Savings, Investment, and Behavioral Finance

Kai-Yin Woo
Wing-Keung Wong
Tai-Yuen Hon
Wing-Kwong Au

KSP Books

Savings, Investment, and Behavioral Finance

Kai-Yin Woo
Hong Kong Shue Yan University, Hong Kong
Wing-Keung Wong
Asia University, Taiwan
Tai-Yuen Hon
Hong Kong Shue Yan University, Hong Kong
Wing-Kwong Au
Hong Kong Shue Yan University, Hong Kong

KSP Books
http://books.ksplibrary.org
http://www.ksplibrary.org

Savings, Investment, and Behavioral Finance

Kai-Yin Woo
Wing-Keung Wong
Tai-Yuen Hon
Wing-Kwong Au

KSP Books
http://books.ksplibrary.org
http://www.ksplibrary.org

ISBN: 978-625-8190-85-4 (e-Book)
KSP Books 2023

Savings, Investment, and Behavioral Finance

Author: ***Kai-Yin Woo*** [a] ***Wing-Keung Wong*** [b] ***Tai-Yuen Hon*** [a] ***Wing-Kwong Au*** [a].

[a] Hong Kong Shue Yan University, Hong Kong.

[b] Asia University, Taiwan.

http://books.ksplibrary.org
http://www.ksplibrary.org

Biographical Notes

Kai-Yin Woo is an Associate Professor at the Department of Economics and Finance of Hong Kong Shue Yan University. He obtained PhD at the University of Stirling, Scotland. His research interests include economics of finance and applied econometrics. His research topics include bubble testing, investigation of price convergence and purchasing power parity, empirical study on Belt and Road Initiative and Greater Bay Area of China. He has published journal articles in Economics Letters, Applied Economics, Economic Modelling, Journal of Macroeconomics, Singapore Economic Review, International Review of Economics and Finance, Advances in Decision Sciences, Applied Economics Letters, The Chinese Economy and so on.

Professor WONG, Wing-Keung obtained his Ph.D. from the University of Wisconsin-Madison, the USA with a major in Business Statistics (Statistics and Finance) and obtained his Bachelor degree from the Chinese University of Hong Kong, Hong Kong, with a major in Mathematics and a double minor in Economics and Statistics. Currently, he is a Chair Professor at the Department of Finance, Asia University. He was a Full Professor at the Department of Economics, Hong Kong Baptist University, and Deputy Director at Risk Management Institute, National

University of Singapore. He appears in "Who's Who in the World". He is ranked top 1% by SSRN and in the list of top Taiwan economists and Asian economists and top economists by RePEc. He has published more than four hundred papers including papers published in some top journals. He has more than 12300 citations in Google Scholar, and more than 4800 citations in Scopus. His h-index is 60, and i10-index is 244 by Google Scholar citation. He has been providing consultancy to several Government departments and corporations, giving lectures and seminars to several universities, serving as editor, guest leading editor, advisor, associate editor for some international journals, and appointed as an external examiner.

Tai-Yuen Hon was an Academic Assistant/Lecturer/Senior Lecturer/Assistant Professor in the Department of Economics and Finance (formerly known as the Department of Economics) of Hong Kong Shue Yan University from 1993 to 2016 and is a Research Affiliate at the Business, Economic and Public Policy Research Centre of this University. He obtained his PhD in Business Administration from the Bulacan State University, and Master of Arts in Money, Banking and Finance from the University of Sheffield. He has published papers in Journal of Risk and Financial Management, Journal of Family and Economic Issues, International Journal of Revenue Management, Advances in Decision Sciences and so on.

Wing-Kwong Au has been working at the Department of Social Work of Hong Kong Shue Yan University since 1990s. He is an Associate Professor / Director of China Liaison Office of the University, the Fellow of the University of Liverpool and the Registered Social Worker of Social Workers Registration Board, Hong Kong. He obtained his MPhil and Ph. D from the University of Liverpool and Master of Arts in Social Work from the University of Wales, Bangor (Bangor University at present) in the United Kingdom. His research interests include elderly services; community development; social services in China (PRC); children and marginal youth; youth work and behavioural finance. He has published the reports on Hidden Youth Drug Abusers; Die in Exhaustion and the Labour Compensation in Hong Kong; the Interventions of the Marginal Youth Behavioural Pattern; Positive Life of Young People in Eastern District of Hong Kong, and a conference paper in Young Night Drifters' Social Workers and Health. He has also published two books "Eastern

District Positive Life project 15th Anniversary: A Book of Reflections" and "The Interventions of the Marginal Youth Behavioural Pattern". A survey report on "Children's life living in sub-divided flats under COVID19" is forthcoming. His current project is a book chapter of "Review on Market Efficiency and Anomalies" and "The Dilemma of Investment Decision for Small Investors in the Hong Kong Stock Market". An article "Children's life living in sub-divided flats under COVID19" with authors in multidisciplinary background is forthcoming.

Acknowledgments

Kai-Yin Woo
The author would like to acknowledge Department of Economics and Finance of the Hong Kong Shue Yan University, for financial and research support. We all are thankful for the former Administrative Head, Department of Economics and Finance, Dr. Poon, Che-Cheong, who gave us invaluable advice and guidance.

Wing-Keung Wong
The author would like to thank Robert B. Miller and Howard E. Thompson for their continuous guidance and encouragement. This research has been supported by Asia University, China Medical University Hospital, The Hang Seng University of Hong Kong, National University of Singapore, Research Grants Council (RGC) of Hong Kong (project numbers 12502814 and 12500915), and the Ministry of Science and Technology (MOST, Project Numbers 106-2410-H-468-002 and 107-2410-H-468-002-MY3), Taiwan. However, any remaining errors are solely ours.

Tai-Yuen Hon
The author would like to thank Dr. Lee Shu-Kam for his continuous encouragement. This book is partially supported by grants from Business, Economic and Public Policy Research Centre of Hong Kong Shue Yan University. The authors are grateful to the book

editor for substantive comments that have significantly improved this book.

Wing-Kwong Au
There are so many people to whom thanks are owed that it would be impossible to list them all individually. Grateful thanks are due to KSP Books which commissioned this project, especially Professor Wong Wing-Keung for his invaluable support and help while the book was being prepared. My thanks go to Tai-Yuen Hon and Kai-Yin Woo for their facilitating work. Without their assistance, this work would never be published in this book. I am grateful to the Shue Yan University Library and University of Hong Kong library – all of which were instrumental in finding many documentary and other sources relating to the social mobility of youth in Hong Kong. My personal gratitude must go to my family especially Kerrie, my wife for her persistent and unfailing support.

The authors would like to thank the co-author Lanz Chan for competing the paper 'Lucky 13? Does The Singapore equities market move in 13-year cycles?'; Che-cheong Poon for completing the two papers 'Household Savings in Hong Kong: A Statistical Analysis' and 'The Discrepancy between the Total Value of Monetary Transactions and GDP in China'; Tao Chen for completing a paper 'Hedging Hong Kong Stock Sectors with Gold: Multivariate Asymmetric GARCH approach'; and Hui-Hui Xu and Suet-Ching Chak for completing a paper 'Cointegration of the Indian Market with other National Stock Markets after Financial Tsunami'. The authors would also like to thank the supports from the editor of Journal of Family and Economic Issues; the editor of Market Technician Journal and the editor of Asian Profile.

Preface

This book has complied with three Journals papers and three working papers, a total of six papers. For all the journal papers, we have obtained permission from the Editors/Editors-in-Chief to include all the journal papers in our book and we have all the rights for our working papers. Thus, we do not have any copyright issue in our book. This book includes the part I: Savings: Chapter 1 would provide a positive contribution to the literature on saving behavior for Chinese communities; the part II Investment: Chapter 2 shows that investors are interested to know how long the bull run will last. While the Singapore markets may not be as efficient as that of the US. Chapters 3 and 4 are helpful for portfolio managers and investors to engage in real-life hedging practices and may also be useful for them to understand the volatility and return spillover effects between gold and different stock sectors in Hong Kong. Also, it is found that there is one cointegration relationship among the nine national stock markets under study (India, the United States, the United Kingdom, Australia, New Zealand, Japan, Singapore, Hong Kong, and Pakistan); the part III Behavioural Finance: Chapter 5 suggests that small investors have some disposition effect, mental accounts, anchors in mind, with the empirical results basically consistent with the predictions of

behavioural finance theory in the Hong Kong derivatives markets; part IV Commentaries: Chapter 6 identifies some major exogenous factors that determining the extent of the discrepancy between the total value of monetary transactions and GDP in China. Four of the authors spend one year to complete this book 'Savings, Investment, and Behavioural Finance'. We are eager to get this book published and intend to keep in friendship.

Contents

Introduction

Chapter 1 'Household Savings in Hong Kong: A Statistical Analysis': Based on the primary data derived from a household savings survey conducted by the authors and supplementary secondary data extracted from government official statistics, the results of statistical analysis showed that the disparities in the distribution of household savings in Hong Kong was more serious than that in household income or expenditure. The major household saving motive was precautionary and the key determinant of household savings was salaries income. The life-cycle hypothesis of savings can be applied in Hong Kong, and savings were not adequate for the vast majority of households in Hong Kong.

Chapter 2 'Lucky 13? Does The Singapore equities market move in 13-year cycles?': Natural cycles like sunspot activity cycle are relatively more stable and its prediction is more reliable. Hence, it is more certain that natural cycles do repeat themselves from time to time because of its long-existing principle of universal movement. However, as for man-made cycles, it is the capricious and complex human mind and

behavior that determines the existence and appearance of the next cycle. Even the American stock market, given its role as the leading and most important stock market in the world, cannot repeat itself precisely in the 4-year cycle dominated by the greatest political event of US— the presidential election. In addition, according to the theory of market efficiency, all of the past information has been contained in the present stock price; it is impossible to predict the future stock price from past information. That is, if the market efficiency theory is true, stock price is random as time passes with few or even without any fixed cyclical patterns. The Singapore stock market is in a bull run now. Investors are interested to know how long the bull run will last. While the Singapore markets may not be as efficient as that of the US; the development of the financial markets in Singapore will certainly increase in terms of market participants and trading volumes.

Chapter 3 'Hedging Hong Kong stock sectors with gold: multivariate asymmetric GARCH approach' investigates the role of gold as a hedge instrument against different stock sectors in Hong Kong. We employ Gold Bullion LBM U$ Troy Ounce and Hang Seng Industrial Composite Indices as the market data. We adopt the VAR-BEKK-TGARCH model and the traditional static Ordinary Least Squares (OLS) model to estimate the optimal hedge ratios and hedging effectiveness. The first of our core findings is that gold serves as an effective hedging instrument for all industrial stock sectors in Hong Kong: the stock-gold portfolio provides better diversification benefits than stock portfolio alone. Second, our findings show that the bivariate VAR-BEKK-TGARCH model provides more effective hedging performance than the OLS model in reducing portfolio volatility; hence, by applying the time-varying GARCH model, portfolio managers and investors can construct a better stock-gold portfolio. Also, the estimation of hedge ratios using the time-varying asymmetric volatility model enables portfolio managers and investors to react to market changes. Third, by analyzing the VAR-BEKK-TGARCH model, we find evidence of volatility spillovers between gold and different stock sectors; we also discover asymmetric

volatility spillovers from the past conditional volatility to the current conditional volatility for all stock sectors.

Chapter 4 'Cointegration of the Indian Market with Other National Stock Markets after Financial Tsunami' investigates cointegration of the Indian stock market with other eight national markets including the United States, the United Kingdom, Australia, New Zealand, Japan, Singapore, Hong Kong, and Pakistan after the 2008 financial tsunami. Multivariate cointegration method, Granger causality tests, and variance decomposition (VD) are adopted. We find some evidence of cointegration and Granger causality among the Indian and other stock markets. Also, the VD of the Indian market is largely explained by innovations in some markets, but it can explain the VD of other markets to a much lesser extent. The results provide implications for portfolio diversification.

Chapter 5 'Behavioural Study of Financial Derivatives Investments in Hong Kong' explores the investment attitudes and patterns among the small investors towards different types of financial derivatives in Hong Kong. We formulate several hypotheses to test the disposition effect, mental accounting, and anchoring in response to the European sovereign debt crisis. The results confirm that experienced small investors can manage their investment risks better and hence suffer lower investment losses when compared with the less experienced small investors during the crisis period, due to their ability to minimize the behavioural biases. This research contributes to the study of behavioural finance in the context of Hong Kong, a prominent Asian financial centre.

Chapter 6 'The Discrepancy between the Total Value of Monetary Transactions and GDP in China': Following the availability of more comprehensive macroeconomic statistics in China and because China's velocity of money circulation of M1 and M2 were significantly lower than those in other advanced and developed countries in 1995-2005, a number of papers that focus on investigating the relationship between China's money supply and GDP have been published recently. We noted that some of these papers were erroneously based on the expression of MV=GDP to develop their policy

suggestions. To enhance the empirical applicability of this expression, this article attempts first to identify the discrepancy between MV and GDP by introducing a new parameter to the expression, and then introduces some major factors that contribute to the discrepancy between the Total Value of Monetary Transactions and GDP in China. In order to show that the total value of monetary transactions (PT) in a country is defined as greater than the value of its GDP, we first use Fisher's exchange equation together with the Cambridge equation to derive an estimator of "λ" by which we can measure the discrepancy between PT and GDP. That is, where $\lambda > 1$. After that, we calculate the estimated λ values of China and compare these values with those calculated from selected countries to highlight the surprisingly high λ values in China; and then, we proceed to identify the factors contributing to China's high λ value during the observed period.

Woo, Wong, Hon & Au
January, 2023

1 Household Savings in Hong Kong: A Statistical Analysis

By
Che-cheong ***Poon***
Tai-Yuen ***Hon***

Introduction

Economists have long been interested in the topic of savings and have formulated different theories to explain savings behavior. For example, the relationship between national savings and GDP growth by Harrod (1939) and Domar (1946), the life cycle hypothesis of savings by Modigliani & Brumberg (1954), exploration in savings behavior by Fisher (1956), and household saving behavior in developing economies by Kelley & Williamson (1968) are some of the earliest publications in this area. The Keynesian saving function suggests that there is a direct relationship between income and savings (Carroll, 1994; Keynes, 1936), but China's per capita GDP was much lower than that of the USA, and the saving rate[1] of the former was much higher than that of the latter. Moreover, it is interesting to note that, according to the World Bank[2] and the National Statistics of the Republic

[1] Saving rate refers the percentage of disposable income that is saved rather than spent.
[2] Available at: [Retrieved from].

of China (Taiwan)[3] in 2012, the saving rate of Hong Kong and Taiwan ranked among the lowest in the developed and developing Asian economies (27% and 29%, respectively), but the saving rates of China (51%) and Macau (56%) were among the highest in the list. This showed that saving was not necessarily positively affected by income. After a careful review of the literature on saving behavior, we found that a number of journal articles have been written examining both national savings and household savings in Taiwan (Athukorala & Tsai, 2003; Deaton & Paxson, 2000; Lin & Lai, 2003; Luo, 1998). Unfortunately, there are only two scholarly articles (Lee *et al.,* 2014; Tse *et al.,* 2007) about national or aggregate savings in Hong Kong, and no empirical literature on its household savings. This may be due largely to the lack of official statistics on household savings. Since it is a consensus among policy makers and economists that savings is an indispensable way to accumulate both a country's physical and human wealth, to reduce a country's fiscal deficits, and to fight against poverty, this study aims to fill the literature gap. The objectives of this paper is to identify the significant characteristics of household saving behavior in Hong Kong and to provide policy recommendations to improve the well-being of Hong Kong people by optimizing savings across different household groups. Specifically, it examines five research questions. (1) What are the disparities in the distribution of household income, expenditure and savings in Hong Kong? (2) What are the major household saving motives in Hong Kong? (3) What are the major determinants of household savings in Hong Kong? (4) Is the life-cycle hypothesis of savings applicable in Hong Kong? (5) If savings are not adequate for the vast majority of households in Hong Kong, are there any effective and reliable methods of promoting private savings? In addition to the two great books by Kotlikoff (1989, 2001) which present a comprehensive compendium of theoretical and empirical work on savings including saving motives, fiscal policy and savings, social security and savings, saving and bequests, and life-cycle

[3] Available at: [Retrieved from].

planning, there are a large number of empirical as well as theoretical studies which provide the basis for this study. These include studies on household income disparity in Hong Kong (Census and Statistics Department, 2012; HKSAR, 2012; Wong *et al.,* 2009), on the motives for household savings (Browning & Lusardi, 1996; Keynes, 1936; Kotlikoff, 2001; Lee & Huh, 2004; Lin & Lai, 2003), on the determinants of household savings (Babiarz & Robb, 2014; Callen & Thimann, 1997; Das & Ray, 2012; Goldsmith *et al.,* 1956; Zagorsky, 2012), on the life-cycle hypothesis of savings (Boskin, 1988; Jappelli, 1999; Jappelli & Modigliani, 1998; Modigliani, 1986; Modigliani & Cao, 2004; Remble *et al.,* 2013), and on the adequacy of savings (Engen *et al.,* 1999; Fornero *et al.,* 2009; Holzmann *et al.,* 2008; Kotlikoff & Summers1981; Li *et al.,* 1996). The remainder of this paper was organized as follows. First, we described the data collection and manipulation process. Then, drawing from the survey dataset, we analyzed and discussed the effect of household characteristics on savings behavior, disparities in the distribution of household income, expenditure and savings, household saving motives and determinants, and the life-cycle hypothesis of savings and adequacy of savings. Finally, we concluded the paper with a discussion of the policy implications and directions for further research. This chapter's appendix, tables and charts are referred to Hon & Poon (2015) for Appendix, Tables 1-11 and Charts 1- 5.

Data and methodology

Data

Supplemented with official statistics released by the Hong Kong Census and Statistics Department, the analysis of this paper is based on the primary data created through the household savings survey in Hong Kong conducted by the authors (available upon request). There is a consensus of thought among social scientists regarding the difficulty of collecting household savings data, and we are aware that the data quality problems are even more severe in some economies such as Hong Kong where privacy is highly valued.

Therefore, in this household savings survey we used a careful data collection strategy in order to obtain a sample which would give the desired degree of precision at the lowest cost. We chose to use the stratified convenience sampling method (Clow *et al.*, 1998; Cochran, 1951; Graves *et al.*, 2007) and telephone interview technique to collect the data. Three hundred and fifty students taking the authors' courses were invited to be enumerators. Each of the students was asked to interview five respondents who were chosen from among their friends or relatives living in different housing categories and in specific age groups: two from public housing tenants (including subsidized home ownership housing), one from private housing tenants, one from home owners without a mortgage, and one from home owners with a mortgage or someone with any other type of housing[4]; additionally, twenty-eight percent of the enumerators were asked to collect data from households with 1 or more members whose ages were 65 or above[5]. In order to monitor the survey data quality, telephone interviews were used and the enumerators were required to provide the respondents' telephone numbers when they returned the completed questionnaires. The questionnaire was refined in light of findings from the pilot survey and the enumerators were briefed in detail. Following this, the survey was carried out from 1 January to 31 March 2014. The questionnaire was completed by 1,687 respondent households, of which 647 were living in public housing estates, 320 in rented private housing units, 324 in self-owned housing units with a mortgage, 352 in self-owned housing units without a mortgage, and 44 in other housing units.

[4] In 2011, there were 30.4% households living in public rental housing and 15.9% in subsidized home ownership housing. Extracted from "Domestic Households by Type of Housing, Hong Kong Population Census 2011 Summary Results, p.75". Available at: [Retrieved from].

[5] There were 668,621 domestic households with 1 or more older persons, constituting 28.2% of the total domestic households in the whole territory. The average household size of these domestic households was 2.8, which was about the same as that for all domestic households in Hong Kong. Extracted from "Thematic Report: Older Persons, Hong Kong 2011 Population Census, Paragraph 2.1". Available at: [Retrieved from].

The Chinese-English bilingual questionnaire consisted of 19 questions and was divided into three sections: six questions for household characteristics, six questions for household financial characteristics, and seven questions for household savings characteristics. It collected information on housing categories, household types, the number of household members in specific age groups, the number of income earners, gender and education level of the household economic decision maker(s), monthly household income, monthly household consumption expenditure, annual tax payments, monthly housing expenditure, total (accumulated) amount of household savings, total household wealth, the most important saving motive, the least important saving motive, saving portfolio, the most important determinant of savings, marginal propensity to save, saving pattern, and the difference between planned and actual savings. There were five derived variables which were computed from the survey dataset: household size was obtained by adding up the number of respondent household members in various age groups; monthly household total expenditure was the sum of monthly consumption expenditure and monthly housing expenditure; monthly household savings was obtained by subtracting the respondent household's monthly total expenditure and monthly tax payments (annual tax payments divided by 12) from its monthly income; household saving rate was the percentage ratio of monthly household savings to income[6]; and the household mean age was the arithmetic mean[7] of the respondent household members' ages. A

[6] Since the denominator of any fraction cannot have the value zero, the survey enumerators were told to remind the interviewees that their household income should include bank deposit interest earnings, social welfare department's Comprehensive Social Security Assistance (CSSA) and Old Age Allowance (Fruit money), or alimony.

[7] The calculating formula is: $\overline{X} = \frac{\sum_{j=1}^{4} f_j X_j}{n} = \frac{1}{n}(f_1X_1 + f_2X_2 + f_3X_3 + f_4X_4)$

where: $\overline{X}$ is the household mean age; n is the household size; f_1, f_2, f_3, and f_4 are the number of household members in the age group under 18, 18

summary of the household savings survey results is available upon request.

Methodology

Before using the data for analysis, we wanted to ensure that the survey results were reliable and valid. According to Carmines & Zeller (1987) and Perry (1996), reliability focuses on the extent to which the empirical indicator provides consistent results across repeated measurements, and validity concerns the extent to which the instrument measures what it purports to measure. Since we do not intend to measure how well a set of variables represents a latent aspect of a group of variables, it is not appropriate to use Cronbach's alpha (Cronbach, 1947) to assess reliability. We used the coefficient of variation (CV)[8] for comparing the reliability and precision of the results of our survey (Census and Statistics Department, 2014; Bruton *et al.*, 2000) which are subject to sampling error and non-sampling error. The CVs of the estimates of the main variables were provided in the Appendix. The maximum and minimum values of the CVs were 15.26% and 0.53%, respectively, with a mean of 3.68%. This is with the exception of total wealth (Q12; CV=15.26%) and total accumulated savings (Q11; CV=8.74%), which should be interpreted with care due to the relatively large sampling error. The reliability of all the other variables was acceptable. To further confirm our judgment, we can take a look at Table 1 which shows the correlation matrix of the six variables indicating household financial characteristics. It reveals that the correlation coefficients corresponding to monthly household income (Q7), monthly household expenditure (Q8), annual tax payments (Q9), monthly housing expenditure (Q10), were all significant at the 0.01 level (2-tailed). However, the correlation

and under 25, 25 and under 65, and 65 and over, respectively; X_1=(18-0)÷2=9, X_2=18+(25-18)÷2=21.5, X_3=25+(65-25)÷2=45, X_4=76.56 (where 76.56 is the mean age of people aged 65 and above, calculated from the Mid 2011 population by age group and sex (p.8), Hong Kong Population Projection 2012-20, Hong Kong Census and Statistics Department.)

[8] The CV is obtained by expressing the standard error as a percentage of the estimated mean to which it refers.

coefficients corresponding to accumulated savings (Q11) and total wealth (Q12) were very weak compared with other variables, and they were not all significant at the 0.01 level. With regards to the validity (Ferrer *et al.,* 1996; Thayer-Hart *et al.,* 2010) or the degree to which the survey results can reveal the traits or theoretical characteristics of households in Hong Kong, our survey results would be valid if we can verify that there is no significant difference between some of our key estimates and the similar estimates available in official statistics. If this cannot be verified, our results would not be valid. In doing this, we used the Z-test for testing the difference between two population means, and between two population proportions, and used Chi Square goodness-of-fit tests for testing the similarity of the distribution of households by housing category, and testing the similarity of the distribution of monthly household income, of the parameters estimated by our survey and those estimated by the official surveys conducted by Hong Kong Census and Statistics Department (Berenson *et al.,* 2011; Snedecor & Cochran, 1968). The hypothesis test results listed in Table 2 indicate that the validity of the household savings survey conducted by the authors is acceptable. After verifying the reliability and validity, we can proceed to analyze the data collected in order to answer the research questions regarding the disparity, saving motives, saving determinants, life-cycle, and adequacy of savings across the respondent households in Hong Kong. Since the questionnaire was designed specifically to collect household budget information and solicit evidence to justify the answers to the above-mentioned research questions, the use of basic statistics is sufficient for the analytical work.

Results and discussion

The effect of household characteristics on savings behavior

Before proceeding to justifying the answer to each of the research questions, we will look at an overview of the effect of household characteristics on saving behavior in Hong Kong

on the basis of the household savings survey results. In Chart 1, the two most favorite options were "saving a little" and "saving regularly" among all housing categories. However, it is interesting to note that about 22% and 9% respondents who chose "saving a little" and "saving regularly", respectively, were come from public housing tenant households. As mentioned earlier in the methodology section, this survey used the stratified convenience sampling method based on the concept of stratification with proportional allocation of sample size (Cochron, 1977). We have tried our best to design the sample size in each of the housing category which could be matched with the real situation of household distribution by of housing category in Hong Kong. Because of the different sample size in each housing category (especially for public housing estate which was about double the size of the other housing categories), it would appear that the results of comparing the saving rate, saving motives and saving determinants of Hong Kong households in terms of the housing categories may have an upward bias towards the public housing tenant households. However, we believe the sample selection bias problem is not serious.

Chart 2 illustrated a similar but clearer household saving pattern by dividing the housing categories into rented and owned housing units, and revealed that households living in rented housing had a higher percentage in "running into debt", "drawing on savings", "no net saving" and "saving a little". In Charts 3 and 4, while the young household group had a larger percentage shares in terms of "saving a little" (31%), "saving regularly" (11%), "no net saving" (4%), and "running into debt" (2%) compared with other household age groups living in public housing estates, the middle aged household group had a larger percentage shares in terms of "saving regularly" (24%), "saving a little" (15%), and "saving a lot" (6%) compared with other household age groups living in housing owned without a mortgage. Since most of the wealthier households were living in housing owned without a mortgage and the less wealthy households were living in public housing estates, we can infer that the wealthier and older the households members, the healthier their saving

behavior. Furthermore, there are four interesting points to be noted. First, the male and female household economic decision makers' families had the highest saving rate of 20.2%, which was significantly more than that of the male or female economic decision makers' households (16.2% and 7.7%, respectively). Regarding education level, the household economic decision makers with no schooling had the highest saving rate of 27.7%, compared to 17% for those with primary education, 15.5% for those with secondary education, and 14% for those with educational attainment at post-secondary or above. These findings revealed the fact that the higher the household economic decision maker's education level, the lower their household saving rate. Secondly, regarding the four household types, single parent households had the highest saving rate of 18.4%, followed by 16.1% for those married with children, 11% for singles with no children, and 4% for married with no children, revealing the fact that the heavier the parental responsibility, the higher the saving rate. Third, among the four categories of households classified by the number of income earners, 18.8% of households with three or more income earners had the highest saving rate (50% and over), followed by 16.3% for those with two income earners, 11.3% for those with one income earner, and 1.8% for those households with no income earner, indicating that the more income earners a household has, the higher the saving rate. Fourth, the median marginal propensity to save (MPS)[9] of 0.5 made it apparent that household income was the major determinant of household savings in Hong Kong.

