1990-2014).

(Source of data: Central banks)

According to this study, the share of domestic loans to SMEs has increased during the last decade noticeably in some emerging Asian countries. On the other hand, the government's support for this sector has increased during recent years. It is documented that the financial sector has paid more funds to SMEs following the government pressures. Hence, SMEs and households are both more dependent on the banking system and more at the risk of internal and external economic shocks.

Also, the uncertainty associated with governmental monetary and fiscal policies as internal shocks will affect the assets and the financial ability of households and SMEs in repaying bank debts. All these evidences show that the concentration of bank loan on household and SMEs is another treatment for banks. Büyükkarabacak and Valev (2010) in a study on 37 developed and developing countries have documented that the expansion of household's debt is the best predictor of systematic banking crisis. Hence, just a one-percent increase in household debt to GDP ratio could lead to a 7.56 percent increase in the expectation of a banking crisis. In this condition, any shock on macroeconomic risk factors can lead to a reduction in the ability of debt repayment of this group of customers. Finally, the probability of default in banking system will also increase due to the increase in credit risk.

Along with the economic stability, the rapid return of foreign capital- which was quickly withdrawn during the global crisis- caused inflation and a strong increase in real asset price. In this situation, any reverse macroeconomic shock can lead to a rapid decrease in asset value and household debt repayment. This condition could lead to a bank's asset value decrease and more probability of default in the bank (Tillmann, 2013). Gai et al. (2008) also refer to the possibility of more bank fragility under the conditions of high macroeconomic stability and financial innovation.

One other important change in banks could be related to the combination of liabilities. The dependency of banks liability on foreign funds was one of the important issues resulting in the 1997 bankruptcy. The rapid withdrawal of short-term foreign funds which had allocated to long-term loans led banks to face with default risk. After the crisis, those affected banks tried to replace the liabilities with domestic funds. As it is

shown in Figure 1.3, the share of foreign funds in total liability has been sharply decreased after the crisis.

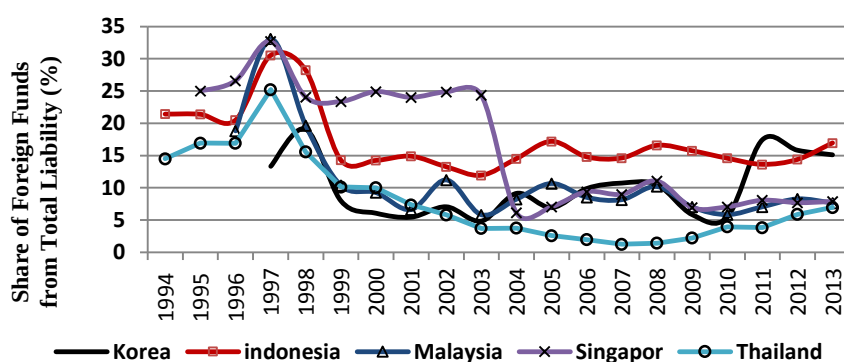


Figure 1.3. The Share of Foreign Funds from Total Liability in Commercial Bank (1994-2013).

(Source of data: Central banks and Datastream)

In contrast, the share of demand and saving deposits increased. These kinds of liabilities are removed very quickly from a bank in critical conditions. Furthermore, the share of fixed deposits as a stable financial resource in banks has decreased. Thus, under critical situations not only the non-performing loan will be increased, but also the depositors will rush to withdraw their money from the banks. Therefore the banks will face a shortage of resources leading to a possible bankruptcy. In other words, the default risk in the bank will be increased.

At the same time the banks' capital is an important hindrance against bankruptcy. As it is illustrated in Figure 1.4, the capital ratio for Malaysia, Thailand, and Indonesia has reached around 14 % that is more than Basel III standards. In Korea and Singapore, this ratio is approximately equal to Basel II standard Ratio. But given the current composition of banks' assets and liabilities, it is not clear whether this amount of capital can prevent the banks from failure in critical conditions or not.

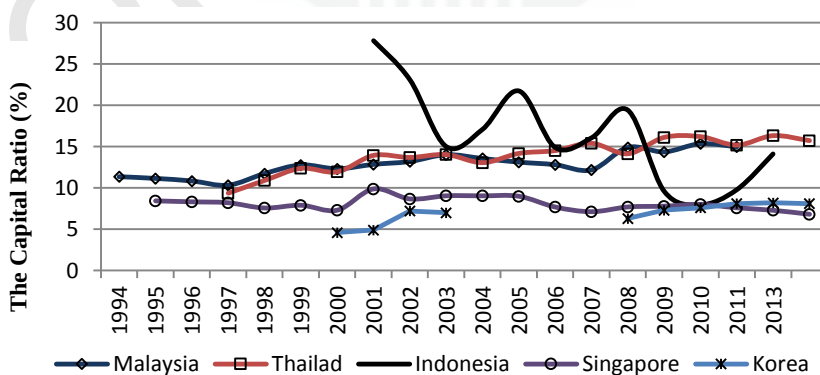


Figure 1.4. The Capital Ratio in Commercial banks (1994-2014).

(Source of data: Central banks and Datastream)

The particular importance of banks capital in dealing with bankruptcy has led the financial analysts in developed countries to focus on banks' capital metrics under shocked conditions of macroeconomic risk factors (see section 2.4.3). The results from these studies have also led the scope of decisions about banks' capital adequacy to go beyond the Basel standards, and a variety of risk models to be applied beside them. There has been an extensive literature on the development of these models over the past two decades (see section 2.2.2.).

The effect of business cycle on credit risk studies was started by Fama and French (1989). Then Wilson (1997) showed a link between credit risk and macroeconomic variables. After that, there were a lot of theoretical (see section 2.2.4) and empirical (see section 2.4.3) studies found in literature in this regard. Given the diversity of the macroeconomic factors affecting the risk, extracting systematic interactions among these variables deemed necessary to predict the shocked risk factors. Therefore, vector autoregressive models were used in different shapes in order to generate the risk factors based on different stress scenario (see section 2.4.1). Following the extensive results obtained from recent studies on risk, the Basel Committee guidelines and standards have been updated with regard to risk.

