

Czech University of Life Sciences Prague

Faculty of Economics and Management

Department of Economics



Bachelor Thesis

Analysis of rice chain in Vietnam

Ha Lan Vu

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BACHELOR THESIS ASSIGNMENT

Ha Lan Vu

Economics and Management

Thesis title

Analysis of Rice Chain in Vietnam

Objectives of thesis

The aim of the bachelor thesis is to determine and to evaluate rice agri-food chain in Vietnam. The aim will be fulfilled based on the partial aims. Then, several hypotheses will be defined and verified. Based on the results of and empirical analysis the final conclusions will be introduced.

Methodology

The bachelor thesis will cover both theoretical and empirical part. Theoretical part will contain theoretical background of the selected topic as well as the methodological framework. Scientific literature will be used to prepare the literature overview. The empirical analysis will be based mainly on the time series analysis. Other suitable methods will be employed as well. Based on the empirical analysis the results will be presented and some recommendations will be suggested.

To fulfill the aim of the thesis the selected methods and indicators of time series analysis will be employed as following:

- regression analysis (trend function)
- index analysis (base index, chain index)

The proposed extent of the thesis

30 – 40 pages

Keywords

Rice, agri-food chain, time series, trend function, Vietnam..

Recommended information sources

FROST, J. *Regression analysis : an intuitive guide for using and interpreting linear models*. Pennsylvania: State College, 2019. ISBN 978-1-7354311-8-5.

GRAVELLE, H. – REES, R. *Microeconomics*. New York: Pearson Education, 2004. ISBN 0-582-40487-8.

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PESARAN, M H. *Time series and panel data econometrics*. Oxford: Oxford University Press, 2015. ISBN 978-0-19-875998-0.

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Declaration

I declare that I have worked on my bachelor thesis titled "Analysis of rice chain in Vietnam" by myself and I have used only the sources mentioned at the end of the thesis. As the author of the bachelor thesis, I declare that the thesis does not break any copyrights.

In Prague on March 15th, 2022

Ha Lan Vu

Acknowledgment

I would like to thank Ing. Lenka Rumánková, Ph.D. for her unconditional help and her advice to make my bachelor thesis perfect.

I would also like to thank my family and friends who have always supported me on this academic journey.

Analysis Of Rice Chain In Vietnam

Abstract

The agricultural sector always accounts for a high proportion of Vietnam's economic and social development, especially the rice industry. Vietnam has risen to become the world's leading rice exporter from a country with food shortages since the 1990s. Vietnam's rice chain has always grown over the years. This thesis focuses on exploiting production and export data from 2000 to 2020 as well as the factors affecting it. Thereby predicting data in the near future as well as highlighting the advantages and disadvantages that the rice chain is facing. The main methods used are descriptive analysis, index analysis. In addition, the time series method includes the trend function, the regression model, and the growth rate method are also used. All methods have been applied to clarify the development of the rice chain in recent years. Besides, it can be commented that the growth rate has gone up but not evenly. Thereby understanding the development of the rice chain so that we can offer methods to improve efficiency in production and export.

Keywords: Vietnam, rice production, rice export, rice chain, trend function, time series, regression model.

Analýza Rýžového Řetězce Ve Vietnamu

Abstrakt

Zemědělský sektor vždy zodpovídá za velkou část ekonomického a sociálního rozvoje Vietnamu, zejména rýžový průmysl. Vietnam stoupl ze zemí s nedostatkem jídla od 90. let na světově přední vývozce rýže. Rýžový řetězec Vietnamu po léta vždy vzrůstal. Tato práce se zaměřuje na využití výroby a vývozních údajů z roku 2000 – 2020, stejně tak jako faktory, které je ovlivňují. Tím předpovídá data v blízké budoucnosti, stejně tak jako zdůrazňuje výhody a nevýhody, kterým rýžový řetězec čelí. Hlavními metody, které se používají jsou deskriptivní analýza a indexní analýza. Navíc, metoda časové řady zahrnuje funkci trendů a regresní model a metoda rychlosti růstu jsou také využity. Všechny metody byly uplatněny k objasnění vývoje rýžového řetězce v posledních letech. Kromě toho můžeme brát, že se rychlost růstu zvýšila, ale nerovnoměrně. Tímto pochopíme vývoj rýžového řetězce, abychom nabídli metody k zlepšení efektivity produkce a exportu.

Klíčová slova: Vietnam, produkce rýže, export rýže, rýžový řetězec, funkce trendů, časové řady, regresní model.

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List of abbreviations

ASEAN: Association of South East Asian Nations
B.C.: Before Christ
Const: Constant
DNA: Deoxyribonucleic acid
EU: European union
Eurostat: European statistics
EVFTA: the EU-Vietnam Free trade Agreement
GDP: Gross domestic product
GPL: General Public License
GSO: General statistics Office
ha: hectare
IRRI: the International Rice Research Institute
kg: kilogram
km ² : squared kilometer
mm: millimeter
OLS: Ordinary Least Square
R ² : Coefficient of determination
USD: United States Dollar
VFA: Vietnam Food Association
VINASEED: Vietnam National Seed Corporation

1 Introduction

Rice is one of the most well-known grains in the world. Furthermore, it is the main source of income for farmers all around the world. It is the world's second-most-produced cereal, after corn. Dryland rice and wetland rice are the two types of rice varieties. Dryland rice varieties thrive on hillsides and in fields, while wetland rice varieties comprise most of the world's rice. Because rice is such an important part of Asian cuisine, Asia accounts for 90% of global rice production and consumption. The main reason is that rice is a food that is high in starch, protein, and fiber, all of which are beneficial to the body.

Meanwhile, Vietnam is known for its agricultural prowess, particularly in rice cultivation. As a result, rice has increasingly become an important part of Vietnam's economic and social development. Rice has evolved into a crucial part of Vietnam's food security. The government attempted to expand rice production first for domestic consumption and then for export. Before the 1990s, Vietnam was still a poor country that had to import approximately 1 million tons of rice each year. Vietnam began to increase rice farming and production in the 1990s. When Vietnam began producing 1.4 million tons of rice, it took the initial steps. Following that, rice exports gradually rose, reaching 4.5 million tons in 1999, only behind Thailand in terms of rice exports (Division, 2001). Agricultural production increased at a constant rate of 4.3% each year from 1990 to 1999. Furthermore, rice yields increased by 33% (Nguyen, 2006). The overall rice harvested area in Vietnam is almost 7.5 million hectares, mainly in the Mekong River Delta with 50.5% and the Red River Delta with 16.1% which account for most of the rice harvested areas (Bank, 2011). Since then, Vietnam has consistently been among the top five rice exporting countries. As a result, the export structure of Vietnam is shifting toward high-quality rice varieties with higher pricing and added values.

This bachelor thesis is made to analyze the rice chain in Vietnam, focusing on the production and export stages. Based on that analysis, it is possible to clarify the influence of rice on Vietnam's socio-economy and the position of Vietnamese rice in the international market.

2 Objectives and Methodology

2.1 Objectives

The main goal of the bachelor thesis is to examine the rice chain in Vietnam from 2000 to 2020, with a particular focus on production and export. Through that, it is possible to assess the role of the rice chain in the Vietnamese economy during that period. The thesis will include supporting arguments to help clarify the main theme. It will identify manufacturing and export strengths. It also outlines the major factors that influence production and export. Thereby, it will outline solutions to promote growth in the two areas mentioned above. It will also demonstrate how the rice chain's development and Vietnam's economic development are linked.

Hypotheses will be made to explain and support the main point. The first hypothesis examined the relationship between rice production in Vietnam and yield. The second hypothesis is that the quantity of Vietnamese rice exports is affected by export prices and production output.

To analyze and clarify these hypotheses, the main data and information will be collected from the Vietnam Food Association, the General Statistics Office of Vietnam, and other official documents.

2.2 Methodology

The thesis is based on theory and data analysis, mainly focusing on analyzing data from 2000 to 2020.

Descriptive statistics

Descriptive statistics are used to define the basic characteristics. They give quick summaries of the sample and the parameters. They can help with two things which are providing basic information about variables in a dataset and highlighting potential correlations between variables (Trochim, 2006).

Measures of location describe the center of the tendency

- Mean is an average value by adding all the values together and dividing by the number of values.
- Median is the middle value in the variation range.
- Mode is the most frequency value in the set.

Measures of variation describe the spread of data and variability

- Variance is the average square difference from each observation and the sample mean.
- Standard deviation is the square root of variance. The size of the values is correlated to the variation: the more homogeneous values, the smaller variance (standard deviation).
- The coefficient of variation is expressed as a percentage of the level dispersion of the standard deviation to the mean (Hlavsa, 2016).

Index analysis

According to R.G.D Allen (Allen, 2008), an index number is a component of economic data that compares quantity or price to a base or standard value. The basic index describes the change in other years compared to the year chosen which is easier to understand and clarify changing percentages over time. In the other words, one year is chosen as the basis year in the base index calculation. That is, all results are based on a comparison to the base period:

$$k_t = \frac{y_t}{y_0}$$

The chain index describes the annual change. In the chain base year index approach, the base year changes from year to year, hence the results for each are first reported as a percentage of the previous year:

$$k_t = \frac{y_t}{y_{t-1}}$$

Time series analysis

A time series is a collection of observations collected throughout time in sequential order and a succession of numerical data points. It's also a set of values for a quantity obtained at different times, usually at similar intervals (Chatfield, 2003).

The regression model generates a linear relationship between dependent and explanatory variables. Software GRETL is used to estimate the linear regression model. GRETL is a cross-platform economic analysis software tool created in the C computer language. It's open-source software that's available for free. The GNU General Public License (GPL) as published by the Free Software Foundation allows redistributing and/or modifying its (Allin Cottrell, Riccardo "Jack" Lucchetti, 2022). The linear regression model is explained by Jim Frost (Frost, 2020) and from Douglas C. Montgomery with his colleagues (D C. Montgomery, E A. Peck, G G Vining, 2012). It not only estimates parameters but also verifies the quality of the estimated model. Parameter's estimation and verification quantify the relationships among selected variables, then it will be able to interpret the influence of every variable on the dependent variable. In the software, the output relates to the model whether it is significant or not. Based on that, the future development of the dependent variable will be forecasted. Based on Ordinary Least Square (OLS), the relationship between dependent and explanatory variables will be determined. The general model with ε means error - the part of variation not explained by regression model and does not affect other variables:

$$y = f(x) + \varepsilon$$

Trend function is used to analyze and explain the long-term tendency included in the analysis time series. The long-term tendency could increase or decrease in the period and quality of the trend function based on the coefficient of determination. The coefficient of determination (R^2) evaluates the quality of the whole trend function. The value of R^2 belongs to the interval between 0 to 1. The higher value the better quality of the model. Trend function based on one time series will be described by the equation:

$$y = f(UV, TV)$$

- Y: dependent variable
- UV: Unit vector
- TV: time vector

GRETL software also analyzes coefficient which influences independent to independent variable and p-value (F) which presents for quality of the whole model. Besides, the p-value verifies alpha based on the t-test. After comparing each p-value with the selected level of alpha:

- P-value < alpha: significance relationship

- P-value > alpha: insignificant relationship

Growth rate

A growth rate (GDP, turnover, earnings, etc.) measures how much it has changed from one period to the next (month, quarter, year). It's expressed as a percentage in most cases. The growth rate is used to determine how far rice exports have progressed. The growth rate is derived by comparing the absolute increase between two periods using the same level as the comparison period (Athanasia Stylianou Kalaitzi, Trevor W. Chamberlain, 2020):

$$\text{Growth rate (\%)} = \frac{\text{Present value} - \text{Past value}}{\text{Past value}} \times 100$$

3 Theoretical part

3.1 Rice history

Rice features a rather long and complicated history. Several authors have mentioned the origin of rice but there is no solid and consistent data on that. However, it could be said that the history of rice and Asian countries are closely connected. There are two types of rice grown in the world that have been identified from ancient times to the present day: rice from Asia (*Oryza sativa*) and rice from Africa (*Oryza glaberrima*) (Hai, 2010). The African type of rice was identified in the upper Niger valley (now in Mali). *Oryza sativa* is the main staple food in East and South Asia, the Middle East, and the West Indies (Nonnabox, 2020).