As indicated by Table 3, while the maximum values of the respondent households' monthly household savings, saving rate, and marginal propensity to save (MPS) were HK$211,667, 91.11%, and 1 respectively, their minimum values were -138,667, -1250%, and 0, respectively, indicating that the deviation of these variables were substantial. In particular, the standard

[9] Marginal propensity to save (MPS) is a component of Keynesian macroeconomic theory and is calculated as the change in savings divided by the change in income.

deviation of the monthly household savings and the saving rates were very large, representing 2.25 and 3.68 times their means, respectively. In addition, the distribution of the monthly household savings had a strong positive skewness, the distribution of saving rates had a very strong negative skewness, and the marginal propensity to save was symmetrically distributed. The marked difference in their degree of skewness indicated the difference between the performance of absolute and relative savings across households in Hong Kong. As shown in Table 4, among all housing categories, households living in rented private housing had the highest negative saving rates, public housing estate households were ranked the highest in the saving rate groups "0% and under 25%" and "25% and under 50%", and households living in housing owned without a mortgage were ranked the highest in the saving rate groups "50% and under 75%" and "75% and under 100%". More importantly, the respondent households had a negative saving rate of about 22% means that they were spending more than 100% of their monthly after-tax income and were required to pay interest on their loans. If they are fail to boost saving in the years ahead, they may face difficulties maintaining their desired lifestyle in retirement.

Disparities in the distribution of household income, expenditure and savings

Although there has been no published systematic research on the disparities in the distribution of household expenditure and/or savings in Hong Kong, a number of empirical as well as theoretical studies have looked at household income disparity in Hong Kong (Economic Analysis and Business Facilitation Unit, 2012; Census & Statistics Department, 2012; Wong *et al.*, 2009) indicating income inequality in Hong Kong was large and fast-growing relative to other developed countries. We chose to use the Gini index and decile-group method[10] to measure the degree

[10] Each of the 10 decile groups contains the same number of domestic households (ranked by household income, expenditure, or household

of disparity in the distribution of household income, expenditure and savings. The results were listed in Tables 5 and 6. The Gini index (Bellù & Liberati, 2006; Poon & Lam, 2014) is strictly linked to the representation of income inequality through the Lorenz curve. In particular, it measures the ratio of the area between the Lorenz curve and the 45° diagonal line to the area of the triangle under the 45° diagonal line. It is expressed as an index number ranging between 0 and 100: the higher the index, the larger the degree of disparity in income distribution. We used the following formula to calculate the Gini index to measure the extent of disparities in the distribution of household income and expenditure.

$$\text{Gini index} = \frac{\sum_{i=1}^{n} \text{Cumulative \% number of households} - \sum_{i=1}^{n} \text{Cumulative \% of household income}}{\sum_{i=1}^{n} \text{Cumulative \% of number of households}} \times 100$$

As the Gini index cannot be calculated from variables which contain negative values, we only calculated the Gini index for household income, expenditure, and savings among households with positive savings. The results were listed in Table 5. The Gini index of monthly household income, expenditure, and savings was 38.3, 37.6 and 56.1, respectively. Since a Gini index less of than 40 is considered not high, the disparity in the distribution of household income and expenditure across households in Hong Kong is acceptable. However, the Gini index was a little bit too high for monthly household savings. If we study the Gini index in specific housing category, we can have some meaningful findings. The Gini index of income was 31.1 for respondent households living in public housing estates, 33.1 for those in rented private housing, 33.5 for those who owned a house with a mortgage, and 33.9 for those who owned a house without a mortgage.

savings respectively). The 1st decile group includes households falling below the 10th percentile, the 2nd decile group includes those falling between the 10th and 20th percentile, and so on.

This means that the dispersion of income for households in public housing estates was the smallest compared with other housing categories. With regards to monthly household expenditure, the Gini index was 30.9 for Hong Kong public housing estate households, 34.2 for those in rented private housing, 33.5 for those who owned a house with a mortgage, and 33.3 for those who owned a house without a mortgage. This means that the dispersion of total household expenditure for those living in rented private housing was the highest among the housing categories. With regards to monthly household savings, the Gini index was 53.2 for Hong Kong public housing estate households, 53.2 for those in rented private housing, 53.5 for those who owned a house with a mortgage, and 49.7 for those who owned a house without a mortgage. This means that the dispersion of positive household savings for those who owned a house without a mortgage was the lowest compared with other housing categories. In order to compare the extent of disparity in household income, expenditure, and savings among households with both positive and negative savings, we used the decile-group method. From Table 6, we discovered that the disparities in the distribution of monthly household income and expenditure were more or less the same, and they were not high; however, there was a high degree of disparity in monthly savings across households. Furthermore, we found that the upper 10% of households accounted for 28% of total income and expenditure, but 47% of savings. We also found that the lower 10% of households accounted for 2% of total income and expenditure, but 87% of total negative savings. These empirical results demonstrating the fact that the distribution of household savings in Hong Kong were characterized by a small number of high and lower income households.

Household saving motives and determinants

The theoretical literature suggests a variety of motives for household savings. According to Horioka & Watanabe (1997), household saving motives can be grouped into three

categories: the first is the life-cycle motive, which is defined as a temporary motive that results from imbalance between income and expenditure at various stages in one's life cycle; the second is the precautionary motive, which is the motive of saving for future uncertainties; and the final one is the bequest motive, which is the motive of saving for transferring to an heir. As shown in Table 7, with regards to motivation, 48.6% of the respondents indicated precaution, 13.2% indicated retirement, and 13% indicated foreseeable major expenses. With the exception the precautionary motive as the first priority for all housing categories, there were different reasons for different housing category households to save money. Results of the cross tabulation analysis revealed that 58.8% of public housing estate households indicated a precautionary motive, which was significantly more than the other housing categories. It is also worth noting that, of those respondents who indicated "pay off debts" as their motive, 50% were households living in housing owned with a mortgage; of those respondents who indicated "education" as their motive, 37.9% were public housing estate households; and of those respondents who indicated "retirement" as their motive, 33.38% were households living in housing owned without a mortgage. While less than 1% of the total respondent households planned to leave money behind when they died, among those who indicated "bequest" as their motive, 40% were public housing estate households.

The best reason for a large proportion of households choosing to use precautionary savings against income or expenditure shocks may be due to the borrowing constraints. In the presence of borrowing restrictions, according to Deaton (1989) and Carroll & Kimball (2005), the consumer saved and dis-saved in order to smooth consumption in the face of income and expenditure uncertainty. That is, if households were not currently liquidity constrained, they might engage in precautionary savings should they be worried about whether they would always be able to borrow from financial institutions. The fact that the existence of liquidity constraints increases the precautionary saving motive is clearly evidenced by the survey results where about 22% of the respondent

households had a negative saving rate in Table 4, and about 12% of the respondent households reported "Running into debt", "drawing on saving", and "No net saving" as illustrated in Chart 1. Therefore, we can infer that the high precautionary saving rate in Hong Kong can mean that its people are facing a high degree of uncertainty in the discrepancy between income and expenditure, and the existence of borrowing constraints in the market for consumer loans especially for the lower income groups. A strong precautionary motive can also be found in other Chinese communities such as China and Taiwan (Kraay, 2000; Lugauer & Mark, 2013; McKenzie, 2006) indicating that save to meet unforeseen contingencies is a virtue of Chinese people. In addition to the saving motives, the voluminous literature on the determinants of savings identifies a broad range of factors grouped under household or micro-level and aggregate or macro-level. For instance, the level of consumption (Browning, 2000), interest rate, growth rate of GDP (Hopf, 2006), income level (Harris *et al.*, 2002), gender and ages (Wakita *et al.*, 2000), and retirement and bequest (Gupta & Li, 2013; Kotlikoff, 1989; Minică, 2012). Since our study focused on the saving determinants at the household-level, we ignored those determinants which are at the macro-level such as GDP growth rate, market interest rate, inflation rate, and unemployment rate. With regard to these determinants, Table 8 reported that 39.54% of the respondents indicated "salary income", 12% indicated "food expenditure", and 11% indicated "education". When we examined the opinions from specific housing category, the findings were very interesting: of those households who agreed that "housing expenditure" was the most important factor determining the amount of their families' monthly savings, 74.7% were respondents living in private rental housing and housing owned with a mortgage; of those households who agreed that "food expenditure" was the most important factor determining their monthly household savings, 59.4% were public housing tenants; and of those households who agreed that "repayment of loan" was the most important factor that determined their monthly household savings, 60.6% were self-owned housing with a mortgage. It

was worth noting that there was no relationship between tax payments and saving rates in terms of the Pearson's correlation coefficient (r = 0.016) because of the low tax rate in Hong Kong.

Life-cycle hypothesis of savings and adequacy of savings

Starting from the life cycle hypothesis formulated by Modigliani & Brumberg (1954), the theoretical literature on household consumption and saving behavior has expanded widely over the last six decades. They posited that saving occurs during people's working years when they have a high income but dissaving occurs in retirement. The life-cycle pattern recommended by Browning & Crossley (2001) was that the younger and older age groups tended to have negative savings, while the middle-aged groups would have positive savings. Empirically, Husain (1995), Horioka & Watanabe (1997), Deaton & Paxson (2000), Thornton (2001), Modigliani & Cao (2004), and Thanoon & Baharumshah (2012) conducted surveys to investigate the saving situation in Asia, China, Japan, Singapore, Taiwan, and the United States, respectively. Their analyses indicated that the traditional life-cycle model was applicable in these countries. To test the applicability of the life-cycle hypothesis of savings in Hong Kong, we can examine the relationship between saving rates and the household mean ages. Table 9 reports the results of a cross tabulation analysis of the three household mean age groups on the one hand, and the households with positive or negative savings on the other hand. It is clear that more households whose mean age was under 25 or 65 and over claimed that they have negative savings than those households with a mean age between 25 and 65. This result illustrates the life-cycle pattern. As shown in Chart 5, the scatter plot resembles a lying oval. That is, savings at the early and latter stages of life were significantly less than those at the middle stage of life. If we calculate the Pearson's product moment correlation coefficient (r) to measure the relationship between the monthly household savings and the household mean age

variables, we find that r = 0.049, but if we calculate the coefficients for each of these three stages of life, r = -0.108 for the early stage of life (the households whose mean age is less than 25), r = 0.087 for the middle stage of life (the households whose mean age is between 25 and 65), and r = -0.204 for the latter stage of life (the households whose mean age is more than 65). Although the correlation coefficients are not strong, they provided some support for the life-cycle hypothesis of savings. Since the life-cycle model of savings predicts that households borrow when they are young and their incomes are relatively low, save for retirement during middle age when their incomes are higher, and then run down that saving during retirement, this illustrates another justification that the life-cycle hypothesis of savings works in Hong Kong. Regarding the adequacy of savings, as there has been no consensus benchmark for adequate saving empirically, we can assume that if those respondent households chose the response "Yes" to the survey question 19 (Would you say your family members do not save as much as they think they should?), they would think their savings were inadequate, if "No", their savings were adequate. Table 10 shows 62.9% of respondent households chose "Yes" indicates that they believed their savings were inadequate. Among the four major housing categories, 66.2% of public housing tenants, 62.2% of private housing tenants, 65.3% of people owned their home with a mortgage, and 56.3% of people owned their home without a mortgage chose "Yes" indicates that these households' perceived inadequacy of savings has no significant different across housing categories. However, there were 68.3% of young households, 59.5% of middle aged households, and 54.7% of old aged households reported that their savings were inadequate. This reveals the fact that the younger the households, the more likely they have inadequate savings, especially for those who are living in public housing estates.

A negative saving rate means that people are using up their accumulated savings to pay for regular and unavoidable items of spending or running into debt, inadequate saving means that wealth accumulation is inefficient for households to

smooth the marginal utility of their consumption over time (Engen *et al.*, 1999). While the former is an objective concept, the latter is a subjective concept. We agree that a community with a high negative household saving rate and a large proportion of households believe that their savings are inadequate must be an unhappy place to live. And thus, the fact that 22% households with negative savings and 63% of households had inadequate savings may bring some adverse effects to the community of Hong Kong. For the high rate of negative saving, arguments of insufficient income and unmanageable increases in costs of living were not supported by national income statistics. The per capita private consumption expenditure and per capita GDP in real terms increased more quickly than per capita GDP in real terms in the past five years in Hong Kong[11] indicated that negative saving does not seem to be caused by earning and spending per person in Hong Kong grew faster than inflation, and also indicated that the rise in spending outpaced income growth, so we cannot blame the cost of living. Moreover, according the credit card lending survey results released by HKMA (2015), the average total receivables in the fourth quarter of 2013 was HK$112,881million (US$14,560 million) or HK$15,705 per person (US$2,027), and the 8.4% of the average annual rate of change in 2008-2013 which was significantly higher than the average economic growth rate in the same period revealed that most Hong Kong people were squander their money on luxury consumption. When we examine Table 11, we found that the sample respondent households' financial portfolio patterns were more or less the same no matter they had positive, negative, adequate, or inadequate savings. It is interesting to note that "mortgage payment of the principal" had the lowest shares of the portfolio, there were only 2.4% household respondents did think mortgage payment of

[11] The average annual rate of change in real GDP per capita and real private consumption expenditure in 2008-2013 was 2% and 3.9%, respectively. The figures are calculated from official statistics provided by Hong Kong Census and Statistics Department. available at: [Retrieved from].

principal are savings. This figure was far less than the 19.2% (324 out of 1.687) household respondents who were living in self-owned housing units with a mortgage. If we follow the argument proposed by Tachibanaki (1994) and Lin & Lai (2003) that mortgage payments should be referred as forced savings, the proportion of households have a negative savings should be less than 22%.

Conclusion

In this chapter, we studied the relationship among household demographic, financial, and saving characteristics in Hong Kong in order to derive policy recommendations to improve the well-being of Hong Kong people by optimizing savings across different household groups. After an extensive review of literature on savings, we found that quite a number of the theoretical and empirical literature on savings focused on national or aggregate savings, but there has been a shortfall of scholarly studies on household savings, especially about Hong Kong. Thus, the household savings survey in Hong Kong conducted by the authors was a good opportunity to investigate the empirical importance of household saving behavior in Hong Kong. As such, the empirical analysis in this paper would provide a positive contribution to the literature on saving behavior for Chinese communities. Based on the primary data derived from a household savings survey conducted by the authors and supplementary secondary data extracted from government official statistics, the results of statistical analysis showed that (1) the disparities in the distribution of household savings was more serious than that in household income or expenditure, this implies saving behavior could not be explained by income or consumption expenditure alone; (2) the major household saving motive was precautionary implies the lack of a satisfactory social security system in Hong Kong; (3) the key determinant of household savings was salaries income implies household savings was substantially affected by economic growth and employment situation; (4) the life-cycle hypothesis of savings could be applied in Hong Kong implies the need to encourage the

working-age population to save regularly; and (5) savings were considered not adequate for the vast majority of households in Hong Kong especially for those young households who were living in public housing estates, this implies the need for the government to address the problem of young-age and old-age poverty. Furthermore, our results explaining differences in savings behavior across households were consistent with theory and previous findings. Similar to the Japan and United States (Campbell & Watanabe 2001), the disparity in household savings in Hong Kong has been driven by a small number of very wealthy or high income households.

In recent years, Hong Kong government has reinforced and enhanced the social security system including the comprehensive social security assistance scheme, the old age allowance scheme, the old age living allowance scheme, and the mandatory Provident Fund system (Lee *et al.,* 2014; Siu 2002). However, an aging population has posed sustained challenges to public finances and some members of the public are worried that Hong Kong will be moving towards welfarism. Taking into account that an even distribution of savings across different household groups can lessen the burden on welfare payments as it provides a buffer against unforeseen contingences, the popularity of luxury consumption among the youth, the severity of disparity in household savings, and perhaps most importantly, an understanding of household saving behavior can assist policy makers in assessing the likely impact on savings for changes in economic circumstances facing households. Therefore, the study results have diverse policy implications and the following proposals to improve the well-being of Hong Kong people by optimizing savings across different household groups can be made. According to Syden (2014), there are two types of savings: compulsory saving which would include products such as life insurance policy or pension fund, and discretionary savings. In this, the Hong Kong government should implement policies to encourage thrift and stimulate household savings such as strengthening the Mandatory Provident Fund system (Siu, 2002), enhancing financial literacy education programs for young adults and students in

order to encourage and foster healthy savings behavior, and increasing the accessibility of financial services to the lower income groups by promoting microfinance and supporting the credit union movement. Since both national savings and household savings statistics are very useful for making socio-economic policy such as determination of the waiting list asset limits for the public housing applicants, health and medical insurance, social security and retirement protection, and even poverty reduction policy, the government is urged to launch such surveys as soon as possible. There are several important points that limit the robustness of this paper. Firstly, time and financial constraints for individual researchers to collect a sufficiently large and well-designed sample, the sample size of 1,687 in our survey is not sufficiently adequate to generate a real picture of household savings in Hong Kong. However, as there is no other study published on this topic, academically, this paper can be seen as a guiding rod, and statistically, it can be seen as a pilot survey. Secondly, since each enumerator was given five questionnaires, this cannot exactly match the theoretical proportion specified by the stratified convenience sampling method. Inevitably, this would incur a slight sample selection bias in estimating population characteristics. Thirdly, the study was based on the one shot survey design which cannot be compared with other dataset crosss-sectionally and longitudinally, and thus a panel survey is recommended for further research.

References

Athukorala, P.C., & Tsai, P.L. (2003). Determinants of household saving in Taiwan: growth, demography and public policy. *The Journal of Development Studies,* 39(5), 65-88. doi. 10.1080/0022038042331333149

Babiarz, P., & Robb, C.A. (2014). Financial literacy and emergency saving. *Journal of Family and Economic Issues,* 35(1), 40-50. doi. 10.1007/s10834-013-9369-9

Bellù, l.G., & Liberati, P. (2006). *Inequality Analysis: The Gini Index. Food and Agriculture Organization of the United Nations*, FAO. [Retrieved from].

Berenson, M.L., Levine, D.M., & Krehbiel, T.C. (2011). *Basic Business Statistics: Concepts and Applications* (12 ed.): Prentice Hall.

Boskin, M.J. (1988). Consumption, saving, and fiscal policy. *The American Economic Review, 78*(2), 401-407.

Browning, M. (2000). The saving behaviour of a two-person household. *The Scandinavian Journal of Economics,* 102(2), 235-251. doi. 10.1111/1467-9442.00197

Browning, M., & Crossley, T.F. (2001). The life-cycle model of consumption and saving. *Journal of Economic Perspectives*, 15(3), 3-22. doi. 10.1257/jep.15.3.3

Browning, M., & Lusardi, A. (1996). Household saving: Micro theories and micro facts. *Journal of Economic Literature,* 34(4), 1797-1855.

Bruton, A., Conway, J.H., & Holgate, S.T. (2000). Reliability: what is it, and how is it measured? *Physiotherapy,* 86(2), 94-99. doi. 10.1016/s0031-9406(05)61211-4

Census and Statistics Department (2012). 2011 Population Census Thematic Report: Household Income Distribution in HK. [Retrieved from].

Census and Statistics Department (2014). Quarterly Report on General Household Survey January-March 2014. [Retrieved from].

Callen, T., & Thimann, C. (1997). *Empirical Determinants of Household Saving-Evidence from OECD Countries (EPub)*: International Monetary Fund. [Retrieved from].

Campbell, D.W., & Watanabe, W. (2001). Household saving in Japan. *Japanese Economic Review,* 52(2), 243-250. doi. 10.1111/1468-5876.00193

Carmines, E.G., & Zeller, R.A. (1987). *Reliability and Validity Assessment* (Sage University Papers Series: Quantitative Applications in the Social Sciences): Sage.

Carroll, C.D. (1994). How does future income affect current consumption? *The Quarterly Journal of Economics, 109*(1), 111-147. doi. 10.2307/2118430

Carroll, C.D., & Kimball, M.S. (2005). Liquidity constraints and precautionary saving. *NJournal of Economic Theory,*195, 105276. doi. 10.1016/j.jet.2021.105276

Clow, K.E., Baack, D., & Fogliasso, C. (1998). Reducing perceived risk through advertising service quality cues. *Journal of Professional Services Marketing,* 16(2), 151-162. doi. 10.1080/15332969.1998.9985302

Cochran, W.G. (1951). General principles in the selection of a sample. *American Journal of Public Health and the Nations Health,* 41(6), 647-653. doi. 10.2105/ajph.41.6.647

Cochron, W.G. (1977). *Sampling Techniques, 3rd Edition*: Wiley.

Cronbach, L.J. (1947). Test "reliability": Its meaning and determination. *Psychometrika,* 12(1), 1-16. doi. 10.1007/bf02289289

Das, S., & Ray, P. (2012). Does developing Asia save more? Evidence from a panel of high saving nations in Asia. *The IUP Journal of Applied Economics,* 11(1), 29-55.

Deaton, A. (1989). Saving and liquidity constraints. *NBER Working Papers*, No.3196. doi. 10.3386/w3196

Deaton, A., & Paxson, C. (2000). Growth and saving among individuals and households. *Review of Economics and Statistics, 82*(2), 212-225. doi. 10.1162/003465300558740

Domar, E.D. (1946). Capital expansion, rate of growth, and employment. *Econometrica, Journal of the Econometric Society*, 14(2), 137-147. doi. 10.2307/1905364

Economic Analysis and Business Facilitation Unit (2012). The Gini coefficient of Hong Kong: trends and interpretations. *Helf-Yearly Economic Report 2012, 86-89.* [Retrieved from].

Engen, E.M., Gale, W.G. & Uccello, C.E. (1999). The adequacy of household saving. *Brookings Papers on Economic Activity*, 2, 65–187.

Ferrer, M., Alonso, J., Prieto, L., Plaza, V., Monsó, E., Marrades, R., Aguar, M.C., Khalaf, A. & Antó J.M. (1996). Validity and reliability of the St George's respiratory questionnaire after adaptation to a different language and culture: the Spanish example. *European Respiratory Journal,* 9(6), 1160-1166. doi. 10.1183/09031936.96.09061160

Fisher, M.R. (1956). Exploration in savings behaviour. *Bulletin of the Oxford University Institute of Economics & Statistics,* 18(3), 201-277. doi. 10.1111/j.1468-0084.1956.mp18003001.x

Fornero, E., Lusardi, A., & Monticone, C. (2009). Adequacy of saving for old age in Europe. *CERP Working Papers*, No.87/09. [Retrieved from].

Goldsmith, R.W., Brady, D.S., & Mendershausen, H. (1956). *A study of saving in the United States* (Vol. 3, Part III): Princeton University Press Princeton. [Retrieved from].

Graves, T., Hamada, M., Booker, J., Decroix, M., Chilcoat, K., & Bowyer, C. (2007). Estimating a proportion using stratified data from both convenience and random samples. *Technometrics*, 49(2), 164-171. doi. 10.1198/004017007000000047

Gupta, A., & Li, Z. (2013). Optimal annuity purchase decisions under uncertain lifetime. *Journal of Family and Economic Issues*, 34(4), 447-459. doi. 10.1007/s10834-012-9340-1

Harris, M.N., Loundes, J., & Webster, E. (2002). Determinants of household saving in Australia. *Economic Record*, 78(241), 207-223. doi. 10.1111/1475-4932.00024

Harrod, R.F. (1939). An essay in dynamic theory. *The Economic Journal*, 49(193), 14-33. doi. 10.2307/2225181

HKMA, (2015). Credit card lending survey results. *Monthly Statistical Bulletin*, January 2015, Issue No. 245, Table 3.8. [Retrieved from].

Holzmann, R., Hinz, R., & Dorfman, M. (2008). Pension systems and reform conceptual framework. *World Bank Discussion Paper, 824*.

Hon, T.Y. & Poon, C.C. (2015). Household savings in Hong Kong: a statistical analysis. *Journal of Family and Economic Issues*, 36(3), 353-368. doi. 10.1007/s10834-015-9457-0

Hopf, G. (2006). A critical assessment of past investigations into Singapore's saving behavior. *The Singapore Economic Review*, 51(01), 67-90. doi. 10.1142/S0217590806002238

Horioka, C.Y., & Watanabe, W. (1997). Why do people save? A micro-analysis of motives for household saving In Japan. *The Economic Journal*, 107(442), 537-552. doi. 10.1111/j.1468-0297.1997.tb00026.x

Husain, A.M. (1995). Determinants of private saving in Singapore. *Occasional Paper-International Monetary Fund*, 42-42. [Retrieved from].

Jappelli, T. (1999). The age-wealth profile and the life-cycle hypothesis: a cohort analysis with a time series of cross-sections of Italian households. *Review of Income and Wealth*, 45(1), 57-75. doi. 10.1111/j.1475-4991.1999.tb00312.x

Jappelli, T., & Modigliani, F. (1998). The age-saving profile and the life-cycle hypothesis. Long-run growth and short-run stabilization: *Essays in Memory of Albert Ando*, No.12. [Retrieved from].

Kelley, A.C., & Williamson, J.G. (1968). Household saving behavior in the developing economies: The Indonesian case. *Economic Development and Cultural Change*, 16(3), 385-403. doi. 10.1086/450300

Keynes, J.M. (1936). *The General Theory of Interest, Employment and Money*. London: Macmillan.

Kotlikoff, L.J. (1989). *What Determines Savings?*, MIT Press Books, 1.

Kotlikoff, L.J. (2001). *Essays on Saving, Bequests, Altruism and Life-cycle Planning*: the MIT Press.

Kotlikoff, L.J., & Summers, L.H. (1981). The adequacy of savings. *NBER Working Paper*, No.627. doi. 10.3386/w0627

Kraay, A. (2000). Household saving in China. *The World Bank Economic Review,* 14(3), 545-570. doi. 10.1093/wber/14.3.545

Lee, K.M., To, B.H.-P., & Yu, K.M. (2014). The new paradox of thrift: Financialisation, retirement protection, and income polarisation in Hong Kong. *China Perspectives*, 2014/1. [Retrived from].

Lee, Y.G., & Huh, E. (2004). Consumption and saving behavior of older and younger baby boomers in Korea. *Journal of Family and Economic Issues,* 25(4), 507-526. doi. 10.1007/s10834-004-5493-x

Li, J., Montalto, C.P., & Geistfeld, L.V. (1996). Determinants of financial adequacy for retirement. *Financial Counseling and Planning,* 7, 39-48. doi. 10.1016/s1057-0810(00)00052-4

Lin, C.C., & Lai, Y.F. (2003). Housing prices, mortgage payments and savings behavior in Taiwan: A time series analysis. *Asian Economic Journal,* 17(4), 407-425. doi. 10.1111/j.1467-8381.2003.00193.x

Lugauer, S., & Mark, N.C. (2013). The Role of Household Saving in the Economic Rise of China. *HKIMR Working Paper,* No.04/2013. [Retrieved from].

Luo, J.D. (1998). The savings behavior of small investors: a case study of Taiwan. *Economic Development and Cultural Change,* 46(4), 771-788. doi. 10.1086/452373

McKenzie, D.J. (2006). Precautionary saving and consumption growth in Taiwan. *China Economic Review,* 17(1), 84-101. doi. 10.1016/j.chieco.2005.05.002

Minică, M. (2012). *Consumption And Saving: Between Theory And Romanian Reality*. Annals of Eftimie Murgu University Resita, Fascicle II, Economic Studies.

Modigliani, F. (1986). Life cycle, individual thrift, and the wealth of nations. *The American Economic Review,* 76(3), 297-313. doi. 10.1126/science.234.4777.704

Modigliani, F., & Brumberg, R. (1954). Utility analysis and the consumption function: An interpretation of cross-section data, in *Post-Keynesian Economics*, (pp.388-436), Routledge.

