International Journal of Research in Engineering, Science and Management
Volume 6, Issue 12, December 2023
https://www.ijresm.com | ISSN (Online): 2581-5792

Self-Sufficiency in Private Sector Dynamics: A Holistic Analysis of the Optimization of the Agricultural Sector in the Philippines

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***Abstract*: This research examines the impact of initiatives from the private sector to reach self-sufficiency in the Agricultural Sector. The researchers utilized the following independent variables: Land Ownership of Farmers, Agricultural Credit, Agricultural Exports, Raw Material Imports, and Foreign Direct Investments concerning Agricultural Output — the dependent variable. Using a Time Series Approach, data from 2005 to 2021 was utilized and tested through the Ordinary Least Squares (OLS) regression analysis. Findings have revealed that while technology and importing raw materials could drive growth, agricultural credit and land ownership heavily depend on government policies and reforms. That said, government intervention could not be isolated from the Agricultural Sector as collaborating between the private and public sectors would optimize the agricultural sector.**

***Keywords*: agricultural output, private sector, technology transfer, land ownership, raw material imports, exports, foreign direct investments, agricultural credit.**

1. Introduction

Elevated poverty rates still exist among individuals in developing nations who depend on agriculture as their fundamental livelihood compared to those involved in alternative economic sectors. Moreover, it is worth noting that these individuals frequently comprise a significant proportion, often the majority, of the overall poverty-stricken populace within their own countries. (Cervantes-Godoy & Dewbre, 2010).

Table 1
Average annual growth of the agricultural sector

	2000-2010	2010-2020
China	4.2	3.7
India	2.7	3.7
Indonesia	3.5	3.8
East Asia and the Pacific	3.5	3
Latin America and the Caribbean	3	2.5
Sub-Saharan Africa	5.2	3.4
Philippines	3.8	1.7

Source: World Bank national accounts data and OECD National Accounts data files

Over the past two decades, the agricultural sector has depicted various global growth trends. China demonstrated solid agrarian growth, with a growth rate of 4.2 percent from 2000 to 2010 and 3.7 percent from 2010 to 2020. Following closely, India and Indonesia exhibited remarkable growth rates. Concerning swiftness, due to the substantial growth, Sub-Saharan Africa surpassed East Asia and the Pacific.

Meanwhile, agriculture in the Philippines has exhibited significant growth during the 1960s and 1970s, mainly due to the adoption of advanced technologies. While agribusiness initiatives propelled growth, obstacles during the 1980s and 1990s still needed to be prevented (Briones, 2021). A decade later, due to the significant price increase, a recovery was evident during the 2000s. However, throughout the 2010s, the growth rate declined vastly to 1.7 percent, indicating a poor performance compared to previous decades.

Despite being in decline together with economic development, the Philippine Agricultural Sector still has significant opportunities for growth given that the dynamic Asian Food Markets are ever-changing. Nevertheless, governance and policy constraints restricted Filipino Farmers' capability to capitalize on these opportunities. Therefore, crucial reforms are necessary to fortify and strengthen the role of agriculture in further shaping our Philippine economy (Rosegrant & Sombilla, 2019).

The unappealing growth of the agricultural sector's factors of production caused the decline in its growth. Additionally, it is ideal for the government to focus on producing public goods that target agro-labor productivity in the long term (Briones, 2021).

Notably, there is significant backing for increased governmental aid toward the agricultural sector, which contradicts the principles of market liberalism that have prevailed over the past decades (Cockfield & Otterill, 2012). Government intervention in the economy is classically justified by ensuring the supply of public goods and alleviating market failure. Observations suggest that governments engage in market intervention even in cases where market failure is absent and a significant proportion of government resources are allocated towards private goods rather than public goods (Lopez, 2005). Nonetheless, government intervention in agriculture to correct market mechanisms is a necessary objective (Czyzewski & Majchrzak, 2017).

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According to a policy effect study in Southeast Asian countries, in early times, government intervention came in the form of tax implementations to gather profits from exports of agricultural commodities. This action's undertaking is with the government's attempt to safeguard both the industry and consumers from the fluctuation of commodity prices, contrary to the interests of farmers. Aside from this, the government often regulates agricultural commodity prices by setting them at a lower rate than the global market to safeguard consumers and industry from the impact of commodity price volatility. Interventions also came in the form of export restrictions, which governments commonly utilize to avert shortages of commodities in the local market, which can increase food prices (Laiparakobsup, 2019).

This study aims to investigate the effects of non-government interventions or private variables on the Agricultural Output of the Philippines. By isolating government interventions, it will be easier to understand the capabilities of the agricultural sector to sustain itself by privatizing the agricultural sector as a whole or at least finding the optimal government intervention to boost the sector's efficiency. The study aims to contribute to future research to find the optimal level of intervention for both private and government to maximize the agricultural sector's contribution to the total GDP.

