

RGC Ref. No.: UGC/FDS15/B06/14 _____ (please insert ref. above)
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**RESEARCH GRANTS COUNCIL
COMPETITIVE RESEARCH FUNDING SCHEMES FOR
THE LOCAL SELF-FINANCING DEGREE SECTOR**

FACULTY DEVELOPMENT SCHEME (FDS)

Completion Report
(for completed projects only)

<p><u>Submission Deadlines:</u> 1. The unspent balance, if applicable, and auditor's report: within six months of the approved project completion date.</p> <p>2. Completion report: within twelve months of the approved project completion date.</p>

Part A: The Project and Investigator(s)

1. Project Title

Nonlinear Cointegration and Relevant Market Definition: A Study of Grocery Markets

2. Investigator(s) and Academic Department/Units Involved

Research Team	Name / Post	Unit / Department / Institution	Contact Information
Principal Investigator	Lee Shu Kam/Associate Professor	Department of Economics and Finance, Hong Kong Shue Yan University (HKSJU)	sklee@hksyu.edu
Co-investigator(s)	Woo Kai Yin/Associate Professor	Department of Economics and Finance, HKSJU.	kywoo@hksyu.edu
Others	Shum Paul Kwok Ching	University of Western Sydney Australia	p.shum@westernsydney.edu.au

3. Project Duration

	Original	Revised	Date of RGC / Institution Approval (must be quoted)
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Project Start Date	1-Jan-2015	NA	NA
Project Completion Date	31-Dec-2016	NA	NA
Duration (<i>in month</i>)	24 months	NA	NA
Deadline for Submission of Completion Report	31-Dec-2017	NA	NA

Part B: The Final Report

5. Project Objectives

5.1 Objectives as per original application

1. Assess whether competition in the Hong Kong grocery industry is fit and proper.
2. Given the concerns about the high concentration in the grocery industry of Hong Kong, identify whether all or just some of the disaggregated product market areas are adversely affected.
3. Propose a set of nonlinear price-based cointegration tests that taken into account transaction costs to provide more precise results for use in the anti-competition decision process. The same methodology will also be applied to some other economies.

4. Disseminate this tool by training students to use the tool to support decision making in their future careers associated with anti-competitive behavior.

5.2 Revised objectives

Date of approval from the RGC:	NA
Reasons for the change:	NA
	NA

- 1.
- 2.
3.

5.3 Realisation of the objectives

(Maximum 1 page; please state how and to what extent the project objectives have been achieved; give reasons for under-achievements and outline attempts to overcome problems, if any)

As for objective 1, the paper on “Dynamic Price Relationship between Supermarket and Non-supermarket sectors in Hong Kong” has been presented in “The Eleventh Annual Conference of The Asian Studies Association of Hong Kong at Kobe University, Japan in April 2016. The revised paper on “Analysis of Threshold Cointegration with Asymmetric Adjustments in the Hong Kong Grocery Industry” has been published in Applied Economics, UK in 2017.

As for objective 2, the paper on “Price Convergence in the Hong Kong Supermarket Industry using the Rank Tests for Nonlinear Cointegration” has been submitted to an international refereed journal (under review). The analysis is based on the firm-level data on product prices obtained from Consumer Council.

As for objective 3, the nonlinear methodology has been applied to Australia beverage markets and UK supermarkets. The paper on “Rank tests for nonlinear cointegration in the Australian beverage markets” has been presented in 2016 International Symposium on Business and Management, held in Tokyo in December 2016. The revised paper “Rank Tests for Price Convergence in Australian Beverage Markets” has been accepted to publish in Applied Economics Letters in September 2017.

The same methodology has been being applied to other economies. The paper on “Price Convergence in the UK Supermarket Chains: Evidence from non-linear cointegration approach” has been submitted to an international refereed journal (under review).

As for objective 4, the objective of training students was addressed in point 9, please refer to point 9.

5.4 Summary of objectives addressed to date

Objectives (as per 5.1/5.2 above)	Addressed (please tick)	Percentage achieved (please estimate)
1. Assess whether competition in the Hong Kong grocery industry is fit and proper.	<input checked="" type="checkbox"/>	100 %
2. Given the concerns about the high concentration in the grocery industry of Hong Kong, identify whether all or just some of the disaggregated product market areas are adversely affected.	<input checked="" type="checkbox"/>	100%
3. Propose a set of nonlinear price-based cointegration tests that take into account transaction costs to provide more precise results for use in the anti-competition decision process. The same methodology will also be applied to some other economies.	<input checked="" type="checkbox"/>	100%
4. Disseminate this tool by training students to use the tool to support decision making in their future careers associated with anti-competitive behaviour.	<input checked="" type="checkbox"/>	90% (The standard techniques and the concepts of the new knowledge including arguments and methodology in evaluating the market power have been mentioned in class. However, the details of the techniques are too advanced for undergraduate students and hence would be mentioned in postgraduate course in near future)