Modigliani, F., & Cao, S.L. (2004). The Chinese saving puzzle and the life-cycle hypothesis. *Journal of Economic Literature*, 42(1), 145-170, doi. 10.1257/.42.1.145

Perry, J.L. (1996). Measuring public service motivation: An assessment of construct reliability and validity. *Journal of Public Administration Research and Theory,* 6(1), 5-22. doi. 10.1093/oxfordjournals.jpart.a024303

Poon, C.C., & Lam, R.C. (2014). 11 Reducing the world's income inequality. *International Economic Development: Leading Issues and Challenges*, 205. [Retrieved from].

Remble, A.A., Marshall, M.I., & Keeney, R. (2013). Household saving behavior and the influence of family-owned business. *Journal of Family and Economic Issues*, 35, 411-422. doi. 10.1007/s10834-013-9372-1

Siu, A. (2002). Hong Kong's mandatory provident fund. *Cato Journal,* 22, 317-332.

Snedecor, G.W., & Cochran, W.G. (1968). *Statistical Methods* (sixth ed.). New Delhi: Oxford & IBH.

Syden, M. (2014). Trends and determinants of household saving in South Africa. *Economic Affairs,* 59(2), 191-208. doi. 10.5958/J.0976-4666.59.2.018

Tachibanaki, T. (1994). Housing and saving in Japan. *Housing Markets in the US and Japan*, University of Chicago Press.

Thanoon, M.A.M., & Baharumshah, A.Z. (2012). Comparing savings behavior in Asia and Latin America: The role of capital inflows and economic growth. *The Journal of Developing Areas,* 46(1), 113-131. doi. 10.1353/jda.2012.0011

Thayer-Hart, N., Dykema, J., Elver, K., Schaeffer, N., & Stevenson, J. (2010). *Survey Fundamentals: A Guide to Designing and Implementing Surveys*. Office of Quality Improvement, University of Wisconsin Survey Center: Madison, WI, USA.

Thornton, J. (2001). Age structure and the personal savings rate in the United States, 1956-1995. *Southern Economic Journal*, 68(1), 166-170.

Tse, R.Y., Man, K.F., & Choy, L. (2007). The impact of housing and financial wealth on household consumption: Evidence from

Hong Kong. *Journal of Real Estate Literature*, 15(3), 429-440. doi. 10.1080/10835547.2007.12090213

Wakita, S., Fitzsimmons, V.S., & Liao, T.F. (2000). Wealth: Determinants of savings net worth and housing net worth of pre-retired households. *Journal of Family and Economic Issues,* 21(4), 387-418. doi. 10.1023/A:1026432705410

Wong, I.O., Cowling, B.J., Lo, S.V., & Leung, G.M. (2009). A multilevel analysis of the effects of neighbourhood income inequality on individual self-rated health in Hong Kong. *Social Science & Medicine,* 68(1), 124-132. doi. 10.1016/j.socscimed.2008.09.064

Zagorsky, J.L. (2012). Do people save or spend their inheritances? Understanding what happens to inherited wealth. *Journal of Family and Economic Issues,* 34(1), 64-76. doi. 10.1007/s10834-012-9299-y

2 Lucky 13? Does The Singapore Equities Market Move in 13-year Cycles?

By
Wing-Keung ***Wong***
Lanz ***Chan***

Introduction

A cursory observation of the Singapore equities market based on the SES All-Share index suggests that the market has possibly moved in 13-year cycles with the first cycle being between January 1975 to December 1987 and the second cycle being between January 1988 to December 2000. See Figure 1.

Figure 1. *13-year cycle pattern of the SES All-Share Index*

The 13-year cycle is evident when the two 13-year cycles are juxtaposed as seen in Figure 2. The interesting observation is that the two 13-year cycles are almost mirror images of each other over their own 13-year period, particularly from the 46th month onwards to the end of the cycle.

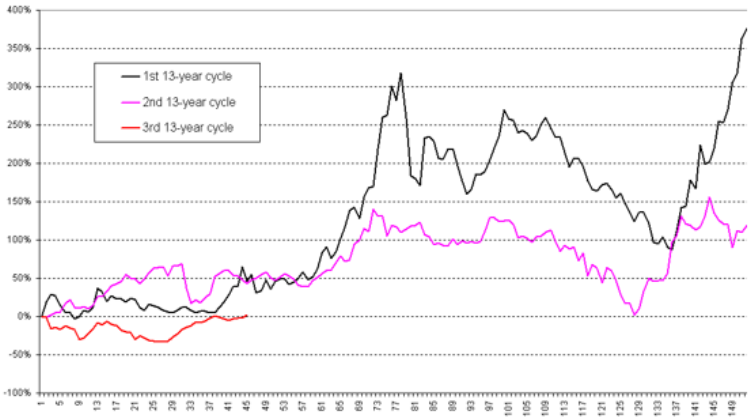


Figure 2. *Juxtaposition of the two 13-year cycles*

Based on the anecdotal evidence regarding the previous two 13-year cycles, it appears that the Singapore equities market could be heading for a third 13-year cycle beginning January 2001.

Note: The SES All-Share index has been chosen as the benchmark market indicator over the ST Index given that the ST Index has been subjected to changes in component stocks over the years and as such, may not be representative of the overall market direction. Moreover, the ST Index also consists mainly of blue chips and small capitalization stocks are not included, further limiting its use here as an overall market indicator.

Double-vision? Early market movement patterns in past cycles appears to have repeated and could be repeating in the current cycle

Further, purely from a technical analysis viewpoint, arbitrary market movement patterns from January 2001 to

December 2004 lend credence to our view that the Singapore equities market is possibly on the third 13-year cycle as the market was also displaying arbitrary movement patterns over the first 45 months of the first two 13-year cycles. See Figure 3.

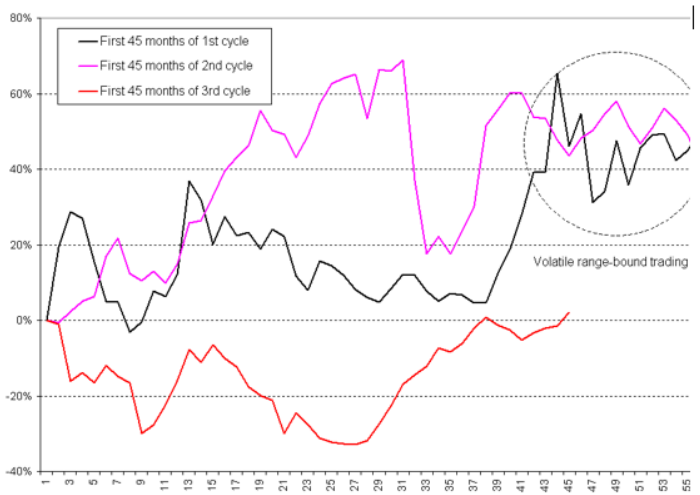


Figure 3. *First 45 months market movement patterns for the three 13-year cycles*

On the growing postulation that the market is currently on the third 13-year cycle and technical analysis reasoning, volatile range-bound trading is expected to dominate marketing proceedings over the next 12 months given that the market was similarly in range-bound trading during the 46th month to 57th month of the first two 13-year cycles.

Analysis of cycle

There are a few techniques for us to turn cycle analysis into practical trading strategies. The most widely used method in the analysis of cyclical patterns of data is Spectrum Analysis and a classical example of applying Spectrum Analysis in cycle theory is the study of sunspot activity; in which a cycle of period around 11 years is found. Assuming sunspot activity reaches its peak this year, one may expect sunspot activity will peak eleven years later.

If cycle theory works well in stock market, investors will be able to generate huge profits if they follow the predicted cycle closely and the cycle repeats itself without any error. To measure cycle in stock markets, many financial analysts frequently apply Spectrum Analysis, in which investors can find out the periods as well as the magnitudes of the cycle(s).

Support from spectrum analysis

As is showed in Figure 4, Singapore stock market possesses many cyclical patterns including cycles of 143 weeks (2.7 years) and cycle of 350 weeks (6.7 years). 13-year period is about twice of 6.7 years and hence our spectrum analysis results suggest that the 13-year cycle may consist of two 6.7-year cycles and hence within the 13-year cycle period, there may have two peaks and two troughs. If the above analysis is correct, from Figure 2 we are at the end of the first quarter of the cycle in which there is not much movement in Singapore stock market. However, from Figure 2, we expect the stock market will peak at the end the second quarter in three years' time and the stock price will dive in the third phase which last longer than other phase due to the asymmetric property of cycle theory and reach a higher peak in the four phases of the cycle in about 9 years from now. Readers may refer to the Appendix for the Introduction of Spectral Analysis.

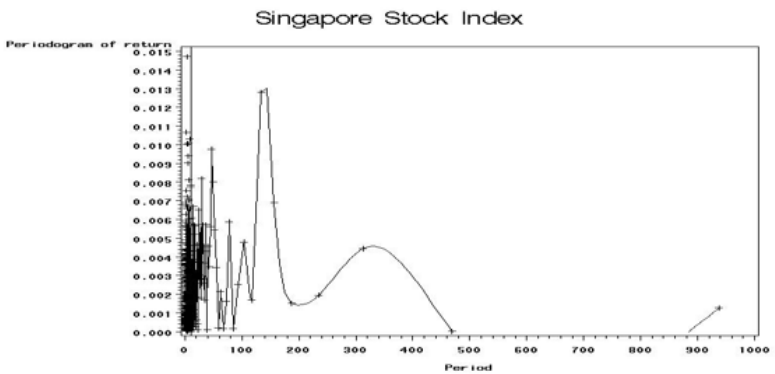


Figure 4. *Spectrum for Singapore Straits Times Index from 1973 to 2004*

Lesson from US stock market

Since Singapore index yields insufficient data points (29 years only) to get good power of statistical test, we use US stock market as a lesson to Singapore stock market, as stock indices for US market is long enough (40 years) to draw good power of the test. To find out whether the cycle will repeat itself consistently in stock market, we divide the entire period of 40 years (from 1965 to 2004) being used in the analysis of the US market into two equal sub-periods: first sub-period from 1965 to 1984, and the second sub-period from 1985 to 2004. The spectrum analysis is then applied to the two sub-periods and the results are as follows:

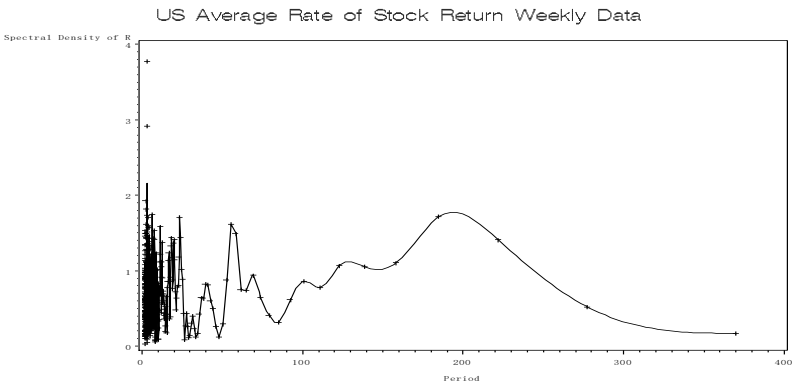


Figure 5. *Spectrum for US Stock Market from Year 1965 to 1984*

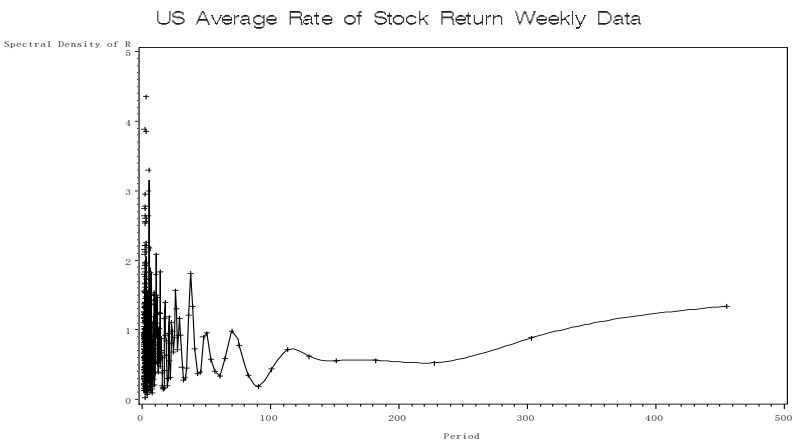


Figure 6. *Spectrum for US Stock Market from Year 1985 to 2004*

Figures 5 and 6 surprise us that the cyclical patterns in US stock market has changed dramatically with the time passing by, in which the periods of cycles are around 200 weeks (3.8 years, about 4 years) and 55 weeks (about 1-year) in the first sub-period, and are around 115 weeks (2.2 years) and 70 weeks (1.3 year) for the second sub-period. At the end of the first sub-period, if investors use the data to get the cyclical pattern in Figure 3, believe blindly the findings and follow it to invest in the second sub-period, one should be able to tell what would happen to their investment.

Should we follow cycles in investment?

Like many other time series data, it is well known that stock index can be anatomized into four parts – trend, cycles, seasonal components and error term. In the time series plot of the weekly S&P 500, the most significant component in the US market TREND from 1965 to 2000. In this situation, the knowledge of cycles may not play important role in generating profit. Investors could simply adopt the buy-and-hold strategy: buy in 1985 and hold it until 2000 and generate a better profit. Thus, cycles become less important in the investment decision

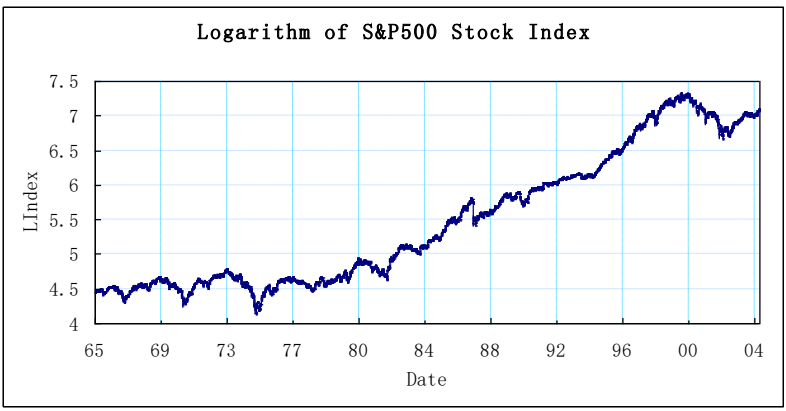


Figure 7. *Plot of S&P 500 stock index from 1965 to 2004*

However, for the Singapore stock market, from the plot of STI from year 1975 to 2004 as shown in Figure 8, it contains the trend as well as the cycles during the whole period.

In Singapore market, if investors can precisely predict all kinds of future mid-term or short-term cyclical patterns of the stock price, cycles can surely make great profits in investment. Nevertheless, in reality, the cyclical patterns in the stock market could be changing from time to time as what it is in the US stock market. Also, from the chart, it seems that the cycles in the Singapore stock market are formed by the combinations of many seed cycles. This will make the Singapore stock price more volatile with a higher number of smaller peaks and troughs, which, in turn, makes it hard for investors to accurately and timely detect the troughs and the peaks of the cycles, or when to buy and sell the stock in order to make the biggest profit.

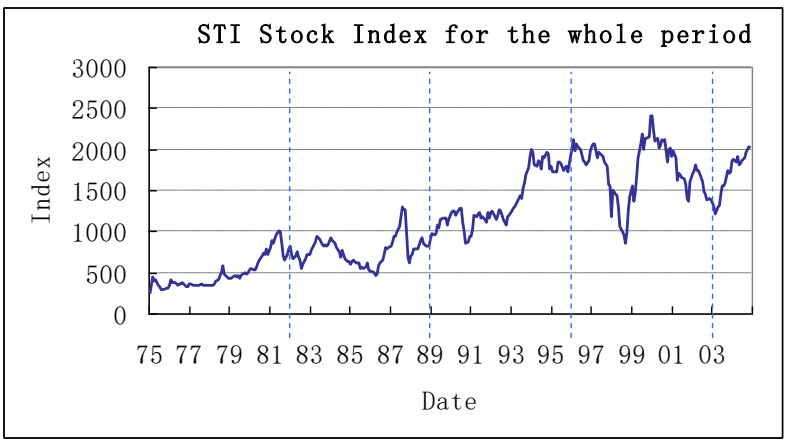


Figure 8. *Plot of STI from 1975 to 2004*

Discussion

Natural cycles like sunspot activity cycle are relatively more stable and its prediction is more reliable. Hence, it is more certain that natural cycles do repeat themselves from time to time because of its long-existing principle of universal movement. However, as for man-made cycles, it is the

capricious and complex human mind and behavior that determines the existence and appearance of the next cycle. Even the American stock market, given its role as the leading and most important stock market in the world, cannot repeat itself precisely in the 4-year cycle dominated by the greatest political event of US— the presidential election. In addition, according to the theory of market efficiency, all of the past information has been contained in the present stock price; it is impossible to predict the future stock price from past information. That is, if the market efficiency theory is true, stock price is random as time passes with few or even without any fixed cyclical patterns.

The Singapore stock market is in a bull run now. Investors are interested to know how long the bull run will last. While the Singapore markets may not be as efficient as that of the US; the development of the financial markets in Singapore will certainly increase in terms of market participants and trading volumes.

Appendix

Introduction of Spectral Analysis

The spectral analysis includes both *periodogram* and *spectral density analyses*. *Periodogram* analysis assumes that a time series, Y_t, can be expressed as a linear combination of sinusoidal waves. The period and amplitude of these cycles are determined through Fourier analysis. The basic equation of the sinusoid may be written as follows:

$$Y_t = R\cos(\omega t + \phi) + \varepsilon_t = A\cos\omega t + B\sin\omega t + \varepsilon_t \quad (1)$$

where R is the amplitude; ω is called the angular frequency (in radians per unit time); ϕ is the phase and ε_t is a random distributed error. We note that $A = R\cos\phi$ and $B = -R\sin\phi$. . The principle of least squares is to minimize the following equation:

$$T(A,B) = \sum_{t=0}^{n-1}(Y_t - A\cos\omega t - B\sin\omega t)^2$$

and obtain the estimates for A, B and R.

The *periodogram* plots the sums of squares from each regression model against the frequencies ω_t. That is, m (m = n/2 if n is even and m = (n-1)/2 if n is odd) regressions are fitted on the data, and the sums of squares for each regression model are calculated and plotted. These sums of squares are called *periodogram ordinates*, which can be interpreted as the amount of variation in Y at each frequency. The regression sums of squares for each model are proportional to the sum of the squared sine and cosine coefficients for each model, which can be written as $n/2(A^2 + B^2)$.

If there is a significant sinusoidal component at a given frequency, then :

(1) the coefficients A or B, or both, will be large;

(2) the regression sums of squares will be large; and

(3) the *periodogram* will have a large ordinate at the given frequency.

If there is no significant sinusoidal component in the data, then the periodogram will not have any large ordinates at any frequency, which means the data is simply white noise and no cycle has occurred.

If time series changes contain any periodicity, their spectral density estimate will display a dominant peak at the corresponding frequency and a concentration in the neighborhood of the peak. In practice, the Tukey and the Tukey-Hamming windows or the

triangular weighting sequence are usually used to smooth the periodogram using weights spectral window. Readers may refer to Granger (1964), Priestley (1981) and Shumway & Stoffer (2000) for more information on the spectral analysis.

References

Granger, C.W.J. (1964). *Spectral Analysis of Economic Time Series*. Princeton: Princeton University Press.

Priestley, M.B. (1981). *Spectral Analysis and Time Series*. London: New York: Academic Press.

Shumway, R.H., & Stoffer, D.S. (2000). Time Series Analysis and its Applications, New York: Springer.

3 Hedging Hong Kong Stock Sectors with Gold: Multivariate Asymmetric GARCH Approach

By
Tao ***Chen***
Kai-Yin ***Woo***

Introduction

Hong Kong has the fifth largest stock market in the world, and it was ranked the third largest in Asia in terms of market capitalization at the end of April 2015 (Information Service Department HKSAR, 2015). Huge varieties of products are traded in the flourishing Hong Kong stock market, and equity investment is one of the most popular investment choices in Hong Kong. Hang Seng Index, an index usually considered the proxy for a broad market portfolio in Hong Kong, grew from HK$81 since its beginning on 22 October 1965 to HK$23151.94 as of 23 October 2015 (HKEx Fact Book).

Despite the flourishing Hong Kong equity market, it has gone through several stock market crashes. Due to high liquidity of equity investments in Hong Kong, these stock market crashes and recessions can greatly hurt investors' wealth and investments. A recession or crisis will tremendously increase the risk, which is defined as the

volatility of portfolio returns (Brooks, Henry & Persand, 1999). Many of the crises or negative events might have their origins in other markets, but the Hong Kong market can be largely affected by spillover effects. Since 1997, the Hong Kong stock market has been hit by the Asian financial crisis from 1997 to 1998, the Dot-com bubble crisis in 2000, the SARS crisis in 2003, and the Wall Street Meltdown from 2008 to 2009. From August to September in 2015, the tremendous fluctuations of the China stock market also increased the stock market volatility in Hong Kong. During these periods, the Hong Kong stock market underwent excessive volatility and a drastic drop in value. Therefore, individual investors, institutional investors and portfolio managers should be cautious about making investment decisions and should look for proper hedging instruments.

Hedging is an activity that involves buying or selling an investment in order to offset a portion of risks of the original investment. An asset portfolio can be hedged by another asset that is negatively or positively correlated with that portfolio (Baur & Lucey, 2010). Sherman (1986) indicates that gold has diversification benefits when it is included in a stock portfolio. Hillier, Draper, & Faff (2006) also find that precious metal, such as gold, platinum, and silver, can exhibit hedging ability, particularly during recessions and financial crashes. Moreover, in Hong Kong, contracts for gold are highly liquid assets, which can be traded daily in the market. Therefore, gold will serve as the hedge instrument against stocks.

This paper is the first one to investigate the return spillover and volatility transmission between the eleven industrial stock sectors in Hong Kong and gold. Subsequently, we estimate optimal hedge ratios and assess the hedging effectiveness of gold against different stock sectors using two methods, i.e., the traditional static Ordinary Least Squares (OLS) model and VAR-TGARCH model. We then compare the optimal hedge ratios and hedging effectiveness estimated by these two methods. The paper finds that gold indeed provides hedging power and has hedging effectiveness on all eleven Hang Seng industrial stock sectors. Furthermore, the hedging effectiveness of gold against stock sectors estimated by the

VAR-TGARCH model is higher than that estimated by OLS model. Therefore, the VAR-TGARCH model is superior to the traditional OLS model in hedging.

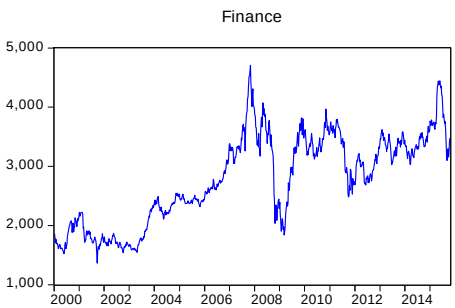
The remaining sections of the paper are organized as follows. Section 2 describes the data. Section 3 introduces the methodology. Section 4 presents the empirical results. The final section concludes the whole study with a summary of the major findings.

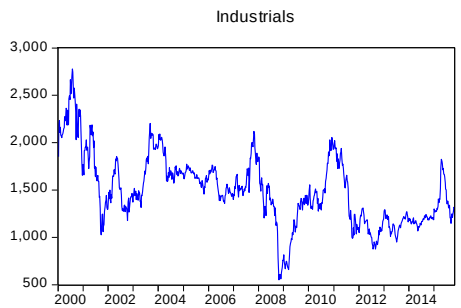
Data

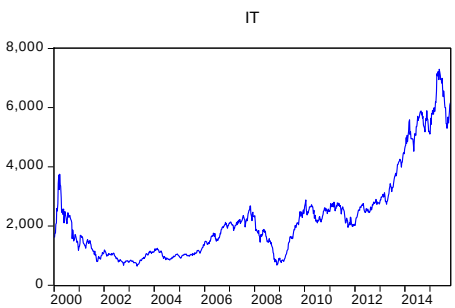
Data used in this study include stock market prices of different industrial sectors in Hong Kong and international gold prices. The stock market prices come from the Hang Seng Industrial Composite Indices, which are the constituents of the Hang Seng Index. They represent different industries and offer comprehensive benchmarks for eleven different industries in Hong Kong. The eleven industries covered are energy, materials, industrials, consumer goods, consumer services, telecommunications (Telcom), utilities, financials, properties & construction (properties), information technology (IT), and conglomerates. The main purposes of the study are to observe whether each of these industrial stock sectors can be hedged by gold, and which industry sector is most effectively hedged. As for the international gold price, we employ the Gold Bullion LBM U$ Troy Ounce. All these data were collected from the DataStream. The timeframe of all weekly price data collected is 7 January 2000 – 23 October 2015, with 825 observations. Table 1 shows the descriptive statistics of all returns series under study generated by the difference of the natural log of series in level. Figure 1 shows the price trends of all the series in level.