A. Significance of the Study

To contribute mainly to the agricultural sector of The Philippines, this paper aims to fill the gaps in past studies by providing Filipinos with a better perspective on understanding the effectiveness and relevance of the private sector in the Philippine agricultural sector. Moreover, future researchers can use this paper as a foundation to understand the optimal level of government intervention to maximize efficiency in the agricultural sector.

B. Scope and Limitation

This research paper focused on assessing the agricultural output in the Philippines while considering land ownership, agricultural credit, raw material imports, foreign direct investments, and agricultural exports from 2005 to 2021. The researchers utilized secondary data gathered from the World Bank, the International Monetary Fund, and the Philippine Statistics Authority.

2. Literature Review

A. Land Ownership of Farmers on Agricultural Output

Land is an essential aspect of agricultural production. It creates opportunities for farmers to increase their production of agricultural goods. Furthermore, land contributes to the productivity of farmers. Studies show that developing countries have given respect to land policies and reforms to maintain productivity in the agricultural sector (Zhang et al., 2022). On the other hand, a study conducted on the Western Himalayas expressed that the limited size of landholding poses a considerable challenge to augmenting agricultural productivity, given that smaller and fragmented land parcels intensify the demand for manual labor. Thereby, it is crucial to prioritize the consolidation of land while considering the principles of sustainability and capability (Shukla et al., 2018).

Numerous studies have shown that higher agricultural productivity stems from their land holding or farm size (Binswanger-Mkhize et al., 2009). Moreover, when farmers hold ownership and property rights to their farmland, it encourages them to invest more, leading to higher agricultural efficiency and productivity (McConnell & Servaes, 1990; Short, 1994; Zhang et al., 2001; Jefferson & Su, 2006). However, some studies also emphasize the unsettled debate regarding the effect of land ownership on agricultural productivity. Other findings have also shown that there should be more focus on agricultural infrastructures and institutions rather than on the privatization of land (Lee, 2011). However, land in the Philippines has been a crucial factor that limits production. According to the International Rice Research Institute (2014), one of the main reasons the Philippines has been importing rice is the need for land ownership. Proper implementation of land reforms is necessary to prevent an increase in rice imports (Koirala et al., 2016). In addition, unregistered land in economically disadvantaged nations significantly impacts their agricultural productivity. The presence of land without a title not only leads to inefficiencies in the land market but also results in distortions in the choice of occupation (Chen, 2017).

H1: Land Ownership of Farmers causes an increase in the Agricultural Output of the Philippines.

B. Agricultural Credit on Agricultural Output

For the past years, the credit source of our farmers has shifted. Commercial banks have become the primary credit source of the agricultural sector for the past few years (Kumar et al., 2010). A study in Nigeria on the effect of their Agricultural Credit Scheme on their Agricultural Output has pointed out that Financial Institutions view the Agricultural sector as a high-risk sector. Additionally, many farmers, especially those economically disadvantaged, have a shortcoming regarding the collateral they need to secure credit from financial institutions (Reubun et al., 2020). Agricultural credit is being referred to by some studies as the manner of offering financial assistance to individuals engaged in agricultural activities, such as farmers. In the study that Sodeeq et al. (2019) conducted, they defined Agricultural Credit as a mechanism through which an institution provides financial aid to an individual, another institution or organization, or a group of individuals, altogether with the knowledge of repaying the borrowed amount according to the terms stipulated in their mutually and legally binding agreement. In addition to this definition, Enoma (2010) has portrayed credit as an efficient and viable method of procuring resources that will help boost agricultural productivity. Moreover, agricultural credit would also allow farmers to explore novel fields of production and instill them with confidence and optimism.

As farming systems develop through modernization, the industry requires even more investments. As most farmers in developing nations own small and fragmented land, it emphasizes the need for agricultural credit for investments.

Moreover, underdeveloped economies have a lower rate of savings. Thus, farmers' owned equity needs to be improved, which leads to external borrowings (Chisasa& Makina, 2012).

The financial conditions in developing countries influence the small farmers' investment decisions. With that said, incomplete insurance and constraints in the credit market reduce investments in high-profit activities (Karlan et al., 2014). According to Stiglitz and Andrew (1983), uncertainties in the credit market happen because of information asymmetry, thus affecting financial institutions. Moreover, agricultural credit allows farmers to finance an agricultural season while protecting them from uncertainties that reduce efficiency (FAO et al., 2013). Supporting this, Donkoh et al. (2016) state that participating in the Agricultural Credit Program caused an increase in crop production in four districts of northern Ghana. Moreover, Ogechi and Ikpesu (2016), Osa-Afiana and Kelikume (2016), and Sunny (2013) all agree that agricultural credit has positive effects that are significant on agricultural productivity.

H2: Agricultural Credit positively impacts the Agricultural Output of the Philippines.

