RGC Ref. No.: (UGC/FDS15/B06/20) (please insert ref. above)

RESEARCH GRANTS COUNCIL COMPETITIVE RESEARCH FUNDING SCHEMES FOR THE LOCAL SELF-FINANCING DEGREE SECTOR

FACULTY DEVELOPMENT SCHEME (FDS)

Completion Report

(for completed projects only)

Submission Deadlines:	1.	Auditor's report with unspent balance, if any: within six months of
		the approved project completion date.
	2.	Completion report: within <u>12</u> months of the approved project
		completion date.

Part A: The Project and Investigator(s)

1. Project Title

Empirical Tests of Economic Integration and Estimates of Transaction Costs: A Study

of Belt and Road Initiative

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

Research Team	Name / Post	Unit / Department / Institution
Principal Investigator	WOO, Kai-yin / Associate Professor Research Affiliate	Economics and Finance / Hong Kong Shue Yan University Business, Economic and Public Policy Research Centre / Hong Kong Shue Yan University
Co-Investigator(s)	LEE, Shu-kam / Associate Professor Director	Economics and Finance / Hong Kong Shue Yan University Business, Economic and Public Policy Research Centre / Hong Kong Shue Yan University
Co-Investigator(s)	WONG, Wing-keung / Professor	Department of Finance / Asia University, Taiwan Fintech Center, and Big Data Research Center / Asia University, Taiwan

		Department of Medical Research
		/ China Medical University
		Hospital,
		Taiwan.
Co-Investigator(s)	AU, Wing-kwong / Associate Professor	Social Work / Hong Kong Shue Yan University
- · · ·	Director	China Liaison Office / Hong Kong Shue Yan University

3. **Project Duration**

	Original	Revised	Date of RGC / Institution Approval (must be quoted)
Project Start Date	1 st Jan, 2021	N/A	N/A
Project Completion Date	31 st Dec, 2022	30 th June, 2023	27th Oct, 2022
Duration (in month)	24	30	27th Oct, 2022
Deadline for Submission of Completion Report	31 st Dec, 2023	30 th June, 2024	27th Oct, 2022

4.3 Please attach photo(s) of acknowledgement of RGC-funded facilities / equipment.

N/A

Part B: The Final Report

5. Project Objectives

- 5.1 Objectives as per original application
 - 1. To test the extent of goods and labour market integration through PPP relationships and wage convergence between China and other BR countries via a set of nonlinear cointegration models;
 - 2. To estimate the total observable and unobservable transaction costs in goods and labour markets from the nonlinear cointegration models, using only exchange rate, price, and wage data.
 - 3. To identify the key economic and non-economic factors that contribute to the reduction of transaction costs and, hence, formulate policies and strategies to promote economic cooperation and integration.
 - 4. To disseminate the analytical econometric methods by training students to use the tools to optimise decision making in the BR and other contexts.
- 5.2 Revised objectives N/A

Date of approval from the RGC:	N/A
Reasons for the change:	N/A

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)

We first collected the relevant data including consumer price indices, spot exchange rates, relevant data relevant to factors of transaction costs such as globalization index, world openness index, index of economic freedom and so on over the past 20 years. We wanted to examine the goods market integration between China and Belt and Road members in the world. We did need to collect relevant data from many countries. We then took much time for data collection and compilation. Also, the exchange rate series are constant for many developing countries in e.g. Africa, with fixed exchange rate regime. We did need to remove them from the list of our sample countries under study.

After data collection and compilation, we then adopted nonlinear non-parametric rank test methods for testing purchasing power parity (PPP) relationship between China

and other countries (most are Belt and Road members) in Asia, Europe, Latin America, post-soviet regions and Africa. condition. Since the nonparametric testing method do not require precise fundamental forms for estimation and allow for nonlinearity in the data, the statistical power is larger than traditional parametric methods that may not allow for nonlinearity and suffer from misspecification errors. As a result, we could find strong evidence of goods market integration through adjustment of those exchange rate-adjusted prices. Further, we divided the total sample periods into two subperiods and we found that goods market integration mainly occurs in the second subperiod, i.e. the last decade. It indicates that rising China's trade penetration and economic power, as well as the introduction of Belt and Road initiative in 2013 lead to goods market integration (**5.4: Objective 1**).