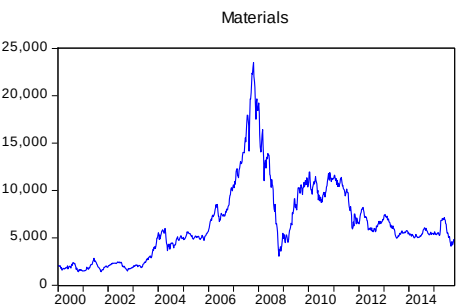
Table 1. *Descriptive statistics of return series*

	Gold	Conglomerates	Consumer Goods	Energy	Financials	Industrials
Mean	0.17182	0.060114	0.105837	0.166162	0.075525	-0.04192
Median	0.33002	0.091718	0.332492	0.215812	0.224492	-0.03827
Maximum	12.6035	12.22818	15.4843	21.35279	14.98683	20.93322
Minimum	-13.253	-19.5773	-14.4987	-31.4878	-17.6146	-30.4885
Std. Dev.	2.52491	3.424573	3.346579	4.673291	3.238496	4.763575
Skewness	-0.4243	-0.24018	-0.40545	-0.21815	-0.21907	-0.25741
Kurtosis	5.41154	5.336908	5.41888	7.252635	6.613242	6.934087
Jarque-Bera	224.393	195.4212	223.4598	627.4504	454.8304	540.4783
	IT	Materials	Properties	Consumer Services	Telecom	Utilities
Mean	0.16296	0.096881	0.06676	0.06188	0.022065	0.164969
Median	0.26230	0.180105	0.02225	0.217672	0.03347	0.285038
Maximum	22.1175	20.68767	15.43962	13.12512	19.92059	10.85777
Minimum	-29.429	-27.1449	-23.9535	-23.9045	-18.6898	-13.6084
Std. Dev.	4.96965	5.29872	4.079081	3.531621	4.336419	2.049083
Skewness	-0.4462	-0.33688	-0.05508	-0.51654	-0.06866	-0.50811
Kurtosis	6.71986	5.496417	5.026378	6.618598	5.560544	7.863782
Jarque-Bera	502.429	229.5542	141.3964	486.2119	225.7499	847.658
Obs	824	824	824	824	824	824









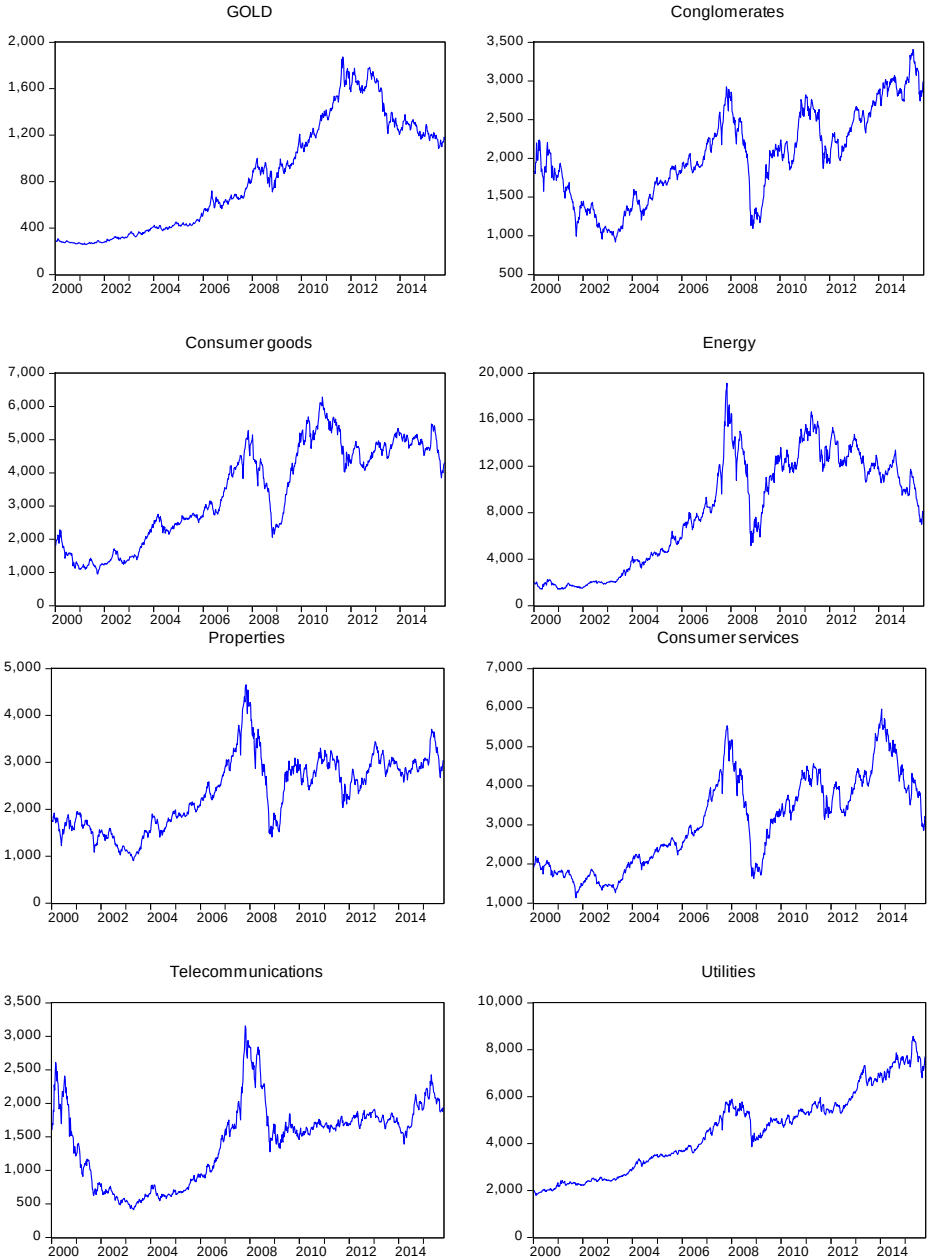


Figure 1. *Price trends of all industrial sectors and gold*

Methodology

Vector Autoregressive bivariate BEKK TGARCH model

Suppose that $R_{g,t}$ is the return on gold between time t-1 and t, $R_{s,t}$ is the return on each industrial sector between t-1 and t. We model the mean equations by a vector autoregressive model of order one denoted by VAR (1). The VAR (1) can reflect the quick responses of markets to new information and measure the return spillovers (Kumar, 2014). The mean equations for returns are modelled as:

$$R_{g,t} = \mu_{g0} + \mu_{g1} R_{g,t-1} + \mu_{g2} R_{s,t-1} + \varepsilon_{g,t} \quad (1)$$

$$R_{s,t} = \mu_{s0} + \mu_{s1} R_{s,t-1} + \mu_{s2} R_{g,t-1} + \varepsilon_{s,t} \quad (2)$$

where $\begin{bmatrix}\varepsilon_{g,t}\\ \varepsilon_{s,t}\end{bmatrix} \Big| \Omega_{t-1} \sim N(0, H_t)$. $\varepsilon_{g,t}$ and $\varepsilon_{s,t}$ are the error terms that are conditional on the information set Ω_{t-1}, which contains all the information available at time t-1. H_t is the conditional variance matrix at time t. μ_{gi} and μ_{si}, i=0,1,2, are coefficients of the equations. A significant value of μ_{s2}, for instance, implies that the current return of gold can help predict the stock sector's future return.

To model the conditional variance and covariance of both gold returns and stock sectors' returns, we employ the multivariate threshold GARCH (TGARCH) model for analysis using the Diagonal BEKK method (Engle & Kroner, 1995). Compared with an earlier diagonal VECH method (Bollerslev, Engle, & Wooldridge, 1988), the diagonal BEKK method guarantees that the H_t matrix must always be positive definite. By considering the exogenous influences and adding a threshold in the bivariate diagonal BEKK-TGARCH (1,1), the 2×2 conditional variance-covariance matrix H_t is represented by:

$$H_t = C'C + A'\epsilon_{t-1}\,\epsilon'_{t-1}A + B'H_{t-1}B + D'\epsilon_{t-1}\epsilon'_{t-1}D * I \quad (3)$$

In matrix form, the model becomes:

$$H_t = C'C + \begin{bmatrix} a_{11} & 0 \\ 0 & a_{22} \end{bmatrix}' \begin{bmatrix} \epsilon_{1t-1}^2 & \epsilon_{1t-1}\epsilon_{2t-1} \\ \epsilon_{2t-1}\epsilon_{1t-1} & \epsilon_{2t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & 0 \\ 0 & a_{22} \end{bmatrix} + \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix}' \begin{bmatrix} h_{11t-1} & h_{12t-1} \\ h_{21t-1} & h_{22t-1} \end{bmatrix} \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix} + \begin{bmatrix} d_{11} & 0 \\ 0 & d_{22} \end{bmatrix}' \begin{bmatrix} \epsilon_{1t-1}^2 & \epsilon_{1t-1}\epsilon_{2t-1} \\ \epsilon_{2t-1}\epsilon_{1t-1} & \epsilon_{2t-1}^2 \end{bmatrix} \begin{bmatrix} d_{11} & 0 \\ 0 & d_{22} \end{bmatrix} * I$$

where a_{ij} is the coefficient of the shocks during the previous period, or the ARCH terms (ϵ^2_{t-1}). b_{ij} is the coefficient of the conditional variance during the previous period, or the GARCH terms (h_{t-1}). d_{ij} is a dummy; when $\epsilon_{t-1} < 0$, I=1, and when $\epsilon_{t-1} > 0$, I=0. It is used to measure the asymmetric or threshold effects of positive news and negative news. Matrix $C = \begin{bmatrix} c_{11} & c_{12} \\ 0 & c_{22} \end{bmatrix}$ is the intercept coefficient matrix. In the following variance-covariance equations, we will use C_{11}, C_{22} and C_{12} to represent the intercept coefficients.

We express the conditional variance and covariance equations of the BEKK-TGARCH (1,1) model as:

$$h_{g,t} = C_{11} + a_{11}^2\epsilon_{1t-1}^2 + b_{11}^2 h_{11t-1} + d_{11}^2\epsilon_{1t-1}^2 I_g \quad (4)$$

$$h_{s,t} = C_{22} + a_{22}^2\epsilon_{2t-1}^2 + b_{22}^2 h_{22t-1} + d_{22}^2\epsilon_{2t-1}^2 I_s \quad (5)$$

$$h_{sg,t} = C_{12} + a_{11}a_{22}\epsilon_{1t-1}\epsilon_{2t-1} + b_{11}b_{22}h_{12t-1} + d_{11}d_{22}\epsilon_{1t-1}I_g\epsilon_{2t-1}I_s \quad (6)$$

in which $I_g = \begin{cases} 1, & \epsilon_{1t-1} < 0 \\ 0, & otherwise \end{cases}$, and $I_s = \begin{cases} 1, & \epsilon_{2t-1} < 0 \\ 0, & otherwise \end{cases}$. $h_{g,t}$ and $h_{s,t}$ represent the conditional variance of return on gold and each stock market sector, respectively; $h_{sg,t}$ represents the conditional covariance of returns on gold and each stock sector.

Optimal hedge ratios by VAR-TGARCH

To estimate the hedging effectiveness, we must first find the optimal hedge ratio that minimizes the variance of the hedged portfolio's returns. The optimal hedge ratio can be computed by using the estimates of conditional variance and

conditional covariance (Kroner & Sultan, 1993; Brooks, Henry, & Persand, 1999). The return of the hedged portfolio can be written as:

$$R_{p,t} = R_{s,t} - \beta_t R_{g,t} \tag{7}$$

where $R_{p,t}$ is the return of the hedged portfolio between time t-1 to t, $R_{s,t}$ is the return of the stock market sector from t-1 to t, $R_{g,t}$ is the return of gold from t-1 to t, and β_t is the hedge ratio from t-1 to t, which, in this case, is estimated from the VAR-TGARCH model and is therefore time-varying. By taking variance of both sides of (7), the variance of the hedged portfolio $h_{p,t}$ can be written as

$$h_{p,t} = h_{s,t} + \beta_t^2 h_{g,t} - 2\beta_t h_{sg,t} \tag{8}$$

where $h_{p,t}$, $h_{s,t}$ and $h_{g,t}$ represent the conditional variance of the hedged portfolio, the stock sector and gold, respectively. $h_{sg,t}$ represents the conditional covariance between the stock sector and gold. According to Ballie & Myers (1991), the optimal hedge ratio is defined as the value of β_t that minimizes the conditional variance of the hedged portfolio, $h_{p,t}$. The minimization process is given as follows. We first differentiate $h_{p,t}$ with respect to β_t, and set the first derivative to be zero:

$$\frac{\partial h_{p,t}}{\partial \beta_t} = 2\beta_t h_{g,t} - 2h_{sg,t} = 0 \tag{9}$$

and then we get

$$\beta_t = \frac{h_{sg,t}}{h_{g,t}} \tag{10}$$

By taking the second derivative, we have

$$\frac{\partial^2 h_{p,t}}{\partial \beta_t^2} = 2h_{g,t} > 0 \tag{11}$$

Hence, from (11), β_t in (10) can minimize the hedged portfolio's variance and is therefore known as the optimal hedge ratio.

Optimal hedge ratio by OLS

Alternatively, constructing the optimal hedge ratio by ordinary least squares (OLS) is actually quite straightforward and similar to the above TGARCH model. The traditional approach to estimate the optimal, or minimum-variance, hedge ratio is done by regressing the return of the stock sector on the return on gold via OLS (Miffre, 2004):

$$s_t = \alpha + \beta g_t + \varepsilon_t \tag{12}$$

where s_t is the return of the stock sector and g_t is the return of gold. The OLS estimated β in (12) is equal to:

$$\beta = \frac{Cov(s,g)}{Var(g)} \tag{13}$$

β in (13) is the time-invariant version of β_t in (10), and then is known as the static optimal hedge ratio.

Hedging effectiveness

Hedging effectiveness measures how well a hedge instrument performs when it is used to hedge an asset (Ku, Chen, & Chen, 2007) and it is written as:

$$Hedging\ effectiveness = \frac{Variance_{unhedged} - Variance_{hedged}}{Variance_{unhedged}} \tag{14}$$

where $Variance_{hedged}$ is the variance of returns of the hedged portfolio, $h_{p,t}$, or the stock-gold portfolio; $Variance_{unhedged}$ is the variance of returns of the stock sector, $h_{s,t}$. A higher hedging effectiveness indicates a better hedging performance and greater portfolio risk reduction. Therefore, by comparing the hedging effectiveness of VAR-TGARCH with that of OLS models, we can infer which model will lead to a better hedging performance.

Emprical results

We first conduct a unit root test to estimate whether the return series are stationary. Subsequently, we report the estimation results of the Bivariate VAR (1)-BEKK-TGARCH (1,1) model. We then use the time-varying variances and covariance estimated by the TGARCH model to find the optimal hedge ratio. We also compute the optimal hedge ratio by the traditional static OLS model. Finally, we obtain the hedging effectiveness estimated from both methods, i.e., bivariate VAR (1)-BEKK-TGARCH (1,1) and OLS and compare one with the other in hedging performance. All data used for empirical analysis are taken in natural logarithms.

Unit root test

Our first procedure is to estimate whether the return series are stationary. A stationary series is defined as one with a constant mean, constant variance, and constant auto-covariance. The paper employs two widely used unit root methods: Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979), and Phillips & Perron test (PP) (Phillips & Perron, 1988). The results are set out in Table 2:

Table 2. *Unit root tests*

	Level		1st Difference	
	ADF	PP	ADF	PP
Gold	-1.05677	-1.00903	-28.8252*	-29.1016*
Conglomerates	-1.19954	-1.29593	-29.1096*	-29.1230*
Consumer Goods	-1.2824	-1.33576	-28.8102*	-28.8518*
Energy	-1.60011	-1.65142	-28.0117*	-28.0356*
Financials	-1.83826	-2.00145	-27.9128*	-27.9789*
Industrials	-2.81453***	-2.8394***	-29.8052*	-29.7957*
IT	0.04942	0.18741	-13.631*	-31.0598*
Materials	-1.8327	-1.73966	-25.0392*	-24.9689*
Properties	-1.81334	-1.8888	-29.119*	-29.1263*
Consumer Services	-1.57604	-1.63507	-28.3925*	-28.4088*
Telecom	-1.53109	-1.66033	-28.6495*	-28.6912*
Utilities	-0.47994	-0.3075	-29.1902*	-29.5141*

Notes: The critical value are -2.5715, -2.8703 and -3.4506 for the 10%, 5% and 1% level, respectively. *, ** and *** indicate the significance at the 1%, 5% and 10% level, respectively.

According to the results in Table 2, the unit root tests do not reject the null hypothesis of a unit root for all series in level, except Industrials. On the other hand, in 1st difference, the unit root tests reject the null hypothesis of a unit root for all series at the 1% significance level. These results indicate that all return series are stationary.

Estimation results of the bivariate VAR-BEKK-TGARCH model

We estimate the VAR (1) model with the results reported in Table 3.

Table 3. *Estimation results of the VAR (1) mean equations*

		μ_{g0}	μ_{g1}	μ_{g2}	μ_{s0}	μ_{s1}	μ_{s2}
Conglomerates	Coeff.	0.157**	-0.0138	0.0018	0.1320	-0.0022	0.086**
	p-value	0.0386	0.7102	0.9399	0.1743	0.9494	0.0298
Consumer Goods	Coeff.	0.185**	-0.0104	-0.0030	0.229**	-0.0018	0.0542
	p-value	0.0152	0.7760	0.8982	0.0233	0.9626	0.1428
Energy	Coeff.	0.179**	-0.0148	0.0106	0.1725	-0.07**	0.106***
	p-value	0.0176	0.6783	0.5402	0.1898	0.0460	0.0690
Financials	Coeff.	0.164**	-0.0089	-0.0308	0.0923	0.0303	0.0494
	p-value	0.0307	0.8101	0.2280	0.2908	0.3838	0.1539
Industrials	Coeff.	0.184**	-0.0143	-0.0073	-0.0261	-0.0149	0.0346
	p-value	0.0144	0.6862	0.6457	0.8370	0.6713	0.5559
IT	Coeff.	0.175**	-0.0109	-0.0070	0.330**	-0.07**	0.0482
	p-value	0.0222	0.7688	0.6619	0.0164	0.0437	0.3588
Materials	Coeff.	0.186**	-0.0125	0.0100	0.1702	0.0427	0.0888
	p-value	0.0138	0.7292	0.5243	0.2340	0.2276	0.1347
Properties	Coeff.	0.1418***	-0.0138	-0.0049	0.0778	-0.0012	0.0584
	p-value	0.0630	0.7131	0.7988	0.5182	0.9749	0.2442
Consumer Services	Coeff.	0.172**	-0.0067	0.0186	0.227**	-0.0290	0.074***
	p-value	0.0240	0.8572	0.4147	0.0287	0.4038	0.0689
Telecom	Coeff.	0.174**	-0.0103	-0.0029	0.0920	-0.0399	0.0233
	p-value	0.0216	0.7782	0.8674	0.4226	0.2591	0.5877
Utilities	Coeff.	0.188**	-0.0072	-0.0115	0.2215*	-0.0543	0.0266
	p-value	0.0134	0.8464	0.7628	0.0002	0.1205	0.2813

Note: *, ** and *** indicate the significance at the 1%, 5% and 10% level, respectively.

The mean equations are shown here again as follows:

$$R_{g,t} = \mu_{g0} + \mu_{g1}R_{g,t-1} + \mu_{g2}R_{s,t-1} + \varepsilon_{g,t}$$
$$R_{s,t} = \mu_{s0} + \mu_{s1}R_{s,t-1} + \mu_{s2}R_{g,t-1} + \varepsilon_{s,t}$$

μ_{go} and μ_{so} are intercept coefficients; μ_{g1} and μ_{s2} are coefficients of lagged gold returns; μ_{g2} and μ_{s1} are coefficients of lagged stock sector returns. Results from the mean equations show that the intercept coefficients, μ_{go}, are significant for all series. It indicates that if we assume the lagged gold return and lagged stock sector return to be zero, the current gold return would be significantly positive, according to the model. On the other hand, the intercept coefficients, μ_{so}, are significant only for the following sectors: consumer goods, IT, consumer services, and utilities. All of the four coefficients are positive. It indicates that the current returns of the four stock sectors would be significantly positive, given that the lagged gold returns and each of their own lagged stock sector returns are zero.

The autoregressive terms, however, are mostly insignificant. Only the coefficient μ_{s2} for Conglomerates, Energy, and Consumer Services, and the coefficient μ_{s1} for Energy and IT are significant. The significant coefficient μ_{s2} for Conglomerates indicates a positive and significant return spillover (0.086) from gold to Conglomerates. An increase of the previous gold return indicates an increase of the current return of Conglomerates. The same argument is applied to the sectors of Energy and Consumer Services. Similarly, significant coefficients μ_{s1} for Energy and IT indicate negative return spillover (-0.071 and -0.070 respectively) from the previous returns of the stock sectors to their corresponding current returns. An increase of the previous returns of Energy or IT indicates a decrease in their corresponding current returns.

The insignificant coefficients suggest that for most of the cases, past returns from stock sectors or past returns from gold cannot help us predict current stock returns or gold returns. In conclusion, the return spillover from past returns of the stock sectors or gold to the current returns is limited.

Next, we estimate the BEKK-TGARCH (1,1) model with the results presented in Table 4.

Table 4. *Estimation results of BEKK-TGARCH variance-covariance equations*

		C_{11}	C_{12}	C_{22}	a_{11}	a_{22}	d_{11}	d_{22}	b_{11}	b_{22}
Conglo-merates	Coeff.	0.21**	0.018	0.212*	0.290*	0.12**	0.023	0.301*	0.938*	0.956*
	p-value	0.041	0.612	0.006	0.000	0.024	0.819	0.000	0.000	0.000
Consumer Goods	Coeff.	0.23**	0.13#	1.571*	0.282*	0.255*	-0.013	0.473*	0.940*	0.814*
	p-value	0.040	0.070	0.000	0.000	0.000	0.883	0.000	0.000	0.000
Energy	Coeff.	0.24**	0.10#	0.629*	0.270*	0.255*	-0.034	0.195*	0.942*	0.940*
	p-value	0.032	0.064	0.009	0.000	0.000	0.740	0.009	0.000	0.000
Financials	Coeff.	0.23**	0.042	0.180*	0.297*	0.151*	0.007	0.338*	0.935*	0.949*
	p-value	0.030	0.222	0.009	0.000	0.007	0.944	0.000	0.000	0.000
Industrials	Coeff.	0.21**	0.030	0.295**	0.284*	0.171*	0.015	0.292*	0.942*	0.956*
	p-value	0.048	0.520	0.012	0.000	0.000	0.882	0.000	0.000	0.000
IT	Coeff.	0.22**	0.08#	0.340*	0.288*	0.057	-0.034	0.218*	0.937*	0.974*
	p-value	0.046	0.081	0.001	0.000	0.261	0.766	0.000	0.000	0.000
Materials	Coeff.	0.21**	0.088	0.572*	0.269*	0.230*	0.000	0.287*	0.945*	0.939*
	p-value	0.037	0.104	0.003	0.000	0.000	1.000	0.000	0.000	0.000
Properties	Coeff.	0.22**	0.080	0.473*	0.302*	0.157*	-0.011	0.370*	0.933*	0.937*
	p-value	0.030	0.108	0.002	0.000	0.002	0.905	0.000	0.000	0.000
Consumer Services	Coeff.	0.23**	0.064	0.461*	0.286*	0.122#	0.020	0.329*	0.939*	0.940*
	p-value	0.048	0.162	0.001	0.000	0.053	0.838	0.000	0.000	0.000
Telecom	Coeff.	0.24**	0.042	0.125#	0.285*	0.184*	-0.066	0.14**	0.937*	0.972*
	p-value	0.029	0.226	0.051	0.000	0.000	0.607	0.030	0.000	0.000
Utilities	Coeff.	0.24**	0.028	0.230*	0.286*	0.185*	0.007	0.296*	0.939*	0.924*
	p-value	0.045	0.357	0.004	0.000	0.001	0.958	0.000	0.000	0.000

Note: *, ** and # indicate the significance at the 1%, 5% and 10% significance level, respectively.

The conditional variance and covariance equations are shown below again:

$$h_{g,t} = C_{11} + a_{11}^2 \epsilon_{1t-1}^2 + b_{11}^2 h_{11t-1} + d_{11}^2 \epsilon_{1t-1}^2 I_g$$
$$h_{s,t} = C_{22} + a_{22}^2 \epsilon_{2t-1}^2 + b_{22}^2 h_{22t-1} + d_{22}^2 \epsilon_{2t-1}^2 I_s$$
$$h_{sg,t} = C_{12} + a_{11} a_{22} \epsilon_{1t-1} \epsilon_{2t-1} + b_{11} b_{22} h_{12t-1} + d_{11} d_{22} \epsilon_{1t-1} I_g \epsilon_{2t-1} I_s$$

The estimation results of the ARCH (a_{ii}) terms and the GARCH (b_{ii}) terms are shown in Table 4. The ARCH coefficients (a_{ii}) are significant (5%) for all industrial sectors and gold except for the IT sector, in which its ARCH coefficient a_{22} is not significant. The significant coefficients a_{ii} indicate that past information shocks have significant impacts on the current conditional volatility. The GARCH coefficients (b_{ii}) are all significant at 1% level for all stock sectors and gold,

indicating that the past variances in these assets significantly affect the current variance.

The asymmetric term d_{11} remains insignificant for all series, while d_{22} is significant at the 1% level for all series. The insignificant d_{11} coefficients indicate that previous negative news does not have larger impacts on the current conditional variance of gold returns than positive news. The significant d_{22} coefficients indicate that previous negative news would have greater impacts on current conditional variance of stock sectors than good news. Therefore, there is asymmetric volatility spillover from the past conditional volatility to the current conditional volatility for all stock sectors.

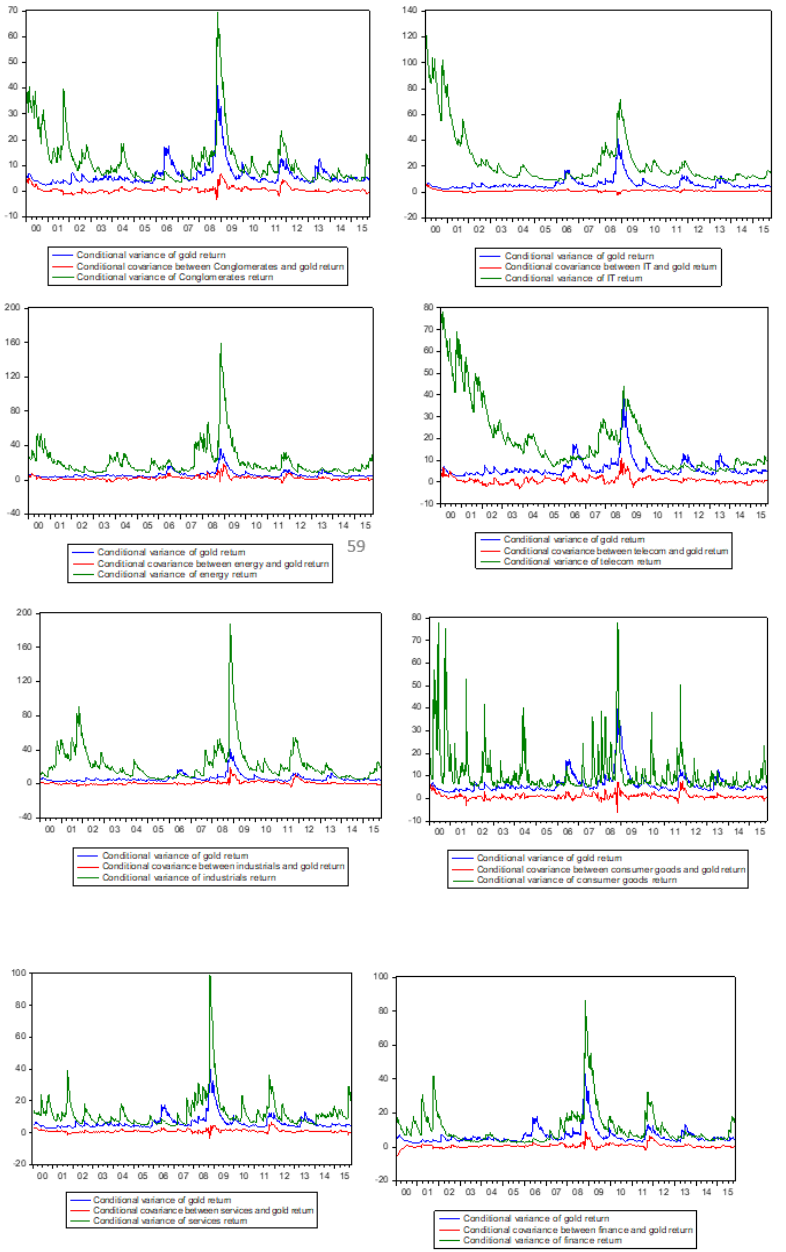
Optimal hedge ratio by VAR-BEKK-TGARCH model

To find the optimal hedge ratio as shown in (10) from the VAR (1)-BEKK-TGARCH (1,1) model, we use the estimates of conditional time-varying covariance and variance ($h_{sg,t}$ and $h_{g,t}$) generated by this model (Kroner & Sultan, 1993). Their descriptive statistics are reported in Table 5.