C. Raw Material Imports on Agricultural Output

In a study conducted in North African countries, it was evident that importing agricultural raw materials gave significant growth in the agricultural sector, eventually leading to economic growth (Bakari, 2019; Abidin et al., 2022). The transfer of technology from imports has significantly increased the country's agricultural productivity (Bakari, 2019). However, trade liberalization or a more open trade makes it harder for raw material imports to enter a country's agricultural sector (Hye, 2011).

The development of a particular commodity depends on the raw materials imported. Studies have shown that imports and exports have complementarity as those who have expanded the importation of raw materials have seen significant growth in their export volumes. However, the benefit would depend on the source of import and the conditions of the industry or company (Feng et al., 2016). A study has also focused on the importance of assessing the risk of imports and not only those of exports (Baranauskaite & Jureviciene, 2021). Mismanagement of import risks would affect the quality of life, food security, and the country's economic and political welfare.

H3: Raw Material Imports are directly related to the Philippines' agricultural output.

D. Foreign Direct Investments in Agricultural Output

The early notion of foreign direct investment started as the classical theory of international trade was first explained or introduced in Ricardo's theory of comparative advantage. Building on Ricardo's theory of comparative advantage, it states that countries should export cheap and abundant products and import scarce resources (Kurtishi-Kastrati, 2013). However, a more modern definition of FDI would be a sum of equity capital, short and long-term capital, or reinvested earnings from a foreign source to a domestic country (World Bank, n.d.). FDI can cause spillover effects from the knowledge and technology of developed countries to developing countries, thus creating opportunities for growth and development for the domestic country or industry (Santangelo, 2018).

Theoretically, foreign direct investment benefits the agricultural sector by acting as a capital that stimulates growth. Moreover, it also benefits the sector by introducing better technology and knowledge from international to domestic (Slimane et al., 2016). However, the results from the studies show that foreign direct investments harm the agricultural sector.

The researchers formulated that the FDI could be the reason for widening income inequality and can obstruct the growth of the domestic economy. Agreeing with the negative impact of FDI, Djokoto (2013) stated that higher investments should lead to better performance. However, there should be an emphasis on inflation and currency conversion. Resources purchased outside the country would result in higher resource prices, thus creating a negative impact. According to Djokoto et al. (2014), FDI has minimal short-term effects because investments such as machinery, irrigation systems, and others take months or years before being set up.

Moreover, investments in agricultural commodities require time before maturing. The findings of Epaphra and Mwakalasya (2017) show that FDI does not affect agriculture. Empirical results showed that the coefficient for FDI is insignificant towards agricultural output.

On the other hand, Awunyo-Vitor and Adjoa Sackey (2018) had different results. In their study, FDI had a significant positive effect on the agricultural sector. Moreover, Agba et al. (2018) also supported the idea that the FDI would only have a positive effect on the sector in the long run. In a study in Nigeria, Akande et al. (2013) concluded that FDI is unlikely to have a long-term effect on agricultural output. Although providing a positive effect in the short run, Iddrisu et al. (2015) additionally proved that FDI harms the Agricultural Sector.

H4: Foreign direct investments negatively affect the Agricultural Output of the Philippines

E. Agricultural Exports on Agricultural Output

According to Verter & Becvarova (2016), exporting goods and services is needed to import foreign products. Moreover, this exchange would create a sustainable exchange to stimulate the economy's capabilities to continue the production of goods and services. Results from the study showed a positive relationship between agricultural exports and economic growth. Agreeing with this, Ijirshar (2015) observed that agricultural exports are essential for economic growth. Moreover, the study's results showed strong empirical evidence that there is a direct relationship between agricultural exports and economic growth, both in the short and long run. A study conducted by Osabohien et al. (2019) had similar findings. However, they added that strengthening the agricultural sector would increase job opportunities and earn more from foreign exchange.

On the other hand, Mehraraa and Baghbanpour (2023) had a different result. In their study, agricultural exports do not affect the economic growth of developing countries. Moreover, developing countries would experience no or minimal

economic growth from the agricultural sector because of the use of traditional equipment and methods. Another factor to consider is farmers' unwillingness to acquire new technologies because of a lack of capital, food, and high energy prices (Matahir & Tuyon, 2013). In a study conducted by Shah et al. (2015), the findings show that agricultural exports have an inverse relationship with Pakistan's economic growth. The explanation is that Pakistan's agricultural exports are composed of raw materials and not value-added products. Moreover, the selling price of raw materials in the world market is low.

H5: Agro-based Exports cause a decrease in the Agricultural Output of the Philippines.

F. Synthesis

This research paper aims to determine the effects of privatizing the agricultural sector by identifying the relationship between agricultural output and non-government variables such as land ownership of farmers, agricultural credit, raw material imports, foreign direct investments, and agricultural exports.

