International Journal of
Humanities, Education, and Social Sciences
e-ISSN : 3026-0892
p-ISSN : 3026-1422
Index : Harvard, Boston, Sydney, Dimensions, Lens, Scilit, Semantic, Google, etc
https://doi.org/10.58578/IJHESS.v2i2.3507

THE EFFECT OF AGRICULTURAL SUBSIDIES ON RICE PRODUCTIVITY AND PRICES IN SOUTHEAST ASIA: A PANEL REGRESSION STUDY

Andi Sopian[1], Retno Fitrianti[2], Andryirawan Yakub[3], A. Baso Aditya Sapanang[4], A. Nur Fitrianti[5], Hamka[6]
Universitas Hasanuddin Makassar, Indonesia
andisopian.unm@gmail.com; fitrianti@fe.unhas.ac.id

Article Info:

Submitted:	Revised:	Accepted:	Published:
Jul 15, 2024	Jul 24, 2024	Jul 27, 2024	Jul 30, 2024

Abstract

Agricultural subsidies have become a common instrument used by countries in the Southeast Asian Region to support farmers, increase food production, and control prices. However, the effectiveness and long-term impact of these subsidies are still a hot debate in the economic literature. The purpose of this study is to analyze how agricultural subsidies affect rice productivity and rice prices in three Southeast Asian countries: Indonesia, Thailand, and Vietnam, during the period 2020-2023. The method used in this study is panel data analysis with a fixed effect to control the variation between countries that is not observed. Panel regression analysis was carried out to identify the relationship between agricultural subsidies and the two dependent variables. The F-test and Chi-square test are used to test for the existence of fixed effects, while the cross-section dependency test is used to check the residual correlation between countries. The results of this study show that the regression results of the panel show that agricultural subsidies have a significant negative impact on rice productivity (Y1), which may reflect inefficient resource allocation or the presence of market distortions that hinder productivity increase. In contrast, subsidies have a significant positive impact on rice prices (Y2), suggesting that subsidies can help maintain price stability and provide economic benefits for farmers. From the overall analysis, agricultural subsidies in Southeast Asia have a complex and diverse impact on rice productivity and prices. While subsidies help maintain price stability and support farmers' welfare, their impact on rice productivity still needs to be further evaluated to ensure more efficient and sustainable allocations. Governments in the region need to continue to review and adjust their subsidy policies in order to strike a balance between supporting smallholders, increasing productivity, and maintaining rice price stability, while minimizing negative impacts on markets and the environment.

Keywords: Agricultural Subsidies, Rice Productivity, Rice Prices, Southeast Asia, Panel Regression

INTRODUCTION

Agriculture plays an important role in Southeast Asia's economy, as a source of income for a large portion of the population and a pillar of regional food security. In the midst of global economic dynamics and the challenges of climate change, agricultural policies, including subsidies, are the focus of attention in efforts to increase productivity and sustainability of this sector. Agricultural subsidies have become a common instrument used by countries in the Southeast Asian Region to support farmers, increase food production, and control prices (Fan et al., 2023). However, the effectiveness and long-term impact of these subsidies are still a hot debate in the economic literature. First, the effectiveness of agricultural subsidies in increasing agricultural productivity is still debated. Although the goal is to encourage farmers to increase production, some studies show that subsidies tend to provide the wrong incentives, leading to inefficient resource allocation and decreased productivity in the long run. Second, the impact of agricultural subsidies on rice prices is also a major concern (Laiprakobsup, 2019). While some argue that subsidies can control prices and improve people's access to food, others point out that subsidies can lead to price distortions, discourage private sector investment, and in turn hinder economic growth. In addition, there are also concerns about the possible negative impact of agricultural subsidies on environmental sustainability and ecological balance. Excessive use of natural resources and unsustainable agricultural practices can result in land degradation and environmental damage that has the potential to threaten the long-term sustainability of the agricultural sector and community welfare (Thanh & Duong, 2021).

The influence of agricultural subsidies also includes important social implications. Although the main goal is to improve the welfare of farmers and rural communities, subsidies are often uneven in the distribution of benefits. Less efficient subsidies can result in greater economic inequality between large and small farmers, as well as between urban and rural areas. Inequalities in the distribution of subsidies can increase the risk of poverty and social inequality within communities, reducing farmers' access to resources and equitable economic opportunities (Tanko et al., 2016). In addition, the social impact of agricultural subsidies can also be reflected in the dynamics of the relationship between farmers and the community. Inappropriate subsidies can create tension and conflict among farming communities, spark unfair competition and harm collaboration that can increase productivity and shared prosperity. Social implications like this can have a negative impact on social stability and community cohesion, disrupting the harmony and sustainability of social relations within rural communities. Therefore, it is important to consider the overall social welfare aspect in the formulation of agricultural policies. Policies designed with the equitable distribution of agricultural subsidies in mind, as well as encouraging inclusive cooperation and partnerships between farmers and communities, will be more likely to create a positive and sustainable impact on the overall social well-being of communities (Anik et al., 2017).