1.5 Capital Adequacy and BASEL III

Due to the recent global financial crisis, Basel Committee of Banking Supervisors (BCBS) has announced a series of initiatives in different areas from 2006 to 2009 to improve the banks' ability to absorb shocks arising from financial and economic stress. Finally, in December 2010, the comprehensive international framework of liquidity risk measurements, standards and monitoring, called Basel III was issued.

Basel III, referring to the relationship between risk sensitivity to economic conditions and capital requirements, prefers to use the probability of default that is estimated on economic downturn to adjust the capital requirement. To this end, Basel III suggested the countries all over the world to use the macro and micro prudential regulations. This method is called "Stress Test" that is seriously considered by financial experts after the recent global crisis. As explained in Basel Committee (2010a), "Banks must have a comprehensive stress testing program for counterparty credit risk" (p. 46) which must be inclusive of a number of elements:

Banks must identify exposures that give rise to a greater degree of general wrong-way risk. Stress testing and scenario analyses must be designed to identify risk factors that are positively correlated with counterparty credit worthiness. Such testing needs to address the possibility of severe shocks occurring when relationships between risk factors have changed. (p. 37)

Stress test has been used by Basel II while the global financial crisis as well as the recent problems of European banks in repaying debts showed that stress test experiences before the crisis could not find any noticeable factor of vulnerabilities. Consequently, it led to structural changes in stress tests and using their results (Haldane, 2009). Thus, Basel III has especially concentrated on this subject and emphasized that banks should perform stress test, particularly those which use internal models to measure the risk. According to global agreement on implementation

timeline, Basel III regulation has to be applied from 2013 until 2019 (see Bank for International Settlements, 2009; 2010; Cecchetti, 2010).

The stress test technique has been used by large international banks from 1990s. Since 1996, banks have been required to develop stress tests as part of their internal models for the calculation of capital requirements. There are many empirical studies which have been done in this area in developed countries (see section 2.3 and 2.4.3). In Southeast Asian countries, after Asian 1997 crises, significant changes have taken place in financial system, and monetary and foreign currency policies. But the test of banks' status and their reaction to potential macroeconomic shocks has received less attention within last decades.

A brief look into the financial system of these countries in the international arena shows its vulnerability to internal and external shocks. Table 1.1 shows some financial indexes about the studied countries, and compares them with China and Japan as two powerful economies in the region.

Table 1.1. Some Financial Features in the Studied Countries.

	FLFA	FR	EDG	SEDR
china	37.9	23.2	6.3	11.9
Japan	-	15	48.76	-
Malaysia	92.6	8.6	28.6	32
Singapore	106.8	8.3	237.6	73.2
Korea	203.9	7.2	28.8	60.3
Thailand	128.4	9.4	15.8	11.1
Indonesia	156	7.8	17.2	46.5

Source: Asian Economic Monitor extracted from Asian Development Bank (ADB), 2011.

Note: FLFA is ratio of foreign liability to foreign asset, FR is ratio of foreign reserve to GDP, EDG is ratio of external debt to GDP and SEDR is ratio of short-term external debt to reserves.

Obviously, the economy in these countries depends on foreign investments and the ratio of foreign liability to foreign asset is much higher than that of China and Japan. In contrast, the foreign reserves ratio in these countries is less than China and Japan. The external debt to GDP ratio is also higher in these countries. All these indices show the vulnerability of these countries against the external shocks. But the test of banks' status and their reaction to potential macroeconomic shocks has received less attention within last decades. Wong et al. (2010) made an attempt to identify the leading effective factors in banking crisis in EMEAP⁶ countries.

Ahmad and Ariff (2007) found some key determinants of commercial banks' credit risk in emerging economies. These indicators were taken from the banks specific features. Bentan (2011), on the other hand, had a case study on Maybank Automobile Financial Services non-performing loans problems. In Honk Kong, Wong and Lam (2008) pointed to data limitation in the application of econometric models, and run

⁶ The Executives' Meeting of East Asia Pacific Central Banks (EMEAP) has 11 members including: HongKong, China, Australia, Japan, Singapore, New Zealand, Korea, Malaysia, Indonesia, Thailand, and the Philippines.

stress test with a history-based model. In Korea, Chang and Kim (2010) did a joint stress testing on Korean financial industries including banking, Non-Life Insurance and Securities Industries by using the Principal Component Analysis (PCA) methods to extract the risk index for all financial industries. They, then, linked this index to macroeconomics and financial variables to do the stress test.

A stress test has been done on Korean household debt by Karasulu (2008) as a working paper in IMF. This study has used a household level panel data model based on family unit balance sheet data in order to show the sources of risks coming from household debts. The author, then, used the Non-Performing Loan ratio in household sector as a risk indicator, and interest rate and real estate price as shocked risk factors in this model. Obviously, there is not much study done in this area in East Asian countries with a special focus on credit risk in banking system. Most of the research has focused on internal shocks and has not used the forward looking approach to credit risk. Only few studies such as Pesaran et al. (2006) included the limited number of commercial banks from Asian countries and examined the effects of external shocks on credit risks. Given the history of the financial crisis on this region with a new structure of banking system, it is necessary to check the health of the banking systems in these countries.

1.6 Statement of the Problem

Banks have two contradictory features which are highly effective in the economy. A strong and stable banking system can play an important role in the implementation of fiscal and monetary policies. On the other hand, a weak and shaky banking system could lead to recession and even financial deterioration in distress conditions. Due to this dual feature of banks, the health and safety of the banking system has become one of the topics of interest to economists. The adequate capital is one of the important criteria for assessing the health in commercial banks. The optimum amount of this index is strongly dependent on risk, and particularly default risk. Meanwhile, the probability of default is affected by macroeconomic risk factors and is directly related to the bank's asset value and liability.

For example, the collapse of many banks in aftermath of the Asian financial crisis led to some fundamental changes in the financial structure of the East Asian emerging countries. Following this restructuring, and especially the development of new financial markets such as stock and bond markets, the liability and asset portfolio in commercial banks have noticeably been affected.