Land ownership structure provides a positive effect on agricultural output and efficiency. Farmers who hold land ownership and property rights stimulate personal investment in the property, thus increasing efficiency, productivity, and ultimately, output (McConnell & Servaes, 1990; Short, 1994; Zhang et al., 2001; Jefferson & Su, 2006; Zhang et al., 2022). According to the International Rice Research Institute (2014), Koirala et al. (2016) and Chen (2017) agree that the lack of land ownership causes inefficiencies in the land market, which causes agricultural output to decrease.

Agricultural credit has positive effects that are notable on agricultural productivity (Sunny, 2013; Osa-Afiana & Kelikume, 2016; Ogechi & Ikpesu, 2016). Agricultural credit empowers farmers to finance agricultural activities while safeguarding them from sector uncertainties (FAO et al., 2013). In a study by Donkoh et al. (2016), agricultural credit caused an increase in crop production in northern Ghana.

Importing agricultural raw materials caused significant growth in the agricultural sector (Bakari, 2019; Abidin et al., 2022). According to Feng et al. (2016), maximizing imports of raw materials would significantly grow outputs. However, the benefit would vary depending on the source of import and conditions of the sector. Moreover, Baranauskaite and Jureviciene (2021) emphasized that assessing the risks included in importing raw materials is essential. Mismanagement of importation risk will affect the country's economic and political welfare.

Foreign Direct Investments (FDI) should benefit the agricultural sector by acting as capital to stimulate growth. However, based on studies, FDI harms the agricultural sector (Akande et al., 2013; Djokoto, 2013; Iddrisu et al., 2015; Slimane et al., 2016; Epaphra & Mwakalasya, 2017). Moreover, inflation and currency exchange rates cause higher resource prices, resulting in a negative impact. Furthermore, FDI can worsen income inequality and obstruct growth in the domestic country (Djokoto, 2013). Furthermore, FDI should have minimal effects in the short run because investments such as machinery, irrigation systems, and agricultural materials take months or years to function fully.

Agricultural exports do not affect the agricultural output. Reasons for this are the farmer's unwillingness to acquire better technology because of a lack of capital, food, and higher energy prices (Mehraraa & Baghbanpour, 2023; Matahir & Tuyon, 2013; Shah et al., 2015). Moreover, in a study conducted by Shah et al. (2015), they observed that the type of agricultural export should be considered. In the case of Pakistan, their primary source of agricultural exports is raw materials and not value-added products, which is why agricultural exports did not affect the agricultural output.

G. Research Gaps

This research did not explore the optimal level of government intervention needed to maximize the agricultural sector. Given that the private sector variables are still affected by government intervention, future researchers can investigate how the government can act as a catalyst to boost the sector's efficiency. Upon reviewing related literature, most research focused on government variables on the productivity of the agricultural sector. This research filled gaps in the literature by conducting a more holistic approach using variables that tackle natural resources, trade, investments, and credit. Furthermore, this paper also covered how commodity exports can sustain the growth of outputs in the sector, which only a few studies have tackled.

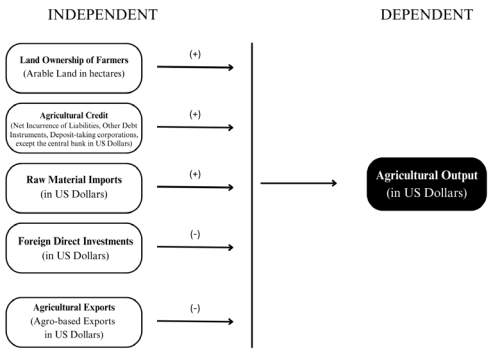

Fig. 1. Simulacrum

3. Research Method

A. Study Design

This paper is written to understand the impact of privatizing the agricultural sector in the Philippines and isolating it from government interventions. To do this, the researchers needed to identify the effects of land ownership, agricultural credit, raw materials imports, foreign direct investments, and agricultural exports on Filipino farmers' agricultural output through a quantitative approach. The authors measured how Agricultural Output is being affected positively and negatively by the following independent variables: land ownership of farmers, agricultural credit, raw materials imports, foreign direct investments, and agricultural exports.

B. Study Site

This paper examined the relationship between land ownership of farmers, agricultural credit, raw materials

imports, foreign direct investments, and agricultural exports with the agricultural output of the Philippines. The researcher's objective is to give a nuanced understanding of the resilience and self-sustainability of the Agricultural Sector In the Philippines. Aside from the fact that the research team resides in the country, it is noteworthy that the Philippines is the home of a diversified agricultural landscape and has always been known to be an agricultural country.