Table 5. *Descriptive statistics of the time-varying conditional covariance (stock sectors & gold) and conditional variance (gold)*

	Time-varying Conditional Covariance ($h_{sg,t}$)			Time-varying Conditional Variance of Gold ($h_{g,t}$)		
Stock sectors and gold	Mean	Median	St. Dev	Mean	Median	St. Dev
Conglomerates	0.675394	0.455739	1.164882	6.284239	4.884972	4.479523
Consumer Goods	0.93496	0.751083	1.186767	6.301034	4.972221	4.321335
Energy	2.353115	1.839585	2.431003	6.311089	5.029026	4.073559
Financials	0.775827	0.619519	1.317802	6.308178	4.902187	4.549898
Industrials	1.24567	0.681175	2.29746	6.540099	5.129991	4.536995
IT	1.023215	1.007137	0.662129	6.269532	4.91069	4.421121
Materials	2.44048	1.685842	3.220392	6.309118	5.010623	4.160644
Properties	1.013968	0.937903	1.271143	6.24954	4.822181	4.587295
Consumer Services	1.071638	0.889084	0.991352	6.333468	4.963706	4.358531
Telecom	0.932563	0.790386	1.564194	6.367392	5.017961	4.392677
Utilities	0.314565	0.338811	0.857197	6.481695	5.120372	4.430683

Figure 2 depicts the conditional variances and covariance of returns on stock sectors and gold estimated by the VAR-BEKK-TGARCH model.



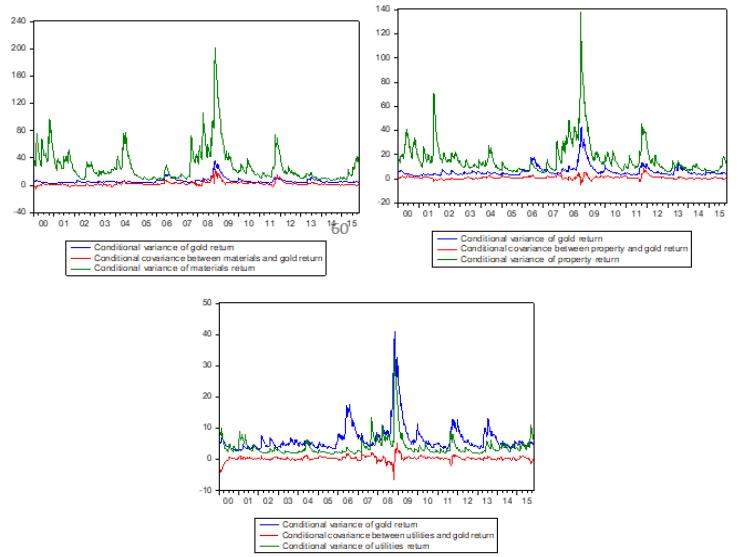


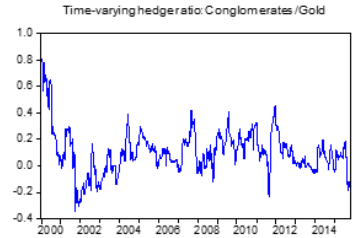
Figure 2. *Conditional variances and covariance of returns on stock sectors and gold*

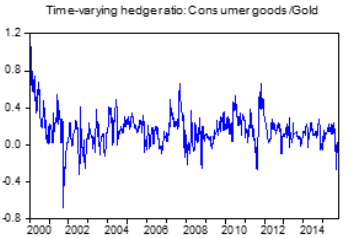
With the results of time-varying conditional covariance between the returns on each stock sector and gold, and time-varying conditional variances of return on gold estimated by VAR(1)-BEKK-TGARCH (1,1) model, we can compute the optimal hedge ratio by using (10). The descriptive statistics of the time-varying hedge ratios are shown in Table 6. We employ gold as the hedging instrument, so we are hedging the stock sectors with gold. It means that we are in a long position in the stock sectors and a short (long) position in gold if β_t is positive (negative). The time-varying hedge ratios indicate that investors should react to the market and adjust their portfolios dynamically.

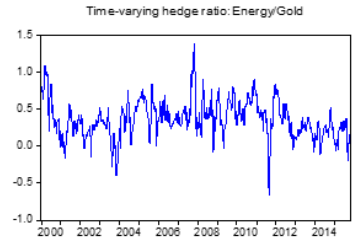
Table 6. *Estimation results of the time-varying optimal hedge ratios*

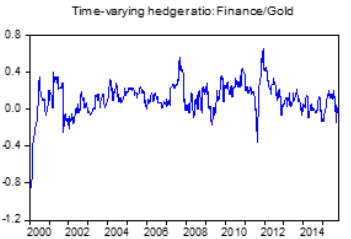
	Mean	Median	St. Dev	Min	Max
Conglomerates/Gold	0.10263	0.09295	0.16082	-0.34871	0.81627
Consumer Goods/Gold	0.16074	0.15061	0.16843	-0.67528	1.06061
Energy/Gold	0.36314	0.34287	0.25427	-0.66081	1.38359
Financials/Gold	0.11896	0.12782	0.16201	-0.85633	0.65728
Industrials/Gold	0.15877	0.13375	0.23811	-0.62784	0.98473
IT/Gold	0.20321	0.20188	0.12811	-0.08954	0.97582
Materials/Gold	0.34658	0.33764	0.30823	-0.8173	1.36905
Properties/Gold	0.18680	0.18680	0.18882	-0.4692	0.85630
Consumer Services/Gold	0.18138	0.16781	0.13135	-0.33881	0.63994
Telecom/Gold	0.14859	0.14568	0.23602	-0.5387	1.25354
Utilities/Gold	0.05765	0.06686	0.11452	-0.75225	0.47489

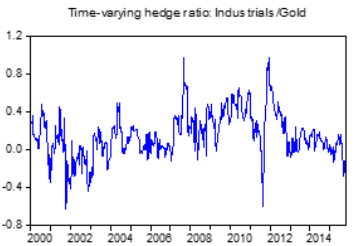
Among all eleven sectors, Energy and Materials have the largest absolute mean value of hedge ratios, which are 0.3631 and 0.3466, respectively. It indicates that an investor can averagely short HK$ 0.3631 in gold for each dollar invested in the Energy stock sector. Similarly, an investor can averagely short HK$ 0.3466 in gold for each dollar invested in the Materials sector. The Utilities sector has the smallest absolute mean value of hedge ratio, which is 0.0576. An investor only shorts HK$ 0.0576 in gold for each dollar invested in the Utilities stock sector. It also has the lowest standard deviation, which implies that the Utilities-gold portfolio might not need dynamic hedge ratio adjustments as frequently as other sectors for hedging.


Time-varying hedge ratio: Conglomerates /Gold

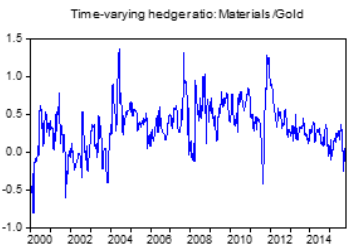

Time-varying hedge ratio: Consumer goods /Gold


Time-varying hedge ratio: Energy/Gold

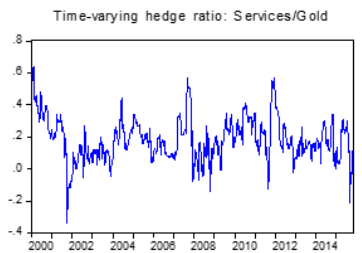

Time-varying hedge ratio: Finance/Gold

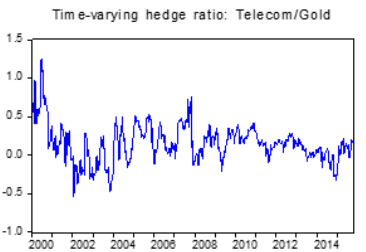

Time-varying hedge ratio: Industrials /Gold


Time-varying hedge ratio: IT/Gold


Time-varying hedge ratio: Materials /Gold


Time-varying hedge ratio: Property/Gold


Time-varying hedge ratio: Services/Gold


Time-varying hedge ratio: Telecom/Gold

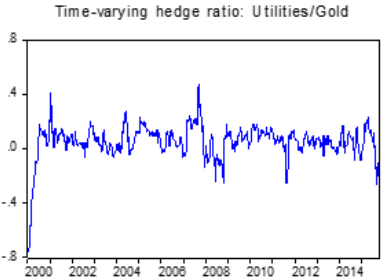


Figure 3. *Time-varying optimal hedge ratios of all pairs estimated by the VAR-BEKK-TGARCH model.*

Optimal hedge ratio by static OLS model

The optimal hedge ratio estimated from the traditional static OLS model is given by $\beta = \frac{\mathrm{COV(s,g)}}{\mathrm{VAR(g)}}$ as shown in (13) and the estimation results are reported in Table 7.

Table 7. *Estimation results of static optimal hedge ratio by OLS*

Long/Short	Hedge ratio		Hedge ratio
Conglomerates/Gold	0.148752	Materials/Gold	0.489834
Consumer goods/Gold	0.20183	Properties/Gold	0.180656
Energy/Gold	0.411522	Consumer services/Gold	0.205674
Financials/Gold	0.168697	Telecom/Gold	0.165413
Industrials/Gold	0.257215	Utilities/Gold	0.048461
IT/Gold	0.156083		

Hedging effectiveness

Tables 8 and 9 report the hedging effectiveness based on (14) estimated by TGARCH and OLS models, respectively.

Table 8. *Hedging effectiveness from VAR-BEKK-TGARCH model*

	Conglomerates	Consumer Goods	Energy	Financials	Industrials	IT
Variance unhedged	11.5335	11.1688	21.0585	10.5669	22.8221	23.3384
Variance hedged	11.3153	10.8581	19.7907	10.3101	22.2181	23.0632
Hedging effectiveness (%)	1.9284	2.8614	6.4062	2.4909	2.7187	1.1932
	Materials	Properties	Consumer Services	Telecom	Utilities	
Variance unhedged	28.1465	16.6879	12.2788	19.0046	3.9908	
Variance hedged	26.5952	16.3107	11.9902	18.5822	3.8919	
Hedging effectiveness (%)	5.8329	2.3127	2.4067	2.2730	2.5419	

Table 9. *Hedging effectiveness from OLS model*

	Conglomerates	Consumer goods	Energy	Financials	Industrials	IT
Variance unhedged	11.7277	11.1996	21.8396	10.4879	22.6916	24.6975
Variance hedged	11.5870	10.9405	20.7626	10.3069	22.2709	24.5425
Hedging effectiveness (%)	1.2145	2.3679	5.1873	1.7560	1.8893	0.6313
	Materials	Properties	Consumer services	Telecom	Utilities	
Variance unhedged	28.0764	16.6389	12.4723	18.8045	4.1987	
Variance hedged	26.5505	16.4313	12.2033	18.6305	4.1838	
Hedging effectiveness (%)	5.7473	1.2632	2.2045	0.9340	0.3570	

The estimation results of the hedging effectiveness by both models indicate that including gold in stock sector portfolio effectively reduces the stock sector portfolio's risks. Among the 11 stock sectors, we find that the Energy sector and the Materials sector are most effectively hedged by gold. Hedging effectiveness of gold against the Energy sector is 6.4062% by the TGARCH model and 5.1873% by the OLS model; hedging

effectiveness of gold against the Materials sector is 5.8329% by the TGARCH model and 5.7473% by the OLS model.

Following this, we compare the VAR (1)-BEKK-TGARCH (1,1) model with the OLS model. A summary is set out in Table 10. From the comparison, we can observe that the hedging effectiveness estimated by the TGARCH model is greater than that by the OLS for all sectors. In the Utilities sector, for instance, the hedging effectiveness estimated by TGARCH is 612.0542% larger than that by OLS.

Finally, we conclude that gold serves as an effective hedging instrument for the stock sectors in Hong Kong when the hedging effectiveness of gold against all stock sectors is positive. Further, after comparing the two models, we discover that the time-varying VAR-BEKK-TGARCH model provides better hedging strategy and optimal hedge ratios than the OLS, for the hedging effectiveness estimated by the former model is altogether greater than by the latter.

Table 10. *Comparison of hedging effectiveness estimated by TGARCH and OLS models*

	Conglomerates	Consumer goods	Energy	Financials	Industrials	IT
HE(%), GARCH	1.9284	2.8614*	6.4062	2.4909	2.7187	1.1932
HE(%), OLS	1.2145	2.3679	5.1873	1.7560	1.8893	0.6313
Δ%	58.7821	20.8382	23.4980	41.8478	43.9023	89.0164
	Materials	Properties	Consumer Services	Telecom	Utilities	
HE(%), GARCH	5.8329	2.3127	2.4067	2.2730	2.5419	
HE(%), OLS	5.7473	1.2632	2.2045	0.9340	0.3570	
Δ%	1.4894	83.0855	9.1709	143.3587	612.0542	

Notes: Δ% represents to what extent the HE of GARCH is better than OLS and is given by $\Delta\% = \left(\frac{HE(\%),GARCH - HE(\%),OLS}{HE(\%),OLS}\right) x\ 100$.HE stands for hedging effectiveness.

Conclusion

This chapter examines the role of gold as a hedging instrument against stocks in the Hong Kong market. In practice, investors usually invest in stocks by constructing stock portfolios. We separate the stock market into different

industrial sectors represented by 11 Hang Seng Industrial Composite Indices. We treat gold as a hedging instrument and find the optimal hedging ratio to construct a stock-gold portfolio that helps reduce risks. In this hedged portfolio, we long one dollar of stock and short (long) H dollar of gold, where H is represented by the optimal hedge ratio if the hedge ratio is positive (negative). Kroner & Sultan (1993) pointed out that the optimal hedge ratio can be obtained by dividing the conditional covariance by conditional variance. Therefore, this paper adopts the bivariate VAR (1)-BEKK-TGARCH (1,1) model to estimate the conditional time-varying covariance and variance of the gold returns and the stock sectors returns; the time-varying optimal hedge ratios are then estimated by the time-varying covariance and variances. The model also helps us understand the return and volatility spillovers between gold and stock sectors. We adopt both of the VAR (1)-BEKK-TGARCH (1,1) model and the traditional OLS model to estimate optimal hedge ratios and the hedging effectiveness for comparisons.

Our findings indicate that gold serves as an effective hedging instrument against stocks in all different industries because all the estimated hedging effectiveness is positive, regardless of which model we adopt. Our core findings suggest that a stock-gold portfolio constructed by the VAR (1)-BEKK-TGARCH (1,1) model provides better diversification benefits than both stock portfolio and the stock-gold portfolio estimated by OLS. The bivariate TGARCH model has greater hedging effectiveness than OLS for all eleven stock sectors. Moreover, the bivariate TGARCH provides some insights about the return and volatility spillovers between gold and different stock sectors. While the return spillover from past returns of the stock sectors or gold to the current returns is quite limited, the volatility spillover effects are significant for almost all series. It implies that the current volatility is indeed significantly affected by the past information shocks and variance. We also discover that there are asymmetric volatility spillovers from the past conditional volatility to the current conditional volatility for all stock sectors.

Our empirical results are helpful for portfolio managers and investors to engage in real-life hedging practices. The results may also be useful for understanding the volatility and return spillover effects between gold and different stock sectors in Hong Kong. We have shown that the time-varying dynamic model, i.e., bivariate VAR (1)-BEKK-TGARCH (1,1), has a better estimation of optimal hedge ratios, which reduce more risks and have higher hedging effectiveness. The findings also encourage portfolio managers and investors to adopt the TGARCH model in estimating the hedge ratios. For further research, we can try other assets as hedging instruments for Hong Kong stock sectors (for example, Woo & Wu, 2022) and we can find out the most optimal assets for hedging purpose.

References

Baillie, R.T., & Myers, R.J. (1991). Bivariate GARCH estimation of the optimal commodity futures hedge. *Journal of Applied Econometrics*, 6(2), 109-124. doi. 10.1002/jae.3950060202

Baur, D.G., & Lucey, B.M. (2010). Is gold a hedge or a safe haven? An analysis of stocks, onds and gold. *Financial Review*, 45(2), 217-229. doi. 10.1111/j.1540-6288.2010.00244.x

Bollerslev, T., Engle, R.F., & Wooldridge, J.M. (1988). A capital asset pricing model with time-varying covariances. *Journal of Political Economy*, 96(1), 116-131. doi. 10.1086/261527

Brooks, C., Henry, Ó.T., & Persand, G. (1999). *Optimal Hedging and the Value of News*. Reading: The ISMA Centre, Department of Economics, University of Reading.

Dickey, D.A., & Fuller, W.A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American Statistical Association,* 74(366), 427-431. doi. 10.1080/01621459.1979.10482531

Engle, R., & Kroner, K. (1995). Multivariate simultaneous generalized ARCH. *Econometric Reviews*, 11(1), 122–150. doi. 10.1017/S0266466600009063

Hillier, D., Draper, P., & Faff, R. (2006). Do precious metals shine? An investment perspective. *Financial Analysts Journal,* 62(2), 98-106. doi. 10.2469/faj.v62.n2.4085

Information Service Department HKSAR. (2015, June). *Hong Kong: The Facts, Financial Services.*

Jaffe, J. (1989). Gold and gold stocks as investments for institutional portfolios. *Financial Analysts Journal*, 45(2), 53-59. doi. 10.2469/faj.v45.n2.53

Kroner, K.F., & Sultan, J. (1993). Time-varying distributions and dynamic hedging with foreign currency futures. *Journal of Financial and Quantitative Analysis*, 28(4), 535-551. doi. 10.2307/2331164

Ku, Y.H., Chen, H.C., & Chen, K.H. (2007). On the application of the dynamic conditional correlation model in estimating optimal time-varying hedge ratios. *Applied Economics Letters*, 14(7), 503-509. doi. 10.1080/13504850500447331

Kumar, D. (2014). Return and volatility transmission between gold and stock sectors: Application of portfolio management and hedging effectiveness. *IIMB Management Review*, 26(1), 5-16. doi. 10.1016/j.iimb.2013.12.002

Miffre, J. (2004). Conditional OLS minimum variance hedge ratios. *The Journal of Futures Markets*, 24(10), 945-964. doi. 10.1002/fut.20116

Phillips, P.C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, 75(2), 335–346. doi. 10.1093/biomet/75.2.335

Sherman, E. (1986). *Gold Investment: Theory and Application*. New York: Prentice Hall.

Woo, K.Y. & Wu, H.F. (2022), Volatility between commodity and stock sectors: evidence in Hong Kong and the implication of hedging effectiveness, *in* W.-K Wong, K.-Y. Woo, W.-K. Au, T.-Y. Hon & M. McAleer (eds.) *Market Efficiency, Behavioural Finance, and Anomalies*, Chapter 5, (pp.96-121), Istanbul: KSP Books.

4 Cointegration of the Indian Market with Other National Stock Markets after Financial Tsunami

By
Hui-Hui ***Xu***
Kai-Yin ***Woo***
Suet-Ching ***Chak***

Introduction

The rising trend for deregulation of international asset markets, advancement in information technology and development of financial innovations have resulted in growing interest in the study of integration among financial markets and portfolio diversification. Optimum wealth management can be achieved by pursuing returns expected from the selection of assets and markets all over the world and managing risk level. Stock is a risky asset, whereby investors wish to construct a portfolio with optimal risk for any given level of expected return. Most risks are unpredictable but can be reduced through diversification. The risks in financial markets come from different factors, including natural disasters, economic recessions, political turbulence and so on. The recent financial tsunami broke out in the US caused by the large-scale default risk of the subprime mortgages, which went up to an extremely high level in early 2008 and was shifted from commercial banks to bond holders through mortgage-loan securitization and CDS

(Credit Default Swaps) contracts. The financial tsunami finally happened on 7 September 2008 and then Fannie Mae and Freddie Mac were put into conservatorship, followed by Lehman Brothers, Merrill Lynch and AIG which were on the verge of bankruptcy. The resulting prices of the subprime bonds and mortgage derivatives totally collapsed. The financial crisis spread to the rest of the world quickly through the contagious effects on stocks, bonds, real estate, commodities and foreign currencies. Since then, it has aroused concerns about integration of asset markets and diversification.

According to Stulz (1981), asset markets are said to be perfectly integrated internationally if two assets, with perfectly positively correlated returns in a given currency are traded in different countries but have identical expected returns in that currency. Financial integration provides practical implications on pricing of assets and international portfolio diversification strategy. With perfect integration in the world market, capital can flow freely across countries so that international investors can diversify their portfolios internationally and the individual country's risk can be diversified away. Thus, the only priced risk in the stock portfolios is the systematic risk relative to the global market (Jorion & Schwartz, 1986). On the contrary, perfect segmentation implies that only domestic systematic risk can affect the pricing of assets. Moreover, according to the stock market integration hypothesis, potential gains from international portfolio diversification would be limited in an integrated global stock market when arbitrage profit will not be earned.

The existence of cointegrated stock markets implies equilibrium constraints among the market indexes resulting from the common driving forces underlying the stock market linkages, such as an arbitrage activity, which bring stock markets together in the long run so that prices in different markets cannot diverge without bound from each other (Gonzalo & Granger, 1995). Hence, if stock markets are cointegrated, stock prices will move together in the long run and opportunities for portfolio diversification are limited

since abnormal profits will be arbitraged away in the long run and, without barriers generating country risk and exchange rate premiums, we would expect similar returns for stocks of similar risk reflected by the common global risk premium, regardless of their nationality (Von Furstenberg & Jeon, 1989; Ng, 2002). Hence, cointegration and co-movement of stock prices may reflect the integration of stock markets (Ahlgren & Antell, 2002) and the potential for earning abnormal profits through international portfolio diversification (Masih & Masih, 2002). Apart from the cointegrating relationship, the gains from portfolio diversification depend upon the sizes and signs of the long-run coefficients in the cointegrating vector (Byers & Peel, 1993; Verchenko, 2000; Raj & Dhal, 2009).

Background of the Indian Stock Market

Since the 1990s, the Indian government has undertaken substantial reforms to liberalize the monetary and banking sectors such as deregulation of interest rate structure, introduction of new money market vehicles, banking system reforms and so on (Kumar, 2014). Moreover, reforms in the Indian capital markets have made much economic progress, including free pricing of equity issues, allowing foreign institutional investors to participate in the capital market and Indian corporations to raise capital abroad, introduction of book-building process dematerialization of securities, introduction of derivatives on equity, and policies to enhance corporate governance and disclosure standards (Raj & Dhal, 2009). The above measures have helped to liberalize the stock market and increase the mobility of capital across Indian and other national markets. Under the wave of integration and liberalization process, the Bombay Stock Exchange (BSE) was the world's 10th largest stock market in terms of market capitalization at US$1.7 trillion as of Jan 2015 (WFE, 2015).

Description of the Research

The aim of this study is to examine the financial integration of the Indian stock market and other national equity markets, which include the stock markets of the

United States (US), the United Kingdom (UK), Hong Kong, Singapore, Japan, Australia, New Zealand and Pakistan. These countries have strong trade and financial relations with India (Narayan, *et al.,* 2004; Dhal, 2009). Among these eight countries, one from North America, one from Europe, two from Asia-Pacific and the remaining four from Asia.[1,2]

We will apply the multivariate cointegration method to conduct cointegration analysis and Granger causality tests based on vector error-correction model (VECM) in order to examine if the Indian market has an influence on other markets or vice versa after the 2008 financial tsunami. Furthermore, we use variance decomposition (VD) method to assess the contribution of the Indian market to the variation in other markets under study, and vice versa. The results of financial integration also provide information about the international portfolio diversification.

We organize the rest of the paper as follows: Section 2 presents the literature review. Section 3 outlines the research methodology. Section 4 describes the data. Section 5 presents the empirical results. Section 6 summarizes the findings, and the critical discussion is made in the last section.

Literature review

There are a number of studies focusing on analyzing the cointegration relationship between Indian and other equity markets. Narayan, *et al.,* (2004) examined the dynamic linkages between the stock markets of India, Pakistan, Bangladesh and Sri Lanka from January 1995 to November 2001. It was concluded that there existed some evidence of

[1] The Pakistan stock market is relatively small. It is selected because the business hour of the India and Pakistan stock markets are almost the same. It is worth examining whether they are closely integrated to each other.

[2] China's stock market capitalization in 2014 reached US$6 trillion, the same as the BSE in India. The China's market is not selected however because the stocks of many large Chinese companies are listed and actively traded on the Hong Kong Stock Exchange, and the Chinese government has many strict restrictions on its domestic stock markets and foreign exchange control.

long-run relationship among the four stock markets and the stock market of India was Granger caused by the markets of Pakistan and Sri Lanka. Lamba (2005) conducted cointegration analysis between the South Asian markets of India, Pakistan and Sri Lanka, and the major developed markets of the United States, the United Kingdom, and Japan during July 1997 to December 2003. It was found that India had a cointegrated relationship with developed markets. Chi *et al.,* (2006) examined three pairs of stock markets (India-United States, India-China and China-United States) and the results presented that the market of the United States led both the Indian and Chinese markets. The results also showed that Indian and Chinese markets appeared to be more closely linked to each other rather than to the United States. Jeyanthi & Pandian (2008) studied the cointegrating relationship among the stock markets of India, Malaysia, Taiwan, China, South Korea, the United States, the United Kingdom, Germany, Singapore, Hong Kong, and Japan, covering the period April 2000 to March 2007. The results indicated that India was not cointegrated with other markets and that international investors could achieve substantial risk diversification benefits in Indian markets. Mukherjee & Bose (2008) examined whether the Indian market moved with the US and Asian markets of Singapore, Hong Kong, Japan, Malaysia, Taiwan, and South Korea, for the period from January 1999 to June 2005. Evidence of cointegration was found. The Indian stock return was led by the United States and Japan as well as some Asian markets. Returns on the Indian market could influence Asian markets. Raj & Dhal (2009) reported evidence of cointegration between the Indian stock market with the global markets of the United States, the United Kingdom, and the regional markets of Hong Kong, Singapore and Japan, during the period from March 1993 to January 2008. The evidence showed that the integration of the Indian stock index with the global markets was much stronger than with the regional markets. Marimuthu (2010) examined the co-movements among the stock markets of India, Malaysia, China, the United States, and the United Kingdom, covering the period from 1997 to 2007. It was found that there

was a long-run relationship among the markets, and also India and Malaysia Granger caused each other.

Furthermore, Srikanth (2012) investigated the dynamic linkage between the Indian and other markets in the Asia-Pacific region such as Hong Kong, Indonesia, Malaysia, South Korea, Japan, and China from January 2000 to December 2010. The results showed that the markets under study were cointegrated and, from VD results, periods of four to five months on average were required for transmission of information impact from other Asia-Pacific stock markets to India, providing short-term arbitrage opportunities for international investors in a short period of time. Tripathi & Sethi (2012) examined the dynamic linkages of the Indian market with the markets of Brazil, Hungary, Taiwan, Mexico, Poland, and South Africa from January 1992 to December 2009. The results could not reject the existence of linkages of the Indian market. Patel (2013a) investigated the dynamic linkages of the Indian stock market with developed equity markets of the United States, the United Kingdom, Germany, Australia, France, Canada, and Japan over the period from January 2000 to August 2012. The results suggested that there was no equilibrium relationship between Indian and other developed markets and neither of the developed equity markets Granger caused the Indian stock market. On the other hand, Patel (2013b) found a cointegrating relationship between the Indian stock market and Asian equity markets of Pakistan, Sri Lanka, Malaysia, South Korea, Japan, Singapore, Taiwan, and China over the period from July 1997 to September 2012. Also, causality ran from Sri Lanka, South Korea, Singapore, and China to India and from India to Pakistan. Palamalai *et al.,* (2013) examined the integration among the Asia-Pacific stock markets of India, Malaysia, Indonesia, Hong Kong, Singapore, South Korea, Taiwan, Japan, and China over the period from January 2000 to January 2013. The results supported the stock market integration among the Asia-Pacific markets under study.

