

A Thesis
on
A Dynamic Relationship Between Production and Consumption of
Rice in Bangladesh, China and India

This report is submitted to the Department of Accounting, Faculty of Business Studies, Hajee Mohammad Danesh Science and Technology University, Dinajpur for the fulfillment of the degree of Master of Business Administration (MBA) program.



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Certificate of Supervisor

I hereby declare that the concerned report '*A Dynamic Relationship Between Production and Consumption of Rice in Bangladesh, China and India*' is a work done by Miftahul Zannat, Student ID-1603014, MBA in Accounting and Information Systems (MBA-AIS), Faculty of Business Studies. Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200 she completed her research program under my supervision and submitted for the fulfillment of the requirement of the degree of Master of Business Administration (MBA), in Accounting and Information Systems (MBA-AIS), at HSTU, Dinajpur.

I wish her every success in life.

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I henceforth admit that concerned research '*A Dynamic Relationship Between Production and Consumption of Rice in Bangladesh, China and India*' is a work done by Miftahul Zannat, MBA in Accounting and Information Systems (MBA-AIS), Student ID-1603014, Department of Accounting, Hajee Mohammad Danesh Science and Technology University, Dinajpur-5200 she complete her six months research program under my co-supervision and required to submit for the successful completion of the degree of Master of Business Administration (MBA), in Accounting and Information Systems (AIS), HSTU, Dinajpur-5200.

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Student's declaration

I hereby declare that the study entitled '*A Dynamic Relationship Between Production and Consumption of Rice in Bangladesh, China and India*' embodies the result of my own works and efforts, prepared under the supervision of Dr. Shaikh Mostak Ahammad, Professor, Department of Accounting, Hajee Mohammad Dansesh Science and Technology University, Dinajpur.

I further affirm that the work and data presented in this thesis report are original, and that the entire work has not been submitted to any other university or institution for any degree or other reason.

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Abstract

This study investigates the dynamic link between rice production and consumption in Bangladesh, China and India using a panel data methodology. The study's time frame is from 1971 to 2022, and the IndexMundi data set is employed. The link between rice production and consumption is examined in this study using panel cointegration analysis. The impulse response functions (IRFs) are also used to explore the causal relationships between production and consumption, both in the short- and long-term. According to the panel cointegration analysis, there is long-run co-movement among the factors according to the statistically significant and positive long-run equilibrium connection between production and consumption. The IRFs demonstrate that the consumption variable's shock approaches equilibrium within a year to 1.5 years from the initial shock.

Keywords: Production, Consumption, China, Bangladesh, India.

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CHAPTER 1

Introduction

Rice is a staple nourishment for the vast majority of the total population, particularly in Asian Nations. The job of rice as well as being a staple food is likewise a kind of revenue for ranchers and day to day necessities for a great many inhabitants. Albeit the public authority has looked for food enhancement, it has so far been not able to change the population inclinations for rice. In this way, the accessibility of rice ought to be kept up with manageability and, surprisingly, expanded.

Panel unit root test is used to determine the acceptance or rejection of null hypothesis for the levels of production and consumption. The current review depends on a total production and utilizes a multivariate panel data structure with the production and consumption of rice to catch short and long run connection between the series viable. Specifically, the panel co integration test researches the long-run connection between production and consumption. The panel VAR model used in this research provides impulse response functions (IRFs) to evaluate the influence of reactions between both the series under consideration.

China is the world's largest rice producer, with the oldest tamed rice producing. Currently, almost every area in China, it produces more than one-fourth of the world's rice annually. Rice provides energy and food to around 65% of the people in China. Variations in rice output affect not only food security, but also the financial well-being of a large population. Because ensuring the absolute security of basic foods is the primary concern, realistic rules for maintaining and expanding rice production are crucial to ensuring food security. A detailed analysis of rice production patterns for the next 20 years is lacking. China has the world's highest rice consumption, using approximately 154.8 million metric tons in promoting year 2022, and rice development in China accounts for almost 30% of global production. In the advertising year 2022, China generated 147 million metric tons. Total production of rice of Bangladesh in 1971 was about 10.59 million tons, when the country's total population was exclusively around 70.88 million. Yet, a country is currently delivering roughly 25.0 million tons to serve her 135 million people. It illustrates that rapid expansion of rice production was far faster than the population's increase in numbers. This increased rice production has been made possible in large part by the acceptance of current rice varieties on around 66% of the rice acreage, which accounts for approximately 73% of the nation's total rice production. Bangladesh produces 35.65 million metric tons of rice in the promotional year 2022 and consumes 3.7 core tons in the promotional year 2022. India is the world's