C. Collection of Data

The researchers used secondary data on all variables for 2005-2021, all sited in the Philippines. The data gathered for the dependent and independent variables are from various sources such as the World Bank, the International Monetary Fund, and the Philippine Statistics Authority. The following variables were measured by their respective measurements: (1) Land ownership of farmers - Arable land (in terms of hectares), (2) Agricultural Credit - Net Incurrence of Liabilities, Other Debt Instruments, Deposit-taking corporations except the central bank (in terms of U.S. Dollars), (3) Raw Material Imports (in terms of U.S. Dollars), (4) Foreign Direct Investments - Foreign Direct Investment inflows (in terms of U.S. Dollars), (5) Agricultural Exports - Agro-Based Exports (in terms of U.S. Dollars), and (6) Agricultural Output - agricultural commodities produced (in terms of U.S. Dollars).

The researchers' study site has limited data focusing on the agricultural sector on a national level. The mentioned variables and data measurements concern the Philippines' GDP, except for Arable land and Agro-based exports. First, farmers' Land ownership is measured by Arable Land in hectares, which are portions of land utilized in farming activities, mostly in crop production and plant growth. Second, the data in terms of Net Incurrence of Liabilities, Other Debt Instruments, and Deposit-taking corporations, except the central bank, was used with respect to GDP. This was used as a proxy for agricultural credit as there was also no data readily available for credits from commercial banks to Filipino farmers. Third, the data was collected from the % of merchandise imports of the Philippines from the World Bank, for GDP. To arrive at the monetary value, the researchers multiplied the percentage of merchandise imports by the amount of GDP that corresponds to Agriculture with the formula:

$$RMI = \frac{Agricultural\ Merchandise\ Imports}{Total\ Merchandise\ Imports}\ x\ GDP_{AGRI}$$

RMI = Raw Material Imports
GDP_{AGRI} = GDP of the Philippines in Agriculture

Fourth, the Foreign Direct Investments made to the Philippines concerning GDP were used as a proxy for investments explicitly focusing on the Agricultural Sector. Lastly, for agro-based exports and agricultural output, exact data were used.

This study uses the Ordinary Least Squares (OLS) regression analysis to determine the effects of privatizing the agricultural sector. The years 2005 to 2021 will be the period to assess the privatization. In this regard, the research will adopt the time-series approach, given that the data will be examined over time. In addition, correlation, collinearity, and unit root tests will be conducted to examine the relation, linear regression, and stationarity of the variables, respectively.

D. Data Collection Procedure

This research utilized regression analysis to measure the relationship between Agricultural Output and its independent variables. To measure and test the relationship of the independent variables with the dependent variable, the following econometric model was used:

$$A_y = \beta_0 + \beta_1 LO + \beta_2 AC + \beta_3 RMI - \beta_4 FDI - \beta_5 AE + u$$

where:
A_y = Agricultural Output
LO = Land Ownership of Farmers
AC = Agricultural Credit
RMI = Raw Material Imports
FDI = Foreign Direct Investments
AE = Agricultural Exports

A_y represents the portion of the GDP that accords to agriculture, fishery, and forestry, however only focusing on agriculture. Moreover, β_0 signifies the intercept wherein Agricultural Output is in its value where X is equal to 0. $\beta_1 LO$ is the measure for the amount of land that is rightfully owned by the farmers. $\beta_2 AC$ represents the regression coefficient for Agricultural Credit. $\beta_3 RMI$ identifies the measure for Raw Material Imports in the Agricultural Sector through GDP. $\beta_4 FDI$ is the measure for Foreign Direct Investment inflows being injected into the Agricultural Sector. Lastly,$\beta_5 AE$ is the Agro-Based Exports measured by their portion in the Philippines' GDP. These coefficients denote the changes in the dependent variable when the independent variables change by one unit. Meanwhile, u signifies the error term.

E. Regression Diagnostics

Alongside the OLS regression analysis, the researchers will be using diagnostic tests such as Ramsey's RESET, Test for Heteroskedasticity, Normality of Residual, Chow Test, Autocorrelation, Durbin-Watson, and Autoregressive Conditional Heteroskedasticity. These will be used to assess and meet the model's assumptions. Each test should not be analyzed exclusively but instead be used in conjunction with each other to effectively determine the significance, validity, and relevance of the independent variables: land ownership, agricultural credit, raw materials imports, foreign direct investments, and agricultural exports towards the dependent variable, the agricultural output of Filipino farmers.

4. Results and Discussion

This paper explored the effects of land ownership, agricultural credit, raw material imports, foreign direct investments, and agricultural exports on the agricultural output of the Philippines. Moreover, the researchers used the Ordinary

Table 2
Diagnostic tests

Diagnostic Tests	Results	Interpretation
ADF Unit Root Test	All p-values < 0.05	No presence of unit root
VIF Multicollinearity Test	All values < 10	No presence of excessive collinearity
Durbin Watson	Value < 2.0	Presence of positive serial correlation
Ramsey RESET Test	P-value > 0.05	No presence of misspecification
White's Test for Heteroskedasticity	P-value > 0.05	No Heteroskedasticity error
Chow Breakpoint Test	P-value > 0.05	No structural breakpoint at observation 2013
Breusch-Godfrey Test	P-value > 0.05	No presence of serial correlation
Normality of Residual	P-value > 0.05	Normally distributed
Test for ARCH	P-value > 0.05	No Autoregressive Conditional Heteroskedasticity

Least Squares (OLS) regression analysis to determine the effects of privatizing the agricultural sector on agricultural output from 2005 to 2021.