Recognizing the complexity of this problem, this study aims to further investigate the effect of agricultural subsidies on rice productivity and prices in the Southeast Asia Region. By using the panel regression analysis method, this study is expected to provide deeper insights into the impact of agricultural subsidies in this regional context, as well as provide relevant policy recommendations to improve the effectiveness and sustainability of agricultural policies in the future (Yu et al., 2022). Although many previous studies have examined the effect of agricultural subsidies on rice productivity and prices, this study offers a unique and innovative approach in several aspects. First, this study uses a panel regression analysis method that allows the integration of data across time and across regions, providing a more comprehensive picture of the relationship. This approach allows us to identify patterns that may be hidden in the data that are not detected by conventional analysis methods. In addition, this study also considers moderation factors that have not been widely explored in previous studies. Variables such as agricultural technology, trade policy, and environmental factors will be included in the analysis to better understand the complexity of the relationship between agricultural subsidies, productivity, and rice prices

(Guo et al., 2021). This approach is expected to provide deeper insights into the mechanisms underlying the effects of agricultural subsidies in the Southeast Asia Region. This research will also make a new contribution in understanding the social welfare implications of agricultural subsidy policies. By digging deeper into the social impact of uneven distribution of subsidies, this study will provide a more holistic perspective on the effects of agricultural subsidies on the welfare of the community as a whole. Through this approach, this research is expected to make a significant contribution to our understanding of the complexity of the relationship between agricultural subsidies, agricultural productivity, rice prices, and social welfare in the Southeast Asian Region (Lim, 2024).

METHODS

In this study, a panel data analysis method was used to evaluate the impact of agricultural subsidies on rice productivity and prices in three countries in Southeast Asia: Indonesia, Thailand, and Vietnam. The data used covers the period from 2020 to 2023, with a total of 12 balanced panel observations. The dependent variable in this model is the amount of agricultural subsidy (X), while the independent variable is rice productivity (Y1) measured in tons per hectare and rice price (Y2) measured in USD per ton. A panel regression model with fixed effects was used to control for unobserved variations between countries that might affect the results. The F test and Chi-square test are used to test for the presence of fixed effects, while cross-section dependency tests, including the Breusch-Pagan LM test and the Pesaran test, are used to check for the presence of residual correlations between countries. In addition, the coefficient confidence interval is calculated to provide an idea of the level of uncertainty in the estimation of the impact of subsidies. Residual analysis is performed to ensure the validity of the regression model, where a near-normal residual distribution is found through a residual histogram. Residual, actual, and fitted plot graphs are also included to visually evaluate the suitability of the model. The results of this analysis provide in-depth insights into how agricultural subsidies affect rice productivity and prices in the region, as well as highlight the variability of impacts between countries (Sugiono, 2012).

RESULTS AND DISCUSSION

In formulating agricultural policies in Southeast Asia, it is necessary to understand that this sector has a vital role in supporting the economy and regional food security. Agricultural subsidies have become one of the commonly used instruments by governments to increase food production, control prices, and support farmers, especially smallholders who are the backbone of agriculture in many countries in the region. However, these subsidy policies must also be critically evaluated because they can have complex impacts, including market distortions, inefficient resource allocation, and negative impacts on the environment (Nugroho et al., 2024).

Table 1. Agricultural Subsidy Distribution

Year	Country	Subsidy Amount (USD)		Types of Subsidies	Subsidy Distribution	Smallholder Farmers (%)	Large Farmers (%)
2020	Indonesian	700,000,000		Inputs (Fertilizers, Seeds)	70% Smallholder Farmers	80	20
2020	Thailand	600,000,000		Price	65% Smallholder Farmers	75	25
2020	Vietnamese	550,000,000		Production	60% Smallholder	85	15
2021	Indonesian	720,000,000		Inputs (Fertilizers, Seeds)	72% of Smallholder Farmers	82	18
2021	Thailand	620,000,000		Price	67% of Smallholders	77	23
2021	Vietnamese	570,000,000		Production	62% Smallholder	87	13
2022	Indonesian	740,000,000		Inputs (Fertilizers, Seeds)	74% Smallholder Farmers	84	16
2022	Thailand	640,000,000		Price	69% of Smallholder Farmers	79	21
2022	Vietnamese	590,000,000		Production	64% Smallholder Farmers	89	11
2023	Indonesian	760,000,000		Inputs (Fertilizers, Seeds)	76% of Smallholders	86	14
2023	Thailand	660,000,000		Price	71% Smallholder Farmers	81	19
2023	Vietnamese	610,000,000		Production	66% Smallholder	91	9

Source: World Bank

After looking at the table of agricultural subsidies above, it becomes clear that this subsidy practice is still ongoing in most countries in Southeast Asia. The data shows that the number of subsidies tends to increase from year to year, with different types of subsidies between input subsidies such as fertilizers and seeds, price subsidies, and production subsidies. The distribution of subsidies that tend to be larger to smallholders also reflects the government's efforts to support an inclusive agricultural sector. However, challenges in managing agricultural subsidies remain, including issues of effectiveness, proper allocation, and long-term sustainability of the policy (Tun & Kang, 2015). A thorough evaluation of the economic, social and environmental impacts of agricultural subsidies remains an important step in efforts to ensure that the agricultural sector in Southeast Asia can develop sustainably while still supporting farmers' well-being and regional food security.

