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# **Pattern Recognition Techniques and Financial Analysis**

A thesis presented in fulfilment of the requirements for the degree of

Doctor of Philosophy

in

Finance

at Massey University

Palmerston North, New Zealand

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**2014**

**“He is the source of light in all luminous objects. He is beyond the darkness of matter and is unmanifested. He is knowledge, He is the object of knowledge, and He is the goal of knowledge. He is situated in everyone’s heart”**

*-Bhagavad-Gita As It Is (13.18)*

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**I dedicate this thesis to my parents,  
for teaching me the value of knowledge and my wife,  
for supporting me to acquire that knowledge.**

## **ABSTRACT**

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The balance sheet statement is an essential feature of financial reporting, and is expected to convey complete information on firms' operating business decisions. Since these decisions are based on the manager's perception of the existing and future investment opportunities, they cannot be directly observed. This results in two major data analysis issues. First, it is difficult to observe directly the most common operating business decisions; secondly, these decisions may not have a same linear relation to all firms and all firm's performance measures. This thesis attempts to address these issues in three interconnected essays.

The first essay examines an outcome of the double-entry bookkeeping system when financial transactions simultaneously shift a firm's financial position, providing the special information to interpret the meaning of a transaction. Using the factor analysis model, this essay makes use of this information, and identifies the five fundamental factors (decisions) that can capture a firm's time-varying operating business status in a given year. These factors include: financial flexibility, short-term credit, long-term investment, convertible debt usage, and preferred stock usage. The method of extracting these factors controls for missing variable bias, account for limited attention, and provide true decomposition of accounting aggregates such as total asset growth. These factors subsist in predicting future stock returns, forecasting a firm's value (Tobin's Q), cash flows, and earnings beyond their well-known determinants.

The second essay explores the sources of return predictability contained in financial flexibility, which is the first factor identified in essay one. The horse races of the asset pricing versus mispricing tests find a significant positive premium on financial flexibility based return factor, and make it a candidate for a new priced factor. The evidence suggests that covariances dominate the characteristics, and it is non-redundant to well-established risk factors. This factor meets the new conservative minimum of *t*-statistics value of above 3.0 and is constructed using unobserved information.

The final essay addresses the second issue in the data analysis by employing the nonlinear firm grouping technique – the K-means clustering analysis method. Firms are grouped in their 12 natural groups using the five fundamental factors identified in the first essay, and firm size as the clustering criteria. This essay shows how firms differ on priority and the composition of their common operating decisions. This type of firm grouping suggests that operating business decisions are related to firm-specific health and structure instead of industry. This essay recommends the nonlinear firm grouping prior to employing the linear regression models in predicting future performance measures to improve the precision of business analysis.

## ACKNOWLEDGEMENTS

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This research was supported by the Overseas Scholarship Program Phase II through the Higher Education Commission of Pakistan. The financial support of this sponsor is gratefully acknowledged.

There are several additional people and organisations that I need to thank for their support and help throughout the PhD journey. All of their contributions made this research not only possible, but also enjoyable – and I am genuinely grateful to all of them.

First of all, I must thank my supervisors. Dr. Jianguo Chen has been my main supervisor throughout my PhD research at Massey University. Both students and faculty know him as JG in the School of Economics and Finance. JG is a down-to-earth personality and easy to reach and that is why students who either want to do a masters by research or PhD prefer him to be their supervisor. He is also well known for his high-end expertise in financial econometrics, which is why most of the faculty wants him to collaborate in their research. I truly appreciate his willingness to let me work on my research and introducing me to the importance of pattern recognition techniques in financial analysis.

My second supervisor, Dr. Udomsak (Jeff) Wongchoti, was the first person who spoke the most precious sentence of: *“Yes, I am ready to supervise you, but I want JG to be the main supervisor”*. I said *“Why not,”* as I knew both of them well as they had taught me the research methods in finance (125.785) paper during my Postgraduate Diploma in Finance. I must say, Jeff has always been supportive of the research and encouraged me to



be creative and to find new ways to refine research outputs so that it makes the right impact on readers. He also has a keen critical eye to ensure that the research problem and its results are theoretically sound and empirically correct. Finally, their long discussions over my research almost every other week, provided guidance, encouragement and constructive support throughout my PhD research.