The expansion of new financial markets has caused a reduction in the dependency of large companies on banks' credits as one of the reasons for bank failures in 1997 crisis. The effects of these policies which are most palpable in Korea, Malaysia, and Singapore have led non-industrial sectors including small size entrepreneurs (SMEs) and households to be targeted by commercial banks as new credit customers. The credits for personal uses and non-industrial purposes have almost tripled compared with the previous decade. As a result, the household debts to GDP ratio for Korea, Malaysia, Singapore, and Indonesia have reached to 85%, 79%, 75%, and 68% respectively by the end of 2012, and the credits to SMEs noticeably increased. This concentration of banks' loan on household and SMEs has led to an increase in the leverage in these sectors which could be a threat to banking system. It should be

mentioned that the less development of bond market in Indonesia and Thailand; however, has led the banks to be still the main source of corporate finance. In fact, the banks in these countries are at risk, and asset depreciation risk is more than before.

On the other hand, after the Asian crisis, the dependency of banks' liability on foreign funds (one of the other reasons of bankruptcy in most banks due to this crisis) has declined. This reduction in foreign funding was compensated by capturing domestic deposits. In the meantime, the share of short-term funds including the demand and saving deposits increased in the same period. In contrast, the share of fixed deposits in 2013 has decreased in comparison with the year 1997. This means that the share of short-term funds is higher than that of long-terms.

Taking all these conditions into consideration, any uncertainty caused by internal economic shocks due to monetary and fiscal policies can affect (decrease) the assets and the financial ability of households and SMEs in paying back the debt of banks. In addition to the devaluation of assets, banks will also be faced with the fast withdrawal of a substantial portion of the deposits. Consequently, the probability of default in banking system will increase. Default risk is not only affected by the internal economic shocks, but also threatened by external shocks in the explored countries. The heavy dependence on exports and existing globalized financial markets in these countries leads to an acceleration in the spread effects of any external shock from foreign lands on these countries. This could have impact on many domestic macroeconomic risk factors and lead to more default risk.

After over one decade of the implementation of financial restructuring policies, and based on the current status of the banks' Portfolio and liability, it is now necessary to assess the health of banks in these countries. To this end, the ability of banks (the capital adequacy) to deal with the potential failures caused by any shocks need to be tested. The average capital ratio in the studied countries' banking systems has reached around 14% in Malaysia, Thailand, and Indonesia, that is more than Basel III standards. In Korea and Singapore, this ratio is approximately equal to Basel II standard Ratio. The important point in this regard is the less attention to market value of assets in current capital measurement. Given the current composition of banks' loan portfolio and liabilities, it is not clear if the amount of the capital can prevent banks from failure in critical conditions.

This issue is one of the particular interests in Basel III, as well. The guideline suggests all countries to use the macro and micro prudential regulations or stress test to adjust the capital requirements. Using the bank leverage ratio and the measurement of probability of default based on market information has resulted in the development of very vast structural credit risk models in recent years. However, reviewing the existing literature reveals that this subject has been given less attention by East Asian emerging countries, and some gaps still exist in this regard.

Therefore, the main issue of this study is to depict the behavior of banks default risk against any shock to macroeconomic risk factors in the studied countries. Furthermore, it will show the amount of bank's capital adaption as a preventive measure of bankruptcy. To this end, the probability of default and the capital adequacy have been considered as risk indicators in commercial banks. Also, the macro stress test model is used to analyze and to examine the systematic effects of shocked macroeconomic

variables on risk parameters, and finally forecast the risk indicators in stress condition. This model enhances the decision-making ability of economists and supports them in identifying and recovering from financial vulnerabilities arising from economic shocks.

1.7 Objective of the Study

The general objective of this study is to estimate the default risk and analyze its behavior to respond to internal and external economic shocks in order to estimate the optimum required capital in the banking system of East Asian emerging countries. In fact, this study aimed to answer the question if banking system can be resilient against external and internal macroeconomic shocked variables. In other words, it wants to ascertain if there is sufficient capital to prevent banks failure in stress time. In addition, this research is an attempt to investigate the relationship between internal/external macro financial scenario and micro-level information of banks default risk indicators such as default probability and capital adequacy. At the same time, the effect of features of a bank such as size, deposit combination (short and long run), and their leverage ratio on these relationships are examined. Thus, the following specific objectives are expected to be addressed throughout this study:

1. To measure the risk indicators (default risk) based on market value of assets for the major banks in selected emerging countries;
2. To analyze the spillover impact of internal and external shocks to macro and finance variables on domestic risk factors;
3. To estimate the optimum capital adequacy in response to any shock to macroeconomic variable.

1.8 Research Scope

In this study, the commercial banks of five emerging countries from South East Asia including Singapore, Korea, Thailand, Indonesia, and Malaysia were selected to investigate the health of their banking system in stress conditions. These countries are also influenced by the flow of foreign funds due to open economy and high export dependency. On the other hand, the financial markets in these countries have structurally changed after the 1997 crisis; such as through the development of equity and bond markets. The banking systems in these economies have been influenced by this structural change and bank lending has been shifted to households and SMEs. One other feature of these countries after the crisis has been concentrating on exchange rate and price stability by adopting a highly flexible exchange rate regime. The monetary policy in these countries is always affected by exchange rate policy and foreign capitals. Hence, the financial systems and especially banks are always at the risk of external and internal shocks. Because of this similarity, the credit risk of the selected countries in their banking systems were analyzed from different aspects in this study.

1.9 The Significant and Contribution of the Study

This thesis provided practical and theoretical criteria for default risk management of commercial banks in Southeast Asian emerging countries. In addition, a significant share of this dissertation was the development of efficient regulatory rules for the banking systems especially in adequate capital measurement for individual commercial banks in these countries. A dynamic, forward-looking approach was used to extract the default risk indicator as a new approach in Southeast Asian countries banking system. Also, the GVAR model provided by Pesaran et al. (2006) was expanded to estimate the systematic interaction among the macroeconomic risk factors. However, restriction on access to data is one of the determining factors in the choice of variables to depict effects of any internal and external shocks. According to the survey results, the financial vulnerability of the selected countries, and particularly the commercial banking systems which are faced with internal and external macroeconomic shocks was examined and their strengths and weaknesses were identified. Hence, certain appropriate fiscal and monetary policy tools were suggested in this research which could be selected by the governments in order to intervene and prevent any potential future financial problems in the region.

Also the central banks according to the results can monitor and control the operation of commercial banks based on their risk management and suggest the best adequate capital ratio regarding to forecasted default risk. The results of this study can also help to Capital and stock market participants to correct decision in order to investment.