A. Results

The researchers used the Augmented Dickey-Fuller Test to determine stationarity. The variables, agricultural output (p-value = 0.00137), land ownership of farmers (p-value = 0.001424), raw material imports (p-value = 0.0001), foreign direct investments (p-value = 2.011e-06), and agricultural exports (p-value = 2.608e-08) are all stationary at their first differences. Meanwhile, private credit (p-value = 6.462e-11) is stationary at its second difference. The Variance Inflation Factor (VIF Multicollinearity Test) for Land ownership of farmers, agricultural credit, raw material imports, foreign direct investments, and agricultural exports are 1.363, 1.085, 1.256, 1.223, and 1.098, respectively. Each independent variable's VIF is less than 10. Therefore, the independent variables do not have any presence of excessive collinearity. In the Durbin-Watson test, the resulting p-value is 1.506, which is less than 2. This means that there is a presence of a positive serial correlation. The Ramsey RESET Test is used to test for different specification errors. Based on the Ramsey RESET Test results, the P-value of 0.644 is greater than 0.05, showing no misspecification presence. White's Test was used to test for heteroskedasticity error. From the test results, the P-value of 0.478 was greater than 0.05, meaning no heteroskedasticity error was found. The Chow Breakpoint Test was used to identify whether the coefficients differ for data sets. Based on the results, the P-value of 0.727 is greater than 0.05, meaning there is no structural breakpoint for 2013. The Breusch-Godfrey Test was used to test for serial correlation to check for autocorrelation in a variable and its lagged version. The p-values for land ownership of farmers, agricultural credit, raw material imports, FDI, and agricultural exports are 0.717, 0.834, 0.834, 0.934, and 0.794, respectively. Based on the test, all the P-values are greater than 0.05, meaning that there is no serial correlation present. The normality of residuals is used to check if the data is symmetrically distributed and has no skewness or kurtosis. Based on the diagnostic test findings, the P-value of 0.662 is greater than 0.05, which indicates that it is normally distributed. Based on the results from the ARCH test, the P-value of 0.778 is greater than 0.05, which means there is no Autoregressive Conditional Heteroskedasticity.

Based on the regression results, all variables were first differentiated and are significant at 0.05 alpha except for agricultural credit and agro-based exports. Foreign Direct Investment (DLFDI) with a p-value of 0.0277 has a significant and direct relationship with agricultural output at a 5% significance level. Based on the estimate, for every 1% increase in FDI, agricultural output will decrease by 0.10. Agricultural credit (DLAC) with a p-value of 0.2326 is insignificant at the 5% significance level but directly affects agricultural output. The estimation suggests that for every 1% increase in agricultural credit, agricultural output increases by 0.12. Agricultural Exports (DLAE) has a p-value of 0.0511, which is insignificant at a 5% significance level. However, it directly affects agricultural output; for every 1% increase in agricultural exports, there is a 0.03 increase in agricultural output. Land ownership of farmers (DLLO), with a p-value of 0.0015, has a significant and direct impact on agricultural output. For every 1% increase in land ownership, there is a 4.49 increase in agricultural output. Raw material imports (DLRMI), with a p-value of 0.0256, significantly and directly affect agricultural output. For every 1% increase in raw material imports, there is a 0.27 increase in agricultural output.

Table 3
Regression results (Ordinary Least Squares)

Variable	Coefficient	St.d Error	t-Statistic	P-value
C	0.01002	0.02536	0.395	0.7011
DLFDI	-0.10402	0.04041	-2.574	0.0277
DLAC	0.12493	0.09831	1.271	0.2326
DLAE	0.03022	0.01364	2.215	0.0511
DLLO	4.49285	1.03786	4.329	0.0015
DLRMI	0.26759	0.10217	2.619	0.0256

R-squared	0.70681	Mean dependent va	0.06295
Adjusted R-squared	0.560215	S.D. dependent var	0.089485
S.E. of regression	0.059343	Akaike info criterion	-40.4954
Sum of squared resid	0.035216	Schwarz criterion	-35.8599
Log-likelihood	26.24772	Hannan-Quinn criter	-40.2581
F-Statistic	4.821515	Durbin-Watson stat	1.506058
P-value(F-statistic)	0.016713		

B. Discussion

1) Foreign direct investments and agricultural output

The regression results exhibit a statistically significant, however, negative impact of Foreign Direct Investments on Agricultural output, in agreement with the conclusions and findings of other experts in the field. Furthermore, scholarly researches published by (Hunya, 2001), (Alfaro, 2003), (Findlay, 1978), and (Wang & Blomstrom, 1992) consistently reveal a more favorable advantage of FDI towards the Manufacturing Sector than the Agricultural Sector. This is due to the technological transfers, managerial expertise, and the establishment of innovative processes that were less beneficial for the Agricultural Sector.