6. Research Outcome

6.1 Major findings and research outcome

(Maximum 1 page; please make reference to Part C where necessary)

1. **Kai-yin Woo, Shu-kam Lee and Paul Shum (2017). Analysis of Threshold Cointegration with Asymmetric Adjustments in the Hong Kong Grocery Industry. Applied Economics, 49, 5591-5600.**

The findings favor the presence of cointegration between the supermarket and non-supermarket price indices with asymmetric adjustment dynamics. We interpret the results of statistically significant downward price adjustments in the outer-band regimes as the evidence of mutual price competition. The estimated thresholds are asymmetric, which much higher for supermarkets than non-supermarkets in absolute value, i.e., the supermarket sector has stronger market power than the non-supermarket sector, and therefore can sustain higher price level without inducing substantial competition pressures inside the neutral band. This may be due to lower search costs for one-stop grocery shopping at supermarket.

2. **Shu-kam Lee and Kai-yin Woo. Price Convergence in the Hong Kong Supermarket Industry using the Rank Tests for Nonlinear Cointegration (submitted to an international peer-reviewed journal for review)**

This paper aims to examine the price convergence of grocery products sold in two Hong Kong supermarket giants. The majority of the empirical studies in the literature on price convergence take into account the presence of transaction costs that are associated with a nonlinear functional form and a nonlinear adjustment process. However, no single theory can provide any precision in the functional form. While parametric linear and nonlinear cointegration tests require the functional form to be exact for estimation, they will suffer from a misspecification problem if the wrong parametric models are identified, and therefore may not be appropriate for our study on competition analysis. Hence, we adopt the non-parametric nonlinear test for analysis which does not require prior knowledge and specification of the linear or nonlinear functional form. Our results confirm the evidence of the price convergence of all grocery products and competition between the two supermarket giants in Hong Kong. Moreover, we find some evidence of nonlinear cointegration relationships between supermarket prices.

3. **Paul Shum, Kai-yin Woo and Shu-kam Lee (2017). Rank tests for price convergence in Australian beverage markets. Applied Economics Letters (In Press, Published online: 13 Sep 2017, 1-5)**

This paper examines the price convergence of beverage products within Australia in order to assess the efficacy of intranational cross-border movements of products under the Australia's Mutual Recognition Agreement. Since the cointegrating relationship between product prices may not be exact or linear, we adopt the rank tests for analysis which do not require prior knowledge and specification of the linear or nonlinear functional form. Our results validate the price convergence of all beverage products within Australia, with the exception of a few regions in the milk market. Furthermore, a subset of the cointegration relationships exhibits nonlinear long-run price co-movements.

4. **Kai-yin Woo and Shu-kam Lee (2017). Price Convergence in the UK Supermarket Chains: Evidence from non-linear cointegration approach. (submitted to an international peer-reviewed journal for review)**

This paper examines the price convergence of fourteen grocery categories between Tesco and other three leading UK supermarkets using non-parametric cointegration

rank tests over the period from 2008:07 to 2015:09. The results confirm the existence of price convergence and competition in the UK grocery retailing industry. Also, we find some evidence of nonlinear cointegration relationships between supermarket prices, especially in the product of alcohol as well as frozen food, fruit & vegetables and meat & fish, which may be caused by transaction costs, nonlinear price interaction behaviours and so on.

6.2 Potential for further development of the research and the proposed course of action (*Maximum half a page*)

Our analysis is based on the price indices which include a basket of goods and aggregate over retailers as disaggregated data over a long span of period are not available. Further cross-country comparative research on the degree of price competition for specific products sold over the distribution channels of specific retailers in the grocery industry is suggested if the disaggregated data are long enough.

Our testing methods on detecting market power in product markets can also be applied to other retail industries across various economies.

The developed quantitative methods can also evaluate the market power in factor markets (i.e., investigating monopsony power) by testing vertical instead of horizontal integration.

7. Layman's Summary

(Describe in layman's language the nature, significance and value of the research project, in no more than 200 words)

As competitive forces would lead to price convergence, testing price co-movement have been deployed in competition analysis. Competition authorities in foreign countries have recognised the usefulness of econometric cointegration tests in detecting price co-movement and have used the test results to support policy and court decisions.

High market concentration in the Hong Kong grocery industry has been prevalent over many years with the domination of a few large supermarket chains. However, no research has used cointegration tests to investigate whether the non-supermarket sector can impose competitive discipline on the dominating supermarket chains. Besides, we argue that standard cointegration tests cannot allow for transaction costs of time spent, search and transportation and distinguish whether the price co-movement is attributable to price competition or collusion. Our study therefore fills this research gap by adopting the threshold cointegration tests to evaluate the market power of the supermarket sectors in the presence of transaction costs.