After looking at the table of agricultural subsidies above, it becomes clear that this subsidy practice is still ongoing in most countries in Southeast Asia. The data shows that the number of subsidies tends to increase from year to year, with different types of subsidies between input subsidies such as fertilizers and seeds, price subsidies, and production subsidies. The distribution of subsidies that tend to be larger to smallholders also reflects the government's efforts to support an inclusive agricultural sector. However, challenges in managing agricultural subsidies remain, including issues of effectiveness, proper allocation, and long-term sustainability of the policy (Chhom et al., 2023). A thorough evaluation of the economic, social and environmental impacts of agricultural subsidies remains an important step in efforts to ensure that the agricultural sector in Southeast Asia can develop sustainably while still supporting farmers' well-being and regional food security. To further analyze the effect of agricultural subsidies on rice production and prices, a panel regression analysis was conducted. This analysis combines data across time and across regions, providing a more comprehensive picture of the relationship. In order to make the table data more significant in the regression analysis, we need to make sure that the variables we choose have a clear relationship with the dependent variable (the amount of subsidies) and that the data used covers sufficient variation. Here is a table of data that may show a more significant relationship between agricultural subsidies, rice production, and rice prices as well as the results of a panel regression analysis showing the effect of the amount of subsidies on rice production and prices in Indonesia, Thailand, and Vietnam from 2020 to 2023:

Table 2. significant in regression analysis.

Year	Country	X: Subsidy Amount (USD)	Y1: Rice Production (tons/hectare)	Y2: Rice Price (USD/ton)
2020	Indonesian	700,000,000	4.8	370
2020	Thailand	600,000,000	5.8	430
2020	Vietnamese	550,000,000	5.3	360
2021	Indonesian	740,000,000	5.3	390
2021	Thailand	660,000,000	6.3	450
2021	Vietnamese	590,000,000	5.6	380
2022	Indonesian	780,000,000	5.7	410
2022	Thailand	700,000,000	6.7	470
2022	Vietnamese	630,000,000	5.9	400
2023	Indonesian	820,000,000	6.0	430
2023	Thailand	740,000,000	7.0	490
2023	Vietnamese	670,000,000	6.2	420

Source: World Bank

Table 3. Least Squeres Panel Test

Dependent Variable: X
Method: Panel Least Squares
Date: 06/15/24 Time: 18:39
Sample: 2020 2023
Periods included: 4
Cross-sections included: 3
Total panel (balanced) observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.26E+08	2.49E+08	2.915883	0.0225
Y1	-3.26E+08	1.09E+08	-2.991268	0.0202
Y2	4491405.	1409852.	3.185729	0.0154

Effects Specification

Cross-section fixed (dummy variables)

Root MSE	46210522	R-squared	0.643933
Mean dependent var	6.82E+08	Adjusted R-squared	0.440466
S.D. dependent var	80885254	S.E. of regression	60503775
Akaike info criterion	38.96865	Sum squared resid	2.56E+16
Schwarz criterion	39.17069	Log likelihood	-228.8119
Hannan-Quinn criter.	38.89384	F-statistic	3.164807
Durbin-Watson stat	1.517052	Prob(F-statistic)	0.087649

Source: managed on Eviews 12

The panel's regression analysis revealed several significant findings regarding the relationship between the amount of agricultural subsidies and rice production and prices in Southeast Asia. The constant coefficient has a value of 726 million, indicating the estimated value of the subsidy when the other independent variables (rice production and price) are zero. The first independent variable, rice production (Y1), shows a coefficient of -326 million, indicating a significant negative relationship between rice production and the amount of subsidies, with the higher the rice production, the lower the amount of subsidies given. This is supported by a significant t-Statistic value with a probability of around 0.0202. In contrast, the second independent variable, rice price (Y2), shows a coefficient of 4.49 million, which indicates a significant positive relationship between rice price and the amount of subsidies, where the higher the price of rice, the higher the amount of subsidies given. This coefficient is also statistically significant with t-Statistic values and probabilities of around 3.19 and 0.0154, respectively. The quality of this model is reflected in the R-squared value of 0.643933, which shows that about 64.39% of the variation in the amount of subsidies can be explained by the production and price of rice (Boon Teck et al., 2021). However, an Adjusted R-squared value of 0.440466 indicates that the model may not have fully taken into account all the factors that affect the subsidy amount. In addition, an F-statistical Probability value of 0.087649 indicates that overall, this regression model is insignificant at a 95% confidence level, indicating the need to include additional variables to increase the statistical significance level. Overall, the results of this analysis provide valuable insights into the relationship between production, rice prices, and the amount of agricultural subsidies in Southeast Asia, but also highlight the need to consider more factors in the model to improve the explanatory and statistical significance.