REFERENCES

- Ahmad, N. H., & Ariff, M. (2007). Multi-country study of bank credit risk determinants. *International Journal of Banking and Finance*, 5(1), 6.
- Alessandri, P., Gai, P., Kapadia, S., Mora, N., & Pühr, C. (2009). Towards a framework for quantifying systemic stability. *International Journal of Central Banking*, 5(3), 47-81.
- Alessandrini, F. (1999). Credit risk, interest rate risk, and the business cycle. *The Journal of Fixed Income*, 9(2), 42-53.
- Alexander, C., & Sheedy, E. (2008). Developing a stress testing framework based on market risk models. *Journal of Banking & Finance*, 32(10), 2220-2236.
- Altman, E. I. (1968). Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. *The Journal of Finance*, 23(4), 589-609.
- Altman, E. I., & Saunders, A. (2001). An analysis and critique of the BIS proposal on capital adequacy and ratings. *Journal of Banking & Finance*, 25(1), 25-46.
- Andersen, H., Berge, T. O., Bernhardsen, E., Lindquist, K., & Vatne, B. H. (2008). A suite-of-models approach to stress-testing financial stability. *Norges Bank, Staff Memo*, 2, 3.
- Anderson, T. W., & Hsiao, C. (1982). Formulation and estimation of dynamic models using panel data. *Journal of Econometrics*, 18(1), 47-82.
- Andrews, D. W., & Ploberger, W. (1994). Optimal tests when a nuisance parameter is present only under the alternative. *Econometrica: Journal of the Econometric Society*, 1383-1414.
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte carlo evidence and an application to employment equations. *The Review of Economic Studies*, 58(2), 277-297.
- Arslanalp, S., & Liao, Y. (2014). Banking sector contingent liabilities and sovereign risk. *Journal of Empirical Finance*, 29, 316-330.
- Asberg, P., & Shahnazarian, H. (2008). Macroeconomic impact on expected default frequency. *Sveriges Riksbank Working Paper*, 219, January.
- Avery, R. B., Belton, T. M., & Goldberg, M. A. (1988). Market discipline in regulating bank risk: New evidence from the capital markets. *Journal of Money, Credit and Banking*, 20(4), 597-610.
- Babecký, J., Havránek, T., Matějů, J., Rusnák, M., Šmídková, K., & Vašíček, B. (2013). Leading indicators of crisis incidence: Evidence from developed countries. *Journal of International Money and Finance*, 35, 1-19.

- Baghli, M., Brunhes-Lesage, V., De Bandt, O., Fraisse, H., & Villette, J. (2004). Model for analysing and forecasting short term developments. *Banque De France Working Paper*, 106.
- Baltagi, B. (2008). *Econometric analysis of panel data* John Wiley & Sons.
- Bank for International Settlements. (2004). An explanatory note on the basel II IRB risk weight functions. *BIS Papers*, June.
- Bank for International Settlements. (2006a). Developing corporate bond markets in asia. kunming, china, 17-18 november 2005, *BIS Papers* 26.
- Bank for International Settlements. (2006b). International convergence of capital measurement and capital standards: A revised framework, comprehensive version. *BIS Papers*, June.
- Bank for International Settlements. (2009). Principles for sound stress Testing Practices and supervision. consultative document. *BIS Papers*, January.
- Bank for International Settlements. (2010). Basel III: International framework for liquidity risk measurement, standards and monitoring. *BIS Papers*, December.
- Bank for International Settlements. (2010a). Basel III: A global regulatory framework for more resilient banks and banking systems. *BIS Papers*, December.
- Beaver, W. H. (1966). Financial ratios as predictors of failure. *Journal of Accounting Research*, 4, 71-111.
- Bentan, G. (2011). *Credit risk management: A case study on maybank automobile financial services*. (Unpublished Master dissertation). Universiti Utara Malaysia, Malaysia.
- Berger, A. N., Herring, R. J., & Szegö, G. P. (1995). The role of capital in financial institutions. *Journal of Banking & Finance*, 19(3), 393-430.
- Berger, A., Davies, S., & Flannery, M. (1998). *Comparing market and supervisory assessments of bank performance: Who knows what when?*. Federal Reserve Board, Working paper, March.
- Bharath, S. T., & Shumway, T. (2008). Forecasting default with the merton distance to default model. *Review of Financial Studies*, 21(3), 1339-1369.
- Black, F., & Scholes, M. (1973). The pricing of options and corporate liabilities. *The Journal of Political Economy*, 81(3), 637-654.
- Black, F., & Cox, J. C. (1976). Valuing corporate securities: Some effects of bond indenture provisions. *Journal of Finance*, 31(2), 351-367.

- Bliss, R. R., & Flannery, M. J. (2001). Market discipline in the governance of US bank holding companies: Monitoring versus influencing. *Prudential supervision: What works and what doesn't* (pp. 107-146) University of Chicago Press.
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115-143.
- Boss, M., Krenn, G., Puhr, C., & Summer, M. (2006). Systemic risk monitor: A model for systemic risk analysis and stress testing of banking systems. *Financial Stability Report*, 11, 83-95.
- Bruno, G. S. (2005). Estimation and inference in dynamic unbalanced panel-data models with a small number of individuals. *Stata Journal*, 5(4), 473.
- Bun, M. J., & Kiviet, J. F. (2001). The accuracy of inference in small samples of dynamic panel data models. *Tinbergen Institute Discussion Paper*, No. 01-006/4
- Bun, M. J., & Kiviet, J. F. (2003). On the diminishing returns of higher-order terms in asymptotic expansions of bias. *Economics Letters*, 79(2), 145-152.
- Büyükkarabacak, B., & Valev, N. T. (2010). The role of household and business credit in banking crises. *Journal of Banking & Finance*, 34(6), 1247-1256.
- Calem, P. S., & Rob, R. (1996). *The impact of capital-based regulation on bank risk-taking: A dynamic model* Division of Research and Statistics, Division of Monetary Affairs, Federal Reserve Board.
- Capinski, M., & Zastawniak, T. (2003). *Mathematics for finance: An introduction to financial engineering*. London: Springer.
- Castrén, O., Dées, S., & Zaher, F. (2010). Stress-testing euro area corporate default probabilities using a global macroeconomic model. *Journal of Financial Stability*, 6(2), 64-78.
- Cecchetti, S. (2010). Financial reform: A progress report. *Remarks Prepared for the Westminster Economic Forum, National Institute of Economic Research, London*. Bank for International Settlements.
- Chacko, G., Anders Sjöman, Hideto Motohashi, & Vincent Dessain. (2006). *Credit derivatives: A primer on credit risk, modelling, and instruments (HB)* Philadelphia, Wharton Book Publishers, Upper Saddle River, NJ.
- Chang, C. (2014). A barrier option framework for rescue package designs and bank default risks. *Economic Modelling*, 38, 246-257.
- Chang, K. H., & Kim, M. J. (2010). Stress testing of financial industries: A simple new approach to joint stress testing of korean banking, securities, and Non-life insurance industries. *Asia-Pacific Journal of Financial Studies*, 38(4), 521-543.