Since the nonlinear cointegrating relationship between product prices may not be exact, we may also adopt the rank tests for analysis which do not require prior knowledge and specification of the nonlinear functional form.

The same methodology will be applied to some grocery industries in other economies.

Part C: Research Output**8. Peer-reviewed journal publication(s) arising directly from this research project**

(Please attach a copy of the publication and/or the letter of acceptance if not yet submitted in the previous progress report(s). All listed publications must acknowledge RGC's funding support by quoting the specific grant reference.)

The Latest Status of Publications				Author(s) (denote the corresponding author with an asterisk*)	Title and Journal/Book (with the volume, pages and other necessary publishing details specified)	Submitted to RGC (indicate the year ending of the relevant progress report)	Attached to this report (Yes or No)	Acknowledged the support of RGC (Yes or No)	Accessible from the institutional repository (Yes or No)
Year of publication	Year of Acceptance (For paper accepted but not yet published)	Under Review	Under Preparation (optional)						
2017				Woo, Kai Yin*, Lee, Shu Kam and Shum, Paul.	Analysis of Threshold Cointegration with Asymmetric Adjustments in the Hong Kong Grocery Industry. Applied Economics, 49, 5591-5600.	2017	Yes	Yes	Yes
	2017			Shum, Paul, Woo, Kai Yin* and Lee, Shu Kam.	Rank tests for price convergence in Australian beverage markets. Applied Economics Letters (In Press, Published online: 13 Sep 2017, 1-5)	2017	Yes	Yes	Yes
		Under Review		Lee, Shu Kam* and Woo, Kai Yin	Price Convergence in the Hong Kong Supermarket Industry using the Rank Tests for Nonlinear Cointegration	No	No	will acknowledge once the paper is accepted	NA
		Under Review		Woo, Kai Yin* and Lee, Shu Kam.	Price Convergence in the UK Supermarket Chains: Evidence from non-linear cointegration approach	No	No	will acknowledge once the paper is accepted	NA

9. Recognized international conference(s) in which paper(s) related to this research project was / were delivered (Please attach a copy of each conference abstract)

Month / Year / Place	Title	Conference Name	Submitted to RGC (<i>indicate the year ending of the relevant progress report</i>)	Attached to this report (<i>Yes or No</i>)	Acknowledged the support of RGC (<i>Yes or No</i>)	Accessible from the institutional repository (<i>Yes or No</i>)
1) 4/2016/Kobe, Japan	Dynamic Price Relationship between Supermarket and Non-supermarket sectors in Hong Kong	1) The Eleventh Annual Conference of The Asian Studies Association of Hong Kong	NO	Yes	1) Yes, in the paper published in "Applied Economics"	1) The conference paper has been published in Applied Economics
2) 12/2016/Tokyo, Japan	Rank tests for nonlinear cointegration in the Australian beverage markets	2) 2016 International Symposium on Business and Management, Japan	NO	Yes	2) Yes, in the paper published in "Applied Economics Letters."	2) The conference paper has been accepted to publish in Applied Economics Letters

10. Whether research experience and new knowledge has transferred /contributed to teaching and learning (*Please elaborate.*)

The standard techniques and the concepts of the new knowledge including arguments and methodology in evaluating the market power have been mentioned in class (please see point 11). However, the details of the techniques are too advanced for undergraduate students and hence would be mentioned in postgraduate course in the near future.

11. Student(s) trained (*Please attach a copy of the title page of the thesis*)

Name	Degree registered for	Date of registration	Date of thesis submission / graduation
1) Kong Xiang Yun's Honours Project: Testing Price Convergence in the UK Supermarket Industry: A Multivariate Cointegration Analysis	1) B.A. (Hons) in Economics and Finance	1) 9/2013	1) 1/2017
2) 130 Students (Course of Introductory Econometrics) Lectured By Shu-kam Lee. ---Lecture on using basic quantitative techniques to detect anti-competitive behaviors	2) B.A. (Hons) in Economics and Finance	2) 9/2015	2) NA
3) 130 Students (Course of Intermediate	3) B.A. (Hons) in Economics and Finance	3) 9/2015	NA

Microeconomics) Lectured by Kai-yin Woo. ----lecture/discussion/project/ on microeconomic theory about anti- competitive behaviors			
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Other impact

(e.g. award of patents or prizes, collaboration with other research institutions, technology transfer, teaching enhancement, etc.)

The same methodology is being applied to Canadian retail industries (co-investigated with Dr. Alan Chan of Crandall University, Canada)

12. Public access of completion report

(Please specify the information, if any, that cannot be provided for public access and give the reasons.)

Information that cannot be provided for public access	Reasons
NA	NA