In addition, multiple existing bodies of literature offer further knowledge into the multifaceted and complex effects of FDI on

the Agricultural Sector. In reference to Djokoto et al. (2014) and Epaphra & Mwakalasya (2017), FDI often exhibits, if not little, negative impacts. This could be credited to the lengthy procedures involved in executing investments, including acquiring and installing machinery and establishing proper irrigation systems. This is further highlighted in the findings of Epaphra & Mwakalasya (2017), which show the insignificance and negligible impact of the FDI Coefficient in accordance with the Agricultural Output.

Time is still a factor, and research conducted by Akande et al. (2013) emphasizes that FDI does not provide a lasting and positive impact on the agricultural sector. In support of this claim, Iddrisu et al. (2015) highlight the possible indirect effects of FDI despite the initial positive effects it provides in the short run.

Alignment is provided by synthesizing findings from present scholarly studies toward this paper's regression results. The negative implications observed in the results are consistent with the existing concept that FDI, despite its statistical significance to agricultural output, still does not contribute to the general growth of the agricultural sector. Its effects still depend on particular contextual factors and time periods.

2) Agricultural credit and agricultural output

The results for the Agricultural credit's effect on the Agricultural Sector have shown that the former is an insignificant measure of the latter (p-value > 0 .05). The relationship between commercial banks and the agricultural sector has been long debatable due to its lack of credit access to our farmers (Sunny, 2013). In support of this, Agricultural Credit could be an insignificant measure of Agricultural output due to the inadequate delivery of credit (Golait, 2007). The lack of credit access and delivery is due to hesitancy to lend credit to marginal and small farmers. In addition to this, the volatility of agricultural production makes it difficult for inflation to be kept low and stable. Gaps between supply and demand for agricultural products have led to an increase in countries' food prices. That said, even if more credit is to be provided, positive changes and proportional increases in the quantity of produced agricultural goods are not evident (Das et al., 2009). It is also noteworthy that with the share of credit declining over time, the agricultural sector is constrained from maximizing its potential (Kumar et al., 2010). In the same study, Kumar et al. (2020) also concluded from their findings that small and marginalized farmers often rely on non-institutional sources for credit and that they consequently pay higher interest rates.

3) Agricultural exports and agricultural output

The regression results have shown that in 2015-2021, Agricultural Exports are not a significant measure of Agricultural Output. It is imperative to remember that in those years, there was an international health crisis — COVID-19. According to the OECD (2020), The disruptions brought about by the pandemic have diminished the significance of agricultural exports as a measure of growth in the agricultural sector. Due to agricultural product surpluses and limited storage, food losses have been encountered. Furthermore, the environment for exports has been complicated further as there were also changes in consumer preferences and behavior as the demand shifted from traditional agriculturally-grown foods to ready-to-eat foods. In addition, health and security restrictions have caused the closure of restaurants, food service providers, and supermarkets, changing the food consumption landscape.

Moreover, aside from the effect of the pandemic, wherein there has been a depletion of world trade activities, agricultural exports have no significant impact on the production of agriculture due to Filipino Farmers' reluctance to embrace modern and cutting-edge technologies. This is caused by the farmers' inadequate financial resources, expensive energy prices, and scarce capital food (Mehraraa & Baghbanpour, 2023; Matahir & Tuyon, 2013; Shah et al., 2015). In addition to this, for agricultural exports to be significant to production, a specific type of export should be considered (Shah et al., 2015). Although importing raw materials could benefit one's sector, the same emphasis on exports exerts no significance on its impact on agricultural output.

4) Land ownership of farmers and agricultural output

The regression results favor the papers' initial findings on the positive impact of Land Ownership of Farmers on Agricultural Output. This further echoes the existing scholarly studies, highlighting the significance of proper land management in agricultural labor productivity even more. Studies conducted by Binswanger-Mkhize et al. (2009), McConnell and Servaes (1990), Short (1994), Zhang et al. (2001), and Jefferson and Su (2006) emphasize and support the relationship between the two mentioned variables. This relationship could not be excluded from government intervention as land ownership closely connects and depends on the existing agricultural reforms. As Zhang et al. (2022) state, land reforms and policies are important as they promote agricultural productivity, especially in developing countries. The studies have also supported the claim that large ownership of lands or bigger farm sizes corresponds to higher agricultural output and productivity. Furthermore, The International Rice Research Institute (2014), that farm land ownership inadequacy in the Philippines majorly impedes rice production, consequently making the country depend on imports. Moreover, the existence of unregistered lands in marginalized countries significantly impacts the agricultural sector's productivity. Even more, it also negatively affects land market efficiency and occupational decision-making distortions (Chen, 2017).