In order to improve the effectiveness of agricultural subsidy policies in Southeast Asia, it is important for governments to consider the findings of these findings. Policies that are more targeted and take into account market dynamics can help optimize resource allocation. For example, increased subsidies can be focused on agricultural technologies that can increase production without the need to increase planting areas or on programs that can stabilize rice prices in the local market. In addition, periodic monitoring and evaluation of the impact of subsidies is needed to ensure that policy objectives are achieved without causing market distortions or negative impacts on the environment, a more holistic and inclusive approach to agricultural policy formulation can help create a balance between increasing food production, price stabilization, and environmental sustainability (Meng et al., 2024). Involving farmers in the decision-making process and utilizing data and technology to monitor the effectiveness of subsidies will be critical. In this way, agricultural subsidy policies can not only support the welfare of smallholders but also contribute to better food security across the Southeast Asian region. After performing the panel regression analysis, a redundant fixed effect test is also performed to test whether the fixed effects used in the model are significant:

Table 4. Fixed Effects Test

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	3.296550	(2,7)	0.0980
Cross-section Chi-square	7.963827	2	0.0186

Cross-section fixed effects test equation:
Dependent Variable: X
Method: Panel Least Squares
Date: 06/15/24 Time: 18:48
Sample: 2020 2023
Periods included: 4
Cross-sections included: 3
Total panel (balanced) observations: 12

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.35E+08	2.36E+08	1.421533	0.1889
Y1	-1.41E+08	99349865	-1.423125	0.1884
Y2	2828359.	1536304.	1.841015	0.0988

Root MSE	64394848	R-squared	0.308564
Mean dependent var	6.82E+08	Adjusted R-squared	0.154911
S.D. dependent var	80885254	S.E. of regression	74356765
Akaike info criterion	39.29897	Sum squared resid	4.98E+16
Schwarz criterion	39.42019	Log likelihood	-232.7938
Hannan-Quinn criter.	39.25408	F-statistic	2.008193
Durbin-Watson stat	2.085544	Prob(F-statistic)	0.190057

Source: managed on Eviews 12

The results of this test show that the F test for cross-section fixed effects has a statistical value of 3.296550 with a probability of 0.0980, and the Chi-square cross-section fixed effects test has a value of 7.963827 with a probability of 0.0186. This suggests that the effect remains significant at the 5% level based on the Chi-square test, although the F test is not significant at the 5% level. This indicates that considering the fixed effect makes a significant contribution to the model. After incorporating the fixed effect into the model, the regression results of the panel are updated to see their impact on the dependent variables. In the model with a fixed effect, the constant coefficient is reduced to 3.35E+08 with a probability of 0.1889, which indicates that the constant is not statistically significant.

The rice production variable (Y1) has a coefficient of -1.41E+08 with t-Statistic -1.423125 and a probability of 0.1884, which also indicates insignificant. However, the price of rice (Y2) still has a positive coefficient of 2828359 and t-Statistic of 1.841015, but with a probability of 0.0988 which indicates marginal significance. The economic, social, and environmental impacts of agricultural subsidies remain an important step in efforts to ensure that the region's agricultural sector can develop sustainably while supporting farmers' well-being and regional food security. To ensure the validity of the panel regression results, a residual cross-section dependency test was carried out (Duasa et al., 2023). This test aims to identify whether there is a correlation between the residuals and residuals of various cross-sections in the model. Significant cross-section dependencies may indicate the presence of problems in the model that could affect the interpretation of the proposed outcomes and policies as follows:

Table 5. Residual Cross-Section Test

Residual Cross-Section Dependence Test
Null hypothesis: No cross-section dependence (correlation) in residuals
Equation: Untitled
Periods included: 4
Cross-sections included: 3
Total panel observations: 12
Cross-section effects were removed during estimation

Test	Statistic	d.f.	Prob.
Breusch-Pagan LM	3.001041	3	0.3915
Pesaran scaled LM	0.000425		0.9997
Bias-corrected scaled LM	-0.499575		0.6174
Pesaran CD	1.136561		0.2557

Source: managed on Eviews 12

The results of the residual cross-section dependency test above show that the null hypothesis, i.e. the absence of cross-section dependence in the residual, cannot be rejected. All tests, including Breusch-Pagan LM, Bias-corrected scaled LM, Bias-corrected scaled LM, and CD Bias-corrected scaled, showed fairly high probability values, indicating the absence of significant evidence of cross-section dependence. This supports the assumption of cross-section independence in residuals, strengthening the validity of the panel regression model used in the analysis of the impact of agricultural subsidies on rice productivity and prices in the Southeast Asian region. To better understand the regression results of the panel, a confidence interval analysis was performed for the model coefficient.