- Chan-Lau, J. (2013). Market-based structural top-down stress tests of the banking system. *IMF Working Paper*, 88.
- Chen, N., Roll, R., & Ross, S. A. (1986). Economic forces and the stock market. *Journal of Business*, , 383-403.
- Chen, H. (2007). *Macroeconomic conditions, corporate financing decisions, and credit risk*. (Unpublished Doctoral Dissertation). The University of Chicago, United States.
- CHEN, H. (2010). Macroeconomic conditions and the puzzles of credit spreads and capital structure. *The Journal of Finance*, 65(6), 2171-2212.
- Cihak, M. (2004). Stress testing: A review of key concepts. *Czech National Bank, Research Department*, 2.
- Cihk, M., & Schaeck, K. (2007). *How well do aggregate bank ratios identify banking problems?* International Monetary Fund.
- Coffinet, J., & Lin, S. (2010). Stress testing banks' profitability: The case of french banks. *Working Paper Series of the Bank of France*, 306.
- CollinaDufresne, P., Goldstein, R. S., & Martin, J. S. (2001). The determinants of credit spread changes. *The Journal of Finance*, 56(6), 2177-2207.
- Commission Bancaire. (2007). The french approach of stress- testing credit risk: The methodology. *Internal Document*, (Direction de la Surveillance Generale du Systeme Bancaire)
- D'Avino, C. (2011). *Banks: Selected investigations on the roles of liquidity, globalization and credit risk*. (Unpublished Doctoral dissertation). Università Ca'Foscari Venezia, Italy.
- De Wet, A. H., Van Eyden, R., & Gupta, R. (2009). Linking global economic dynamics to a south african-specific credit risk correlation model. *Economic Modelling*, 26(5), 1000-1011.
- Dees, S., Holly, S., Pesaran, M. H., & Smith, L. V. (2007). Long run macroeconomic relations in the global economy. *Economics - the Open-Access, Open-Assessment E-Journal*, 3.
- Dees, S., Mauro, F. d., Pesaran, M. H., & Smith, L. V. (2007). Exploring the international linkages of the euro area: A global VAR analysis. *Journal of Applied Econometrics*, 22(1), 1-38.
- Delamaire, L. (2012). *Implementing a credit risk management system based on innovative scoring techniques*. (Unpublished Doctoral dissertation). University of Birmingham, UK.

- Delianedis, Gordon; Geske, Robert L. (2003). Credit risk and risk neutral default probabilities: Information about rating migrations and defaults. *EFA 2003 Annual Conference Paper*, 962.
- Demirgüç-Kunt, A., & Detragiache, E. (1998). The determinants of banking crises in developing and developed countries. *Staff Papers-International Monetary Fund*, 45(1), 81-109.
- Demirgüç-Kunt, A., Detragiache, E., & Romero, C. A. (1997). The determinants of banking crises: Evidence from industrial and developing countries. *World Bank-Free PDF*, (1828)
- Domanski, D. (2005). Foreign banks in emerging market economies: Changing players, changing issues. *BIS Quarterly Review*, 4, 69-81.
- Dornbusch, R. (1976). Expectations and exchange rate dynamics. *The Journal of Political Economy*, 1161-1176.
- Drehmann, M., Sorensen, S., & Stringa, M. (2010). The integrated impact of credit and interest rate risk on banks: A dynamic framework and stress testing application. *Journal of Banking & Finance*, 34(4), 713-729.
- Durand, D. (Ed.). (1941). *Risk elements in consumer installment financing*. New York: National Bureau of Economic Research.
- Efron, B. (1979). Bootstrap methods: Another look at the jackknife. *The Annals of Statistics*, 7(1), 1-26.
- Elmer, P. J., & Borowski, D. M. (1988). An expert system approach to financial analysis: The case of S&L bankruptcy. *Financial Management*, 17(3), 66-76.
- Elton, E. J., Gruber, M. J., Agrawal, D., & Mann, C. (2001). Explaining the rate spread on corporate bonds. *The Journal of Finance*, 56(1), 247-277.
- End, W. A. (2011). *Credit and liquidity risk of banks in stress conditions: Analyses from a macro perspective* University Library Groningen.
- Fama, E. F., & French, K. R. (1989). Business conditions and expected returns on stocks and bonds. *Journal of Financial Economics*, 25(1), 23-49.
- Fisher, R. A. (1936). The use of multiple measurements in taxonomic problems. *Annals of Human Genetics*, 7(2), 179-188.
- Flannery, M. (2009). Stabilizing large financial institutions with contingent capital certificates. *University of Florida, Working Paper*.
- Flannery, M. J. (1994). Debt maturity and the deadweight cost of leverage: Optimally financing banking firms. *The American Economic Review*, 84(1), 320-331.