Rice was first grown in the Yangtze River valley, and archaeologists have discovered how wild rice was finally domesticated and cultivated around 12,000 B.C. The rice grains were found to be white when exposed, but exposure to air turned them black within a few minutes. Near the Yellow River of Jiahu in Henan Province in northern China, evidence of rice dating back to 7000 B.C. has been found. It is unclear whether the rice was grown or simply harvested. Rice deposits dating to 6000 BC were discovered at Changsa in Hunan Province (Hai, 2010). The first-time rice was cultivated in India was around 2000 B.C. According to Vavilov, they believed that India could be the origin of rice and after that passed it on to China (Vavilov, 1952). Africans cultivated another type of rice around 1500 BC. Between 1500 and 800 BC, rice was spread from the Niger Delta to Senegal, but it never really grew beyond its original place of growth (Nonnabox, 2020).

In the early 2000s, a team from South Korea's National University of Chungbuk found 14,000 BC in the Paleolithic site of Sorority to estimate that wetland rice farming was brought directly from China. Wild rice grows in forest clearings but is adapted to grow in shallow flooded fields. DNA analysis shows that these early forms of rice were different from the varieties eaten today. Wet rice civilizations are ancient civilizations that arose in Southeast Asia about 10,000 years ago. This civilization had reached a sufficiently high level in wet rice cultivation, irrigation, the development of special tools, and animal husbandry techniques. Wet rice plants could only grow well when

living in suitable climate areas such as the tropics. This climate brings a new amount of alluvium, which accumulates every year during the flood season. Some other scientists do not recognize Southeast Asia as the phylogenetic center of agriculture but only rank it as a secondary center. They argue that the topography and climate, as well as ethnicity, of the Red River Delta, share a prehistoric origin with southern China. Thus, Southeast Asia is the secondary source of cultivated rice (Hays, 2014). According to Vietnamese scientists, the archaeological site of rice grown in Asia is the earliest discovered in the world, but not necessarily the first rice grown in China. Wild rice is abundant in Vietnam and spread over the entire territory, from the south to the center and north. Cultivated rice varieties such as Indica and Japonica have a long-standing presence in our country, which is one of the important factors that confirm the origin of rice in Vietnam. They also believe that the North in Vietnam is the center of origin for the world's rice (Van, 2005).

3.2 Categories of rice

3.2.1 Types of rice

Rice is often classified based on different shapes and sizes. Therefore, rice is divided into three main types – long, medium, and short-grain. Figure 1 shows the three types of rice divided by shape and size.

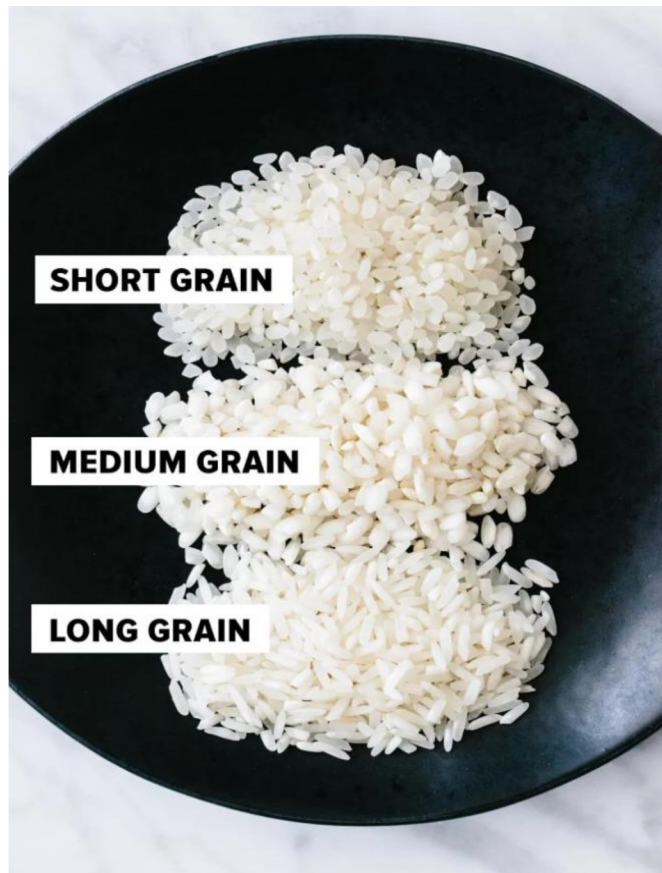


Figure 1: Types of grain (source: Downshifology)

Long-grain rice has a length of three to five times its width (k-agriculture, 2006). One of the most valued long-grain rice is the intensely aromatic Basmati, which is traditionally grown in the foothills of the Himalayas. In addition to Basmati, the Carolina Gold of America and jasmine rice are mainly grown in Southeast Asia. While the different long-grain rice varieties differ in texture and flavor, they all have a relatively low starch content. When cooked, it has a spongy texture.

Medium-grain rice is shorter and moister than long-grain however it is not as starchy as short one (McKeown, 2021). While medium-grain Italian rice is risotto, medium-grain japonica rice is frequently in a daily meal in China, Korea, and Japan. Short or round grains have a pearly white or brown color. Besides, short-grain rice becomes clumpy and sticky when cooked. The most common one is sushi rice or brown rice, which tends to absorb more water than the medium or long grain (JAMPEL, 2020).

3.2.2 Famous rice varieties in Vietnam

ST24 and ST25 rice varieties

ST24 and ST25 rice are among the best in the world. In 2014, it was released the rice ST24 and then ST25. Ho Quang Cua, a Vietnamese agricultural engineer, entered the ST24 rice variety in the World's Best Rice competition for the first time in 2017 and earned third place which is repeated the following year. This catalyzed further development of the ST25 rice variety, which went on to win first place in the World's Best Rice competition at the 11th World Rice Conference in Manila in 2019. ST25 rice features a pandan leaf aroma as well as an early sticky rice aroma. ST25 is not only exceptional in quality and look, but it is also disease resistant and adaptable to its surroundings. Pest and disease resistance are higher in these two kinds than in other rice varieties. ST25 is a rice variety that can be cultivated twice a year on the same land and yields 5 times the amount of other rice kinds. In 2020, ST25 finished second position in the World's Best Rice competition. This rice variety is mostly farmed in the Mekong River Delta's eastern section because of ideal soil and climatic conditions that make the rice grain more palatable while also providing a high yield to the people (Hoang Oanh, 2021)

OM rice varieties

OM is a purebred rice variety selected from the Mekong Delta Rice Institute. This rice has a high yield and great rice quality, which meets export criteria. Rice blast and brown planthopper infestation are not a problem for this plant. The white rice grain is elongated and bright, with a soft texture (Chu Se, 2021).

VNR 20 rice varieties

Vietnam National Seed Corporation (VINASEED) created the VNR20. This rice variety is harvested twice a year, in the spring and the summer. Disease resistance is good, and cultivation is intensive. The plant is disease resistant in a variety of ways. The white rice grain is clear, white, bright, and flexible in shape, with a rich and sweet flavor (Tien Do, 2020).

DT8 rice varieties

The Department of Crop Production recognized DT8 in 2018 for its high output in the Mekong Delta. DT8 rice exports contribute 26% of total rice exports in 2020. The strong stems, long aromatic seeds, high yields, and resistance to diseases like rice blast and aphids

are all reasons why DT8 is so popular. Hence, production costs are lowered which explains the popularity of this rice variety. This rice has a long grain and is white. It has a silky, soft texture and a great flavor when cooked. It not only has the great yield of this rice type, but another benefit of DT8 is also its excellent quality inferring frequently sold at a premium (Minh Dam, 2021).

3.3 Rice cultivation conditions

3.3.1 Geographical location

Vietnam has a total area of 331 690 km² with 325 360 km² of land area, with approximately 20% to 25% of the land being used for agricultural cultivation. Despite the limited amount of land devoted to agriculture, more than half of the land is devoted to rice production. The main rice production areas are in the two deltas along the Red and Mekong rivers. The Red River Delta and the Mekong Delta are two large deltas in Vietnam. The deltas represent about 15% of the total land area of the country but account for more than two-thirds of rice production in Viet Nam. Alluvium from two huge rivers, the Red River, and the Thai Binh River, is deposited in the Red River Delta (Northern Delta), which is around 15 000 km² in size. This is the residence of the ancient Vietnamese people, also the place where the wet rice civilization was formed. The Mekong River Delta (Southern Delta) is Vietnam's largest granary with 36 000 km² wide, which is a fertile land with a favorable climate (Nicholas Minot, Francesco Goletti, 2000). Figure 2 with green areas shows the rice-growing areas in Vietnam.