second-largest rice producer. In monetary year 2022, production volume of rice in India is around 124 million metric tons and the consumption of rice is around 37 million tons.

The remaining part of this research has been laid out since continues to follow. The literature is addressed in chapter 2. The 3rd section provides a detailed outline of methodology and data. Section 4 indicates the empirical results and discussion. Section 5 denotes findings and suggestions. Section 6 provides the conclusions of the study.

Objectives of the study

- To investigate the connection among production and consumption of rice in Bangladesh, China and India
- To analyze the long-run and short-run relationship between these two variables (production) and (consumption) in these three countries.

CHAPTER 2

Literature Review

This paper presents current knowledge about the dynamic relationship between rice production and consumption. Numerous research compared statistics on rice production and consumption using restricted panel data.

Emodi and Madukwe (2008) explained that from 1986 to 1995, there was a ban on rice importation in the country, making it illegal to import rice into the country. As a result, the government has become overly reliant on rice imports rather than focusing on indigenous production, which will offer better outcomes for the country's economy in terms of foreign money and food security.

Emodi and Dimelu (2011) observed that there will be an encouragement of the local producers of rice when a ban is put in place on the importation of rice in Nigeria. In as much as there are other challenges on the production of rice in Nigeria, looking up for adequate solutions for this purpose require majors' steps to be taken by the government to ban the importation of rice and rather create an avenue for the foreign investors to come and invest in Nigeria where rice can be produced locally.

Rahji and Adewumi (2008) noticed that in the early 1960s, the Nigerian economy is dependent on agriculture, which produces food and raw materials for both the industrial sector and for consumption. Unfortunately, due to the discovery of oil in the 1970s, farming activities declined. As the supply-demand imbalance rose, so did demand for rice, and local supply became insufficient, resulting in a significant need for imported rice. Despite this, the predicted demand was five million tons when the expected local rice output was three million tons.

According to Emodi and Akaze (2010), Nigeria is the West African sub-greatest region's rice user. He also asserted that the grade of rice produced in Nigeria is significantly superior than that produced locally. For some, it is a habit, while for others, it is a quality preference over locally produced rice. Nigeria has a significantly greater population than the rest of West Africa, and rice is consumed and eaten as an everyday meal by the majority of homes.

Abidin (2015) determined rice production by multiplying rice production by the rice production conversion rate. The entire population is multiplied by per capita consumption to

compute rice demand. According to Abidin (2009), based on a comparison of rice production and necessity, Indonesia experienced a rice surplus from 2009 to 2013.

Santosa et al. (2011) and Rungkat et al. (2014) narrated this method of calculating rice demand was also used to determine rice consumption.

Yadav (2020) advocated increasing the area of spring rice (Chaite) cultivation to 330 thousand ha by 2025, up from 120 thousand ha now. However, nearly tripling Chaite rice area would be dependent on a number of factors, including Chaite rice's competitiveness and profitability relative to other competing crops, the development of a year-round irrigation system, and the selection of appropriate Chaite rice varieties to fit into the narrow cropping sequence window. This is feasible if rice production is changed into a fully automated system supported by rice nursery enterprises. The development and deployment of hybrid rice technologies is another option for increasing rice production and productivity in Nepal.

Gairhe et al. (2021) stated rice imports in Nepal are largely fine and aromatic rice. To a considerable extent, boosting productivity to allow improved milling recovery of rice grains could be a complementary strategy for Nepal to achieve self-sufficiency in rice production.