- Flannery, M. J. (1998). Using market information in prudential bank supervision: A review of the US empirical evidence. *Journal of Money, Credit and Banking*, 30(3), 273-305.
- Flannery, M. J. (2001). The faces of “market discipline”. *Journal of Financial Services Research*, 20(2), 107-119.
- Flannery, M. J., & Sorescu, S. M. (1996). Evidence of bank market discipline in subordinated debenture yields: 1983?1991. *The Journal of Finance*, 51(4), 1347-1377.
- Flannery, M. J., & Hankins, K. W. (2013). Estimating dynamic panel models in corporate finance. *Journal of Corporate Finance*, 19, 1-19.
- Fleming, J. M. (1962). Domestic financial policies under fixed and under floating exchange rates (politiques financiereures interieures avec un systeme de taux de change fixe et avec un systeme de taux de change fluctuant)(politica financiera interna bajo sistemas de tipos de cambio fijos o de tipos de cambio fluctuantes). *Staff Papers-International Monetary Fund*, 369-380.
- Focardi, S. M., & Fabozzi, F. J. (2005). An autoregressive conditional duration model of credit-risk contagion. *Journal of Risk Finance, the*, 6(3), 208-225.
- Foglia, A. (2009). Stress testing credit risk: A survey of authorities’ approaches. *International Journal of Central Banking*, 5(3), 9-45.
- Forbes, K. J., & Chinn, M. D. (2004). A decomposition of global linkages in financial markets over time. *Review of Economics and Statistics*, 86(3), 705-722.
- Fungacova, Z., & Jakubík, P. (2012). Bank stress tests as an information device for emerging markets: The case of russia. *Bank of Finland Discussion Paper*, , 3.
- Gai, P., Kapadia, S., Millard, S., & Perez, A. (2008). Financial innovation, macroeconomic stability and systemic crises. *The Economic Journal*, 118(527), 401-426.
- Gali, J., & Monacelli, T. (2005). Monetary policy and exchange rate volatility in a small open economy. *The Review of Economic Studies*, 72(3), 707-734.
- Geske, R. (1979). The valuation of compound options. *Journal of Financial Economics*, 7(1), 63-81.
- Geske, R. (1977). The valuation of corporate liabilities as compound options. *Journal of Financial and Quantitative Analysis*, 12(04), 541-552.
- Geske, R., & Johnson, H. E. (1984). The valuation of corporate liabilities as compound options: A correction. *Journal of Financial and Quantitative Analysis*, 19(02), 231-232.

- Glick, R., & Rose, A. K. (1999). Contagion and trade: Why are currency crises regional? *Journal of International Money and Finance*, 18(4), 603-617.
- Gordy, M. B., & Howells, B. (2006). Procyclicality in basel II: Can we treat the disease without killing the patient? *Journal of Financial Intermediation*, 15(3), 395-417.
- Gorton, G., & Santomero, A. M. (1990). Market discipline and bank subordinated debt: Note. *Journal of Money, Credit and Banking*, 22(1), 119-128.
- Gray, D. F., & Walsh, J. P. (2008). Factor model for stress-testing with a contingent claims model of the chilean banking system. *IMF Working Paper*, 8.
- Gururaj, S. P. (2009). *Essays on macroeconomics and credit risk*. (Unpublished Doctoral dissertation). Columbia University, United State.
- Hackbarth, D., Miao, J., & Morellec, E. (2006). Capital structure, credit risk, and macroeconomic conditions. *Journal of Financial Economics*, 82(3), 519-550.
- Haldane, A. G. (2009). Why banks failed the stress test. *BIS Review*, 18.
- Hanson, B. E. (2002). Tests for parameter instability in regressions with I (1) processes. *Journal of Business & Economic Statistics*, 20(1), 45-59.
- Hart, O., & Zingales, L. (2011). A new capital regulation for large financial institutions. *American Law and Economics Review*, 13(2), 453-490.
- Hawley, D. D., Johnson, J. D., & Raina, D. (1990). Artificial neural systems: A new tool for financial decision-making. *Financial Analysts Journal*, 46(6), 63-72.
- Hendricks, D., & Hirtle, B. (1997). Bank capital requirements for market risk: The internal models approach. *Economic Policy Review*, 3(4)
- Hendry, D. F., & Mizon, G. E. (1998). Exogeneity, causality, and co-breaking in economic policy analysis of a small econometric model of money in the UK. *Empirical Economics*, 23(3), 267-294.
- Herring, R. (2005). Implementing basel II: Is the game worth the candle? *Financial Markets, Institutions & Instruments*, 14(5), 267-287.
- Imbs, J. (2004). Trade, finance, specialization, and synchronization. *Review of Economics and Statistics*, 86(3), 723-734.
- Imerman, M. B. (2011). *Structural credit risk models in banking with applications to the financial crisis*. (Unpublished Doctoral dissertation). Rutgers, The State University of New Jersey, United State.
- Inder, B. (1993). Estimating long-run relationships in economics: A comparison of different approaches. *Journal of Econometrics*, 57(1), 53-68.

- Ishili, S., Habermeier, K. F., & Kriljenko, J. I. C. (2002). Capital account liberalization and financial sector stability. *IMF Working Paper*, 211.
- Itô, K. (Ed.). (1944). *Stochastic integral* Proc. Imp. Acad. 20(8), 519-524.
- Ito, T., & Sato, K. (2008). Exchange rate changes and inflation in Post-Crisis asian economies: Vector autoregression analysis of the exchange rate PassaThrough. *Journal of Money, Credit and Banking*, 40(7), 1407-1438.
- Jarrow, R. A. (2007). A critique of revised basel II. *Journal of Financial Services Research*, 32(1), 1-16.
- Jeon, B. N., Olivero, M. P., & Wu, J. (2011). Do foreign banks increase competition? evidence from emerging asian and latin american banking markets. *Journal of Banking & Finance*, 35(4), 856-875.
- Jiménez, G., & Mencía, J. (2009). Modelling the distribution of credit losses with observable and latent factors. *Journal of Empirical Finance*, 16(2), 235-253.
- Jondeau, E., Poon, S., & Rockinger, M. (2007). *Financial modeling under non-gaussian distributions*. London: Springer.
- Jones, M. T., Hilbers, P. L. C., & Slack, G. L. (2004). Stress testing financial systems: What to do when the governor calls. *IMF Working Paper*, , 127.
- Karasulu, M. (2008). StressTesting household debt in korea. *IMF Working Paper*, 255.
- Kareken, J. H., & Wallace, N. (1978). Deposit insurance and bank regulation: A partial-equilibrium exposition. *Journal of Business*, 51(3), 413-438.
- Kashyap, A. K., & Stein, J. C. (2004). Cyclical implications of the basel II capital standards. *Economic Perspectives-Federal Reserve Bank of Chicago*, 28(1), 18-33.
- Kashyap, A., Rajan, R., & Stein, J. (2008). Rethinking capital regulation. In: Maintaining stability in a changing financial system. , 431-471(Federal Reserve Bank of Kansas City.)
- Kealhofer, S., & Bohn, J. (2001). *Portfolio management of credit risk. technical report*. New York: KMV working paper.
- Kim, D., & Santomero, A. M. (1988). Risk in banking and capital regulation. *The Journal of Finance*, 43(5), 1219-1233.
- Kiviet, J. F. (1995). On bias, inconsistency, and efficiency of various estimators in dynamic panel data models. *Journal of Econometrics*, 68(1), 53-78.
- Kiviet, J. F. (1999). Expectations of expansions for estimators in a dynamic panel data model; some results for weakly exogenous regressors. In C. Hsiao, K. Lahiri,