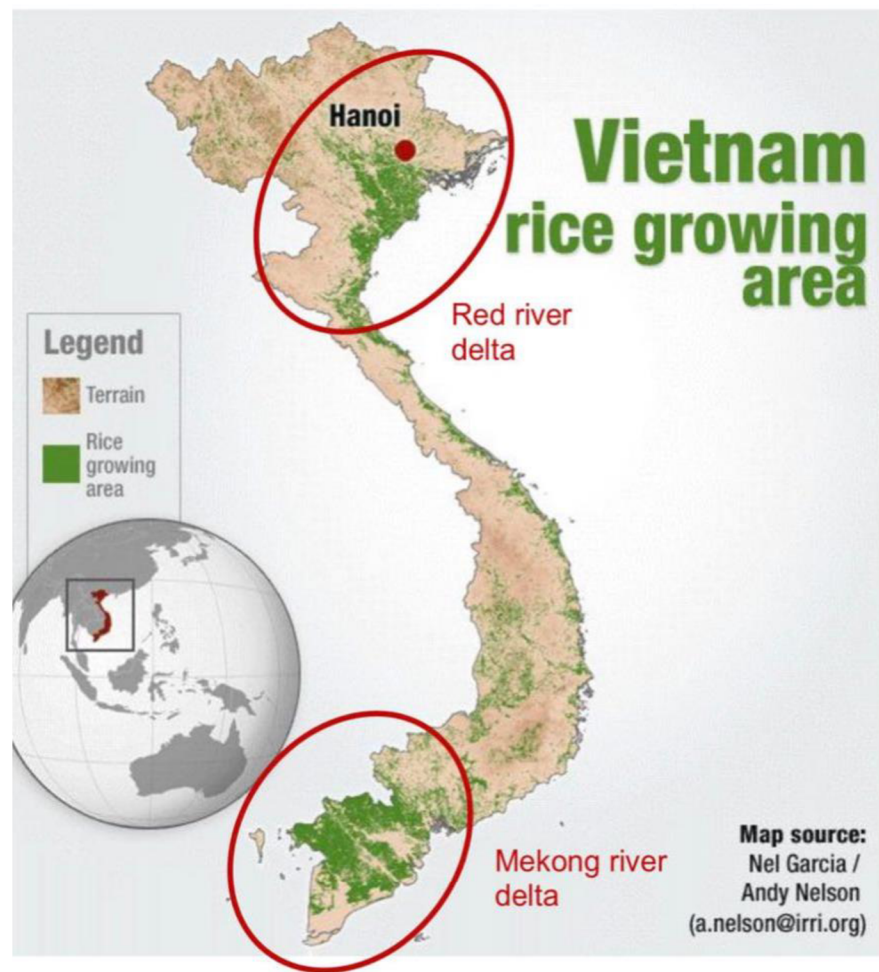


Figure 2: Map of rice cultivation in Viet Nam (Source: a.nelson@irri.org)

Rice is cultivated in all agro-ecological regions of Vietnam, but most of the rice is produced in the lands of the Red River Delta to the north and the Mekong River to the south. In the Red River Delta, the typical cultivation pattern is the planting of rice during the winter-spring and monsoon seasons. The cultivation pattern in southern regions, including the Mekong Delta region, is generally a triple crop of rice, with rice being planted during the winter-spring, summer-fall, and monsoon seasons. Thus, the Mekong Delta region, with just over double the area of the Red River Delta devoted to rice, may have a harvested area more than three times that of the Red River Delta. The Mekong is the most important rice production area in the country and accounts for more than half of national production. The most productive season is the winter-spring season, which accounts for almost 50% of the annual paddy production of the Mekong Delta, with high average yields of 6.5 tons/ha in recent years (International, 2002).

In the international market, Vietnam has become the third-largest rice exporter in the world. The country's rice exports increased from 3.48 million tons to more than 6 million tons from 2000 to 2017, of which 95% came from the Mekong Delta. A large and growing share of export trade is carried out on a government-to-government basis around 2.5 to 3 million tons per year are distributed through such schemes in the Philippines, Indonesia, Cuba, and African countries (Dao The Anh, 2015).

3.3.2 Weather condition

Vietnam has a humid tropical monsoon climate with a wide range of climatic conditions. The average annual temperature in the country (excluding high mountains) is more than 20°C, much exceeding tropical climate norms. Although there appears to be plenty of sunshine, the overall quantity of sunshine hours varies by location, ranging from 1400 to 3000 hours each year. The annual rainfall is heavy, ranging from 1500 to 2000mm, and is evenly spread across the country. The humidity in the air is extremely high, exceeding 80%, and the moisture balance is always positive, above zero. Vietnam is governed by two main seasons: a dry season in winter and a monsoon in summer and early fall. For the winter monsoon in the North, the northeast monsoon occurs from November until April the following year. The most common weather pattern is for the beginning of winter to be cold and dry, and for the end of winter to be cold and wet. The Northern Hemisphere's Wind Tin Phong will blow northeast, bringing rain to the Central Coast. This is the cause of the dry season in the South and Central Highlands. In the summer monsoon, the humid tropical air mass originating in the North Indian Ocean flows southwestward to the mainland at the start of summer, bringing heavy rain to the southern delta provinces. The weather brings rain to both the North and the South in the middle and late summer (Dao The Anh, 2015). The features of the humid tropical monsoon environment have resulted in distinct regional variances. All four seasons occur in the northern provinces, including spring and autumn. Summers in the north are hot and rainy, while winters are cold and dry with minimal rain. The weather in the South is divided into two seasons: the rainy season and the dry season. The difference in climatic conditions between the North and the South means that there are also differences between the agricultural production systems used in the North and the South. Agricultural productivity is influenced by the humid tropical monsoon climate. This climate provides the benefits of a high temperature, high humidity, and plentiful rain creating ideal

conditions for the development of wet-rice agriculture, expanded cropping, and crop diversification. Unfortunately, Vietnam also faces challenges due to the climate such as frequent droughts, floods, and other natural catastrophes that disrupt farming activities, seasonality, and methods of preventing disasters. Besides these obstacles, high humidity promotes disease outbreaks which have an impact on plant growth. (International, 2002).

3.4 Processing of harvested rice

After the rice is harvested, it is put into the production line to turn the raw rice grain into the final products which are sold to the customer. Rough rice is an entire grain of rice with hulls that contains approximately 20% of the grain (Ffoulkes, 1998). It is a rougher product than brown rice, which is a husk-free rice grain but still contains bran, or polished rice, which is bran-free rice ((AFZ), 2015). The motive of rice processing is to split the endosperm from different components with the littlest degree of fragmentation, thereby manufacturing top-quality rice. The main step could be divided into cleaning, hulling, polishing, then grading, sorting, and finally packing (Group, 2020) (Gummert, 2010). Figure 3 describes the process of processing rice after harvesting until the finished product.

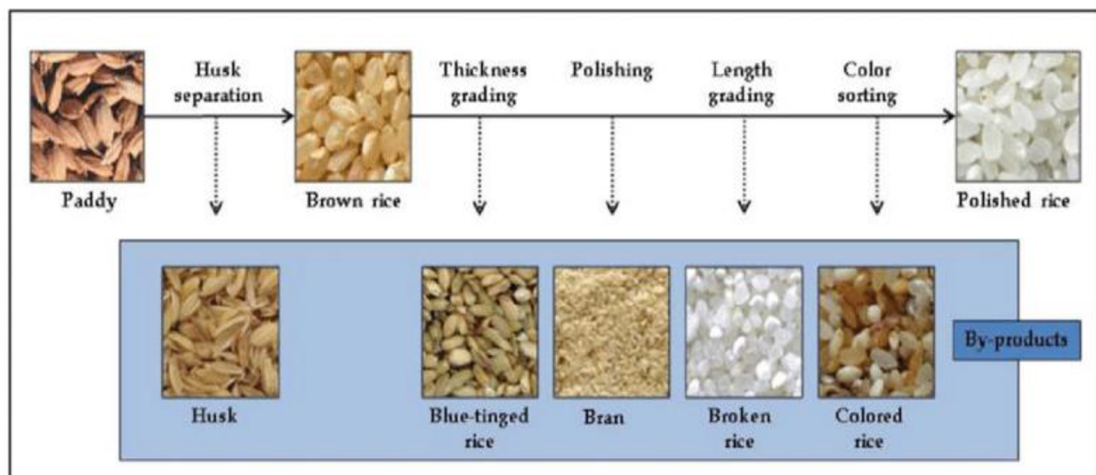


Figure 3: Rice Processing (Source: [Rice-processing](#))

The paddy rice cleaning process is the first step of the rice grinding systems after the paddy has come for the grinding process in the rice mill of the rice farms. The paddy always arrives with a lot of external material including weeds, soil, seeds, etc. These external elements must be removed before they are taken to the shelling process, therefore the productivity of the

sheller, as well as the grinding, is not affected. If they are not removed properly, the machines in the rice mill will not be as efficient. By removing the husk from coarse paddy rice, brown rice is produced. The husk is removed by friction allowing unpeeled grains to easily pass between two abrasive surfaces that move at different speeds. It allows easy removal of the husk after suction and its transport to a storage dump outside the mill (Gummert, 2010).

The next step is about the rice whitening process in a modern rice mill. White rice is produced by removing the bran and germ layers from the rice. An abrasive or friction polishing machine removes the bran layer from the kernel. The amount of bran removed is usually 8% to 10% of the total weight of the paddy. To reduce the number of broken grains during the whitening process, the rice is usually passed through two to four milling machines in a series. After the rice polishing is finished, the white rice is separated into head, small, broken, and coarse rice. In this progress, the broken rice is separated at first, then the remaining rice is divided into groups based on different lengths. To have a higher degree of accuracy for grading and separating, a length or indent grader is used. Sorting is a process in which the discolored, yellow, and immature rice is removed at this point, adding value to the rice (M Gummert, JF Rickman , 2010).

The progress of mixing a fine mist of water traps the dust on the milled rice, which enhances the luster of the rice. Furthermore, carrying out this progress does not affect the quality of rice. The final blanching process is ideal for the last polishing before the sale. The last step is the weighing of the rice for sale. To put it simply, rice is normally sold in bags of 1 kg to 50 kg, and it must be accurately weighed and labeled. Nowadays, most rice mills prefer to use the advanced manual mechanical weighing system, to get accurate results. Advanced machines achieve amazing results in the rice milling operations (Rice Drying, Storage and Processing: Effects of Post-Harvest Operations on Grain Quality, 2022).

3.5 The EU-Vietnam Free Trade Agreement (EVFTA)

The EU-Vietnam Free Trade Agreement (EVFTA) was signed on 30th June 2019, and it is a free trade agreement between Vietnam and the EU member states (Hong Van, 2020). The deal, which was approved by Council Decision (EU) 2020/753 on the conclusion of the EU-Vietnam free trade agreement on 30th March 2020, strengthens cooperation between the two countries (Union, 2020). The agreement was passed by the Vietnamese National Assembly

on 8th June 2020 and went into effect on 1st August 2020 (Thanh Thuy, 2020). According to European Commission, both parties will be able to enhance trade and support jobs and growth through the agreements:

- “Eliminating 99% of all tariffs”
- “Reducing regulatory barriers and overlapping red tape”
- “Ensuring protection of geographical indications”
- “Opening up services and public procurement markets”
- “Making sure the agreed rules are enforceable” (Commission, 2019)

According to the Ministry of Industry and Trade of the Socialist Republic of Vietnam, the EVFTA has produced significant outcomes after a year and a half of enforcement, particularly in the problematic development of the Covid-19 pandemic in both Europe and Vietnam.