The above literature generally provides evidence of a cointegrating relationship between Indian and other markets in the world over the past decade. However, if the sample

covers the period across the 2008 financial tsunami, there may be structural changes in the long-run coefficients. Hence, we attempt to examine the cointegration relationship between the Indian market and other national markets by focusing upon the recent sample period after the financial tsunami in 2008.

Research methodology

To test for cointegration, we use Johansen's (1991) maximum likelihood estimation procedure, which can capture the long-run and short-run dynamics of variables. The analysis starts with a p-dimensional unrestricted vector autoregressive (VAR) model of order k:

$$Z_t = \sum_{i=1}^{k} \Pi_i Z_i + \mu + \varepsilon_t, \quad t = 1,...,T \qquad (1)$$

where Z_t is a $p \times 1$ vector of stochastic variables, $Z_{-k+1},..., Z_0$ are considered fixed, and ε_t $(t = 1,2,...,T)$ is a sequence of independent Gaussian variables with a mean of zero. Π is a $p \times p$ matrix and μ is a p-dimensional vector, both of which need to be estimated from the model. The individual variables included in Z_t are integrated at most on the order of one or I(1). The unrestricted VAR (k) representation can be expressed as a vector error-correction model (VECM) with k-1 lags:

$$\Delta Z_t = \Pi Z_{t-1} + \sum_{i=1}^{k-1} \Pi_i \Delta Z_{t-i} + \mu + \varepsilon_t, \quad t = 1,...,T, \qquad (2)$$

where $\Pi = -I + \sum_{1}^{k} \Pi_i$ and $\Gamma_i = -\sum_{i+1}^{k} \Pi_j$, i = 1,...,k-1.

The hypothesis of cointegration is formulated as a reduced rank of the long-run impact matrix Π. In particular, if Π has a reduced rank r, where $r \leq p - 1$, then there exist (i) two $p \times r$ matrices α and β such that $\Pi = \alpha\beta'$, and (ii) r co-integrating vectors. The non-zero matrix $\beta' Z_{t-1}$ represents r lagged error-

correction correction terms or equilibrium errors. The likelihood ratio (LR) test of at most r cointegrating vectors is given by the following Trace test statistic:

$$\text{Trace} = -T \sum_{i=r+1}^{P} \log(1 - \lambda_i), \; r = 0,1,2,\ldots, p - 1. \quad (3)$$

where λ_i refers to the i^{th} eigenvalue of the restricted model. If the null hypothesis of r=0 is rejected by the Trace statistic, we continue the LR test and examine the null hypothesis of r=1 until the null hypothesis is not rejected.

Moreover, we test hypotheses on the long-run coefficients using the individual t-test and assess whether an index is required in the cointegrating relationship. We can also measure the relative importance of the index in the cointegrating relationship in terms of the sign and size of its coefficient.

If there is cointegration among the variables, a VECM representation can capture the dynamic relationship between them. One distinct feature of the VECM is that it allows for two sources of causality to be examined (Granger, 1988). The first source is through the lagged error-correction term in α whose coefficients contain information about the direction and average adjustment speed of the dependent variables that each has to make in order to adjust the system back to its long-run equilibrium. The causal impact that the lagged error correction term (ECT) impinges on the long-run relationship of the cointegrated process is considered the long-run Granger causality (Granger & Lin, 1995). Therefore, the statistical significance of the adjustment coefficients in α, which is tested by estimating the t-test statistics, indicates the existence of the long-run Granger causality. The second source of Granger causality can be revealed through the impacts of the sum of the lags of each explanatory variable on the dependent variables, which are short-run and do not have any influence on the long-run relationship. Such short-run causal impacts can be detected using the standard Wald test.

Finally, variance decomposition (VD) measures the proportion of a variable's forecast error variance explained by

its own shocks and shocks to other variables in the system. Therefore, VD allows us to determine the relative strengths of various shocks in accounting for the variations of a variable of interest and it therefore can give more detailed analyses of dynamic relationship among variables in a cointegrated system.

Data

The dataset for our study comprises the selection of 9 national stock markets. The national stock indexes include the S&P BSE SENSEX for India, which is a market-weighted stock index with 30 listed companies on the Bombay Stock Exchange; the NYSE Composite for the US, which covers all common stocks listed on the New York Stock Exchange; the FTSE All-Share Index for the UK, which contains about 1000 companies traded on the London Stock Exchange; the ASX All Ordinaries for Australia, which comprises all ordinary shares listed on the Australian Security Exchange; the NZX All Index for New Zealand, which covers all domestic shares listed on the New Zealand Exchange Main Board; the Nikkei 225 Average Index for Japan, which is price-weighted stock market index for the Tokyo Stock Exchange; the Straits Times Index for Singapore, which consists of the top 30 listed companies on the Singapore Exchange; the Hang Seng Index for Hong Kong, which is a capitalization-weighted stock market index with large blue-chip listed companies on the Hong Kong Stock Exchange; and the Karachi Stock Exchange 100 Index for Pakistan, which is a capital-weighted index with 100 listed companies which have the highest market capitalization on the Karachi Stock Exchange. All stock indexes expressed in national currencies are collected from *DataStream*.

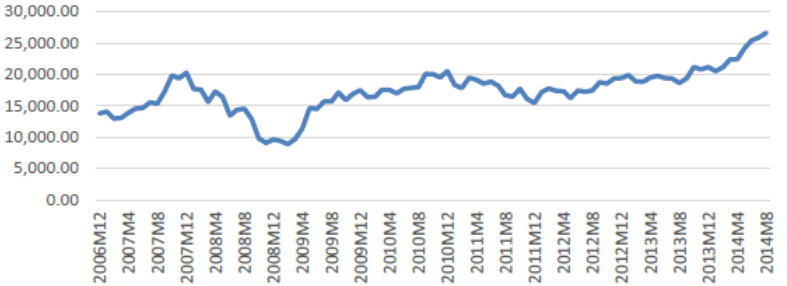
This study is to investigate the dynamic linkages of Indian and other national stock markets after the 2008 global financial crisis. The collapse of the Lehman Brothers Holdings took place in September 2008, leading to the subsequent crash in the global stock markets. After that, the US started the first round of QE on 25th November 2008 and the global

markets gradually settled down. Our data set therefore covers the post-crisis period from 1st December 2008 to 31st August 2014 after the first step on QE in the US. The number of usable observations is 1,500. All data are taken in natural logarithms.

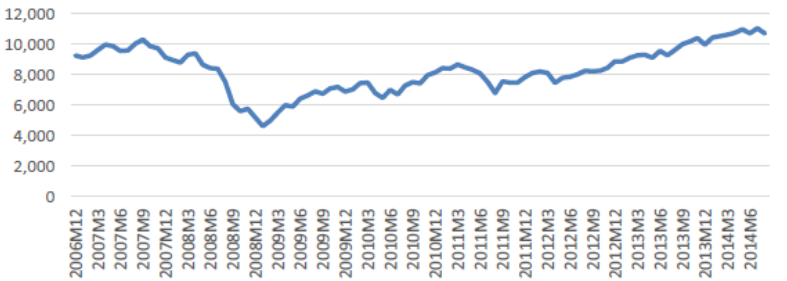
Daily data are adopted because they can capture speedy transmission of information among stock markets (Hassan & Naka, 1996). Also, the stock price indexes expressed in national currencies can restrict their change to movements in security prices and avoid distorting the empirical results due to wide fluctuations of exchanges rates that occurred in the regions (Choudhry *et al.*, 2007).

Before the empirical study, the above stock index movements covering 92 months are shown in Figure 1, starting from January of 2007 to August 2014 for comparing the stock market movements before and after the 2008 financial tsunami. Among the nine stock markets, Japan was the first to turn downward when the Nikkei 225 Index started to decline from June 2007 onwards. Most markets started to turn downward from the last quarter of 2007 including the US, Australia, New Zealand, and Singapore. India started to turn downward from January 2008. Hong Kong, the UK and Pakistan started from April 2008. Also, we find that all the nine stock indexes were going up continuously after February 2009 when the first round of the US Quantitative Easing (QE) policy was implemented.

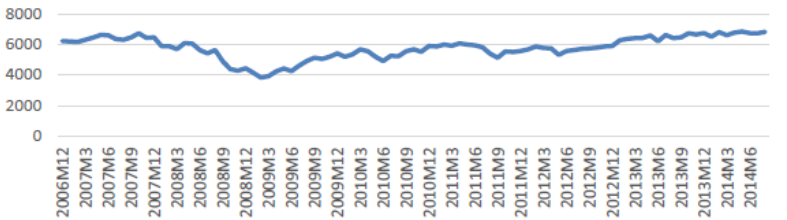
India S&P BSE SENSEX 2007-2014



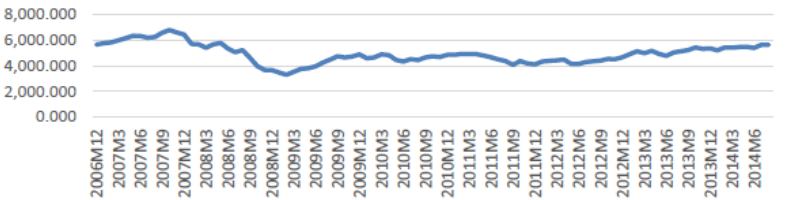
US NYSE Composite Index 2007-2014



UK FTSE Index 2007-2014



Australia: ASX Index 2007-2014



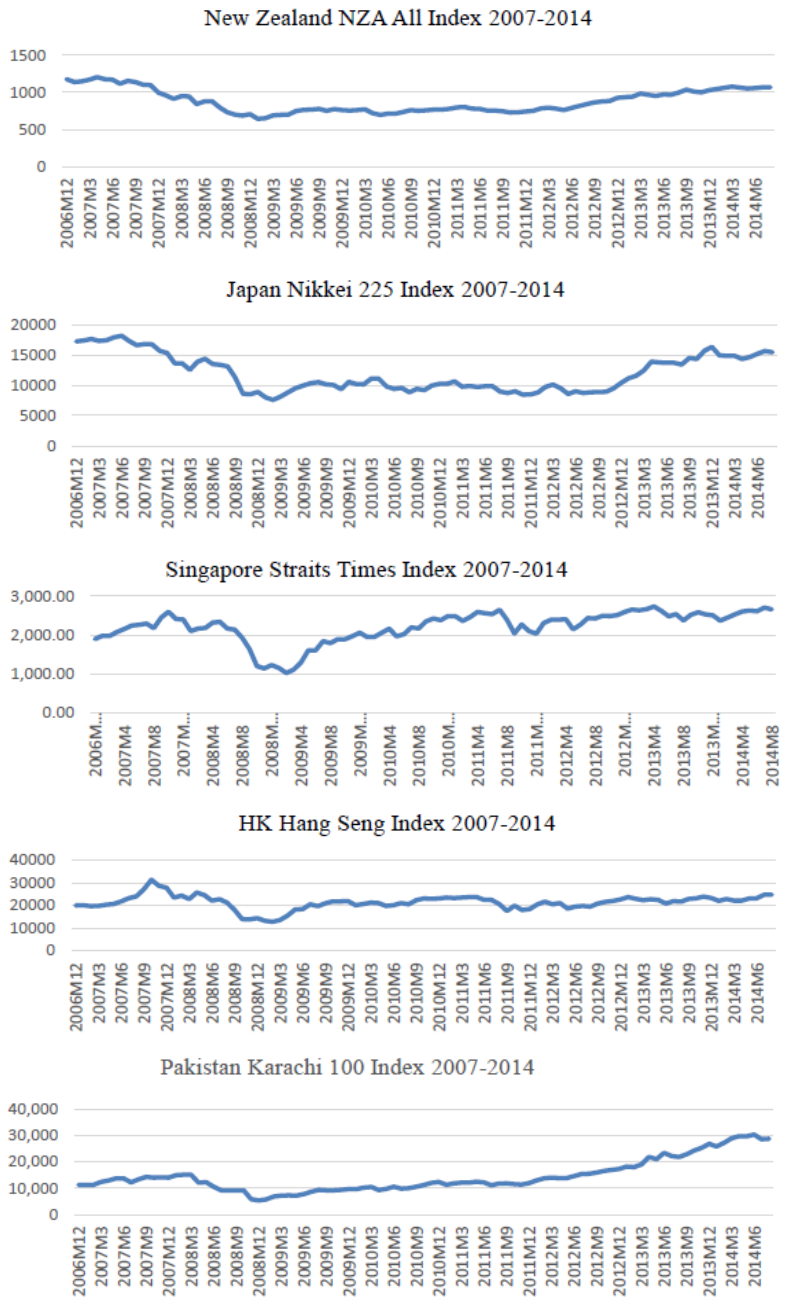


Figure 1. *National stock market indexes*

Emprical results

Descriptive Statistics for the Nine Stock Indexes

Table 1 gives descriptive statistics for the daily stock market returns. The Indian market shares the highest daily return with an average of 0.071%. Over the whole period, the maximum daily return is the also highest for India, up to 15.99% and its minimum daily return is -7.52% which is the third lowest in the sample. With evidence of the highest value for kurtosis and for skewness, the Indian market, compared with other markets, experienced extreme occurrences. Moreover, the return distributions for all markets under study are non-normal when the null hypothesis of normality is rejected at the 1% level by the Jarque-Bera statistics.

Table 1. *Descriptive Statistics for daily stock market returns*

	Mean	Max	Min	SD	Skewness	Kurtosis	JB
ΔIND	0.071%	15.99%	-7.523%	1.316%	1.163	18.948	16236.05***
ΔUS	0.045%	7.06%	-9.484%	1.294%	-0.491	8.853	2202.11***
ΔUK	0.035%	5.764%	-0.051%	1.071%	-0.152	6.153	627.240***
ΔAUS	0.028%	3.627%	-0.429%	0.968%	-0.276	4.708	201.463***
ΔNZ	0.028%	2.446%	-3.026%	0.596%	-0.463	5.400	413.807***
ΔJAP	0.039%	5.522%	-11.15%	1.439%	-0.604	7.328	1262.34***
ΔSGP	0.043%	5.768%	-4.243%	1.021%	0.417	7.642	1390.42***
ΔHK	0.038%	8.303%	-5.827%	1.378%	0.110	6.154	625.073***
ΔPAK	0.075%	5.301%	-5.13%	1.127%	-0.377	6.208	678.948***

Notes: Max, Min and SD stand for the values of maximum, minimum and standard deviation, respectively. JB refers to the Jarque-Bera statistics. IND stands for India; US United States; UK United Kingdom; AUS Australia; NZ New Zealand; JAP Japan; SGP Singapore; HK Hong Kong and PAK Pakistan. *** denotes statistical significance at the 1% level.

Unit Root Test

After explaining the descriptive statistics, we test for the unit root property of the variables to be used in the model using Ng-Perron unit root test with the results presented in Table 2. The results of modified forms of the Phillips-Perron Za statistics (MZa) and Zt statistics (MZt), the Bhargave (1986) R_1 statistics (MSB) and the ERS Point Optimal statistics (MPT) all suggest that the data are all non-

stationary, and their first differences are stationary. Thus, nine stock price indexes are all I(1) processes.

Table 2. *Ng-Perron unit root test*

	MZa	MZt	MSB	MPT
IND	-2.2230	-1.0494	0.4721	40.7508
US	-10.4098	-2.2782	0.2189	8.7700
UK	-8.8405	-2.0693	0.2341	10.4387
AUS	-7.3377	-1.9148	0.2610	12.4201
NZ	-6.5137	-1.7534	0.2672	14.0178
JAP	-6.5281	-1.7671	0.2407	13.9818
SGP	-1.8102	-0.8677	0.4793	44.3071
HK	-4.7857	-1.5341	0.3206	18.9663
PAK	-4.6300	-1.4707	0.3176	19.3402
ΔIND	-690.3630***	-18.5789***	0.0269***	0.1323***
ΔUS	-663.6560***	-18.2149***	0.0275***	0.1393***
ΔUK	-526.6200***	-16.2249***	0.0308***	0.1764***
ΔAUS	-142.6660***	-8.4380***	0.0591***	0.6647***
ΔNZ	-350.7100***	-13.2415***	0.0378***	0.2612***
ΔJAP	-574.2670***	-16.9446***	0.0295***	0.1594***
ΔSGP	-567.4740***	-16.8436***	0.0297***	0.1621***
ΔHK	-390.9520***	-13.9788***	0.0358***	0.2380***
ΔPAK	-1051.0400***	-22.9057***	0.0218***	0.1101***

Notes: A linear trend and an intercept were included in the test equation. The bandwidths were chosen based on the Newey-West selection method using Parzen kernel and they are shown in the parentheses.
*** denotes statistical significance at the 1% level.

Johansen Cointegration Test

The next step of the analysis is to identify the number of cointegrated or long-run relations in the 9-variable VECM using the Trace statistics. Table 3 reports the cointegration test results, which show that there is at most one long-run equilibrium relationship among the nine national market indexes in the system.

Table 3. *Unrestricted Cointegration Rank Tests*

Null Hypothesis	Eigenvalues	Trace	p-value
$\mathbf{r} \leq 0$	0.037	208.048**	0.013
$\mathbf{r} \leq 1$	0.026	150.718	0.136
$\mathbf{r} \leq 2$	0.022	110.514	0.285
$\mathbf{r} \leq 3$	0.018	76.811	0.476
$\mathbf{r} \leq 4$	0.013	49.575	0.656
$\mathbf{r} \leq 5$	0.010	29.975	0.720
$\mathbf{r} \leq 6$	0.005	13.634	0.860
$\mathbf{r} \leq 7$	0.003	5.411	0.763
$\mathbf{r} \leq 8$	0.000	0.013	0.906

Notes: r refers to the number of cointegrating vectors under the null hypothesis. The number of lag lengths is 3 for the VECM based on the Akaike information criterion (AIC). An intercept is included in the cointegrating equation and is included in the VECM. The p-values are calculated based on MacKinnon, Huang & Michelis (1999).
** denotes statistical significance at the 5% level.

The cointegrating vector is normalized on the Indian stock price index and the vector of the long-run coefficients shown in Table 4 is expressed as $\beta = (1, -\beta_2, \ldots, -\beta_9)'$ where β_i refers to the long-run coefficient of the i^{th} stock market price index in the cointegrating vector. Results of restriction tests on β's using t-statistics are shown in Table 4 and they indicate that all the stock market indexes in the cointegrating vector should not be excluded in the VECM because all t-statistics are significant. Moreover, the estimated coefficients of stock price indexes have different signs which convey different implications on portfolio management practice.

Table 4. *Long-run coefficients of stock market indexes $\beta = (1, -\beta_2, \ldots, -\beta_9)'$*

	β	t-ratio statistics
IND (Normalized)	1.0000	
US	-1.4553 ***	-3.790
UK	2.6859 ***	6.515
AUS	-1.8783 ***	-6.129
NZ	0.8199 ***	3.212
JAP	0.2490 **	2.131
SGP	-1.0667 ***	-4.782
HK	0.5292 **	2.074
PAK	-0.4164 ***	-4.340

Notes: ** and *** denote statistical significance at the 5% and 1% level, respectively.

Table 4 shows some coefficients β_i are positive, like the indexes of US, AUS, SGP, and PAK, indicating that those stock price indexes have a direct effect on the India market in the long run. It implies that the stock assets in the US, AUS, SGP, and PAK can contain similar risk-return tradeoffs to those in India and can play a leading role over the movements of the Indian market in the long run.

On the contrary, the coefficients of other markets are negative (UK, NZ, JAP, and HK), which suggest that the movements of these stock markets have a long-run inverse effect on that of the Indian market. Hence, the stock assets in the markets of UK, NZ, JAP, and HK that could provide competing asset portfolio and rebalancing choices against the assets in the stock market of India in the long run are considered as portfolio diversifier assets (Raj & Dhal, 2009) for the risk diversification in the investment portfolios of the Indian stock market. Both the positive and negative long-run effects of other national stock indexes on India are summarized in Figure 2.

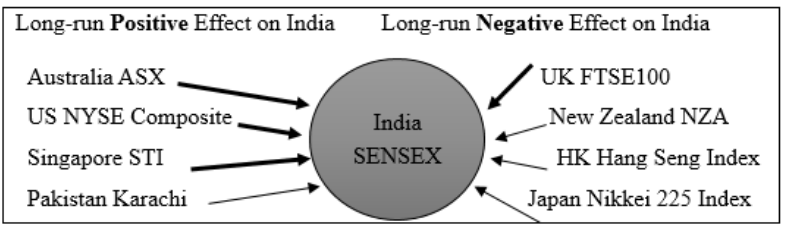


Figure 2. *Positive and negative long-run effects of other national markets on India*

Note: Positive or negative long-run effects are based on the estimated signs of the long-run coefficient β shown in Table 4. The Bold arrows indicate that the estimated sign is larger than one in absolute value.

Furthermore, from the sizes of their absolute values, changes in the market price indexes of US, UK, AUS, and SGP produce a more than proportionate effect on the Indian market Index when their long-run coefficients are larger than unity in absolute value. In particular, the coefficient of UK in absolute terms is the highest; substantially higher than those of the other markets including US. The absolute value of

2.6859 implies that a percentage change of stock index in UK will be associated with about 2.6859% change in the Indian stock market. Hence, the market index in UK is an important hedging asset in the international portfolios that include that of India. Among the Asian markets, it is found that the market of SGP has the most significant effect on India. It is surprising that the Japanese stock market has the least long-run effect on India markets, even smaller than Pakistan in absolute value.

Among the integrated markets, gains from portfolio diversification would be eliminated in the long run when the markets move in the same direction over time. Nevertheless, portfolio diversification in the long run would depend upon the sign as well as the size condition of the long-run coefficients in the cointegrating vector. Inclusion of markets for NZ, JAP, HK, and especially UK, can help reduce the risk exposure of the investment portfolios which include the market of India, in the long run. Also, because of varying degrees of business and financial risks of different securities, and because of various security cash flows co-varying less than perfectly across different countries, the diversification benefits in cointegrated markets in the long run are not likely to be completely eliminated in practice, even though they may be reduced to a certain degree. Finally, cointegration does not rule out the benefits from portfolio diversification across countries in the short term, which may last for quite a while due to slow speed of convergence (Constantinou *et al.*, 2008).

Granger Causality Test and Vector Error Correction Model

Long-run Causality Test

The speed of adjustment, along with the long-run Granger causality, can be examined through the zero restrictions on the adjustment coefficients in α using t-test. The adjustment coefficients in the VECM indicate the adjustment direction and speed of the stock markets in response to changes in the lagged disequilibrium. Table 5 presents the estimates of adjustment coefficients and the results of the long-run

causality test. It is found that the adjustment coefficients are significant at the 5% level or higher in the cases of IND, PAK, and UK only. Hence, only the stock price indexes of IND, PAK, and UK are Granger caused by the deviations from equilibrium and move to adjust the system back to the long-term equilibrium level. The signs and the sizes of the adjustment coefficients provide information about the adjustment speed and the direction of adjustments of stock price indexes in the long-run equilibrium adjustment path. In the case of IND and UK, these national market indexes move downward to eliminate about 1.55% and 0.92% of the lagged disequilibrium respectively. In the case of PAK, the market index will move upward to correct about 1.71% of deviations from equilibrium. The overall results imply long-run Granger causality running from all markets in the system towards the markets for IND as well as UK and PAK.

Table 5. *Long-run Granger Causality Test*

Dependent Variables	α	t-ratio statistics
ΔIND	-0.015***	-2.676
ΔUS	0.002	0.574
ΔUK	-0.009**	-2.350
ΔAUS	0.005	1.402
ΔNZ	-0.001	-0.450
ΔJAP	0.006	0.986
ΔSGP	0.002	0.601
ΔHK	-0.005	-0.876
ΔPAK	0.017***	3.496

Notes: ** and *** denote statistical significance at the 5% and 1% level, respectively.

Short-rum Causality Test

When the adjustment coefficients are not significant in other markets, these markets are not strictly exogenous to the system since the short-run causal channels may be still active (Masih & Masih, 2002). We test for the short-run causal chains through the significance of the coefficients of the lagged differences in the VECM using the standard Wald test. From the results reported in Table 6, when ΔIND is the dependent variable in the VECM, the Wald statistics are significant for the coefficients of the lagged first difference of

the explanatory variables, ΔUS, ΔUK, and ΔNZ. It implies that the markets of US, UK, and NZ can Granger cause the market of IND in the short run. At the same time, the stock price index in India can Granger cause the short-run movements of stock price indexes for all with the exception of PAK when the Wald statistics for the coefficients of the lagged first difference of ΔIND in all equations are significant except for the equation of ΔPAK. Therefore, it is possible to conclude that there are both short-run and long-run causal chains between the Indian and most of other markets in the system.

Table 6. *Short-run Causality Tests*

	Dependent Variable = ΔIND		Explanatory Variable = ΔIND	
	Wald	p-value	Wald	p-value
ΔUS	12.780***	0.005	39.778***	0.000
ΔUK	16.608***	0.001	65.871***	0.000
ΔAUS	4.000	0.261	39.425***	0.000
ΔNZ	7.919**	0.047	15.311***	0.001
ΔJAP	1.602	0.658	16.480***	0.001
ΔSGP	0.786	0.852	22.915***	0.000
ΔHK	3.312	0.306	33.073***	0.000
ΔPAK	3.595	0.308	1.711	0.634

Notes: Wald statistics are distributed as χ^2 with 3 degrees of freedom. Critical values of χ^2 with 3 degrees of freedom are 7.815 and 11.345 at the 5% and 1% level, respectively.
** and *** denote statistical significance at the 5% and 1% level, respectively.

Variance Decomposition (VD)

The Granger causality tests may be interpreted as within-sample causality tests since they provide evidence of directions of temporal causality within the sample period. Hence, we conduct VD analysis based on VECM in order to assess the relative strength of the Granger-causal chain or quantify to what extent shocks to a certain market are explained by other markets in the system beyond the sample period. Table 7 presents the VD of the national market indexes over 1 to 30 days. The table results show that besides the effect of its own variation, the volatility of IND largely comes from US, SGP, and AUS. In particular, up to the 30-day horizon, about 47% of total variance in IND comes from its own innovations, and about 15.6%, 19.6% and 8.5% of total

variance are caused by US, SGP, and AUS, respectively. However, the results show that the innovations in the market of IND explain only small proportions of the variance of other markets, which are mostly around 2-3% only. Although there is evidence of short-run Granger causality running from India to other markets, the relative strength of the causality is minimal. Excepting PAK, the US market can largely explain fluctuations of all other market price indexes as in literature (for example, Masih & Masih, 2002), maintaining the dominance of the US market in the world.