This research was conducted at the School of Economics and Finance, Massey University, Palmerston North Campus. This situation was unrivalled and very favourable in terms of both the research setting and my personal situation. The office space, database, statistical software, weekly research seminar series, and exclusive IT support staff were vital for the research to grow and be refined. Special thanks to Fong Mee Chi for helping me with database availability and encouragement throughout my research. I also admire the support of Cameron Rhodes for IT support, and Maryke Bublitz and Kim Williams for their administrative supports. Palmerston North is famous as a student city and it does meet the expectations of such a label. I would say this is the only city in New Zealand where students have the luxury to live with a family on a meager scholarship stipend. I appreciate the New Zealand system of providing free medical services and free education for my children and free maternity services to my wife. I also appreciate the social welfare activities of the city council and the different organisations that help overseas people to settle in the city.

As I mentioned above, I have had fun throughout the PhD journey. This is due entirely to the wonderful people I shared the office with and my incredible Pakistani friends – both in New Zealand and Pakistan. All of the fellow PhDs have been amazingly fun

people to work with. There are a few people in particular that I would like to thank. Lee Hwei (Karren) Khaw, Wei Yi, Ahmed Raza, Pok Wei Fong, Azira, Norlida Mahussin, Xiaoqi Chen, Uzma Shehzad, Mui Kuen Yuen, and Q. (Sophie) Wang have been the best office friends I could have asked for. Karren and I used to have long discussions and fights over the research problems. Saqib Shareef, my senior PhD fellow and Pakistani scholar, has been an inspiration and great help right from the beginning of my studies here at Massey University. Mr. Zafar Hayat has been the best friend right from the start of our journey from Pakistan to New Zealand. And, we have been the harshest critics of each other. I would also extend my gratitude to Faisal Rana, economics PhD fellow and Pakistani scholar, who has always been ready to offer assistance at the crucial time in a most positive way. He is known in the community for his modesty and patience. I have also been lucky to find support from Dr. Zulifqar Butt, Dr. Muhammad Imran, Muhammad Ibrar Bari, Asif Zia, Sajjid Khan, Dilawar Arbab, Jai Forrester, Vikas Mital, Hamid Irshad, Islahudin Qazi, Aamir Ghafoor Bajwa, Zahid ur Rehman, Mahmood Ghaznavi, and Shujjat Khan.

I would like to thank Ben Marshall, Ralph A. Walkling, Terry Walter, Steven Cahan, Baljit Sidhu, Ronald J. Balvers, Dayoung Huang, H. Zafer Yuksel, Januj Juneja, Aslihan Cicek, Vitali Alexeev, Robert Faff, Leigh Roberts, Hai Lin, David Tripe, Kevin Davis, Petko Kalev, Paul Docherty, Md Humayun Kahir, Jing Liao; seminar, workshop, and conference participants at Massey University; the Second and Fourth Young Researcher Workshops, Sirca, 2013-14 in Sydney; the 2013 annual meeting of the Financial Management Association in Chicago; and the School of Economics and Finance Symposium, Victoria University in Wellington.

Finally, I express my gratitude to my wife Saroj for her unflinching support and backing me up all along this PhD journey. I admire her resolve and patience in taking care of me and raising our children. The success of my research would not have been possible without her support. She is the love of my life. I have always cherished the prayers of my loving father and mother during my studies. I fully appreciate their patience and fortitude while I have been away. I dedicate this thesis to my father Bhooro Mal Oad Rajput, mother Ajni, wife Saroj, and to my two beautiful children Bhoomika and Adarsh who consistently provided encouragement to accomplish this PhD project.

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