Ayanwale et al. (2011) researched rice supply response to price and non-price factors such as policy and climate variables. The responsiveness of supply to the parameters considered was investigated using an Error Correction Model in a co-integration framework. According to the study, rice supply in Nigeria is unaffected by price, climate, importation, or trade control policy.

Babatunde et al. (2017) evaluated Nigeria's rice farming system's yield gap. The researchers used Gross Margin Budgetary Analysis, Stochastic Frontier, and Linear Regression Model to examine profitability, technical efficiency, and yield gap factors in both production systems. According to the study's findings, irrigated rice farming is more economical and efficient than rainy rice production.

Rezitis, A. N., and Ahammad, S. M. (2016) examined the dynamic relationship between energy consumption and economic growth in nine South and Southeast Asian countries (i.e., Bangladesh, Brunei Darussalam, India, Indonesia, Malaysia, Pakistan, the Philippines, Sri Lanka and Thailand) in a panel data framework. The time period for the study is 1990–2012, and the World Bank Development Indicators data set is used. This study undertakes panel

cointegration analysis to investigate the relationship between energy consumption and economic growth

Above all of these studies analyzed a system of importing the rice into other country, producing rice and raw materials for both industrial sector and for consumption, computing rice demand, determining rice consumption, the development of hybrid rice technologies, rice farming system's yield gap all of which are unavailable in this study.

CHAPTER 3

Methodology of the study

3.1. Methodology

First, panel unit root tests are utilized in this evaluation to provide information about the fixed qualities of the factors feasible. Second, panel cointegration tests (e.g., Pedroni) are employed to determine whether or not cointegration exists. Third, the assessment of long-run cointegration boundaries is completed in light of Pedroni's findings. Finally, a panel VAR model is utilized to assess the panel causal relationship between production and consumption in the short and long run, which is followed by panel IRFs.

3.2. Panel Unit Root Test

Unit root tests, cointegration tests, and the examination of long-run (and short-run) relationships are common components of cointegration analysis with panel data. A panel investigation begins with panel unit root testing to eliminate incorrect results. If indeed the series are not fixed, a investigation will go on to panel cointegration testing. This examination employs the following unit root tests after the panel: IPS (Im, Pesaran, and Shin, 2003), PP (Choi, 2001), ADF (Maddala and Wu, 1999) and HT test (Hadri, 2000).

3.3. Panel Cointegration Test

Pedroni (1999, 2004), Kao (1999), Maddala, and Wu are all authors who have evaluated the panel cointegration test (1999). Pedroni and Kao extend Engle-(1987) Granger's two-step system to include panel data testing. Pedroni demonstrated a few cointegration tests that take into account heterogeneous intercept and trend coefficients across cross-segments. The Kao test is based on a similar concept, but it has cross-segment precise intercepts and homogenous coefficients on the first regressors. Maddala and Wu (1999) employed Fisher's joined test, which leverages the results of the individual autonomous tests, and Johansen's test process, which consolidates a test from specific cross-sections to provide panel-wide testing data.

If we represent the autoregressive coefficient of the residuals in the with unit by γ_i then the panel statistics alternate hypothesis is as follows:

$$H_0: \gamma_i = 1 \quad \text{for all } i,$$

$$H_A: \gamma_i = \gamma < 1 \quad \text{for all } i \dots \dots \dots (1)$$

In contrast, the hypothesis of group statistics is described as follows:

$$H_0: \gamma_i = 1 \quad \text{for all } i,$$

$$H_A: \gamma_i < 1, \quad \text{for all } i \dots \dots \dots (2)$$

It should be noted that the alternative hypothesis of the within-dimension (panel) statistics assumes a common value for $\gamma_i = \gamma$, whereas the between-dimension (group) statistics do not and therefore allow for an extra source of potential heterogeneity among individual units of the panel. According to Pedroni cointegration test,

In any study, the goal of employing regression is to investigate the relationship that exists between one or more predictors or exploratory variables and one dependent variable. The model specification in regression is such that the dependent variable y_i is stated as a linear combination of the exploratory variables. $x_1, 2, \dots, x_t$:

$$y_i = \beta_0 + \beta_1 x_{1i} + \dots + \beta_p x_{pi} + \varepsilon_i \dots \dots \dots (3)$$

Where x_{ij} is the i th observation on the j th independent variable, $\beta_0, 1, \dots$, are the regression coefficients and ε is the error term. In this study we run the following regression model:

$$\text{Equation: } LCON = \beta_0 + \beta_1 LPRO$$

where,

LPROD= Log PRODUCTION

LCON= Log CONSUMPTION

PRODUCTION and CONSUMPTION are converted into their natural logarithmic (LPRO, LCON) to reduce potential heteroskedasticity. Here, LCON is the dependent variable, and LPRO is independent variable.