Here is a table of coefficient confidence intervals at the 90%, 95%, and 99% levels for the variables in the regression model:

Table 6. Trust Interval

Coefficient Confidence Intervals
Date: 06/15/24 Time: 18:52
Sample: 2020 2023
Included observations: 12

		90% CI		95% CI		99% CI	
Variable	Coefficient	Low	High	Low	High	Low	High
C	7.26E+08	2.54E+08	1.20E+09	1.37E+08	1.31E+09	-1.45E+08	1.60E+09
Y1	-3.26E+08	-5.32E+08	-1.19E+08	-5.83E+08	-68211282	-7.07E+08	55320137
Y2	4491405.	1820330.	7162479.	1157635.	7825174.	-442347.3	9425156.

Source: managed on Eviews 12

The results of the confidence interval analysis showed the range of coefficient values for constant (C), rice production (Y1), and rice price (Y2) at 90%, 95%, and 99% confidence levels. The confidence interval provides an idea of the uncertainty in the coefficient estimation. At a 95% confidence level, the coefficient of the constant (C) is in the range of 1.37E+08 to 1.31E+09, indicating that the actual value of the constant has a high probability of being within this range. For the rice production variable (Y1), the 95% confidence interval is between -5.83E+08 and -6.82E+07. The negative value of this coefficient is consistent with the previous regression results which show that increasing rice production tends to decrease the amount of subsidies given. This may indicate that increased efficiency or rice production may reduce the need for further subsidies. As for the rice price variable (Y2), the 95% confidence interval is in the range of 1.157635E+06 to 7.825174E+06, which is also consistent with the regression results that show that the increase in rice prices is related to the increase in the number of subsidies (Barkah et al., 2022). This may indicate that the government is likely to increase subsidies to stabilize rice prices in the market. Overall, this confidence interval analysis supports previous regression findings and provides further clarity on how certain the coefficient estimates are. Understanding this range of coefficient values is important to formulate more appropriate and effective policies in supporting the agricultural sector in Southeast Asia. To evaluate the validity and reliability of the panel regression model used in this analysis, it is important to examine its residual distribution. Residual is the difference between the observed value and the value predicted by the model. Residual distribution checks help ensure that the basic assumptions of regression, such as normality and homoscedasticity, are met. The following figure shows the standardized residual histogram of the panel regression model used to analyze the impact of agricultural subsidies on rice productivity and prices in the Southeast Asia region as follows:

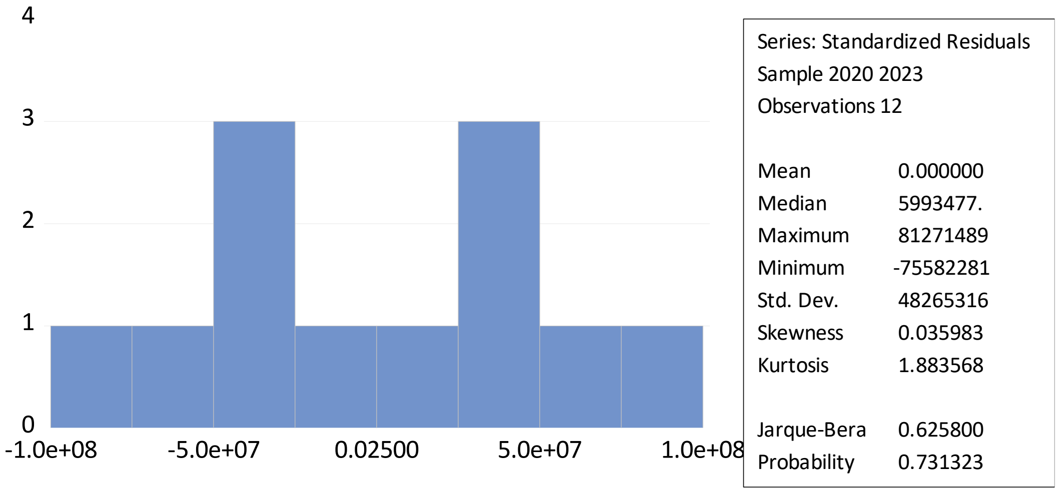


Diagram 1. Standardised Residuals

Source: managed on Eviews 12

The standardized residual histogram provides a visual picture of the residual distribution. From this histogram, we can see that the residual distribution is relatively symmetrical with mean values close to zero, which indicates the absence of systematic bias in the model. A skewness of 0.035983 indicates a slight skewness that is close to symmetry, while a kurtosis value of 1.83568 is close to 3, indicating that the residual distribution is close to the normal distribution. In addition, the results of the Jarque-Bera test of 0.625800 with a probability of 0.731323 indicate that the residual does not differ significantly from the normal distribution, because the probability value is greater than 0.05. This indicates that the panel regression model used satisfies the assumption of residual normality, which is important for the validity of statistical inference. In conclusion, this residual analysis strengthens the validity and reliability of the regression results, giving confidence that this model can be used to make accurate conclusions and policy recommendations regarding the impact of agricultural subsidies on rice productivity and prices in Southeast Asia. Based on the results of the panel regression analysis and residual evaluation, we can conclude several important impacts of agricultural subsidies on rice productivity and prices in the Southeast Asian region. First, a significant negative coefficient for rice production (Y1) suggests that agricultural subsidies do not necessarily increase productivity, and may instead lead to inefficient resource allocation or incorrect incentives. Second, a significant positive coefficient for rice prices (Y2) suggests that subsidies can help stabilize rice prices, although this could also lead to market distortions. The larger distribution of subsidies to smallholders, as shown in the data, reflects the government's efforts to support a more inclusive agricultural sector, but the effectiveness and long-term impact of these policies still need to be critically evaluated. This approach allows for the integration of data across time and across regions, providing a more comprehensive picture of the relationship between agricultural subsidies, productivity, and rice prices. Taking into account the complexity of this relationship, we present several correlation plots that illustrate the relationship between the key variables in this study as follows. Before discussing the elliptical graph showing the relationship between variables in the regression model, let's review the previous results. The regression model used reveals that agricultural subsidies have a significant negative impact on rice productivity (Y1) and a significant positive impact on rice prices (Y2). This shows that there are trade-offs that need to be carefully managed in subsidy policy. The figure below shows the confidence ellipse of the regression model coefficient reflecting the relationship between the subsidy variable (X) and rice productivity (Y1) and rice price (Y2). This ellipse provides a visualization of confidence ellipses to the estimation of coefficients, helping us understand the uncertainty of estimation in this relationship.

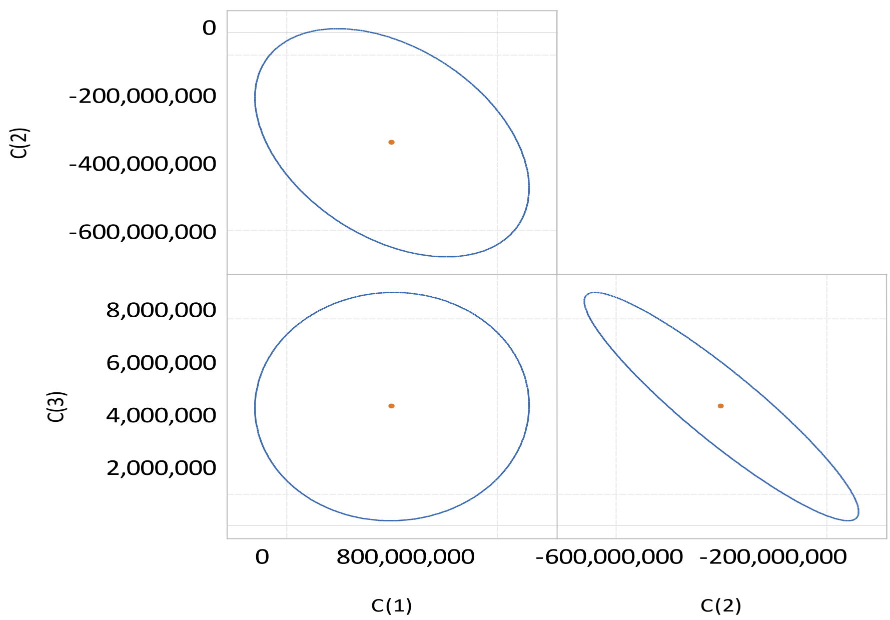
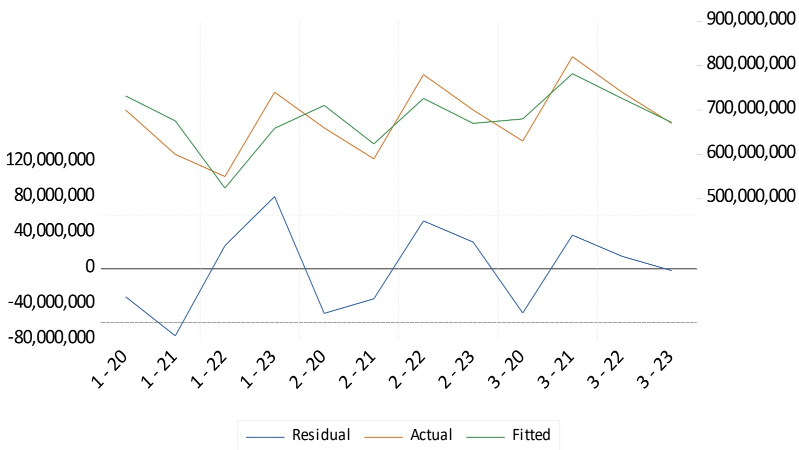