According to the General Department of Vietnam Customs, Vietnam's rice exports to the EU market in the first 11 months of 2021 did not show a significant increase in volume, but the export value increased significantly, with 53.91 thousand tons worth 38.07 million USD, up 0.8% in volume but 21.6% in value when compared to the same period in 2020. Despite accounting for a minor portion of Vietnam's total rice exports, the EU represents a major market for high-value rice exports. Some Vietnamese specialty rice cultivars, such as ST24 and ST25, were the first to be sold to European markets. The proportion of aromatic rice in Vietnam's overall rice exports to the EU grew to 70% in the first 11 months of this year, up from 64% in the same period last year.

According to data from Eurostat, Vietnam ranks 10th in terms of supplying rice to the EU, with a volume of 43.57 thousand tons, down 5.9% from the same period in 2020. Vietnam's rice market share in total EU rice imports climbed marginally to 1.7% in the first 9 months of 2020, up from 1.6%. The reason for the steep fall in EU rice imports from the ASEAN region this year was due to major Covid-19 outbreaks in the region, which affected commercial activities, specifically, due to the epidemic's influence on logistics, high logistical costs, a shortage of empty containers, no capacity on trains, or a labor shortage for loading and unloading (Kylie Nguyen, 2021).

After 3-5 years, the EU will reduce the tax rate on rice products to 0%. This has given Vietnamese rice a chance to compete with rice from other countries when selling to the EU. Vietnamese businesses will effectively use benefits from the EVFTA to boost the value of

rice exports to the EU, particularly in the face of difficult diseases and rising sea freight charges to Europe, which have resulted in a decline in EU rice imports in the past year (Sen Nguyen, 2021).

4 Analysis of rice chain in Vietnam

4.1 Rice production

According to statistics from the International Rice Research Institute (IRRI), Vietnam has a great potential to produce rice. Currently, rice plays a critical role in Vietnam's economic and social growth. Rice represents 82% of arable land in Vietnam. The Mekong Delta contributes 52% of Vietnam's rice, while the Red River Delta provides 18% (Rikolto, 2018).

To further clarify the development of rice production in Vietnam, this thesis will analyze rice production from 2000 to 2020. Figure 4 shows rice production in Vietnam with data collected from the General Statistics Office of Vietnam.

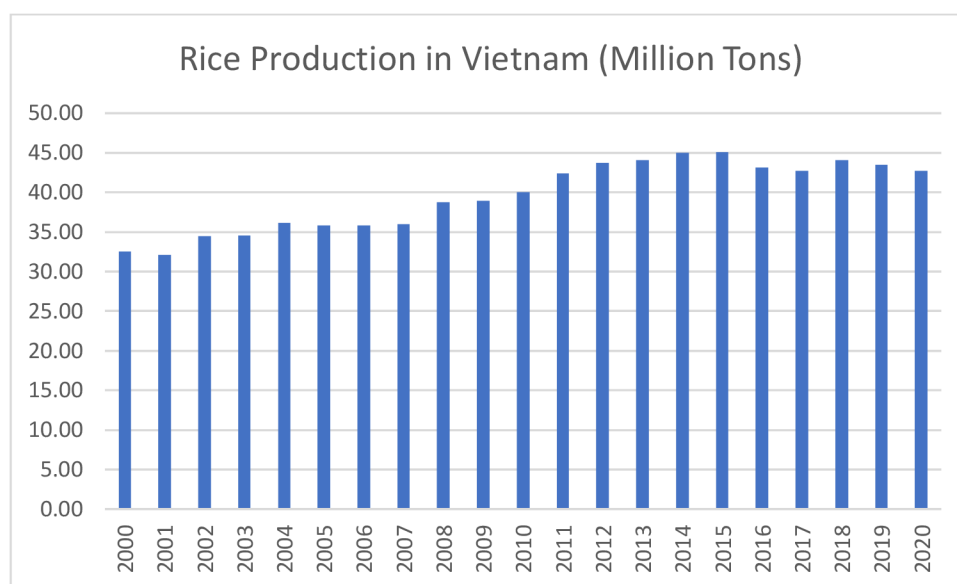


Figure 4: Rice Production in Vietnam 2000-2020 (Million Tons) (Source: GSO of Vietnam. Graph is made by author)

4.1.1 Rice production - Descriptive statistics and index analysis

Year	Total Production (Million Tons)	Basic index	Chain index
2000	32,53	1,00	-
2001	32,11	0,99	0,99
2002	34,45	1,06	1,07
2003	34,57	1,06	1,00
2004	36,15	1,11	1,05
2005	35,83	1,10	0,99
2006	35,85	1,10	1,00
2007	35,94	1,10	1,00
2008	38,73	1,19	1,08
2009	38,95	1,20	1,01
2010	40,01	1,23	1,03
2011	42,40	1,30	1,06
2012	43,74	1,34	1,03
2013	44,04	1,35	1,01
2014	44,97	1,38	1,02
2015	45,09	1,39	1,00
2016	43,17	1,33	0,96
2017	42,74	1,31	0,99
2018	44,05	1,35	1,03
2019	43,50	1,34	0,99
2020	42,75	1,31	0,98
Minimum	32,11		
Maximum	45,09		
Mean	39,60		
Mode	-		
Median	40,01		
Standard deviation	4,38		
Variation coefficient	0,11		

Table 1: Descriptive statistics and index table of rice production in Vietnam 2000-2020 (Million Tons) (Source: The GSO of Vietnam. Table and calculation are made by author)

In table 1, the first column is the time series to be analyzed from 2000 to 2020. The second column is the rice production output for each respective year (in million tons). This is followed by 2 columns that calculate the base index and the chain index. For the base index, the year 2000 is set as the base year. Only the year 2001 decreased 1% compared to the base year. The remaining years are increased compared to the base year. The biggest increase is in 2015 with 39% and 2014 with 38% compared to the year 2000. The chain index shows the year-to-year comparison. It could be seen that the previous year and the following year

have a negligible difference. The highest increase is in 2001-2002 and 2007-2008 with 8%. The biggest decrease is in 2002-2003 and 2008-2009 with 7%. The difference is mainly due to objective issues. The weather in Vietnam is quite complicated and it has a certain influence on the efficiency of domestic rice production. After the long floods in the Mekong Delta causing widespread flooding, there are prolonged heat waves in the dry season that make it difficult for rice production.

In general, production output from 2000 to 2020 has a certain growth but is uneven. In the beginning, Vietnam was a country that tries to produce rice to serve the domestic market has achieved certain successes. Rice production in Vietnam reached the largest output in 2015 with 45.09 million tons while in 2001 had the lowest rice production with 32.11 million tons. Starting from 2010, Vietnam's rice production has reached over 40 million tons per year, although there has been an increase and decrease but not significantly. The average production from 2000 to 2020 is 39.6 million tons. Since there are no duplicate values from 2000 to 2020 in the production category, no mode value matches. Median belongs to the year 2010 with 40.01 million tons. The coefficient of variation is 0.11 which shows the relative size of the standard deviation to the mean. The coefficient of variation is low, so the data is quite stable.

4.1.2 Rice production - The trends analysis

The dependent variable is “Total production”. The parameters will estimate by the time series containing 21 observations. In figure 5, total production in the time series is analyzed from 2000 to 2020.

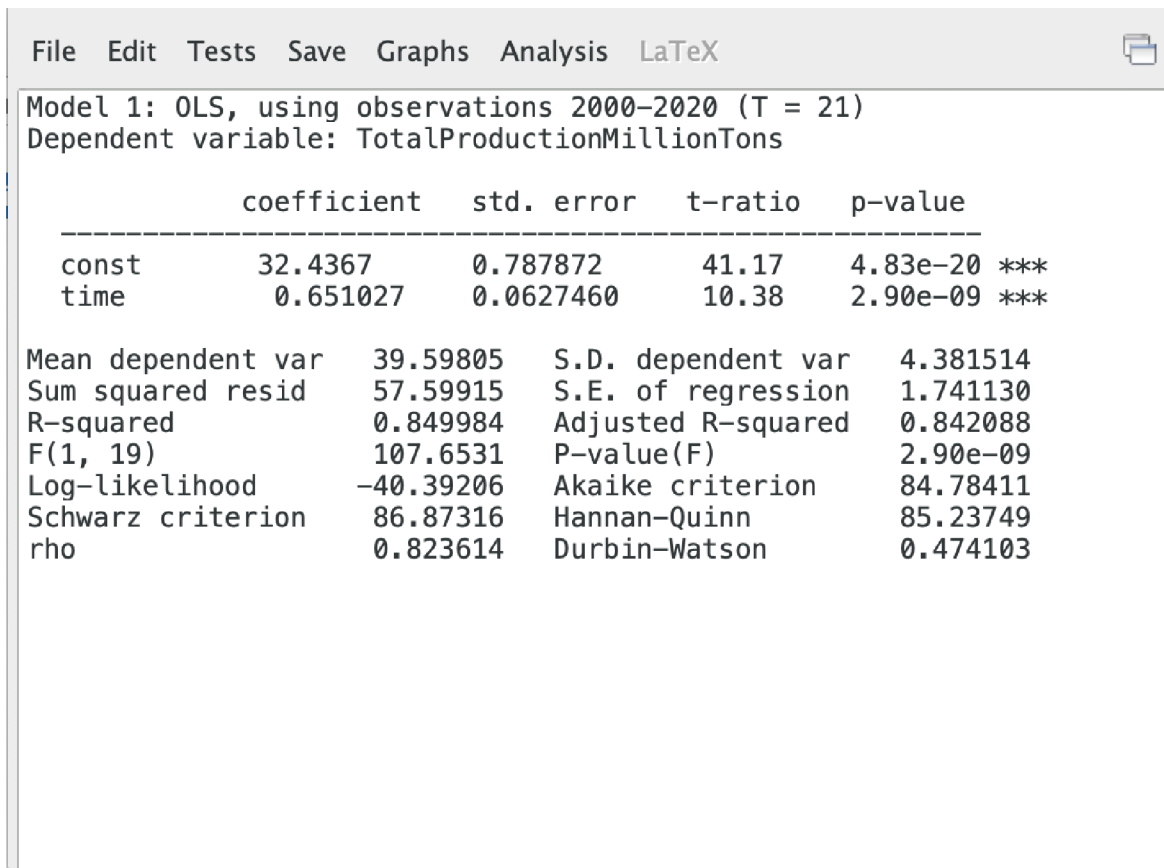


Figure 5: Trend function of Total Production (Million Tons) (Source: The GSO of Vietnam. Calculation is made by author)

- Const = 32.4367 shows the initial level of “total production” in million tons. If there will be no influence of time, “total production” is approximately 32 million tons. Time represents the slope of the trend function and the slope = 0.651027. Because it is a positive number, it increases long-term tendency. Hence, it is an increased trend function: “Total production increases approximately 0.65 million tons per year”.
- Considering p-value, alpha = 0.01 with three asterisks are presented. Compared with alpha, the p-value is smaller than the level of significance. Both parameters of this trend function are statistical significance.
- This figure shows R-squared = 0.849984 which means about 85% of the variation in “Total production” which is explained by this trend function. The result is good from a statistical viewpoint.
- P-value (F) is smaller compared with alpha (alpha = 0.1), which shows a significant relationship between them.