The Kao test is based on the same fundamental concepts as the Pedroni tests, but it specifies cross-section specific intercepts and homogenous coefficients on the first-stage regressors. We have in the bivariate scenario presented by Kao (1999).

$$y_{it} = \alpha_i + \beta x_{it} + \mathcal{C}_{it} \dots \dots \dots (4)$$

$$y_{it} = x_{it-1} + u_{i,t} \dots \dots \dots (4.1)$$

$$x_{it} = x_{it-1} + \varepsilon_{i,t} \dots \dots \dots (4.2)$$

More broadly, we may perform the first stage regression Equation (48.6), requiring heterogeneity, homogeneity across cross-sections, and setting all trend coefficients to zero.

Kao then runs either the pooled auxiliary regression,

$$C_{it} = \rho C_{it-1} + u_{it} \dots \dots \dots (4.3)$$

Or the augmented version of the pooled specification,

$$C_{it} = \tilde{\rho} C_{it-1} + \sum_{j=1}^{\rho} \psi_j \Delta C_{it-j} + v_{it} \dots \dots \dots (4.4)$$

Based on the findings of the individual tests, Fisher (1932) creates a composite test. Maddala and Wu (1999) suggest a different method for testing for cointegration in panel data by combining tests from specific cross-sections to get a test statistic for the complete panel using Fisher's finding. The null hypothesis for the panel is if is the p-value from a cross-sectional individual cointegration test.

If π_i is the p-value from an individual cointegration test for cross-section i , then the panel, under the null hypothesis,

Equation:

$$-2 \sum_{i=1}^N \log(\pi_i) \rightarrow \chi^2 2N \dots \dots \dots (5)$$

By default, EViews reports the X2 value for Johansen's cointegration trace test and maximum eigenvalue test based on MacKinnon-Haug-Michelis (1999) p-values.

3.4. Data

Annual observations from 1971 to 2022 were used in this investigation. The data for Bangladesh, China and India were derived from the IndexMundi. A remaining nation has been removed because of the absence of data for all variables (i.e., data from 1971 to 2022). A natural logarithm of production (lnPRODUCTION) in metric ton and consumption (lnCONSUMPTION) in metric ton is included in the multivariate panel data technique.

CHAPTER 4

Result and Discussion

4.1. Panel Unit Root Result

Tables 1 and 2 show the results of the panel unit root test. The great majority of unit panel root tests indicate a proclivity to fail to dismiss the null hypothesis of a panel unit pull for the levels of the components. In actuality, a majority of panel unit tests indicate that its choice of stationary first differences of factors was chosen over the null of a panel unit basis upon the factors' primary distinctions. In this approach, panel unit root analysis may very well show that its components are coordinated of request one, potentially trying to suggest a long-term cointegrating connection between factors, such as (lnPRODUCTION, lnCONSUMPTION). The next phase in the observational investigation is to determine whether there is cointegration between the potentially relevant components.

Table 1: Results of panel unit root ADF and IPP test

ADF test				IPS test	
Variables in levels	None	Individual	Individual & Trend	Individual	Individual and Trend
lnPro	0.02925 (1.00)	7.01317 (0.31)	6.90597 (0.32)	-0.51638 (0.30)	-0.51179 (0.30)
lnCon	0.00367 (1.00)	12.2344 (0.05)	3.89392 (0.69)	1.45671 (0.07)	0.77053 (0.77)
ADF test				IPS test	
Variables in 1 st differences	None	Individual	Individual & Trend	Individual	Individual & Trend
lnPro	94.5461 (0.00)	82.1007 (0.00)	75.0813 (0.00)	-9.91243 (0.00)	-9.52370 (0.00)
lnCon	54.5898 (0.00)	59.7537 (0.00)	56.1658 (0.00)	-7.46999 (0.00)	-7.28526 (0.00)

Note: P-values are numbers in parenthesis.