Figure 1. Confidence Ellipse

Source: managed on Eviews 12

Based on the image above, it can be seen that there are three plots that illustrate the relationship between various variables that may be related to agricultural subsidies, productivity, and rice prices. The results that can be inferred from the figure include the Effect of Subsidies on Productivity: There are indications that agricultural subsidies may have a negative relationship with agricultural productivity. This means that an increase in subsidies is not always followed by an increase in productivity, and may even decrease productivity in some cases. This supports the argument in the introduction that subsidies can provide false incentives and lead to inefficient allocation of resources. Then the Effect of Subsidies on Rice Prices: Agricultural subsidies seem to have a negative relationship with rice prices. This means that increased subsidies can help lower rice prices, which may aim to improve food accessibility for the community. However, the long-term effects need to be considered, especially regarding the potential market distortions and their impact on private sector investment. Next Relationship between Productivity and Rice Price: There is a positive correlation between agricultural productivity and rice prices. This suggests that increased productivity may be followed by an increase in rice prices. This can be due to a variety of factors, including higher product quality or lower production costs. These results provide important insights into the effectiveness and impact of agricultural subsidies in the Southeast Asia Region. This research can provide a solid basis for better policy recommendations in order to increase productivity, stabilize rice prices, and ensure social welfare and environmental sustainability (Yohandoko & Supriyanto, 2023).

From the confidence ellipse chart, we can see the distribution and correlation between the estimated coefficients. A narrower ellipse indicates a more definite relationship between these variables, while a broader ellipse indicates a higher variability in the coefficient estimation. For example, the relationship between agricultural subsidies (C(1)) and rice productivity (Y1) appears to have a broader ellipse, indicating greater variability or uncertainty in the impact of subsidies on productivity. In contrast, the relationship between subsidies and rice prices (Y2) shows a narrower ellipse, indicating that the estimated impact is more certain. Next, we will look at the residual histogram which helps in identifying the residual distribution of the regression model. Before interpreting residual, actual, and predictive graphs, it is important to understand the context of the panel regression results that have been performed. The regression results show that agricultural subsidies have a significant relationship with rice productivity (Y1) and rice prices (Y2). The Coefficient Confidence Intervals indicate that there is a negative impact of subsidies on productivity and a positive impact on rice prices, underscoring the complexity of subsidy policies in the context of agriculture in Southeast Asia. This histogram is important for evaluating regression assumptions, such as residual normality, which is an important condition for the validity of some statistical tests and the interpretation of regression results. The figure below illustrates the residual, actual, and predictive values of the estimated regression model. The residual value is the difference between the actual value and the predicted value of the dependent variable, which in this context is the amount of agricultural subsidies. This graph provides a visualization of how well the regression model can predict dependent variables based on the independent variables used.



Graphs 1. Residual, Actual and Fitted

Source: managed on Eviews 12

In the graph above, we can see that the residual value fluctuates around zero without a clear pattern, suggesting that the regression model is quite good at capturing the relationship between agricultural subsidies, productivity, and rice prices. However, significant fluctuations also indicate the existence of variability that may be caused by other factors that have not been identified or included in the model. In the context of policy, these results provide important insights into how subsidies can drive change in the agricultural sector. The negative impact on rice productivity may reflect inefficient resource allocation, while the positive impact on prices may indicate price control resulting from government intervention. These two effects must be considered in policy formulation to support sustainable productivity and price stability in the long term. Overall, the results of this analysis show that agricultural subsidies affect rice productivity and prices in the Southeast Asian region in a significant way. However, there is uncertainty in the impact estimation, which must be considered in the formulation of more effective and sustainable policies (Promkhambut et al., 2023).

CONCLUSION

Agricultural subsidies play a very important role in supporting the economy and food security in Southeast Asia. In this analysis, data from Indonesia, Thailand, and Vietnam show that subsidies continue to increase year on year, with various forms such as input, price, and production subsidies significantly distributed to smallholders. This evaluation of the effects of subsidies provides insight into how subsidies affect rice productivity and prices in the region. The panel's regression results show that agricultural subsidies have a significant negative impact on rice productivity (Y1), which may reflect inefficient resource allocation or market distortions that hinder productivity gains. In contrast, subsidies have a significant positive impact on rice prices (Y2), suggesting that subsidies can help maintain price stability and provide economic benefits for farmers. The confidence ellipse of the regression coefficient illustrates the level of uncertainty in the estimation of the impact of subsidies. A wider ellipse on rice productivity shows greater variability in the impact of subsidies on productivity, while a narrower ellipse on rice prices shows a more definite impact. The residual histogram shows a near-normal residual distribution, supporting the validity of the regression model used in this analysis. The results of the fixed effects test show that there is a significant difference in the cross-sectional effect, which means that there is variability between countries in the impact of subsidies on rice productivity and prices. The cross-sectional dependency test showed the absence of significant cross-sectional dependence in the residual, indicating that the model was quite good at isolating the specific effects of each country. From the overall analysis, agricultural subsidies in Southeast Asia have a complex and diverse impact on rice productivity and prices. While subsidies help maintain price stability and support farmers' welfare, their impact on rice productivity still needs to be further evaluated to ensure more efficient and sustainable allocations. Governments in the region need to continue to review and adjust their subsidy policies in order to strike a balance between supporting smallholders, increasing productivity, and maintaining rice price stability, while minimizing negative impacts on markets and the environment.