- L. F. Lee & M. H. Pesaran (Eds.), *Analysis of panels and limited dependent variables*. Cambridge: Cambridge University Press.
- Kocagil, A. E., Reyngold, A., Stein, R. M., & Ibarra, E. I. (2002). Moody's RiskCalc™ model for privately-held U.S. banks. *Moody's Investors Service Special Comment*, July.
- Kohen, M., & Santomero, A. M. (1980). Regulation of bank capital and portfolio risk. *The Journal of Finance*, 35(5), 1235-1244.
- Koop, G., Pesaran, M. H., & Potter, S. M. (1996). Impulse response analysis in nonlinear multivariate models. *Journal of Econometrics*, 74(1), 119-147.
- Koopman, S. J., & Lucas, A. (2008). A non-gaussian panel time series model for estimating and decomposing default risk. *Journal of Business & Economic Statistics*, 26(4), 510-525.
- Koutsomanoli-Filippaki, A., & Mamatzakis, E. (2009). Performance and merton-type default risk of listed banks in the EU: A panel VAR approach. *Journal of Banking & Finance*, 33(11), 2050-2061.
- Krainer, J., & Lopez, J. A. (2004). Incorporating equity market information into supervisory monitoring models. *Journal of Money, Credit and Banking*, 36(6), 1043-1067.
- Krugman, P. (1979). A model of balance-of-payments crises. *Journal of Money, Credit and Banking*, 11(3), 311-325.
- Krugman, P. (1999). Balance sheets, the transfer problem, and financial crises. In P. Isard, A. Razin & A. Rose (Eds.), *International finance and financial crises: Essays in honour of Robert P. Flood Jr* (International Monetary Fund, C 1999 ed., pp. Chapter 2). Boston: Kluwer Academic, Washington D.C.
- Kubo, H., & Sakai, Y. (2011). On long-term credit risk assessment and rating: Towards a new set of models. *Journal of Risk Research*, 14(9), 1127-1141.
- Leland, H. (2004). Predictions of default probabilities in structural models of debt. *Journal of Investment Management*, 2, 5-20.
- Leland, H. (2009). Structural models and the credit crisis , China international conference in finance. Haas School of Business, University of California, Berkeley, July 8, 2009.
- Leland, H. E., & Toft, K. B. (1996). Optimal capital structure, endogenous bankruptcy, and the term structure of credit spreads. *The Journal of Finance*, 51(3), 987-1019.
- Li, F. (2013). A macro stress test model of the default risk of canadian banking sector. *Bank of Canada (Preliminary Paper)*,

- Lin , Y. K. (2012). *The effectiveness of implementing sterilization for thailand, indonesia, the republic of korea and malaysia after the asian financial crisis*. (Unpublished Doctorate in Economics). The Claremont Graduate University, United States.
- Longstaff, F. A., & Schwartz, E. S. (1995). A simple approach to valuing risky fixed and floating rate debt. *The Journal of Finance*, 50(3), 789-819.
- MacKinnon, J. G. (2006). Bootstrap methods in econometrics. *Economic Record*, 82(s1), S2-S18.
- Mann, D., Narayanan, C., Caparusso, J., & Chandra, P. (2013). Asia leverage uncovered. *Standard Chartered Global Research*,
- Marcucci, J., & Quagliariello, M. (2008). Is bank portfolio riskiness procyclical?: Evidence from italy using a vector autoregression. *Journal of International Financial Markets, Institutions and Money*, 18(1), 46-63.
- Merton, R. C. (1974). On the pricing of corporate debt: The risk structure of interest rates. *The Journal of Finance*, 29, 449.
- Messier, W. F., & Hansen, J. V. (1988). Inducing rules for expert system development: An example using default and bankruptcy data. *Management Science*, 34(12), 1403-1415.
- Mundell, R. A. (1963). Capital mobility and stabilization policy under fixed and flexible exchange rates. *Canadian Journal of Economics and Political Science*, , 475-485.
- Myers, S. C. (1977). Determinants of corporate borrowing. *Journal of Financial Economics*, 5(2), 147-175.
- Navajas, M. C., & Thegeya, A. (2013). Financial soundness indicators and banking crises. *IMF Working Paper*, 263.
- Nyblom, J. (1989). Testing for the constancy of parameters over time. *Journal of the American Statistical Association*, 84(405), 223-230.
- Obstfeld, M. (1995). The logic of currency crises. *Cahiers Économiques Et Monétaires (Banque De France)*, 43, 189-213.
- Obstfeld, M. (1996). Models of currency crises with self-fulfilling features. *European Economic Review*, 40(3), 1037-1047.
- Ogawa, E., & Yang, D. Y. (2008). The dilemma of exchange rate arrangements in east asia. *Japan and the World Economy*, 20(2), 217-235.
- Pesaran, H. H., & Shin, Y. (1998). Generalized impulse response analysis in linear multivariate models. *Economics Letters*, 58(1), 17-29.