Table 2: Results of panel unit root PP and HT test

PP test				HT test	
Variables in levels	None	Individual	Individual & Trend	Individual	Individual and Trend
lnPro	0.02286 (1.00)	5.49597 (0.48)	23.6127 (0.00)	9.02662 (0.00)	3.94633 (0.00)
lnCon	0.02179 (1.00)	8.23894 (0.22)	4.51072 (0.60)	8.99984 (0.00)	5.43765 (0.00)
PP test				HT test	
Variables in 1 st differences	None	Individual	Individual and Trend	Individual	Individual and Trend
lnPro	370.972 (0.00)	92.4033 (0.00)	87.1661 (0.00)	-0.35132 (0.63)	-0.90917 (0.81)
lnCon	247.359 (0.00)	104.714 (0.00)	90.1999 (0.00)	-0.47776 (0.68)	0.33018 (0.37)

Note: P-values are numbers in parenthesis.

4.2. Panel cointegration test

A finding of Pedroni's, Kao's, and Johansen Fisher's panel cointegration test indicates that there is without a doubt a long-term relationship between production and consumption. In both situations, with and without intercept, the vast majority of Pedroni's measurements rejects a null hypothesis with no co - integration test among factors, revealing an existence of a long - run panel cointegration relationship between the two analyzed components (Table 3). As a result, it is possible that a long-distance connection exists. Kao's panel co-integration experiment also firmly rejects a null hypothesis with no co-integration for both components, demonstrating the existence of a long-run panel co-integration connection between observed factors (Table 4).

Table 3: Panel Cointegration Test

Intercept					Intercept and Trend			
	Statistic	Probability	Weighted Statistic	Probability	Statistic	Probability	Weighted Statistic	Probability
Panel v Statistic	3.815697	0.00	4.166737	0.00	2.256658	0.01	2.524827	0.01
Panel rho-statistic	-7.786963	0.00	-8.638669	0.00	-4.337413	0.00	-4.988513	0.00
Panel pp-Statistic	-5.363210	0.00	-5.922069	0.00	-4.057542	0.00	-4.560277	0.00
Panel ADF -Statistic	-3.211529	0.00	-3.426814	0.00	-1.601435	0.05	-1.727166	0.04
Group rho-Statistic	-8.351394	0.00			-4.895143	0.00		
Group PP- Statistic	-7.295906	0.00			-5.118395	0.00		
Group ADF- Statistic	-4.693913	0.00			-2.365920	0.00		

Table 4: Kao Residual cointegration test

Variable	ADF test	
	t-Statistic	Probability
lnPRODUCTION, lnCONSUMPTION	-3.860725	0.00

At last, Johansen Fisher follow and most extreme eigenvalue tests reject the null hypothesis with no co- integration test between factors demonstrating its existence of a long-term panel co integrationconnection between the production as well as the consumption (Table 5).

Table 5: Johansen Fisher's panel cointegration test (Trace and Maximum Eigenvalue)

	Variables: lnPRODUCTION, lnCONSUMPTION			
Hypothesized No. of CE(s)	Fisher Stat. *(from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	46.84	0.00	40.20	0.00
At most 1	19.78	0.00	19.78	0.00

4.3. Panel Multivariate Impulse Response Function (IRFs)

The panel impulse functions (IRFs) are made through creating unit shocks to every one of the factors production (PRODUCTION) and consumption (COMSUMPTION). Figure 1 illustrates the panel IRFs for two factors of Bangladesh, China and India. The factor stunned has been introduced inside the column, while the objective factor is already in the row. Figure 1, that now may very well be shown that the vast majority of shocks of the multitude of factors arrives only at equilibrium level somewhere in around 1 year to 1.5 years.