To estimate the transaction costs which may not be observable, we further estimate the goods market integration using the three-regime residual-based threshold cointegration approach. The advantage is that we can obtain the estimates of thresholds that can be the proxy for proportional transaction costs, when transaction costs may be unobservable and we can use price, and exchange rate data only for estimation. Each testing equation can provide two proportional transaction costs in the upper and lower regime where error-correcting dynamics are undertaken, with one middle regime within which price difference is too small to bring profits for goods arbitrage high enough to cover transaction costs. In the upper and lower regimes, the proportional transaction costs are represented by the thresholds. In the upper regime, the thresholds indicate that the export price of China is lower than that of trading partner by some percentage, and then it induces China to export goods. Likewise, in the lower regime, the import price of China is higher than that of trading partner by some percentage, it induces China to import goods. Good market integration and PPP relationship can be maintained through goods arbitrages (**5.4: Objectives 1-2**).

Another advantage is that we can regress the thresholds with independent variables which represent factors of transaction costs such as globalization, corruption, openness, economic freedom, languages, culture, and distance between China and the trading partners. The statistical significance of the coefficients in the regression can help identify factors of transaction costs. Our results show that distance and economic freedom are statistically significant factors of transaction costs. Distance represents the transportation costs, and economic freedom includes free goods and labour markets, protection of private property, sound justice and so on. Transportation costs and economic freedom are considered as economic factors. Non-economic factors such as languages and culture are however not statistically significant (**5.4: Objective 3**).

We attempted to use the above mentioned nonparametric and parametric threshold models to investigate labour market integration with estimation of transaction costs. However, the evidence is scant because data availability is limited, statistical power of the threshold model due to small sample size is low, and labour markets are not really integrated with China. Hence, the next steps of economic integration had better focus upon labour markets (**5.4: Objective 3**).

We introduced the nonlinear estimation methods adopted in the project to undergraduate students in a seminar and graduate students in a graduate course. They all obtained solid background knowledge of nonlinearity in econometrics. An MPhil student will adopt nonlinear volatility models in one chapter of his thesis (5.4: Objective 4).

5.4 Summary of objectives addressed to date

Objectives	Addressed	Percentage Achieved
(as per 5.1/5.2 above)	(please tick)	(please estimate)

1. To test the extent of goods and labour market integration through PPP relationships and wage convergence between China and other BR countries via a set of nonlinear cointegration models;	\checkmark	100%
2. To estimate the total observable and unobservable transaction costs in goods and labour markets from the nonlinear cointegration models, using only exchange rate, price and wage data.	\checkmark	100%
3. To identify the key economic and non-economic factors that contribute to the reduction of transaction costs and, hence, formulate policies and strategies to promote economic cooperation and integration.	\checkmark	100%
4. To disseminate the analytical econometric methods by training students to use the tools to optimise decision making in the BR and other contexts.	\checkmark	100%

6. Research Outcome

6.1 Major findings and research outcome

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

Using nonparametric nonlinear rank tests, our findings show that some Asian BRI countries have experienced integration of their markets with that of China during the recent decade but not over the entire sample period (Part C: (B)). This implies that China's economic power has been rising with larger trade volumes with Asian trading partners, especially during the most recent decade, which, in turn, infers that the integration of markets through Belt and Road projects has been enhanced. However, hidden transaction costs due to geopolitical risks may have resulted in the failure of the PPP relationship between Singapore, Malaysia, and Thailand during the past decade. Furthermore, we found strong evidence of nonlinear cointegration between prices in China and selected European countries, both EU and non-EU members (Part C: (C)). Cointegration in more cases in the recent decade than in the early 2000's period indicates the growing trend of PPP and goods market integration between China and Europe. Also, we found that the participation in the Belt and Road is not a guarantee for the existence of PPP and goods market integration with China; many of the European countries in the sample are not Belt and Road members but have PPP with China, while some Belt and Road members (Cyprus, Estonia, Greece, Slovakia, Slovenia, Bulgaria, Croatia, Poland and Romania) do not have the PPP relationship. Hence, the degree of trade penetration and relations, rather than the signature on the BRI MOU, is the key to having goods market integration between European countries and China. Further, countries having no PPP with China are mostly from Central and Eastern Europe. These countries experience trade deficits with China that possibly result from insufficient trading opportunities in Chinese markets. Preferential trade policies for both sides are required. The favorable evidence of goods market integration implies a need for stronger economic cooperation toward the next stage of economic integration in the future but the prospect may be unfavorably affected by the Russia-Ukraine War. Similar results were obtained in the cases of post-Soviet countries (Part C: (A)).