Table 7. *Variance decomposition analysis*

Percentage of forecast variance explained by innovations in:									
Horizon	IND	US	UK	AUS	NZ	JAP	SGP	HK	PAK
Variance decomposition of ΔIND									
1	66.898	7.079	0.452	6.317	0.028	0.531	15.553	3.030	0.107
10	54.662	14.426	0.800	5.992	0.950	0.284	18.658	4.174	0.049
20	50.397	15.243	1.782	7.456	1.507	0.475	19.405	3.496	0.234
30	47.458	15.628	2.691	8.579	1.940	0.619	19.683	2.941	0.456
Variance decomposition of ΔUS									
1	0.000	100.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
10	3.426	77.348	0.245	10.126	0.040	0.033	7.606	0.995	0.177
20	3.466	76.594	0.177	10.621	0.049	0.026	7.877	1.030	0.155
30	3.397	76.399	0.142	10.877	0.057	0.025	7.953	1.008	0.138
Variance decomposition of ΔUK									
1	0.000	43.125	56.874	0.000	0.000	0.000	0.000	0.000	0.000
10	3.368	54.972	18.790	13.241	0.043	0.159	8.622	0.747	0.053
20	2.818	56.493	15.806	15.128	0.073	0.249	8.838	0.556	0.033
30	2.369	57.278	14.277	16.310	0.117	0.313	8.864	0.419	0.048
Variance decomposition of ΔAUS									
1	0.000	34.650	1.963	63.385	0.000	0.000	0.000	0.000	0.000
10	3.602	36.564	0.823	55.712	0.284	0.405	2.559	0.032	0.014
20	4.326	36.861	0.886	54.344	0.285	0.398	2.793	0.067	0.036
30	4.773	36.989	0.987	53.539	0.266	0.382	2.899	0.103	0.059
Variance decomposition of ΔNZ									
1	0.000	17.983	0.271	5.957	75.787	0.000	0.000	0.000	0.000
10	1.476	20.178	0.659	17.624	57.962	0.082	1.980	0.006	0.031
20	1.443	21.102	0.515	19.317	55.399	0.112	2.042	0.006	0.060
30	1.356	21.365	0.441	19.974	54.597	0.127	2.044	0.010	0.082
Variance decomposition of ΔJAP									
1	0.000	25.686	1.271	11.587	0.172	58.669	2.614	0.000	0.000
10	1.904	27.570	0.747	14.663	0.059	44.019	10.626	0.181	0.226
20	2.186	27.881	0.718	14.871	0.048	42.654	11.110	0.236	0.291
30	2.316	27.970	0.725	14.882	0.046	42.195	11.277	0.264	0.321
Variance decomposition of ΔSGP									
1	0.000	17.431	0.019	15.746	0.222	0.000	66.580	0.000	0.000
10	1.825	22.038	0.016	14.809	0.036	0.757	59.928	0.540	0.047
20	1.879	22.199	0.015	14.968	0.028	0.865	59.415	0.591	0.037
30	1.869	22.249	0.017	15.062	0.027	0.805	59.239	0.596	0.031
Variance decomposition of ΔHK									
1	0.000	24.757	0.000	16.5510	0.005	0.672	17.117	40.895	0.000
10	1.639	27.636	0.144	16.924	0.139	0.212	23.249	29.562	0.191
20	1.394	27.725	0.268	17.667	0.225	0.235	23.775	28.369	0.337
30	1.208	27.781	0.374	18.193	0.281	0.257	23.824	27.642	0.435
Variance decomposition of ΔPAK									
1	0.000	1.701	0.431	0.009	0.774	0.003	0.345	0.306	96.427
10	0.759	5.430	2.720	0.549	0.159	0.331	3.623	1.490	84.933
20	2.042	5.915	4.458	0.352	0.248	0.513	4.234	2.663	79.571
30	3.184	6.117	5.832	0.236	0.380	0.645	4.548	3.596	75.107

Summary

Our paper investigates the integration of the Indian stock market with other national markets after the 2008 financial tsunami. It is found that there is one cointegration relationship among the nine national stock markets under study (India, the United States, the United Kingdom, Australia, New Zealand, Japan, Singapore, Hong Kong, and Pakistan). In the long run, stock price indexes of the United States, Australia, Singapore, and Pakistan move in the same direction as the Indian stock market, while the other four stock markets move in the opposite direction. These contain implications for asset pricing and international portfolio diversification.

Moreover, the Indian stock market, as well as the markets of the UK and Pakistan, is long-run Granger caused by other markets through ECTs. In the short run, the Indian market can also be influenced by the markets of the US, the UK and New Zealand, and can influence most stock markets, excluding Pakistan.

Finally, the analysis of VD can indicate the relative strength of the causality linkages. It is found that the Indian market is explained mostly by the US, Singapore, and Australia, but its influence on the variance of other national market indexes is relatively small.

Discussion

From the results of VD in Table 7, the New York Stock Exchange is still the leader among all stock markets in the world with higher influence on the UK, Australia, Japan, Hong Kong, and Singapore but lower on India. The stock price index of India is influenced more by Singapore in the short run and long run. The business hours of the Singapore Exchange (GMT+8) start 3.5 hours earlier than the Bombay Stock Exchange in India (GMT+5.5). Now do movements of STI in the morning give a reliable hint to Indian investors before the opening of the Bombay Stock Exchange?

Theoretically, investments in different markets could reduce the risks specific to individual economies. However, it

may not be feasible for small investors to make stock investments globally because (i) the choice of foreign investment funds for small investors is limited as many global investment funds require minimum investment amounts; (ii) more time and efforts are required to handle equity diversification; (iii) it is costly to acquire the information of foreign stock markets; (iv) buying stocks in foreign markets entail exchange rate risks. In reality, intensive diversification in various markets could only be implemented by global financial institutions.

It is found that there are various kinds of derivatives listed on stock markets for speculation or hedging. For example, an investor can reduce the price risk by buying or writing options for hedging. Therefore, apart from diversification, there are many alternative ways to reduce risks.

In addition, this paper does not consider the trading volumes in the empirical model. In reality, investors like to buy actively traded equity assets with high trading volumes. The US ranked as the top with market capitalization of US$ 40,719.6 billion in 2020, while the figure in that year was US$ 132.2 billion for New Zealand and US$ 32.6 billion for Pakistan. High trading volumes make the US stock market more competitive and efficient. On the contrary, stock prices in markets having low trading volumes can be manipulated by speculators with ease.

Also, we do not consider the impacts of changes in interest rate and money supply caused by the QE policy in our study. The QE policy was initiated by a German economist, Richard Werner who was a visiting fellow at the Bank of Japan in 1995. Japan had already adopted the QE from 2001 to 2006 after the failure of zero-interest-rate policy to overcome domestic deflation. After the financial tsunami broke out in September 2008, not only the Bank of Japan, but also the central banks of the US, the UK, and the EU kicked off QEs to recure their respective financial systems and the economies. The first round of the QE started from the last quarter of 2008. Under the QE, the Federal Reserve Bank revamped market liquidity by buying asset-backed securities and equities from the public and at the same time setting the discount rate to zero or even

negative. Under these circumstances, increasing money supply continued to flow not only into the real economy but also the stock markets.

For future research on integration of financial markets, we suggest addition of variables such as exchange rate, interest rate, money supply and trading volume to econometric models for testing. We can consider adopting a time-varying VECM for analysis when the coefficients would change subject to changing economic conditions and monetary policies.

References

Ahlgren, N., & Antell, J. (2002). Testing for cointegration between international stock prices, *Applied Financial Economics*, 12(12), 851-861. doi. 10.1080/09603100110050743

Bhargave, A. (1986). On the theory of testing for unit roots in observed time series, *Review of Economic Studies*, 53(3), 369-384. doi. 10.2307/2297634

Byers, J.D., & Peel, D.A. (1993). Some evidence on the interdependence of national stock markets and the gains from international portfolio diversification, *Applied Financial Economics*, 3(3), 239-322. doi. 10.1080/758535729

Chi, J., Li, K., & Young, M. (2006). Financial integration in East Asian equity markets, *Pacific Economic Review*, 11(4), 513-526. doi. 10.1111/j.1468-0106.2006.00332.x

Choudhry, T., Lu, L., & Peng, K. (2007). Common stochastic trends among far east stock prices: Effects of the Asian financial crisis, *International Review of Financial Analysis*, 16(3), 242-261. doi. 10.1016/j.irfa.2006.12.001

Constantinou, E., Kazandjian, A., Kouretas, G.P., & Tahmazian, V. (2008). Common stochastic trends among the Cyprus stock exchange and the ASE, LSE and NYSE. *Bulletin of Economic Research*, 60(4), 327-349. doi. 10.1111/j.1467-8586.2008.00282.x

Dhal, S. (2009). Global crisis and the integration of India's stock market, *Journal of Economic Integration*, 24(4), 778-805. doi. 10.11130/jei.2009.24.4.778

Gonzalo, J., & Granger, C. (1995). Estimation of common long-memory components in cointegrated systems, *Journal of Business and Economic Statistics*, 13(1), 27-35. doi. 10.2307/1392518

Granger, C.W.J. (1988). Some recent development in a concept of causality, *Journal of Econometrics*, 39(1-2), 199-211. doi. 10.1016/0304-4076(88)90045-0

Granger, C.W.J., & Lin, J.L. (1995). Causality in the long run, *Econometric Theory*, 11(3), 530-536. doi. 10.1017/S0266466600009397

Hassan, M.K., & Naka, A. (1996). Short-run and long-run dynamic linkages among international stock markets, *International Review of Economics and Finance*, 5(4), 387-405. doi. 10.1016/S1059-0560(96)90025-8

Johansen, S. (1991). Estimation and hypothesis testing of cointegration vectors in Gaussian vector autoregressive models, *Econometrica*, 59(6), 1551-1580. doi. 10.2307/2938278

Jorion, P., & Schwartz, E. (1986). Integration vs. segmentation in the Canadian stock market, *Journal of Finance*, 41(3), 603-614. doi. 10.1111/j.1540-6261.1986.tb04521.x

Kumar, S. (2014). Financial development as an instrument of economic growth in India: Evidence from cointegration and causality analysis, *The IUP Journal of Applied Economics*, 8(4), 28-41.

Lamba, A.S. (2005). An analysis of the short- and long-run relationships between South Asian and developed equity markets, *International Journal of Business*, 10(1), 384-402.

MacKinnon, J.G., Haug, A., & Michelis, L. (1999). Numerical distribution functions of likelihood ratio tests for cointegration, *Journal of Applied Econometrics*, 14(5), 563-577. doi. 10.1002/(SICI)1099-1255

Marimuthu, M. (2010). The co-movements of the regional stock markets and some implications on risk diversification, *The IUP Journal of Applied Economics*, 9, 61-80.

Masih, A.M.M., & Masih, R. (2002), Propagative causal price transmission among international stock markets: evidence from the pre- and post- globalization period, *Global Finance Journal*, 13(1), 63-91. doi. 10.1016/S1044-0283(02)00039-X

Mukherjee, P., & Bose S. (2008). Does the stock market in India move with Asia? A multivariate cointegration – Vector autoregression approach, *Emerging Markets Finance and Trade*, 44(5), 5-22. doi. 10.2753/REE1540-496X440501

Narayan, P., Smyth, R., & Nandha, M. (2004). Interdependence and dynamic linkages between the emerging stock markets of South Asia, *Accounting and Finance*, 44(3), 419-439. doi. 10.1111/j.1467-629x.2004.00113.x

Ng, T.H. (2002). Stock market linkages in South-East Asia, *Asian Economic Journal*, 16(4), 353-377. doi. 10.1111/1467-8381.00157

Palamalai, S. Kalaivani, M., & Devakumar, C. (2013). Stock market linkages in emerging Asia-Pacific markets, *SAGE Open*, 3(4), 1-15. doi. h10.1177/2158244013514060

Patel, S.A. (2013a). Dynamic linkages of developed equity markets with Indian stock market, Vilakshan: The *XIMB Journal of Management*, 10, 21-36.

Patel, S.A. (2013b). Dynamic interdependence among Asian equity markets: Empirical evidence from India, *Journal of Management Science*, 13(4), 219-228.

Raj, J., & Dhal, S.C. (2009). Is India's stock market integrated with global and major regional markets? *ICFAI Journal of Applied Finance*, 15, 5-37.

Srikanth, P. (2012). Integration of Indian stock market with other markets in the Asia-Pacific region, *The IUP Journal of Financial Economics*, 10(1), 18-31.

Stulz, R.M. (1981). A model of international assets pricing, *Journal of Financial Economics*, 9(4), 383-406. doi. 10.1016/0304-405X(81)90005-2

Tripathi, V., & Sethi, S. (2012). Inter linkages of Indian stock market with advanced emerging markets, *Asia-Pacific Finance and Accounting Review*, 1(1), 34-51.

Verchenko, O. (2000). Potential for portfolio diversification across Eastern European stock markets, *M.A. Thesis*, National University Kiev-Mohyla Academy.

Von Furstenberg, G.M., & Jeon, B.N. (1989). International stock price movements: Links and messages, *Brooking Papers on Economic Activity*, 1(1), 125-176. doi. 10.2307/2534497

WFE (World Federation of Exchange), (2015). Monthly Report, Source: [Retrieved from].

5 Behavioural Study of Financial Derivatives Investments in Hong Kong

By
Tai-Yuen ***Hon***
Paul ***Shum***
Wing-Kwong ***Au***

Introduction

The world stock markets have been increasingly volatile, especially during the European sovereign debt crisis starting in 2009. Likewise, the prices of derivatives products fluctuated wildly during this period. Unlike the institutional investors, such as mutual funds which use other people's money (OPM) for investment, small investors who invest with their own monies have incurred loss and risks in the volatile investment markets. In the context of behavioural finance, small investors are considered to have behavioural biases, such as over-confidence and disposition effects, which may result in a huge loss of investments. This has drawn increasing attention from many small investors throughout the world. Also, the coverage of financial news and information in the press may affect their decisions. It is thus interesting to investigate how these investors allocate their investment portfolios and the correlation between their investment experience and average returns. The primary objective of our study is to discover the profile and attitudes of small investors towards financial derivatives in Hong Kong

and their investing patterns for different financial derivatives. We formulate three hypotheses regarding the changes in the opinions and investment behaviours of small investors. These hypotheses are then tested with the data collected from 1,130 respondents in Hong Kong via a survey questionnaire. By doing so, we contribute to the study of behavioural finance in the Hong Kong derivatives markets. In the Hong Kong derivatives markets, various kinds of products, e.g. warrants, options, futures, callable bull/bear contracts and Renminbi non-deliverable are trade. Trading of options, futures, callable bull/bear contracts are conducted in The Hong Kong Exchanges and Clearing Limited (HKEx). Trading of Renminbi non-deliverable forwards investment services is accessible to small investors through commercial banks by opening an investment services account for transaction but investors must pass a risk aptitude test before trading. As the first warrant was listed in Hong Kong in the late 1970s, the market size of the Hong Kong derivatives market has grown and reached the top ten and thirty in Asia and the world respectively. The most dominant kind of derivatives in Hong Kong is the stock option in terms of contract volume. This chapter's tables are referred to Hon, Shum & Woo (2015) for Tables 1-3.

Literature review

From Disposition effect, investors dislike incurring losses much more than they enjoy making gains. Hence, the investors When the stocks lose the value, they will still hold on them. But they will sell stocks when the values have risen. (Shefrin & Statman, 1985). Rather than the highly experienced investors, small investors usually have disposition effects (Choe & Eom, 2009). Moreover, experienced investors will hold the stocks or derivative tools based the Prospect Theory. When facing the choices of 2 or 3 values, they will predict the rise or lose by adopting the S-shaped value function of Prospect Theory to analyse the situation. When the stock or derivative tools activate in market, they will look at the trend if they will gain less in utility, or in sometime, when facing

losses, they will adopt the Theory to study if the losses will be larger than the gains. The more the investor adopt this to watch the trend of stocks of the derivative tools, they have the higher frequently to find out the losses and gains. It will lead the small investors create the behaviours of being withdrawn when committing losses (Kahneman & Tversky, 1979). Echo to the Prospect Theory, experienced investors can easily fall into such irrational behaviour as they will sell all the stocks but prolongedly hold the stocks which is prolonged loss in the market. When receiving a lot of information, investors will assess the possibilities based on their previous feelings and experience, it can be subjective as it is not relied on the assessed by the overall probability (Kahneman & Tversky, 1973; Kahneman & Frederick, 2002). Moreover, investors may not take all information investors or rely on limited attention to information due to the overloaded cognitive capacity and complicated environment, however, limited or selected information may disproportionately stimulate the investors' decision making owning to the recency and saliency; the investors may easily fall into the irrational behaviour that they will sell all finically products which are rising the values, but prolongedly hold all the products which are suffering in lose, it is the disposition effect.

Although many factors can influence trading (e.g., tax-loss selling, rebalancing, changing risk preference, or superior information), Barber *et al.,* (2009) argued that their empirical results are primarily driven by three behavioural factors: the representativeness heuristic, limited attention, and the disposition effect. Investors make the decision to buy the stocks based on representativeness heuristic. Investors usually pay attention on stocks, but they own do not have any idea to sell stocks; moreover; they are not used to sell their stocks shortly. As investors refrain from the experience, they are selling losers. In the critical moment, they will not sell the stocks prolongedly lose based on the countervailing factor; besides; they do not want to recall the regret. In result, it forms the disposition effect. Barber *et al.,* (2007) discovered that investors in Taiwan stock marker between 1995 to 1999, they sold winners and kept losers disregard the gender and

sincerity in experience in stock exchange. The effect of disposition declined the market appreciation in that period. Traditionally people thought that funding can be fungible, but the silo approach can be created by people with the mental accounting. Mental accounting can be beneficial to people as it can help people to be self-control and encouraging the use of rules such as "don't dip into retirement savings," and "pay for luxuries out of savings". People can be encouraged to be rationalized when using money in daily life (Thaler, 1999). Under this concept, people can save more and be economic in life.

Anchoring effect is formed when people make the cognitive bias in comparing the prices of products to make a decision. They are usually affected by the numerical value of pricing. The customers will tend to anchor the price of products, how the product value presented can affect the customers' decision. If the seller set up a higher price that it will deter customer making purchases. Then the seller set up a higher price with more pieces of products which looks like offering. Anchoring can also affect negotiations for prices. The first suggested price will set a precedent for all subsequent suggestions, including the final price. The customers will make an anchor as the price of the product.

Research questions and hypotheses

In this chapter, the authors will study the behaviours of small investors in the Hong Kong derivatives market and apply some behavioural theories to test if they are applicable to the real setting. This study can fill in the research gap and find out how the small investors behave in the derivatives market. The research questions will be based on three theories, namely the disposition effect, mental accounting, and anchors. The authors finally conclude whether the corresponding hypotheses (H1 to H3) would be validated by the sample data.

Q1: Is there a correlation between the investment experience of small investors and lower the disposition effect caused by behavioural bias inerivatives in Hong Kong?

Behavioural bias caused by the disposition effect is the reason for sustaining loss (Choe & Eom, 2009). Small investors with prolonged investment experience may show a smaller disposition effect because they have a better understanding of the derivatives markets and are more aware of such behavioural bias, and hence they are more likely to avoid it. Therefore, highly experienced small investors may suffer a smaller loss from their investments in derivatives due to the disposition effect compared with less experienced investors.

H1: A significant correlation exists between the investment experience of small investors and their average returns on investment in financial derivatives.

Q2: Is there a correlation between small investors' lesser weight on financial derivatives in an overall portfolio and the effect of the recent European sovereign debt crisis on their desire to invest in Hong Kong financial derivatives?

Small investors may have two mental accounts: one with low-risk portfolios (i.e., cash or bonds) for wealth protection from inflation and another one with risky portfolios (i.e., financial derivatives) designed for wealth accumulation. Such behavioural bias may be more common in the face of large price volatility after the European sovereign debt crisis when small investors, lacking the concept of integrated portfolio construction, were consciously avoiding investment loss.

H2: A significant correlation exists between small investors' lesser weight on financial derivatives in an overall portfolio and the effect of the recent European sovereign debt crisis on their desire to invest in Hong Kong financial derivatives.

Q3: Is there a correlation between the opinion of small investors on whether the derivatives markets will recover if there is an economic downturn and their opinion on the market value today?

Small investors often have some reference points or anchors. When they consider the market as under-traded currently, they may think that it will return in the next few years to levels that prevailed during the buoyant derivatives markets. Values in speculative markets, such as the stock market, are inherently ambiguous. It is difficult to judge what the value of the Hang Seng Index should be. There is no

commonly agreed economic theory that would provide an answer to this question. In the absence of any better information, past prices are likely to be important determinants of prices today. Therefore, the anchor is the most recently remembered price. So, anchoring refers to the decision-making process in which quantitative assessments are required and where these assessments may be influenced by suggestions. People have in their minds some reference points (anchors), for example of previous price. When they get new information they adjust this past reference insufficiently (under-reaction) to the new information acquired. Anchoring describes how individuals tend to focus on recent behaviour and give less weight to more prolonged trends.

H3: A significant correlation exists between the opinion of small investors on whether the derivatives markets will recover if there is an economic downturn and their opinion on the market value today.

Data and method

The data for the present study were collected from small investors in Hong Kong through a survey questionnaire. The main purpose of the questionnaire study is to collect the opinions of small investors and to analyse their investment behaviour and financial decision-making patterns in derivatives markets. The questionnaire was designed to elicit information about demographics, investment experience and behaviour, and factors affecting the financial decision-making of the respondents. The first part of the questionnaire focused on investment experience, perceptions about the investment conditions and factors that affect financial decision-making. The second part collected respondents' personal particulars, including gender, age, education level, employment status and average monthly income. The survey was conducted during the period of 21 January 2014 to 21 March 2014. Since the majority of Hong Kong's population is Chinese, the questionnaire was written in Chinese. After a pilot test on ten respondents, some amendments (such as the rewording of

some questions to eliminate ambiguities) were made before the questionnaire was finalized. Since some respondents did not reply to all the questions in the questionnaire, only the number of replies were used to calculate the total number and the percentage of the total for the individual entries(i.e., the questions that respondents did not answer were not counted).

We selected the respondents using the snowball sampling method. A group of undergraduate students helped to distribute the questionnaires to the respondents. The target population was small investors in the Hong Kong derivatives markets. We distributed 1,200 questionnaires to our students. A total of 1,130 respondents (a response rate of 94%) filled in and returned the questionnaires.

The profile of the respondents is reported in Table 1, which shows that 64% were male and 36% were female. The majority of them were under the age of 55 (94%). As for the education level, the majority of the respondents had undergone tertiary education (57.8%). Regarding their employment status, 73% of the respondents were employees, 15.8% were self-employed, 5.3% were retired and 5.9% were classified as "others", which included housewives and students. Finally, the respondents' median income was HKD 16,363.84. The results indicate that 24% of the respondents traded warrants most frequently. The second most frequently traded derivatives product was stock options, favoured by 23% of the respondents; the third most frequently traded product was Hang Seng Index futures, preferred by 19.3% of the respondents; the fourth most frequently traded was callable bull/ bear contracts, favoured by 17.6% of the respondents; the fifth most frequently traded product was Hang Seng Index options, preferred by 12.3% of the respondents; and the least frequently traded product was Renminbi non-deliverable forwards, favoured by only 3.7% of the respondents.

In view of the above demographic profile of the respondents, we believe that the respondents are representative of small investors in the Hong Kong financial derivatives markets. We estimated the correlation of the individual's responses to different items in the questionnaire

to test the hypotheses H1 to H3 using Cramer's V and Chi-square (χ^2) test.

Results

The distribution of the respondents' answers to various question items in the questionnaire is shown in Table 2. The items were designed to reflect some important concepts in behavioural finance. The response to one item is supposed to be related to the response to another item, as stated in the hypotheses. The statistical results of the Cramer's V statistics with their corresponding significance levels are reported in Table 3.

H1 is tested by comparing the responses to item 1 and item 2. It specifies the correlation between the investment experience of small investors and their average returns on their financial derivatives investments. The existence of such a correlation implies that Shefrin & Statman's (1985) disposition effect may exist among the less experienced small investors. The result indicates that the Cramer's value is 0.130, and the correlation is significant at the 0.01 level. Given this finding, H1 is supported.

Also, H2 is tested by comparing the responses to item 3 and item 4. Item 4 concerns the weight allocated to financial derivatives within the respondents' investment portfolios. H2 is backed by the mental accounting theory. Small investors who tended to be affected by the recent European sovereign debt crisis might be concerned about risk control. Rather than combining risky and riskless assets into an overall portfolio for portfolio management, small investors may however attempt to adjust the investment risk level by simply allocating the risky and riskless assets into two mental accounts, that is, more on riskless portfolios and less on risky ones. According to the data from the questionnaires, 74.3% of the respondents were influenced by the European sovereign debt crisis; 65.8% of the respondents revealed that they allocated less than 30% of the total investment portfolio to derivatives products. The Cramer's value is 0.219, with a 1% significance level. In other words, there is a significant

correlation between the responses to item 3 and item 4, and thus H2 is supported.

H3 is tested by comparing the respondents' answers to item 5 and item 6. The comparison was used to determine whether there was a correlation between over-confidence and over-optimism on one hand, and anchoring on the other hand. A small investor who considers the derivatives markets to be under-traded today is likely to believe that the derivatives markets will recover in a few years to levels that prevailed during the buoyant stock market. This belief is expected to be related to his or her opinion regarding the value of the derivatives today. H3 is supported, as the Cramer's V value is 0.155 with a 1% significance level.

Conclusion

The primary objective of this research study was to discover the profile and attitudes of small investors towards financial derivatives in Hong Kong and their investing patterns for different financial derivatives. Based on several key concepts in behavioural finance, including the disposition effect, mental accounting and anchoring, we proposed three hypotheses to be tested with a data set of a survey questionnaire collected from 1,130 small investors in Hong Kong. Several findings emerged from the study. Firstly, we explored the trading patterns and performance of the small derivatives investors. We found that small investors traded mostly warrants (24%) and stock options (23%). Small investors have more experience in warrant markets. These warrants are attractive investment vehicles for two reasons: their leveraging effect and limited loss feature make them attractive to aggressive investors, and they can serve as hedging instruments to reduce the risk exposures arising from other related investments. The Cramer's V statistics indicated a significant correlation between the investment experience of small investors and their average returns from derivatives investments. Small investors who have more trading experience may have a lower disposition effect because they have a better understanding of the market and are more

aware of such a tendency, and hence they are more likely to correct it. Therefore, highly experienced small investors would suffer a smaller amount of loss from their derivatives investments compared with the less experienced ones.

Secondly, we observed that the European sovereign debt crisis affected the desire to invest in financial derivatives of 74.3% of the small investors in the study. As a result, most of them took a put position on derivatives, with a small proportion in their portfolio; 40.1% of them took a put position on 10% to less than 30% of derivatives investments in their portfolios. We found a significant correlation between small investors having a smaller proportion of their investment portfolio in financial derivatives and the European sovereign debt crisis in recent years, which apparently affected their desire to invest in financial derivatives. This may be explained by the high sensibility to loss during the European sovereign debt crisis which meant that they allocated risky and riskless assets to two separate mental accounts.

Finally, we found a significant correlation between the opinion of small investors on whether the derivatives markets would recover in the event of an economic downturn and their opinion on the value of the derivatives today. This finding suggests that small investors have some reference points (i.e., anchors) in mind when they make their investments in the derivatives markets. For example, a small investor who believes the derivatives markets are under-traded in volume today may plausibly think that the derivatives markets will recover in a few years to levels that prevailed during the time of buoyant derivatives markets.

References

Barber, B.M., Lee, Y.T., Liu, Y.J. & Odean, T. (2007). Is the Aggregate Investor Reluctant to Realize Losses?, *European Financial Management*, 13(3), 423-447. doi. 10.1111/j.1468-036X.2007.00367.x

Barber B.M., Odean T., & Zhu N. (2009). Systematic noise, *Journal of Financial Markets*, 12(4), 547-569. doi. 10.1016/j.finmar.2009.03.003

Chapman, G.B., & Johnson, E.J. (2002). Incorporating the irrelevant: Anchors in judgments of belief and value, *In* T. Gilovich, D. Griffin, & D. Kahneman, (eds.), *Heuristics and Biases: The Psychology of Intuitive Judgment*, Cambridge University Press, Cambridge, U.K.