Figure 6 shows the total rice production of trend function which means predicting the trend in the future.

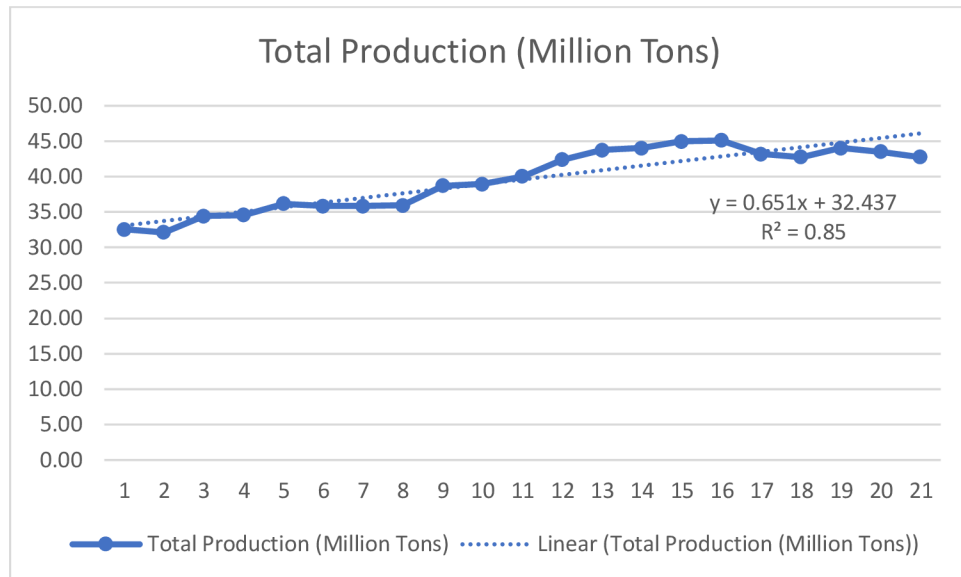


Figure 6: Trend function of Rice production (million tons) (Source: The GSO of Vietnam. Graph is made by author)

From figure 6, there is an equation: $y = 0.651x + 32.437$. Predicting the following years will be calculated using the trend function.

- When $x = 22$ (year 2021)

$$y_{22} = 0.651 \cdot 22 + 32.437 = 46.78 \text{ (million tons)}$$

In the 22nd year (the year 2021), the predicted value for rice production in Vietnam is 46.78 million tons.

According to the Ministry of Agriculture and Rural Development, rice production in 2021 was reached over 43.86 million tons, up 1.1 million tons from 2020. The data was not as expected mainly due to the pandemic. Vietnam carried out social distancing and there was a shortage of human resources. Besides, the influence of weather factors and pests were not excluded.

- When $x = 23$ (year 2022)

$$y_{23} = 0.651 \cdot 23 + 32.437 = 47.41 \text{ (million tons)}$$

In the 23rd year (the year 2022), the predicted value for rice production in Vietnam is 47.41 million tons.

- When $x = 24$ (year 2023)

$$y_{24} = 0.651 \cdot 24 + 32.437 = 48.06 \text{ (million tons)}$$

In the 24th year (the year 2023), the predicted value for rice production in Vietnam is 48.06 million tons.

4.1.3 Rice production – influence of yield

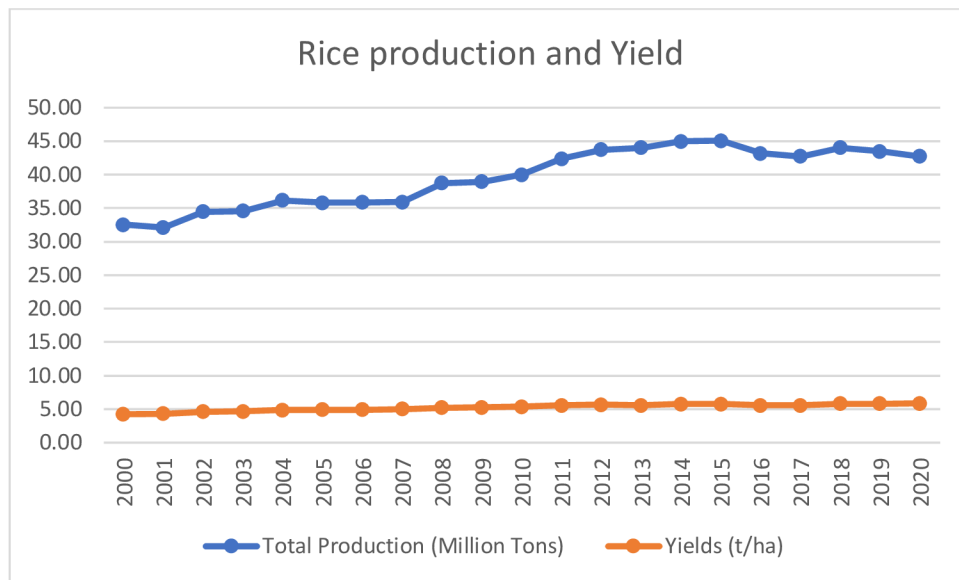


Figure 7: Rice production and yield in Vietnam (t/ha) (Source: The GSO of Vietnam. Graph is made by author)

Figure 7 shows the total output and yield of rice in Vietnam for 21 years from 2000 to 2020:

- Yield and total output are always interrelated. As yield increases, total output increases, and vice versa.
- Based on the graph, the yield of rice production over 21 years is almost unchanged, ranging from 4.24 tons/ha to 4.99 tons/ha (2000 - 2007) and from 5.23 tons/ha to 5.87 tons/ha (2008 - 2020). It is proved that the yield in production has not improved significantly.
- In terms of total output, the change is more obvious. From 2000 to 2007 the fluctuation in total production was low, showing that in those 7 years total rice production was still limited. From 2008 to 2020, the total production output was increased compared to 8 years ago, but compared to other years, the difference is not large. Therefore, the total production output tends to increase, but over the years, it is generally uneven and does not grow strongly.
- To explain the fluctuations of the two factors above, why there is not much change over a long period of 20 years as follows:

- The yield and total production of rice depend mainly on the cultivar: When the plant varieties are improved such as overcoming the weaknesses, improving the defects of the old varieties which will help improve yield, and create a high total production at the same time.
- Depending on the cultivation and cultivation process: When the cultivation process is optimized, improved, and modernized, the cultivation will be convenient, fast. Moreover, the same period of cultivation will create high yield efficiency, and lead to an increase in total output.
- Depends on cultivation technology: If the farming tools are improved by gradually replacing the tools with specialized machines, it will make farming easier, shorter time, higher yield, and have more optimal efficiency (HNN, 2022).

4.2 Rice export

From a poor country, with insufficient food to supply the whole country, Vietnam has gradually risen to one of the leading countries in exporting rice worldwide. Rice export has always been one of the important export industries in the Vietnamese economy. Therefore, it also contributes significantly to the economic growth of the country.

4.2.1 Rice export - Descriptive statistics and index analysis

Year	Exports Quantity (Million Tons)	Basic Index	Chain Index
2000	3,39	1,00	-
2001	3,53	1,04	1,04
2002	3,25	0,96	0,92
2003	3,92	1,16	1,21
2004	4,06	1,20	1,04
2005	5,21	1,54	1,28
2006	4,69	1,38	0,90
2007	4,53	1,34	0,97
2008	4,68	1,38	1,03
2009	6,05	1,78	1,29
2010	6,75	1,99	1,12
2011	7,13	2,10	1,06
2012	7,72	2,28	1,08
2013	6,68	1,97	0,87
2014	6,32	1,86	0,95
2015	6,57	1,94	1,04
2016	4,89	1,44	0,74
2017	5,77	1,70	1,18
2018	6,15	1,81	1,07
2019	6,40	1,89	1,04
2020	6,25	1,84	0,98
Minimum	3,25		
Maximum	7,72		
Mean	5,43		
Mode	-		
Median	5,77		
Standard deviation	1,32		
Variation coefficient	0,24		

Table 2: Descriptive statistics and index table of rice export in Vietnam (million tons) (Source: The GSO of Vietnam.

Table and calculation are made by author)

In table 2, the first column is the time series to be analyzed from 2000 to 2020. The second column is the export quantity output for each respective year (in million tons). This is followed by 2 columns that calculate the base index and the chain index. For the base index, the year 2000 is set as the base year. Only the year 2002 decreased 4% compared to the base year. The remaining years are increased compared to the base year. The biggest increase is in 2011 with 110% and in 2012 with 128%. Rice exports during those two years have reached their peak. From 2006 to 2012, there is remarkable growth. However, there is a gradual

decrease but not too obvious and uneven from 2012 to 2020. The chain index shows the comparison between the current year to the year before. It could be seen that the previous year and the following year have a quite big difference. The highest increase is from 2016 to 2017 with 44%. The strong growth of rice exports was mainly due to the impact of climate change. Moreover, the demand increased from the main consuming market such as China, Malaysia, the Philippines, South Korea, etc. in particular, the expansion of rice exports to new markets like Bangladesh and Iraq also contributed to the increase in Vietnam rice exports (VNExpress, 2017). The biggest decrease is in 2005-2006 with 38%. The disease caused crop failure in the South, so rice export output decreased, not achieved as planned (Hoang Ha, 2006).

In general, export output from 2000 to 2020 has a certain growth but is uneven. Rice export quantity in Vietnam reached the largest output in 2012 with 7.72 million tons while in 2002 had the lowest rice export with 3.25 million tons. The average production from 2000 to 2020 is 5.43 million tons. Since there are no duplicate values from 2000 to 2020 in the production category, no mode value matches. Median belongs to the year 2017 with 5.77 million tons. The coefficient of variation is 0.24 which shows the relative size of the standard deviation to the mean. The result is quite low, the dispersion of data around the mean is not great.

4.2.2 Trend function of rice export

The dependent variable is “Export quantity”. The parameters will estimate by the time series containing 21 observations. In figure 8, total rice export in the time series is analyzed from 2000 to 2020.