Additionally, favorable empirical evidence of the cointegrating relation in PPP between China and selected African BRI countries is found (**Part C: (D**)). We also find increasing trend for evidence of PPP after the implementation of BRI. The overall results confirm the achievement of goods market integration in most cases. It also justifies optimistic prospects of further economic cooperation under the BRI in factor, services, and financial sectors to build a free trade area or a common market with the BRI countries in Africa. Also, the similar results were found in Latin American trading partners with China (**Part C: (E)**). The rank tests also generate some evidence of nonlinearity in the PPP relationship due to e.g. nonlinear adjustments to PPP equilibrium, the presence of transaction costs, heterogeneity of opinion in foreign exchange markets and government intervention (**5.4; Objective 1**).

We further employ a three-regime (two thresholds) residual-based TAR cointegration method to test the PPP relationship (**Part C: (F), (G), (H)**). The findings affirm cointegration in the PPP between China and the 40 out of 73 countries in Asia, Africa, and Latin America (including some Middle East and post-Soviet countries which are considered as West and North Asian countries). This suggests that China should consider strengthening economic cooperation by formulating policies to integrate labor and financial markets. This study estimates proportional transaction costs based on the thresholds. Iran and Ukraine in West Asia, Sudan in Africa and Dominica in Latin America experienced the largest transaction costs in our sample. The estimated transaction costs were the largest in African countries (**5.4: Objectives 1-2**). Using cross-section regression models, we study the effects of distance, and indexes for economic freedom, corruption, openness, and globalization on thresholds. We found that distance and economic freedom were two statistically significant factors of transaction costs in our sample. Others were statistically insignificant. We should improve the economic freedom to reduce transaction costs and improve the goods market integration. However, the results might be affected by data availability, measurement methods of the indexes and so on (**5.4: Objective 3**).

Furthermore, we adopted the above nonlinear nonparametric and TAR tests for wages convergence (Part C: (F)). However, the evidence is scant when the labour market integration is

not mature during our sample periods. It may also result from limited data availability for wages and low statistical power of the tests due to small sample size. The transaction costs of labor markets are also estimated. Liberalization in labour markets is suggested (**5.4: Objectives 1-3**).

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

We are able to adopt alternative forms of nonlinearity for testing and more advanced nonlinear panel methods. New testing results may be found.

Another future research direction is to undertake country-level empirical studies on the effects of Belt and Road projects, for example, the Chinese investments in infrastructure, public utilities, manufacturing industries and so on, on PPP and economic integration between China and Belt and Road members. It is important to explain further why the evidence of PPP between China and Belt and Road members is heterogeneous. A larger set of data would be required.

7. Layman's Summary

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

The Belt and Road Initiative (BRI) launched in 2013 is designed to foster mutually beneficial relationships between member countries and China by strengthening cross-border trading activities and economic integration. In this project, we test for goods market integration between China and its trading partners, especially Belt and Road members, in Asia, Europe, post-soviet countries and Latin America. We found that due to the rising economic power of China, goods market integration has been established during the sample period. Labour markets are however not integrated. If goods markets integration between China and its trading partners and BRI members are valid, the next step will involve strengthening economic cooperation by formulating policies to integrate financial and labour markets, potentially forming a common market.