First row of figure shows that the impulse reactions of factors to a one-unit shock in consumption. From diagram, this is obvious that a one-unit shock inside the consumption positively influences the production. This chart likewise shows that the most elevated reactions of all factors happen in the span of one year from the underlying shock and they expect around 1 year to 1.5 year to arrive at their equilibrium stage.

Its second row of Figure 1 illustrates the impulse reactions of factors to a one - unit shock in production. From the chart, this is clear that a one - unit shock in production positively influences the consumption. This diagram likewise shows that the most noteworthy reactions of all factors happen in the span of one year from the underlying shock.

Response to Cholesky One S.D. (d.f. adjusted) Innovations ± 2 S.E.

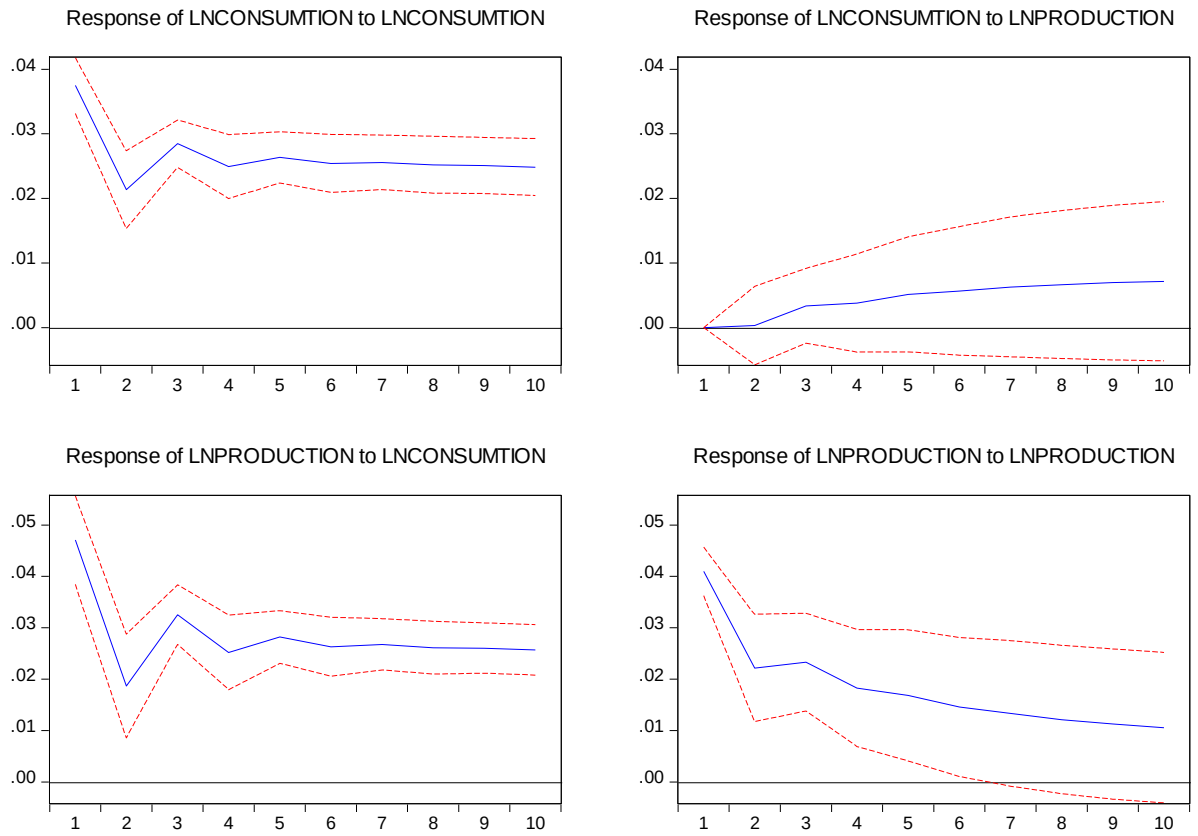


Figure 1. Panel (IRFs) comparison of Bangladesh, China and India

CHAPTER 5

Findings and Suggestions

5.1. Findings

- i. Based on the consequences of the discoveries of the unit root test, it was tracked down that every one of the factors (rice production, consumption) are non-fixed at their levels, yet fixed at their first level.
- ii. Unit root test shows that the factors have a long-run relationship.
- iii. The consequence of the cointegration test shows that there is a long-run connection among production and consumption of rice in Bangladesh, China and India.
- iv. The IRFs test investigation shows that a shock of rice production positively affects consumption. What's more, one shock of consumption impacts a constructive outcome on rice production.
- v. Between 1971 and 2022, every one of the three nations encountered an expansion production and consumption, with China and India encountering a more critical increment than Bangladesh.
- vi. China delivered the most elevated measure of rice in outright terms, trailed by India and afterward Bangladesh.
- vii. The production and consumption of rice of the three nations have been expanding throughout the long term, showing the changes in their economies.

5.2. Suggestions

- i. The development of producing of rice in the three nations has come about expanded business potential open doors, innovation move and further developed efficiency.
- ii. The three nations need to do whatever it may take to send out rice in different nations to set out a tremendous freedom in their economy.
- iii. The administrative climate and the public authority strategies assume an imperative part in drawing in and establishing a good business climate for outsider financial backers.
- iv. Based on the discoveries of the cointegration examination policymakers in these three nations ought to consider approaches that advance increment rice production and consumption as two factors have positive on lengthy run relationship to one another's.

- v. To figure out short run deviation from the long-run relationship, policymakers might have to execute momentary arrangements, for example, cost controls or financed to corrals the rice market.
- vi. IRFs recommend that strategies pointed toward expanding Gross domestic product that welcomes a beneficial outcome on rice production and consumption.
- vii. Future examination could extend the investigation to incorporate other south Asian nations other rural wares to acquire a more extensive comprehension of the provincial and worldwide farming business sectors.