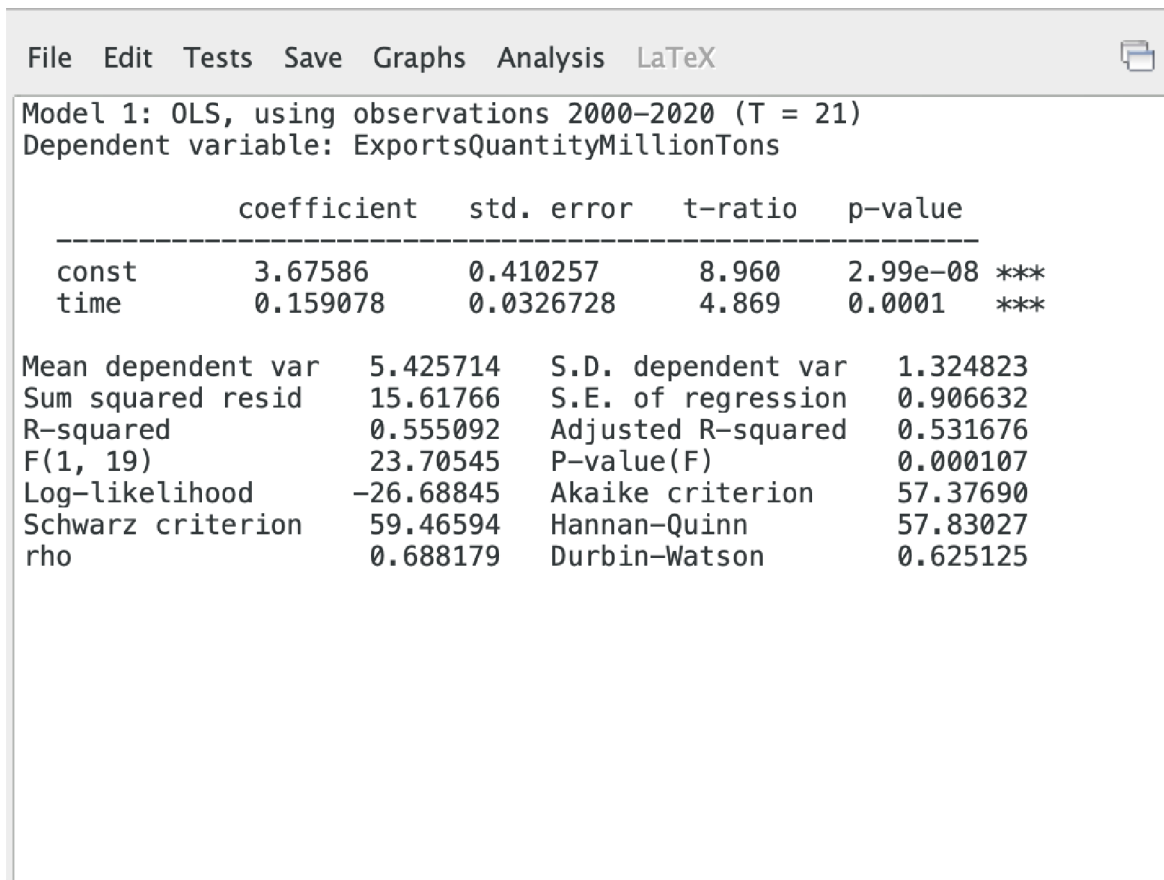


Figure 8: Trend function of Total Rice Export (Million Tons) (Source: The GSO of Vietnam. Calculation is made by author)

- Const = 3.67586 shows the initial level of “export quantity” in million tons. If there will be no influence of time, the “export quantity” is approximately 3.7 million tons. Time represents the slope of the trend function and the slope = 0.159078. Because it is a positive number, it increases long-term tendency. Hence, it is an increased trend function: “Export quantity increases approximately 0.16 million tons per year”.
- Considering p-value, alpha = 0.01 with three asterisks are presented. Compared with alpha, the p-value is smaller than the level of significance. Both parameters of this trend function are statistical significance.
- This figure shows R-squared = 0.555092 which means 56% of the variation in “Export quantity” which is explained by this trend function. The result is not very good from a statistical viewpoint.
- P-value (F) = 0.000107 is smaller compared with alpha (alpha = 0.01), which is significant.

Figure 9 shows the total rice production of trend function which could be used to forecast for the following year.

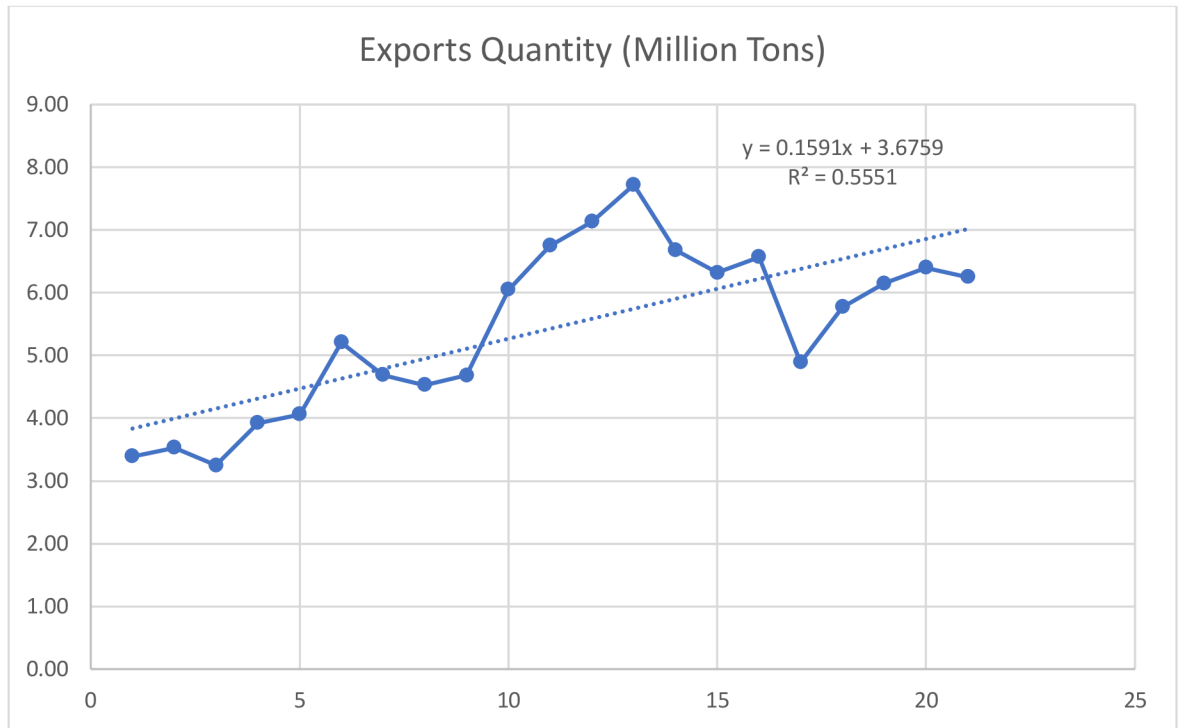


Figure 9: Trend function of Exports quantity in Vietnam (million tons) (Source: The GSO of Vietnam. Graph is made by author)

From figure 9, there is an equation: $y = 0.1591x + 3.6759$. Predicting the following 3 years will be calculated using the trend function.

- When $x = 22$ (year 2021)

$$y_{22} = 0.1591 \cdot 22 + 3.6759 = 7.1761 \text{ (million tons)}$$

In the 22nd year (the year 2021), the predicted value for rice export quantity in Vietnam is 7.1761 million tons.

In 2021, Vietnam aimed to export 6.5 million tons of rice. According to the Ministry of Agriculture and Rural Development, in the first 10 months of 2021, the country's rice exports reached nearly 5.2 million tons. The Philippines continued to be Vietnam's top rice export market, followed by China. However, complicated developments of the fourth Covid-19 epidemic have disrupted the supply chain and rice consumption in Vietnam. The whole country implemented social distancing, limited travel. Furthermore, because of the lack of laborers to load or unload goods and the shortage of empty containers disrupted exports, many businesses had been ordered from abroad but could not deliver them on time.

Therefore, the export volume was unlikely to meet the expectations as predicted by the trend function (Do Thi Bich Thuy, 2021).

- When $x = 23$ (year 2022)

$$y_{23} = 0.1591 * 23 + 3.6759 = 7.3352 \text{ (million tons)}$$

In the 23rd year (the year 2022), the predicted value for rice export quantity in Vietnam is 7.3352 million tons.

- When $x = 24$ (year 2023)

$$y_{24} = 0.1591 * 24 + 3.6759 = 7.4943 \text{ (million tons)}$$

In the 24th year (the year 2023), the predicted value for rice export quantity in Vietnam is 7.4943 million tons.

4.2.3 Linear regression model between export quantity and export value, total production

It is assumed that rice export quantity is affected by export value and total production. Therefore, export quantity is the dependent variable, and the independent variables are export value and total production.

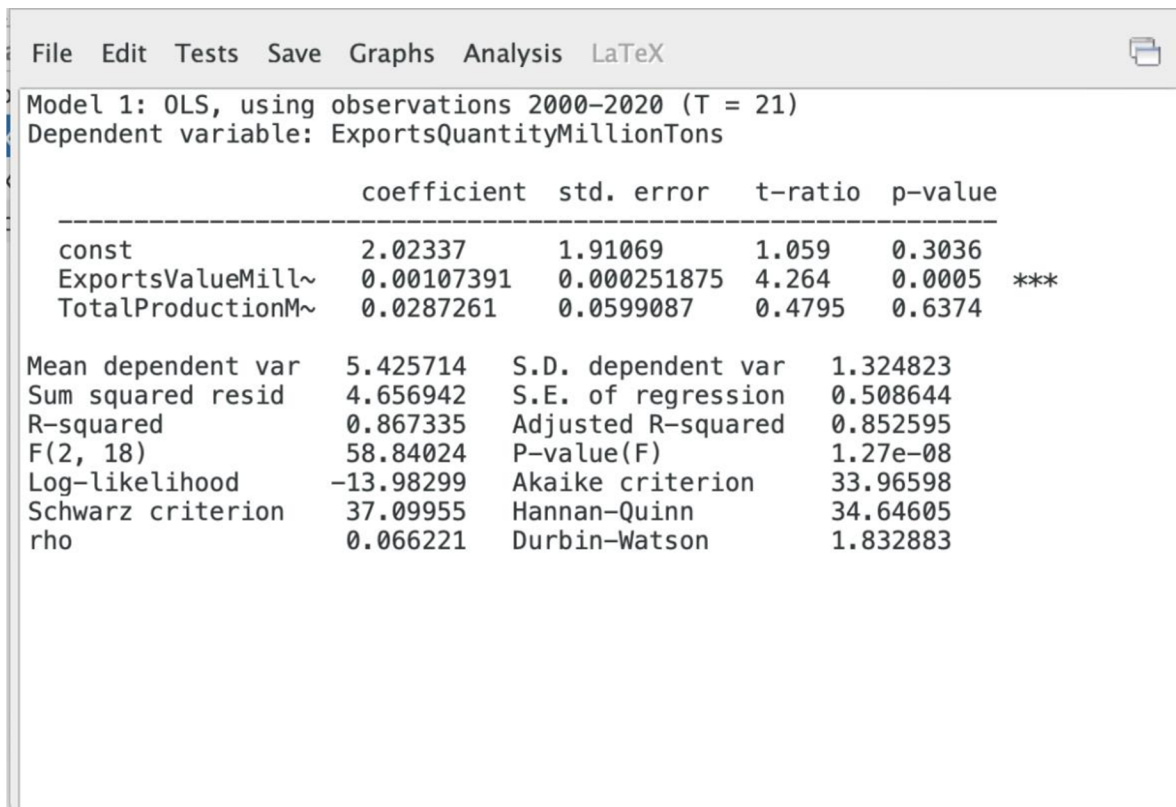


Figure 10: Linear regression model between export quantity and export value, total production (Source: The GSO of Vietnam. Calculation is made by author)

Figure 10 is examined the relationship between dependent and independent variables.