- Pesaran, H., Smith, V., & Smith, R. (2010). Supply, demand and monetary policy shocks in a multi-country new keynesian model. *1239*, 3.
- Pesaran, M. H., Schuermann, T., & Smith, L. V. (2009a). Forecasting economic and financial variables with global VARs. *International Journal of Forecasting*, 25(4), 642-675.
- Pesaran, M. H., Schuermann, T., & Smith, L. V. (2009b). Rejoinder to comments on forecasting economic and financial variables with global VARs. *International Journal of Forecasting*, 25(4), 703-715.
- Pesaran, M. H., Schuermann, T., & Weiner, S. M. (2004). Modeling regional interdependencies using a global error-correcting macroeconometric model. *Journal of Business & Economic Statistics*, 22(2), 129-162.
- Pesaran, M. H., & Smith, R. (2006). Macroeconometric modelling with a global perspective. *The Manchester School*, 74(s1), 24-49.
- Pesaran, M. H., Schuermann, T., Treutler, B. J., & Weiner, S. (2006). Macroeconomic dynamics and credit risk: A global perspective. *Journal of Money, Credit and Banking*, 38(5), 1211-1261.
- Ploberger, W., & Krämer, W. (1992). The CUSUM test with OLS residuals. *Econometrica: Journal of the Econometric Society*, , 271-285.
- Prieto, E., Buch, C. M., & Eickmeier, S. (2010). Macroeconomic factors and bank risk. *Beiträge Zur Jahrestagung Des Vereins Für Socialpolitik 2010: Ökonomie Der Familie - Session: Macroeconomics of Banking*, G12-V2.
- Quagliariello, M. (2009). *Stress-testing the banking system: Methodologies and applications*. Cambridge: Cambridge University Press.
- Quandt, R. E. (1960). Tests of the hypothesis that a linear regression system obeys two separate regimes. *Journal of the American Statistical Association*, 55(290), 324-330.
- Rehm, F., & Rudolf, M. (2000). KMV credit risk modeling. *Risk management* (pp. 141-154) Springer.
- Rochet, J. (1992). Capital requirements and the behaviour of commercial banks. *European Economic Review*, 36(5), 1137-1170.
- Ross, S. A. (1976). The arbitrage theory of capital asset pricing. *Journal of Economic Theory*, 13(3), 341-360.
- Saeed, M., & Izzeldin, M. (2014). Examining the relationship between default risk and efficiency in islamic and conventional banks. *Journal of Economic Behavior & Organization*, <http://dx.doi.org/10.1016/j.jebo.2014.02.014>

- Santomero, A. M., & Watson, R. D. (1977). Determining an optimal standard for the banking industry. *The Journal of Finance*, 32(4), 1267-1282.
- Santos, J. A. (2001). Bank capital regulation in contemporary banking theory: A review of the literature. *Financial Markets, Institutions & Instruments*, 10(2), 41-84.
- Santos, L. A., & Barrios, E. B. (2011). Small sample estimation in dynamic panel data models: A simulation study. *Open Journal of Statistics*, 1, 58.
- Santoso, W. (2009). Comment on" the determinants of cross-border merger and acquisition activity in the banking sector in asia: Did the asian financial crisis change them?" 2. *Financial Sector Development in the Pacific Rim, East Asia Seminar on Economics*, Volume 18, 236-240.
- Saunders, A., & Allen, L. (2002). *Credit risk measurement: New approaches to value at risk and other paradigms* (2nd ed.) New York: Wiley.
- Schechtman, R., & Gaglianone, W. P. (2012). Macro stress testing of credit risk focused on the tails. *Journal of Financial Stability*, 8(3), 174-192.
- Sharpe, W. F. (1978). Bank capital adequacy, deposit insurance and security values. *Journal of Financial and Quantitative Analysis*, 13(4), 701-718.
- Shinozaki, S. (2012). A new regime of SME finance in emerging asia: empowering growth-oriented SMEs to build resilient national economies. *ADB Working Paper Series on Regional Economic Integration*, No. 104, December, Asian Development Bank.
- Sims, C. A. (1980). Macroeconomics and reality. *Econometrica: Journal of the Econometric Society*, 48(1), 1-48.
- Sironi, A., & Resti, A. (2007). *Risk management and shareholders' value in banking: From risk measurement models to capital allocation policies*. John Wiley & Sons.
- Smith, L., & Galesi, A. (2014). *GVAR toolbox 2.0 user guide*. University of Cambridge: CFAP & CIMF, Cambridge.
- Squam Lake Working Group. (2009). An expedited resolution mechanism for distressed financial firms: Regulatory hybrid securities. *Council on Foreign Relations*, 10.
- Taylor, J. B. (1993). Discretion versus policy rules in practice. *Carnegie-Rochester Confer.Series on Public Policy*, 39(C), 195-214.
- Tillmann, P. (2013). Capital inflows and asset prices: Evidence from emerging asia. *Journal of Banking & Finance*, 37(3), 717-729.

- Varotto, S. (2011). Stress testing credit risk: The great depression scenario. *Journal of Banking & Finance*, 36(12), 3133-3149.
- Vasicek, O. A. (1984). Credit valuation. *Unpublished paper, KMV Corporation, March*
- Vazquez, F., Tabak, B. M., & Souto, M. (2012). A macro stress test model of credit risk for the brazilian banking sector. *Journal of Financial Stability*, 8(2), 69-83.
- Wikipedia.Itō's lemma. Retrieved from http://en.wikipedia.org/wiki/Itō's_lemma
- Wilson, T. (1998). Portfolio credit risk. *Economic Policy Review*, 4(3)
- Wilson, T. (1997). Credit portfolio risk (I, II). *Risk Magazine*, 10(10), 56-61.
- Wong, J., Wong, T. C., & Leung, P. (2010). Predicting banking distress in the EMEAP economies. *Journal of Financial Stability*, 6(3), 169-179.
- Wong, M. C., & Lam, Y. (2008). Macro stress tests and history-based stressed PD: The case of hong kong. *Journal of Financial Regulation and Compliance*, 16(3), 251-260.
- Wong, T., Hui, C., & Lo, C. (2007). Ratings versus market-based measures of default risk of east asian banks. *20th Australasian Finance & Banking Conference*,
- Woodford, M. (2003). *Interest and prices: Foundations of a theory of monetary policy* Princeton, N.J.: Princeton University Press.
- Woodford, M. (2011). *Interest and prices: Foundations of a theory of monetary policy* Princeton, N.J. :Princeton University Press.
- Zheng, C., Xu, T., & Liang, W. (2012). The empirical research of banks' capital buffer and risk adjustment decision making: Evidence from china's banks. *China Finance Review International*, 2(2), 163-179.
- Zhou, Q., Faff, R., & Alpert, K. (2014). Bias correction in the estimation of dynamic panel models in corporate finance. *Journal of Corporate Finance*, 25, 494-513.