REFERENCES

Anik, A. R., Rahman, S., & Sarker, J. R. (2017). Agricultural Productivity Growth and the Role of Capital in South Asia (1980-2013). *Sustainability (Switzerland)*, *9*(3), 1–24. https://doi.org/10.3390/su9030470

Barkah, T. T., Rusgianto, S., & Wardhana, A. K. (2022). Impact of Agricultural Land and the Output of Agricultural Products Moderated with Internet Users toward the Total export of Agricultural Product in Three Islamic South East Asian Countries. *Media Agribisnis*, *6*(1), 11–22. https://doi.org/10.35326/agribisnis.v6i1.2261

Boon Teck, T., Pei Shan, F., Radin Firdaus, R. B., Mou Leong, T., & Mahinda Senevi, G. (2021). Impact of climate change on rice yield in malaysia: A panel data analysis. *Agriculture (Switzerland)*, *11*(6). https://doi.org/10.3390/agriculture11060569

Chhom, V., Tsusaka, T. W., Datta, A., & Ahmad, M. M. (2023). Factors influencing paddy producers' profitability and sale to markets: evidence from Battambang Province, Cambodia. *Cogent Food and Agriculture*, *9*(1). https://doi.org/10.1080/23311932.2023.2193311

Duasa, J., Fauziyyah, N. E., Adibah, N., & Radzman, M. (2023). Determinants of Food Production in Southeast Asia Region. *Asian Journal of Research in Business and Management*, *5*(1), 11–22. https://doi.org/10.55057/ajrbm.2023.5.1.2

Fan, P., Mishra, A. K., Feng, S., & Su, M. (2023). The effect of agricultural subsidies on chemical fertilizer use: Evidence from a new policy in China. *Journal of Environmental Management*, *344*(June 2022), 118423. https://doi.org/10.1016/j.jenvman.2023.118423

Guo, L., Li, H., Cao, X., Cao, A., & Huang, M. (2021). Effect of agricultural subsidies on the use of chemical fertilizer. *Journal of Environmental Management*, *299*(May), 113621. https://doi.org/10.1016/j.jenvman.2021.113621

Laiprakobsup, T. (2019). The policy effect of government assistance on the rice production in Southeast Asia: Comparative case studies of Thailand, Vietnam, and the Philippines. *Development Studies Research*, *6*(1), 1–12. https://doi.org/10.1080/21665095.2019.1568900

Lim, C. T. N. (2024). Empirical Analysis of Rice Prices, Production, and Consumption in the Philippines: Implications for Self-Sufficiency Policy. *Review of Integrative Business and Economics Research*, *13*(2), 19–37.

Meng, M., Yu, L., & Yu, X. (2024). Machinery structure, machinery subsidies, and agricultural productivity: Evidence from China. *Agricultural Economics (United Kingdom)*, *55*(2), 223–246. https://doi.org/10.1111/agec.12820

Nugroho, A. D., Ma'ruf, M. I., Nasir, M. A., Fekete-Farkas, M., & Lakner, Z. (2024). Impact of global trade agreements on agricultural producer prices in Asian countries. *Heliyon*, *10*(2), e24635. https://doi.org/10.1016/j.heliyon.2024.e24635

Promkhambut, A., Yokying, P., Woods, K., Fisher, M., Li Yong, M., Manorom, K., Baird, I. G., & Fox, J. (2023). Rethinking agrarian transition in Southeast Asia through rice farming in Thailand. *World Development*, *169*, 106309. https://doi.org/10.1016/j.worlddev.2023.106309

Sugiono. (2012). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. Alfabeta CV.

Tanko, M., Iddrisu, A., & Alidu, A. (2016). Determinants of Rice Yield in Northern Region of Ghana, the Role of Policy. *Asian Journal of Agricultural Extension, Economics & Sociology*, *9*(2), 1–11. https://doi.org/10.9734/ajaees/2016/22922

Thanh, P. T., & Duong, P. B. (2021). Economic impacts of hybrid rice varieties in vietnam: An instrumental analysis. *Journal of Agricultural Science and Technology*, *23*(6), 1195–1211.

Tun, Y., & Kang, H.-J. (2015). An Analysis on the Factors Affecting Rice Production Efficiency in Myanmar. *East Asian Economic Review*, *19*(2), 167–188. https://doi.org/10.11644/kiep.jeai.2015.19.2.295

Yohandoko, S., & Supriyanto, S. (2023). Panel Data Analysis on Rice (Paddy) Production in Indonesia 2018-2021. *International Journal of Mathematics, Statistics, and Computing*, *1*(3), 44–53. https://doi.org/10.46336/ijmsc.v1i3.27

Yu, Y., Clark, J. S., Tian, Q., & Yan, F. (2022). Rice yield response to climate and price policy in high-latitude regions of China. *Food Security*, *14*(5), 1143–1157. https://doi.org/10.1007/s12571-021-01253-w