- The selected alpha here is 0.01 which is represented in figure 10 with three asterisks. Only export value has a p-value smaller than alpha, therefore, this variable is significant. The p-value of total production is larger than alpha. Therefore, it is statistical insignificance and it is not sure about alpha between them.
- R-squared = 0.867335 which means nearly 87% of the variation of rice production is explained by the analysis relationship.
- P-value (F) = 1.27e-08 is smaller than selected alpha (0.01) which is significant.
- The initial rice export is 2.02337 if the other values are equal to zero.

The regression model describes the relationship among the selected variables, so the relationship between them could be described by the function with ϵ is the error term

$$y = 2.0234 + 0.001x_1 + 0.0287x_2 + \epsilon_1$$

- X_1 represents the export value (million USD). If the export value increases by 1 million USD, the export quantity will increase by 0.001 million tons or by 1 thousand tons.
- X_2 represents the total production (million tons). If total production increases by 1 million tons, the export quantity will increase by 0.0287 million tons or by 28,7 thousand tons. However, the estimated parameter shows that there is no relationship between the two variables. Therefore, the relationship is not significant and not strong because it is not an important value of the estimated parameter.

Analyze the relationship between export quantity and export value

Because in figure 10 some of the parameters are insignificant, the relationship among them could be modified again. Probably, the relationship in “Total Production” is not so strong, it will be excluded from the model. This purpose is to increase the quality model from a statistical viewpoint. In figure 11, it shows more clearly the relationship between export quantity and export value.

File Edit Tests Save Graphs Analysis LaTeX				
Model 2: OLS, using observations 2000-2020 (T = 21)				
Dependent variable: ExportsQuantityMillionTons				
	coefficient	std. error	t-ratio	p-value
const	2.93131	0.250298	11.71	3.90e-10 ***
ExportsValueMill~	0.00118276	0.000106902	11.06	1.01e-09 ***
Mean dependent var	5.425714	S.D. dependent var	1.324823	
Sum squared resid	4.716426	S.E. of regression	0.498230	
R-squared	0.865641	Adjusted R-squared	0.858569	
F(1, 19)	122.4120	P-value(F)	1.01e-09	
Log-likelihood	-14.11626	Akaike criterion	32.23252	
Schwarz criterion	34.32157	Hannan-Quinn	32.68590	
rho	0.058540	Durbin-Watson	1.841298	

Figure 11: The relationship between export quantity and export value (Source: The GSO of Vietnam. Calculation is made by author)

- P-value: It shows us clearly that quality is better (alpha = 0.01). From a statistical viewpoint, both are significant.
- *R-squared* = 0.87, it is quite the same. So, it means 87% of the variation of “Exports Quantity” is explained by the relationship.

“Exports value” is the most effective to “Exports quantity”. “Export quantity” could be influenced by other factors that were not included in analyzing the relationship. Although “total production” is no statistical significance, “total production” could be kept in the model. However, it should be interpreted as an insignificance influence on the selected dependent variable.

Export growth

Several studies have found that exports have a favorable impact on economic growth due to increased economies of scale, adoption of new technologies, and capacity utilization. Export growth, in particular, boosts investment in sectors where a country has a competitive edge, boosting national production and increasing the rate of economic growth. Increased exports

enhance foreign exchange inflows and allow for increased purchases of services and capital goods, both of which are vital for enhancing productivity and economic growth (Athanasia Stylianou Kalaitzi, Trevor W. Chamberlain, 2020). The growth rate is calculated by subtracting the past from the current value, and divide that number by the past value, then multiplying by 100 to express it as a percentage as the formula below:

$$\text{Growth rate (\%)} = \frac{\text{Present value} - \text{Past value}}{\text{Past value}} \times 100$$

In table 3, export growth will be calculated from 2000 to 2020. The growth rate represents the development of Vietnam's rice production to the international market.

Year	Exports Value (Million USD)	Growth rate (%)
2000	615,82	-
2001	544,11	-11,64%
2002	608,12	11,76%
2003	693,53	14,04%
2004	859,18	23,89%
2005	1279,27	48,89%
2006	1194,63	-6,62%
2007	1338,13	12,01%
2008	2663,44	99,04%
2009	2464,30	-7,48%
2010	2911,64	18,15%
2011	3519,29	20,87%
2012	3449,56	-1,98%
2013	2893,49	-16,12%
2014	2789,50	-3,59%
2015	2679,50	-3,94%
2016	2128,40	-20,57%
2017	2539,40	19,31%
2018	3151,50	24,10%
2019	2843,23	-9,78%
2020	3122,20	9,81%

Table 3: Export value and growth rate of rice in Vietnam (2000-2020) (Source: The GSO of Vietnam. Table and calculation are made by author)

From 2001-2008, there was growth but unevenly. There was a slight decrease in 2006 but in 2008 the export value was outstanding at 99% compared to 2007. That is because the export turnover in 2008 doubled compared to 2007. According to the data of VFA, the price of rice

in Vietnam had many fluctuations. The export price of rice was nearly 400 USD/ton at the beginning of 2008, but it jumped to about 900 USD/ton by the end of the year. From 2009 to 2020, there are year-to-year fluctuations. In the years 2012-2016, the growth rate decreased continuously between the years, not to mention that in 2013 it decreased by 16% compared to 2012, and in 2016 decreased by about 21% compared to 2015. Rice exports in 2013 decreased due to highly competitive pressure and falling demand from familiar markets such as Indonesia, Malaysia, and the Philippines. Like 2016, the sharp decline in rice exports is since exports to Vietnam's main markets (China, Indonesia, Malaysia, and the Philippines) have declined significantly in both volume and value in recent years. In addition, the international export market has many fluctuations. In 2016, Thailand announced to discharge all its reserves for export, just as India won contracts with the governments of major countries with the advantage of cheap rice prices and good quality. That has become a great pressure for major rice exporting countries including Vietnam (VNA, 2016). The growth rate increased by 19.59% from 2019 to 2020, although the export volume decreased by 250 thousand tons which showed that the export price of rice was higher than the previous year. Therefore, the main reason for decreasing export output is the shortage of shipping containers causing high shipping costs because of the pandemic.

Analyzing “Export value”

The dependent variable is “Export value”. The parameters will estimate by the time series containing 21 observations. In figure 12, rice export value in the time series is analyzed from 2000 to 2020.

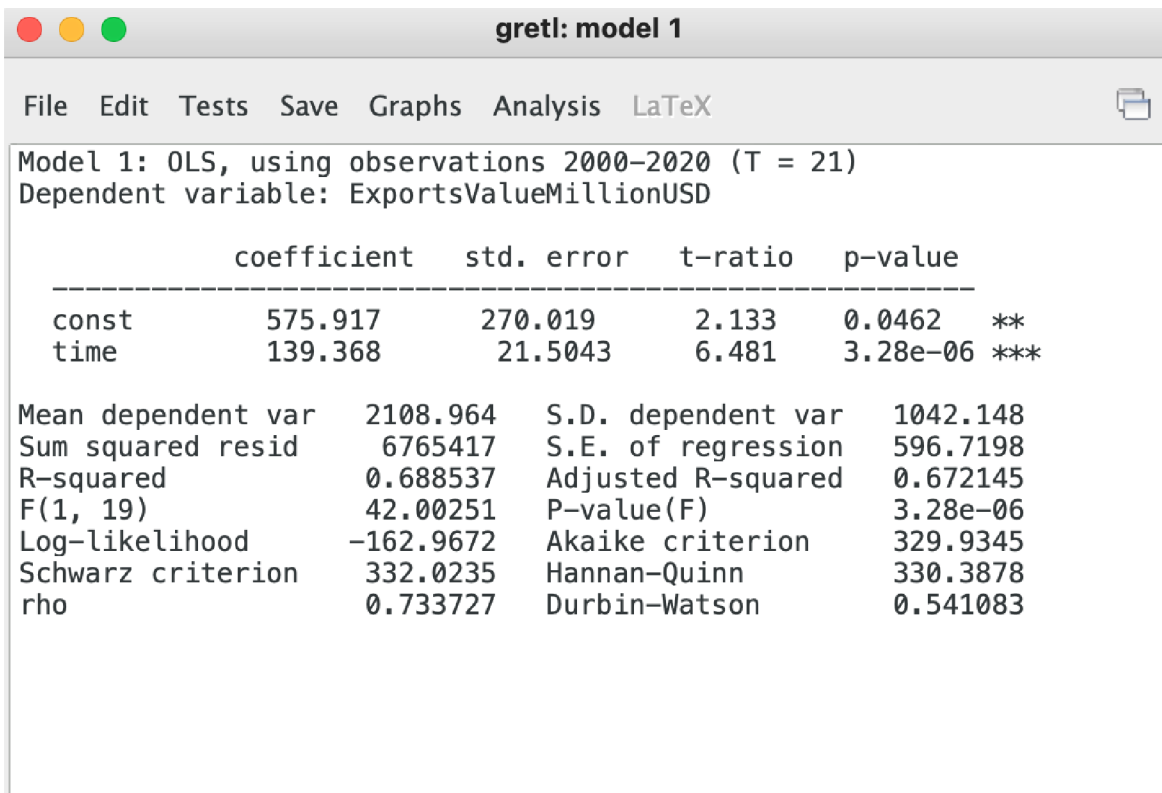


Figure 12: Time series of Export Value (Million USD) (Source: The GSO of Vietnam. Calculation is made by author)

- Const = 575.917 shows the initial level of “export value” in million USD. If there will be no influence of time, the “export value” is approximately 576 million USD. Time represents the slope of the trend function and the slope = 139.368. Because it is a positive number, it increases long-term tendency. Hence, it is an increased trend function: “Export value increases approximately 139 million USD per year”.
- Considering p-value, the constant has alpha = 0.05 (represented by two asterisks) and the time has alpha = 0.01 (represented by three asterisks). Compared with alpha, the p-value is smaller than the level of significance. Both parameters of this trend function are statistical significance.
- This figure shows R-squared = 0.688537 which means 69% of the variation in “Export value” which is explained by this trend function. The result is not very good from a statistical viewpoint.
- P-value (F) is smaller compared with alpha (alpha = 0.01 and 0.05), which is significant relationship

Figure 12 shows the export value of the trend function which could be used to forecast for the following year.