CHAPTER 6

Conclusions, policy implications and future work

6.1. Conclusions

This study focuses at the connection among production and consumption of rice in Bangladesh, China and India utilizing the panel data approach. In vicariate examination, a frequent issue that could happen is truly the ignored variable predilection (Lütkepohl). To avoid this issue, the present research investigates a link among rice production and consumption within a multivariate panel data system by including production and consumption. This research includes panel cointegration inquiry to determine the powerful connections, the panel IRFs to analyze the impact of responses among production and consumption of rice. Maintaining at the top of the priority list that time span covered by data is 52 years in every one of nations, the Pedroni's test that has used test for panel co - integration test without any primary break in data, the accompanying general outcomes may radiate. The panel data test exposes that probably the long-run harmony connections connecting production and consumption are positive as well as significant, suggesting that there is long-run co development among variables. Panel multivariate impulse response capabilities show that: (I) reactions to stun of the consumption variable arrive at the equilibrium level inside coordinated and half years with in period of time, (ii) a one-unit shock in consumption decidedly influences the production (iii) a one-unit shock in production positively influences the consumption.

6.2. Policy implications

The experimental consequences of the current review could provide policymakers with a superior comprehension of the connection between production and consumption to form energy approaches in Bangladesh, China and India. The examination of the powerful connection between production and consumption on has significant approach suggestions. The powerful connections between energy consumption and financial development of the current concentrate plainly demonstrate that production fundamentally affects consumption. This implies that persistent production might add to a constant increment in consumption, indicating that consumption is fundamentally motivated by production. Notwithstanding, the excessive production may create long-run environmental results.

6.3. Future work

We present the fundamental data about the production and consumption of rice. In this investigation paper, we think about Bangladesh, China and India as model regions and look at production and consumption of rice in every place. The production and consumption of rice vacillate in every space constantly. The expansion in land region under development, use of compost and water accessibility will induce augmentation the rice production to satisfy the need of rice consumption. We need to concentrate on rice-shortage, rice - surplus regions and their complete equilibrium. A little insurance is needed to make up for the rice globe assets and to aid ranchers and scientists with establishing innovative cultivating frameworks. Other models like vector GARCH, auto regressive integrated moving average (ARIMA), ARDL model, FMOLS model can be added to the relationship to test the relationship with production and consumption of rice.

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