We use econometric methods to estimate proportional transaction costs using price, wages and exchange rate data. We further identify economic freedom and transport cost proxied by distance are two significant factors of transaction costs of goods markets. The policy implications are that investments in advanced transportation and logistics infrastructure, enhancing economic freedom and further reduction of trade barriers, help strengthen the degree of economic integration. Transaction costs of labour markets are also estimated. Liberalization in labour markets is suggested.

Part C: Research Output

8. Peer-Reviewed Journal Publication(s) Arising <u>Directly</u> 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 Statu	s of Public	cations		Title and Journal / Book				
Year of Publication	Year of Acceptance (For paper accepted but not yet published)	Under Review	Under Preparation (optional)	Author(s) (denote the correspond-in g author with an asterisk [*])	(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)
2023		N/A	N/A	Lee, Shu-Kam, Lee, Hugo Hin-To and Woo, Kai-Yin*	Long-run validity of purchasing power parity between China and the post-soviet BRI countries, <i>The Empirical</i> <i>Economics</i> <i>Letters</i> , Vol. 22, No. 4, p.1-11.	N/A	Yes	Yes	Yes
2023		N/A	N/A	Lee, Shu-Kam, Shum, Paul Kwok-Ching, Lee, Hugo, Hin-To and Woo, Kai-Yin*	(B) Purchasing power parity between China and selected BRI countries in Asia, Advances in Decision Sciences, Vol. 27, Issue 3, p.86-108.	N/A	Yes	Yes	Yes
2024		N/A	N/A	Lee, Shu-Kam, Lam, Lubanski and Woo, Kai-Yin*	(C) Tests of goods market integration between China and European Countries: A nonlinear nonparametric approach, <i>China</i> <i>Economic</i> <i>Journal</i> , Vol. 17, Issue 2, 285-299.	N/A	Yes	Yes	Yes

2024		N/A	N/A	Lee, Shu-Kam, Shum, Paul Kwok-Ching and Woo, Kai-Yin *	(D) Tests of goods market integration between China and African BRI countries, <i>International</i> <i>Studies of</i> <i>Economics</i> , Vol. 19, 223-246	N/A	Yes	Yes	Yes
N/A	N/A	2024	N/A	Lee, Shu-Kam, Lam, Lubanski and Woo, Kai-Yin*	(E) Testing for goods market integration between China and Latin American countries, Submitted to <i>Applied</i> <i>Economics</i> <i>Quarterly</i>	N/A	Yes	Yes	No
N/A	N/A	N/A	Yes. It was finished in 2024 and will be submitted to a peer-reviewed journal	Woo, Kai-Yin* and Lee, Shu-Kam	(F) Study on goods market integration, labour market integration and estimation of transaction costs	N/A	Yes	Yes	No

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 (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)
July 2023, Japan	(G) Tests for Purchasing Power Parity between China and Selected Countries in Asia, Africa and South American Countries	The 14th Biennial Conference of Asian Consumer and Family Economics Association (ACFEA),	N/A	Yes	Yes	No

	(H)					
July 2023, Japan	TAR Cointegration Tests for goods market integration of China and selected countries in Asia, Africa and Latin America"	The 7th International Conference on Business and Social Science (ICBSS)	N/A	Yes	Yes	No

10. Whether Research Experience And New Knowledge Has Been Transferred / Has Contributed To Teaching And Learning

(Please elaborate)

We transferred the knowledge of nonlinear econometric methods to MPhil and PhD

Students in one lecture of the graduate course: Econ602 Advanced Quantitative Methods in

Economics

We introduced the basic ideas of the research methods to undergraduate students in FDS

seminar: Empirical Tests of Economic Integration and Estimates of Transaction Costs: A

Study of Belt and Road Initiative

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
N/A	N/A	N/A	N/A

12. Other Impact

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

N/A

13. Statistics on Research Outputs

	Peer-reviewed Journal Publications	Conferen ce Papers	Scholarly Books, Monographs and Chapters	Patents Awarded	Other Research Outputs (please specify)	
No. of outputs arising directly from this research project	4	2	0	0	Type One manuscript was submitted to a journal	No. 1
					One manuscript will be sent to a journal	1

14. 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			
N/A	N/A			