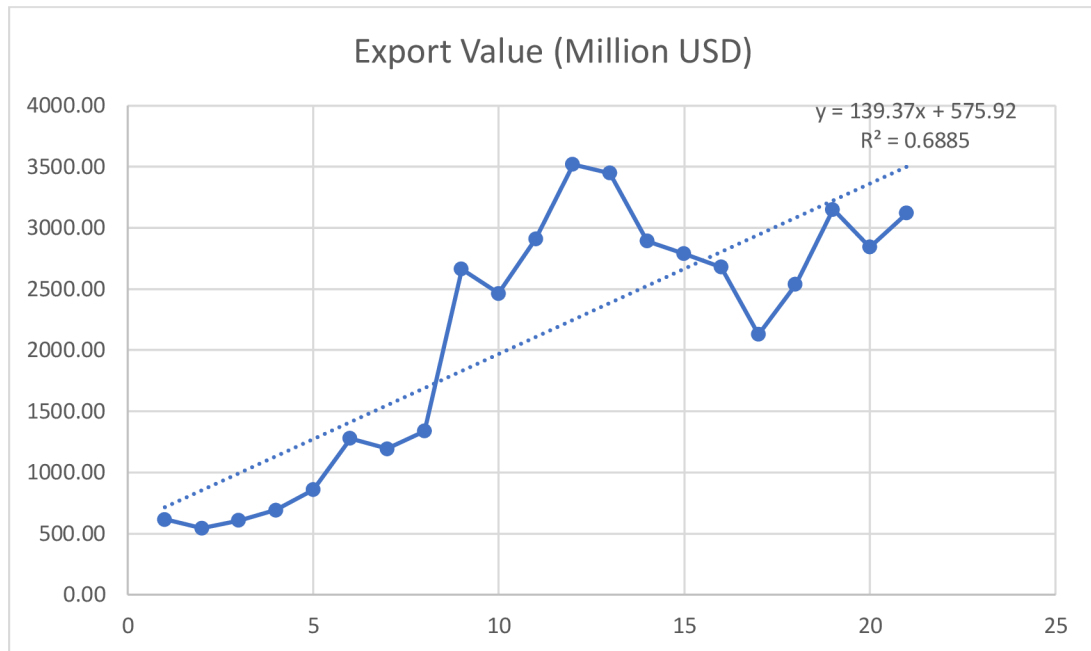


Figure 13: Trend function of Exports Value in Vietnam (million USD) (Source: The GSO of Vietnam. Graph is made by author)

From figure 13, there is an equation: $y = 139.37x + 575.92$. Predicting the following years will be calculated using the trend function.

- When $x = 22$ (year 2021)
 $y_{22} = 139.37 \cdot 22 + 575.92 = 3642.06$ (million USD)

In the 22nd year (the year 2021), the predicted value for rice export value in Vietnam is 3642.06 million USD.

According to the preliminary statistics figures of the General Department of Vietnam Customs, Vietnam's rice export earned nearly 3.03 billion USD in November of 2021. Vietnam's rice export turnover was estimated to reach 3.27 billion USD for the whole year 2021 (VNA, Business, 2022). In any case, the export price of rice did not reach the price predicted by the trend function. The reason is that the rice price is unstable over time, it is difficult to ensure the sustainability of the development of export value. However, the export price of Vietnamese rice has had the biggest gain when it has always remained at a higher level than in other countries. According to VFA, the export price has increased by 5.5% compared to the previous year.

- When $x = 23$ (year 2022)

$$y_{23} = 139.37 \cdot 23 + 575.92 = 3781.43 \text{ (million USD)}$$

In the 23rd year (the year 2022), the predicted value for rice export value in Vietnam is 3781.43 million USD.

- When $x = 24$ (year 2023)

$$y_{24} = 139.37 \cdot 24 + 575.92 = 3920.8 \text{ (million USD)}$$

In the 24th year (the year 2023), the predicted value for rice export value in Vietnam is 3920.8 million USD.

5 Results and Discussion

Vietnam has always played its part well when continuously maintaining the top position in the ranking of rice exports worldwide. According to the analysis results, rice production and yield interrelate with each other. In addition, the export quantity is affected by the export value, not the rice production. In recent years, Vietnam's rice production and export output have grown steadily and maintained their original form despite being affected by the Covid epidemic. The annual increase in total output and export value shows that rice has always played a significant role in Vietnam's economy. In 2020, Vietnam's rice production reached 42.75 million tons, exported 6.26 million tons with a value of about 3122 million USD. In recent years, due to the high export price of rice, although the export volume is not stable, it still brings a high income to the rice export industry.

As predicted by the trend function about production, export output, as well as export value will increase in the following years. However, objective factors such as the epidemics or weather can influence that predicted value - which humans have no control over. The biggest difficulty of the rice industry now is the sudden increase in prices of materials such as fertilizers and pesticides, especially fertilizer prices. The government should make decisions to stabilize the price of materials as well as transportation costs to minimize the above costs and stabilize production costs. Besides, businesses are also boldly investing in a system of modern warehouses and factories to increase the value of exported rice. They also promote links with localities, building high-quality rice-growing areas specializing in exporting to the US and Europe. This method makes make the rice production process more professional, more fruitful, and it achieves the best results.

Currently, Vietnam is focusing on the research and development of new rice varieties because the need to import and store rice in other countries is always increasing. If Vietnam wants to increase the value of rice exports, it must create rice varieties with higher yields and better quality. Thus, Vietnam can meet the strict demands from customers and compete in the field of rice exports.

If the problem of machinery and rice variety is overcome, it will greatly influence the yield. Since the yield is closely related to rice production, once the yield peaks, production increases rapidly. Just as a good rice variety will increase the value of the item, the export

value is significant for the export volume and additionally for the Vietnamese economy. At that time, the annual turnover of Vietnam will also be greatly enhanced.

Due to the COVID-19 epidemic still being very problematic, the Vice President of the Vietnam Food Association (VFA) stated it is logically impossible to anticipate anything about the rice export market in 2022. However, even in the face of such an outbreak, global food consumption will remain steady. To ensure people's food security, governments in all countries need to pay close attention to food and build up their national rice stockpiles. Rice exports may expand in quantity and value when countries such as China reopen trade gates and traditional rice-consuming markets such as the Philippines, Malaysia, etc. will increase import demand. Furthermore, the EU-Vietnam Free Trade Agreement is going to provide enormous prospects for Vietnam's rice grain to boost the value of its rice exports to Europe. Rice export will continue to be the industry which promotes Vietnam's brand and long-term development in the global market in the coming years.

6 Conclusion

This bachelor thesis analyzes the Vietnamese rice chain in the period 2000 to 2020. In particular, the analysis focuses on the production and export side. The thesis has shown that rice production and yield always have a reciprocal relationship with each other. In addition, the factors affecting the yield are also pointed out such as rice varieties and modern machines to improve and enhance production. It also clarifies that rice exports are significant for export values, which are not influenced by annual rice production.

The method used in this bachelor's thesis is based on descriptive statistical analysis as well as index analysis. The base index shows the rice chain development based on the year 2000, while the chain index clarifies the changes of the following year to the previous year. Moreover, the time series analysis is also applied with trend function and linear regression. It is used not only to describe developments in rice production and exports between 2000 and 2020 but also to predict future trends. The growth rate is used to reflect the change over two consecutive periods.

Vietnam is an agricultural country with great potential for rice cultivation. Vietnam has been able to take advantage of a country that has not been able to guarantee food security before the 1990s but has risen to become the world's leading rice exporter. The fertile alluvial soil from the delta and the weather favor wet rice development. The analysis of the Vietnamese rice chain shows the production output increases but is uneven due to the inevitable impacts from natural disasters and pests. However, the export value of rice has improved because good rice varieties in addition to Vietnam always meet the import needs of other countries. Rice farming is one of the main industries contributing greatly to the total export turnover of the country, which plays an important role in economic restructuring and social stability.

Vietnam always aims to reach higher and higher in the world rice export market. Therefore, in recent years, Vietnam has always tried to research and improve plant varieties, which help in increasing rice yield and improving rice quality, therefore helping to raise prices for high-grade rice varieties. Now through this approach, Vietnamese rice is of a higher quality and has more of a well-respected impression among other types of rice. Furthermore, Vietnam also needs to modernize supply

machinery and expand factories to meet the export requirements of importing countries. Especially, when the epidemic is still breaking out, the state should stabilize the price of domestic raw materials and the shipping fee abroad.

Another key point is that the EVFTA's influence cannot be overlooked. This is not only a powerful tool for promoting two-way trade but also a significant advantage for both sides' business community, given the worldwide economic and trade impact of the COVID-19 epidemic. The EVFTA has given Vietnam-EU relations a new impetus, opening up the large potential for cooperation and assisting in the promotion of economic activity. As a result, Vietnam's rice exports are set to begin on an exciting new road in the upcoming years.

Researching the bachelor thesis analysis on the Vietnamese rice chain has helped to study more about the development process of the rice industry from 2000 to 2020. Through that analysis, it is possible to predict the future direction in addition to the state difficulties still encountered. From that point, improved methods will be developed to contribute to the further modification and development of the rice chain in the future.

7 References

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8 Appendix

Year	Total Production (Million Tons)	Yields (t/ha)
2000	32,53	4,24
2001	32,11	4,29
2002	34,45	4,59
2003	34,57	4,64
2004	36,15	4,86
2005	35,83	4,89
2006	35,85	4,89
2007	35,94	4,99
2008	38,73	5,23
2009	38,95	5,24
2010	40,01	5,34
2011	42,40	5,54
2012	43,74	5,64
2013	44,04	5,57
2014	44,97	5,75
2015	45,09	5,76
2016	43,17	5,58
2017	42,74	5,55
2018	44,05	5,82
2019	43,50	5,82
2020	42,75	5,87

Table 4: Production and Yields 2000-2020 (Source: GSO of Vietnam)

Year	Exports Quantity (Million Tons)	Exports Value (Million USD)	Total Production (Million Tons)
2000	3,39	615,82	32,53
2001	3,53	544,11	32,11
2002	3,25	608,12	34,45
2003	3,92	693,53	34,57
2004	4,06	859,18	36,15
2005	5,21	1279,27	35,83
2006	4,69	1194,63	35,85
2007	4,53	1338,13	35,94
2008	4,68	2663,44	38,73
2009	6,05	2464,30	38,95
2010	6,75	2911,64	40,01
2011	7,13	3519,29	42,40
2012	7,72	3449,56	43,74
2013	6,68	2893,49	44,04
2014	6,32	2789,50	44,97
2015	6,57	2679,50	45,09
2016	4,89	2128,40	43,17
2017	5,77	2539,40	42,74
2018	6,15	3151,50	44,05
2019	6,40	2843,23	43,50
2020	6,25	3122,20	42,75

Table 5: Exports quantity, exports value, and total production data 2000-2020 (Source: GSO of Vietnam)