Choe, H., & Eom, Y. (2009). The disposition effect and investment performance in the futures market, *Journal of Futures Markets*, 29(6), 496-522. doi. 10.1002/fut.20398

Hon, T.Y., Shum, P., & Woo, K.Y. (2015). Behavioural study of financial derivatives investments in Hong Kong, *Asian Profile*, 43(6), 539-548. [Retrieved from].

Kahneman, D., & Tversky, A. (1979). Prospect theory: An analysis of decision under risk, *Econometrica*, 47(2), 263-291. doi. 10.2307/1914185

Securities and Futures Commission, (2014). A review of the global and local securities in 2013, *Research Paper*, No.54. [Retrieved from].

Shefrin, H., & Statman, M. (1984). Explaining investor preference for cash dividends, *Journal of Financial Economics*, 13(2), 253-282. doi. 10.1016/0304-405X(84)90025-4

Shefrin, H., & Statman, M. (1985). The disposition to sell winners too early and ride losses too long: Theory and evidence, *Journal of Finance*, 40(3), 777–790. doi. 10.1111/j.1540-6261.1985.tb05002.x

Thaler, R.H. (1999). Mental accounting matters, *Journal of Behavioral Decision Making*, 12(3), 183-206. doi. 10.1002/(SICI)1099-0771(199909)12:3

Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases, *Science, New Series*, 185(4157), 1124-1131. doi. 10.1126/science.185.4157.1124

6 The Discrepancy between the Total Value of Monetary Transactions and GDP in China

By
Che-cheong ***Poon***
Kai-Yin ***Woo***

Introduction

Following the availability of more comprehensive monetary statistics in China,[1] several papers focusing on investigating the relationship between China's money supply and GDP have been published in local and international journals (Ding, 2003; Zhao & Wang, 2005; and Lu, 2005). Unfortunately, by ignoring the operational characteristics of the economy of China, authors of these articles have erroneously used the year-end money supply statistics rather than the monthly ones and substituted the PT on the right-hand side of the Fisher's exchange equation by GDP to facilitate their analysis. This bias in the estimated value of the velocity of money circulation (V) has made their empirical results questionable. To explore the empirical applicability of the Fisher's exchange equation and the Cambridge equation in formulating monetary policy in China,

[1] Quarterly and monthly monetary statistics on M_0, M_1 and M_2 have been available since 1990 and 1997 respectively in the People's Bank of China Quarterly Bulletin.

the main objective of this paper is to identify some major exogenous factors that determine the extent of the discrepancy between the total value of monetary transactions and GDP in China.

Although reforming the price system to reflect supply and demand rather than being artificially set by central government planners was enormously difficult, China today has successfully achieved its price reform target with about 99% of commodity prices market determined. With the establishment of a price mechanism, the role of money is not just a lubricant that greases the wheels of economic activity in the days of a state-controlled socialist economy but now it also plays a key role in influencing the performance of the economy as a whole; so that monetary policy has become a more and more important policy tool in regulating economic activity in China

In the theory of monetary management, classical monetarists postulate that there is a stable relationship between money and aggregate nominal income and that a monetary rule to control, for example, the growth rate of the money supply, however defined, was considered the most effective mechanism for monetary policy in the long run. To this extent, it is to be hoped that this framework would be workable in practice to identify the above-mentioned exogenous factors by investigating the relationship between the money stock and GDP flow in China.

Theoretical background and formula derivation Applying the Fisher's exchange equation

The Fisher's exchange equation (Fisher, 1922, pp.vii, pp.8-32, pp.276-306, pp.372-375) separates money into components of currency and bank deposits, while the turnover of each is treated separately. This equation is written as $MV + M'V' = \sum pq$, where M is the currency component, M' is bank deposits, V and V' are the velocities of currency and deposits respectively, $\sum pq$ is the sum of all prices (p) times the physical volume of trade (q).

For the sake of simplicity, we replace $\sum pq$ by PT, and write the Fisher's exchange equation as

$$MV + M'V' = PT \quad (1)$$

Note that, money (including M and M') is the average amount of currency and deposits in circulation in the community during the year. It should be the simple arithmetic mean of the amounts of money existing at successive instants which are separated from each other by equal, infinitely small intervals of time. Hence, when Fisher's exchange equation is applied in empirical research, we should use monthly average monetary statistics if they are available.[2]

As we know, a country's nominal GDP measures the total expenditure on final goods (and services) during a year; however, the expenditure of money for the purchase of goods (PT) on the right-hand side of the exchange equation encompasses both final and intermediate goods. To view Fishers' exchange equation in this way, we have reason to say that the value of PT must be greater than the value of GDP; and thus, we can write

$$PT = \lambda \cdot GDP; \text{ where } \lambda > 1 \quad (2)$$

By substituting (2) into (1), we have

$$MV + M'V' = \lambda \cdot GDP \quad (3)$$

To facilitate empirical study, we let $M = M_o$ (currency in circulation), $V = V_{mo}$ (M_o velocity), $M' = D$ (demand deposits), $V' = V_d$ (demand deposits velocity), and then, equation (3) can be rewritten as:

[2] Taking China's 2005 M1 figure as an example, the year-end figure was 10727.99 billion Yuan, but the monthly average figure was 9873.49 billion Yuan. That is, the year-end M1was 8.65% higher than its monthly average figure; as a consequence, the computed velocity of M1 circulation dropped from 1.85 to 1.70.

$$M_0 \cdot V_{m0} + D \cdot V_d = \lambda \cdot GDP \quad (4)$$

By letting $D = \alpha M_o$ (i.e., $\alpha = \frac{D}{M_0}$) and $V_d = \beta V_{mo}$ (i.e. $\beta = \frac{V_d}{V_{m0}}$), (4) can be rewritten as:

$$M_0 V_{m0} + (\alpha \cdot M_0)(\beta \cdot V_{m0}) = \lambda \cdot GDP$$

or

$$M_0 V_{m0}(1 + \alpha \cdot \beta) = \lambda \cdot GDP \quad (5)$$

Synthesizing Fisher's equation and Cambridge cash balance equation

The Cambridge equation may be expressed as being $M^d = k \cdot PNy'$. If we replace k and PNy' by 1/V (V represents income velocity) and GDP respectively, and assuming $M^d = M^S$, the equation becomes

$$M^S = \frac{1}{V} \cdot GDP \text{ or } \quad M^S V = GDP \quad (6)$$

Since the two observed variables, M^S and GDP, in the above income form of the quantity equation are available in the national monetary statistics worldwide, it is sensible to observe the empirical relationship between money supply and GDP in selected countries via equation (6) before we proceed to further analysis. The data listed in Table 1 below shows the monthly averages of monetary aggregates and year-end nominal GDP for Mainland China, Hong Kong, the United States, Russia, Hungary, the Czech Republic, and Poland. We have also calculated the money circulation velocity (M_o velocity and M1 velocity) in these countries and the results are reported in Table 2.

Table 1. *GDP, Currency in circulation (M_0), Demand deposits (D) and Narrow Money (M1) in China, Hong Kong, United States, Russia, Hungary, Czech Republic and Poland: 1995-2005*

Year	Mainland China (Billions of Yuans)				Hong Kong (Billions of HK dollars)				United States (Billions of US dollars)				Russia (Billions of Rubles)			
	GDP	M_0	D	M1	GDP	M_0	D	M1	GDP	M_0	D	M1	GDP	M_0	D	M1
1995	5847.8	738.2	1484.9	2223.2	1096.3	70.9	100.5	171.4	7397.7	366.2	776.4	1142.6	1429.0	75.9	66.9	142.8
1996	6788.5	826.1	1758.4	2584.5	1210.9	74.2	107.5	181.7	7816.8	381.6	724.1	1105.8	2008.0	94.0	74.3	168.3
1997	7446.3	963.7	2176.5	3140.2	1344.5	80.6	121.9	202.4	8304.3	409.2	660.0	1069.2	2343.0	124.0	108.3	232.2
1998	7834.5	1059.5	2455.8	3515.3	1279.9	81.2	95.8	177.0	8747.0	441.2	638.5	1079.7	2630.0	140.1	135.8	275.9
1999	8206.8	1183.8	2842.4	4026.2	1246.1	86.8	97.2	184.0	9268.4	485.8	615.6	1101.5	4823.0	208.5	197.4	406.0
2000	8946.8	1380.2	3440.1	4820.3	1288.3	91.6	109.0	200.6	9817.0	523.0	580.7	1103.7	7306.0	313.8	339.0	652.8
2001	9731.5	1477.2	4014.1	5491.3	1269.9	96.8	112.8	209.6	10128.0	555.0	585.2	1140.2	8944.0	481.9	492.9	974.8
2002	10517.2	1600.8	4772.3	6373.1	1248.0	108.3	130.5	238.8	10469.6	609.0	587.3	1196.2	10830.5	636.0	574.6	1210.5
2003	11739.0	1812.6	5780.5	7593.1	1234.0	122.2	168.6	290.8	10960.8	647.7	626.1	1273.8	13243.2	897.8	807.2	1704.9
2004	13687.6	2005.3	6835.4	8840.6	1291.6	136.6	243.8	380.4	11712.5	680.7	664.2	1344.9	16966.4	1272.0	1062.6	2334.6
2005	18232.1	2203.3	7670.2	9873.5	1382.1	144.1	226.5	370.6	12455.8	710.1	661.8	1371.9	21598.0	1651.9	1425.6	3087.5
S.D.	3407.6	461.9	1998.6	2457.6	70.4	24.0	50.0	72.83	1534.4	116.4	57.7	102.5	6400.6	506.4	430.8	938.6
Mean	9907.1	1386.4	3930.1	5316.5	1262.9	99.4	137.7	237.0	9734.4	528.1	647.3	1175.4	8374.6	536.0	480.4	1017.3
CV	0.34	0.33	0.51	0.46	0.06	0.24	0.36	0.31	0.16	0.22	0.09	0.09	0.76	0.94	0.90	0.92
$\bar{r}$ (%)	12.04	11.55	17.84	16.08	2.34	7.34	8.47	8.02	5.34	6.84	-1.59	1.85	31.20	36.07	35.78	35.98

Table 1. *Continued*

Year	Hungary (Billions of Forints)				Czech Republic (Billions of Koruny)				Poland (Billions of zlotys)			
	GDP	M_0	D	M1	GDP	M_0	D	M1	GDP	M_0	D	M1
1995	5614.0	425.1	518.4	943.4	1466.5	91.7	297.0	388.7	n.a.	n.a.	n.a.	n.a.
1996	6893.9	461.3	613.2	1074.4	1683.3	110.5	311.4	422.0	n.a.	n.a.	n.a.	n.a.
1997	8540.7	528.7	778.2	1307.0	1811.1	117.2	283.5	400.7	444.7	26.3	44.8	71.1
1998	10087.4	607.4	1104.1	1711.5	1996.5	110.5	269.7	380.2	589.4	29.2	51.6	80.7
1999	11393.5	723.5	1307.9	2031.5	2080.8	140.2	276.3	416.6	666.3	33.5	66.1	99.6
2000	13172.3	820.0	1540.7	2360.7	2189.2	166.3	313.0	479.3	744.6	34.1	69.6	103.7
2001	14849.8	910.3	1760.0	2670.2	2352.2	174.0	366.4	540.4	779.2	35.0	71.7	106.7
2002	16740.4	1097.0	2062.4	3159.4	2464.4	188.5	528.1	716.6	807.9	40.6	83.0	123.5
2003	18574.0	1275.6	2399.3	3674.8	2577.1	213.5	614.4	827.8	842.1	46.8	97.1	143.9
2004	20216.2	1316.7	2559.9	3876.7	2781.1	231.4	702.6	934.0	922.2	50.3	116.1	166.4
2005	21802.3	1453.7	3024.1	4477.8	2978.2	251.4	760.3	1011.7	975.0	53.9	134.9	188.7
S.D.	5210.9	348.0	796.6	1143.6	445.9	51.4	177.7	226.1	217.3	9.1	27.9	36.9
Mean	13444.0	874.5	1606.2	2480.7	2216.4	163.2	429.3	592.5	674.8	38.8	81.6	120.5
CV	0.39	0.40	0.50	0.46	0.20	0.31	0.41	0.38	0.32	0.23	0.34	0.31
$\bar{r}$ (%)	14.53	13.08	19.29	16.85	7.34	10.61	9.86	10.04	10.30	9.37	14.78	12.98

Notes: M_0, D, and M1 are monthly average figures. $M1 = M_0 + D$.

Data on Polish monetary aggregates published by the National Bank of Poland started in December 1996. S.D. stands for standard deviation. CV (Coefficient of variation) is calculated as $CV = \frac{S.D.}{\bar{X}}$ where $\bar{X}$ refers to the sample mean. $\bar{r}$ (%) is the average rate of change, which is equal to $\left[\sqrt[n]{\frac{X_{t+n}}{X_t}} - 1\right] \times 100\%$, where X_t and X_{t+n} represent the first and the last value of the observed period, respectively.

Data sources: The People's Bank of China Quarterly Statistical Bulletin, various issues. HKMA Monthly Statistical Bulletin, various issues. Hong Kong Census and statistics Department, 2006, Gross Domestic Product, 2005. IMF International Financial Statistics, various issues [Retrieved from]. [Retrieved from]. [Retrieved from]. [Retrieved from]. [Retrieved from]. [Retrieved from].

Table 2. *The money circulation velocity in China, Hong Kong, United States, Russia, Hungary, Czech Republic and Poland: 1995-2005*

Year	China		Hong Kong		United States		Russia		Hungary		Czech Republic		Poland	
	M_0 Velocity	M1 Velocity	M_0 Velocity	M1 Velocity	M_0 Velocity	M1 Velocity	M_0 Velocity	M1 Velocity	M_0 Velocity	M1 Velocity	M_0 Velocity	M1 Velocity	M_0 Velocity	M1 Velocity
1995	7.92	2.63	15.46	6.40	20.20	6.47	18.83	10.0	13.21	5.95	16.00	3.77	n.a.	n.a.
1996	8.22	2.63	16.32	6.66	20.48	7.07	21.36	11.93	14.95	6.42	15.23	3.99	n.a.	n.a.
1997	7.73	2.37	16.69	6.64	20.29	7.77	18.90	10.09	16.15	6.53	15.45	4.52	16.91	6.26
1998	7.39	2.23	15.76	7.23	19.82	8.10	18.77	9.53	16.61	5.89	18.07	5.25	20.21	7.30
1999	6.93	2.04	14.36	6.77	19.08	8.41	23.13	11.88	15.75	5.61	14.84	5.00	19.92	6.69
2000	6.48	1.86	14.06	6.42	18.77	8.89	23.28	11.19	16.06	5.58	13.17	4.57	21.83	7.18
2001	6.59	1.77	13.11	6.06	18.25	8.88	18.56	9.17	16.31	5.56	13.52	4.36	22.26	7.30
2002	6.57	1.65	11.52	5.22	17.19	8.75	17.03	8.95	15.26	5.30	13.08	3.44	19.92	6.54
2003	6.48	1.55	10.10	4.24	16.92	8.60	14.75	7.77	14.56	5.05	12.07	3.11	18.01	5.85
2004	6.83	1.55	9.45	3.40	17.21	8.71	13.34	7.27	15.35	5.21	12.02	2.98	18.33	5.54
2005	8.28	1.85	9.59	3.73	17.54	9.08	13.07	7.00	15.00	4.87	11.85	2.94	18.10	5.17

Notes: $M_0\,\text{Velocity} = \frac{GDP}{M_0}$, $M_1\,\text{Velocity} = \frac{GDP}{M_1}$.

Data sources: Same as those in Table 1

It is interesting to note that the figures for M_0 velocity in these countries are significantly higher than the figures for M1 velocity. Taking the United States as an example, the 9.08 M1 velocity in 2005 demonstrates that the average hoarding of narrow money (M1) in the hands of the non-bank public was 40.2 days; however, the 17.54 M_0 velocity demonstrates that the average hoarding of currency (M_0) was 20.81 days. Viewed in this way, it should be reasonable to interpret the variable M^S in equation (6) as M_0 rather than M1. That is, M^S and V in equation (6) should be respectively referred to M_0 and M_0 velocity (V_{m0}). Thus, equation (6) can be rewritten as

$$M_0 V_{m0} = GDP \tag{7}$$

By substituting (7) into (5), we have

$$GDP(1 + \alpha \cdot \beta) = \lambda \cdot GDP$$

or

$$\lambda = 1 + \alpha \cdot \beta = 1 + \frac{D}{M_0} \cdot \frac{V_d}{V_{m0}} \tag{8}$$

where V_d is considered as an institutional parameter, and $V_d \neq \frac{GDP}{D}$[3]

After substituting (7) into (8), we have:

$$\lambda = 1 + V_d \cdot \frac{D}{GDP} \tag{9}$$

For the sake of straightforward comparison of the λ values across countries, we assume the demand deposit account balance (D) is cleared every week, and so the average demand deposits velocity (V_d) is 52 per year. After rearranging equation (9), we obtain a formula to estimate λ:

$$\lambda = 1 + 52 \cdot \frac{D}{GDP} \tag{10}$$

The empirical values of λ have been calculated and reported in Table 3. Four characteristics can be observed: firstly, the λ values in Mainland China are the highest amongst the countries under investigation; secondly, the λ values of the five former socialist economies (China, Russia, Hungary, Czech Republic and Poland) showed an upward trend while a general decline is observed in mature market economies such as the United States; thirdly, the pattern of λ values in Hong Kong appears to follow that in the United States before its handover to Mainland China in 1997, but after that, the movement follows that of China's rising pattern; and finally, in the case of China and Russia, it demonstrates that a higher money growth rate is not necessarily associated with a lower velocity of money circulation. Among these four characteristics, the abnormally high λ values in Mainland China should be the one with significant policy implications.

[3] If $V_d = \frac{GDP}{D}$, then λ= 2, which is substantially different from our computed λ values as shown in Table 3.

Table 3. *The computed λ value for China, Hong Kong, United States, Russia, Hungary, Czech Republic and Poland: 1995-2005*

Year	Mainland China	Hong Kong	United States	Russia	Hungary	Czech Republic	Poland
1995	14.20	5.77	6.46	3.44	5.80	11.53	n.a.
1996	14.47	5.62	5.82	2.92	5.63	10.62	n.a.
1997	16.20	5.71	5.13	3.40	5.74	9.14	6.24
1998	17.30	4.89	4.80	3.68	6.69	8.02	5.55
1999	19.01	5.06	4.45	3.13	6.97	7.91	6.16
2000	20.99	5.40	4.08	3.41	7.08	8.44	5.86
2001	22.45	5.62	4.00	3.87	7.16	9.10	5.78
2002	24.60	6.44	3.92	3.76	7.41	12.14	6.34
2003	26.61	8.11	3.97	4.17	7.72	13.40	7.00
2004	26.97	10.82	3.95	4.26	7.58	14.14	7.55
2005	22.88	9.52	3.76	4.43	8.21	14.28	8.19

Major factors contributing to the discrepancy between the total value of monetary transactions and GDP in China

After a thorough examination of the working of the economy of China regarding the relationship between total value of monetary transactions and GDP, we have come to a tentative conclusion that China's settlement system, the existence of a shadow economy, the extent of intermediate transactions and the value of net exports are the four major exogenous factors determining the velocity of money circulation due mainly to the existence of a discrepancy between PT and GDP.

The payments settlement system

In the pre-financial reform period of the 1990s, China's Government wanted better control of the real sector as well as the financial sector for the prevention of corruption and illegal business transactions. This required the state-owned enterprises and public units to settle their economic transactions through a non-bank account transfer system. There was also a cash circulation control policy which disallowed institutions from using cash to settle transactions that exceeded a particular amount. Although these regulations have gradually become obsolete, they have

increased non-cash transactions outside the financial sector contributing to a low level of money circulation because the public tends to conserve cash as a precaution in the event of emergency purchases (Poon, 1987).

We may note that the monetarization process in China, which is defined as the proportion of economic transactions conducted using money for measurement of value and as the medium of exchange, has been increasing (Yi, 1993, 2003). We can acknowledge that the monetarization process would be continued in Mainland China, and it may, in the long run, contribute to a rapid growth in M_o as well as V_{mo}, and a lower λ resulting from narrowing the gap between PT and GDP. This pattern can explain that the high λ value or low velocity of money circulation in China in the past decade was partly due to the low level of monetarization.

Shadow economy

The existence of a shadow economy will lead to an understatement of the GDP figures, which helps explain the high value of λ in China. A shadow economy can be defined as "market-based production of goods and services, legal or illegal, which escapes detection in the official estimates of GDP" (Smith, 1994; Fleming *et al.*, 2000). Illegal activities in a shadow economy include trade in stolen goods, drug dealing and manufacturing, smuggling, prostitution, fraud and the like, whereas legal activities include unreported income from unreported work as well as tax evasion and avoidance activities. Generally, the above examples in a shadow economy may be common in Mainland China. The growth of the shadow economy may be caused by many factors, including the rise of tax burdens and the complexity of the tax system, increased regulation in the official economy, corruption and bureaucracy, the decline of civic virtue towards the Government and the decline of tax morale (Schneider & Enste, 2000). Based on a survey in 1998-99, the size of the shadow economy encompassed 14% of GDP in Hong Kong, but in Russia, it encompassed 44% (Schneider & Enste, 2002). Since the problem of a shadow economy in an

emerging economy such as Mainland China could be much more serious than in a well-developed economy, we have reason to believe it contributes to a high value of λ or a low velocity of money circulation.

Number and value of intermediate transactions

According to standard Economics textbooks, nominal GDP is a measure of the market values of all final goods produced in a country in a given year. PT measures the total values of all transactions including all intermediate goods as well as final goods. Intermediate goods include those that are purchased for resale or for further processing or manufacturing during the stages of production. Final goods are those that are purchased for final use. Included in the values of intermediate goods, PT must then be larger than nominal GDP. In Mainland China, the gap between PT and GDP is found to be much wider than in other countries mentioned in Table 1, thereby leading to higher value of λ than other countries.

Difference between the value of imports and net exports

Net exports equal exports minus imports of goods and services. Nominal GDP includes the market values of net exports, but PT includes the total values of domestic demand for all goods and services, produced by both local and foreign resources. In other words, PT includes monetary transactions for imported goods and services (in the forms of private consumption expenditure, fixed domestic capital formation, and government consumption expenditure) but excludes those for exports. So, the larger the difference between imports and net exports, the higher the value of λ may be observed.

Conclusion

This chapter demonstrates that a higher money growth rate is not necessarily associated with a lower velocity of money circulation. After investigating the working of the China's economy, we consider four major factors contributing

to the discrepancy between the total value of monetary transactions and GDP in China, and therefore affecting the effectiveness of demand management monetary policy.

References

China Statistical Information and Consultancy Service Centre. China Report: Social & Economic Development (1949-1989), Influxfunds Co. Ltd. And Zie Yongder Co. Ltd. Hong Kong, 1990.

Ding S. (2003). Study on monetary environment and monetary performance of China, *China Finance Publisher*, p.239. (Chinese)

Fisher, I. (1922). *The Purchasing Power of Money*, (first Edition 1911, Second Edition 1922), Reprinted by Augustus M. Kelley Publishers, 1971.

Fleming, M.H., Roman, J., & Farrell, G. (2000). The shadow economy. *Journal of International Affairs*, 387-409.

Friedman, M. (1987). Quantity theory of money, *in* J. Eatwell, M. Milgate, & P. Newman (ed.), *The New Palgrave Dictionary of Economics*, Macmillan.

Hong Kong Census and Statistics Department, (2005). Gross Domestic Product, 2005, 2005 Edition, Government Press, Hong Kong.

Hong Kong Census and Statistics Department, (1978-88-98-2004-2005). *Hong Kong Annual Digest of Statistics*, 1978, 1988, 1998, 2004, 2005. Editions, Government Press, Hong Kong.

Hong Kong Monetary Authority, Hong Kong Monthly Statistical Bulletin, Various issues.

Lu, Y.H. (2005). The empirical research on the relationship among monetary supply, prive level and GDP in the Chinese economy: 1952 – 2003, *Economic Science*, 2(3), 35-45.

Miles, M.A., Feulner, E.J., & O'Grady, M.A. (2004). *Index of Economic Freedom*, The Heritage Foundation and Dow Jones & Company, Inc., 2004.

Poon, C.C. (1987). Towards a cashless society, *Economic Journal of HKSYC*, [Retrieved from].

Prasad, E.S. (2004). China's growth and integration into the world economy: Prospects and challenges. *International Monetary Fund*, Occasional Paper, No.232. [Retrieved from].

Rogoff, K.S., Husain, A.M., Mody, A., Brooks, R., & Oomes, N. (2004). Evolution and performance of exchange rate regimes *International Monetary Fund*, Working Paper, No.WP/03/243. [Retrieved from].

Schneider, F. (2000). Dimensions of the shadow economy, *The Independent Review*, 5(1), 81-91.

Schneider, F., & Enste, D. (2000). Shadow economies: Size, causes, and consequences, *Journal of Economic Literature*, 38(1), 77-114. doi. 10.1257/jel.38.1.77

Schneider, F., & Enste, D. (2002). Hiding in the shadows: The growth of the underground economy. *IMF Economic Issues*, No.2002/001. [Retrieved from].

Schneider, F. (2005). The size of shadow economies in 145 countries from 1999 to 2003. *The Brown Journal of World Affairs*, 11(2), 113-129.

Smith, P. (1994). Assessing the size of the underground economy: The statistics Canada perspective. *Statistics Canada*, National Accounts & Environment Division. [Retrieved from].

State Statistical Bureau, (n.d.). *China Statistical Yearbook*, China Statistical publishing House, various years.

The People's of China, (n.d.). *The People's Bank of China Quarterly Statistical Bulletin*, Various issues (1998-2005).

Vickers, D. (1985). *Money, Banking, and the Macroeconomy*, Prentice-Hall.

Yi, G. (1994). *Money, Banking, and Financial Markets in China*, Westview Press.

Yi, G. (2003). *The Monetarization Process in China* (Chinese book), Commercial Press.

Zhang, X. (2004). Report on martetization process in China, *The Chinese Economy*, 37(3), 68-84. doi. 10.1080/10971475.2004.11033511

Zhao, L., & Wang, Y. (2005). Chinese experience on monetary stock and price level, *Economic Science*, 2, 35-45.

Savings, Investment, and Behavioral Finance

Author: **Kai-Yin Woo** [a] **Wing-Keung Wong** [b] **Tai-Yuen Hon** [a] **Wing-Kwong Au** [a].

[a] Hong Kong Shue Yan University, Hong Kong.

[b] Asia University, Taiwan.

ISBN: 978-625-8190-85-4 (e-Book)

KSP Books 2023

Kai-Yin Woo
Wing-Keung Wong
Tai-Yuen Hon
Wing-Kwong Au

Household Savings in Hong Kong: A Statistical Analysis
Che-cheong **Poon** & Tai-Yuen **Hon**

Lucky 13? Does The Singapore Equities Market Move in 13-year Cycles?
Wing-Keung **Wong** & Lanz **Chan**

Hedging Hong Kong Stock Sectors with Gold: Multivariate Asymmetric GARCH Approach
Tao **Chen** & Kai-Yin **Woo**

Cointegration of the Indian Market with other National Stock Markets after Financial Tsunami
Hui-Hui **Xu**, Kai-Yin **Woo** & Suet-Ching **Chak**

Behavioural Study of Financial Derivatives Investments in Hong Kong
Tai-Yuen **Hon**, Paul **Shum** & Wing-Kwong **Au**

The Discrepancy between the Total Value of Monetary Transactions and GDP in China
Che-cheong **Poon** & Kai-Yin **Woo**

KSP Books

e-ISBN
978-625-8190-85-4