5) Raw material imports and agricultural output

The regression results for raw material imports have shown a positive effect on agricultural output. This is consistent with the researcher's initial findings through the existing literature, further highlighting the significance of having inflows of agricultural raw materials for the agricultural sector's growth and contribution to the country's economic growth. Bakari (2019) and Abidin et al. (2022) support this observation even more.

Moreover, there must be a technology transfer for raw material imports to impact agriculture significantly and positively. Raw material imports and technology are proven to have bolstered the agricultural productivity of countries (Bakari, 2019). This suggests that for agricultural performance and productivity to be realized, technological innovations must

be incorporated into agricultural raw materials. Furthermore, the concept of complementarity should also be recognized, wherein the interdependence of imports and exports is emphasized. This explains that if a nation increases and invests in its raw material imports, a significant growth in exports could also be experienced.

5. Summary and Conclusion

This paper investigated the effects of farmers' land ownership, agricultural credit, raw material imports, foreign direct investments, and agricultural exports on the agricultural output of Filipino farmers in the years 2005 to 2021 using Ordinary Least Squares (OLS) regression.

The variables are measured by Land ownership - Arable land (in terms of hectares), Agricultural Credit - Private Credit used for agriculture, Raw Material Imports - Raw materials used in agriculture, Foreign Direct Investments - Private investments in agriculture, Agricultural Exports - Exports produced by agricultural sector, and Agricultural Output - agricultural commodities produced, all measured in U.S. Dollars.

Based on the regression analysis, Foreign Direct Investment has a significant but negative effect on agricultural output. The results are consistent with the literature that FDI would do more harm in the sector. Time is an imperative factor in agriculture. With that being said, implementing and executing investments is time-consuming. Moreover, the literature suggests that FDI does not provide lasting effects needed for the sector. While technology, managerial expertise, and innovative processes are byproducts of FDI, its benefits are not maximized in the Philippines' agricultural sector. Agricultural credit has a positive but insignificant impact on agricultural output. Literature suggests that there is an inadequate delivery of credit.

Moreover, it is hard for small-scale farmers to access credit, resulting in volatile agricultural production, thus making inflation harder to control. Agricultural exports also have a direct but insignificant impact on the agricultural output. The reason for this is the current state of Filipino farmers. Farmers cannot modernize their machinery and equipment that can enhance their efficiency and result in profit. Farmers do not have enough capital to acquire new machinery, maintain the machinery, pay for utilities, and struggle to pay for food. For exports to significantly impact agricultural output, specific produce should be emphasized. According to the regression analysis, land ownership has a significant and positive impact on the agricultural output of the Philippines. Related literature pointed out that large ownership of lands or bigger farm sizes corresponds to higher agricultural productivity and output. However, government intervention cannot be excluded from this variable as this variable is heavily connected to existing agricultural reforms.

Furthermore, studies suggest that effective land reforms and policies are essential to promote productivity and increase agricultural output. Lastly, the importation of raw materials has a direct and significant impact on the output of Filipino farmers. Based on existing findings, an inflow of raw agricultural materials contributes significantly to the sector's output. Furthermore, raw material imports and technology are factors that influence the outputs. For better performance and productivity, the sector must also incorporate technological advancements. Moreover, imports and exports should be used in conjunction. As the country imports raw materials, export growth should also be experienced.

Therefore, the authors accept the following null hypotheses: H1, stating that land ownership of farmers causes an increase in the agricultural output of the Philippines; H3, which states that raw material imports are directly related to the agricultural output of the Philippines; H4, stating that foreign direct investments negatively affect the agricultural output of the Philippines. On the contrary, the authors reject the following null hypotheses: H2, which asserts that agricultural credit positively impacts the agricultural output of the Philippines, and H5, which claims that agro-based exports cause a decrease in the agricultural output of the Philippines.

A. Policy Implications

In the researcher's aim to examine the self-sufficiency and self-sustainability of the Philippine Agricultural Sector from the government, the research findings specify relevant policy implications that would suggest agricultural development. These implications further emphasize the need for a more adaptable and comprehensive strategy that would integrate both private sector engagements on focused types of government intervention as it was proven that both entities could not be excluded from one another, being that the latter always affects the former.

B. Foreign Direct Investments and Agricultural Output

As the findings have shown that Foreign Direct Investments provide adverse effects on the agricultural output of farmers, policymakers should place caution in their approach to the allocation of FDI. It is imperative for our policymakers to ensure that the inflow of investments is directed strategically on sectors or regions wherein the yield of returns would be more favorable for the agricultural sector. Moreover, there should also be an emphasis on making policies that would further promote a favorable environment for the technology transfer and agricultural innovation in the sector for these investments to translate investments into significant growth for the sector, and improve resilience, and, agricultural productivity.

C. Agricultural Credit and Agricultural Output

The reasons for the insignificance of agricultural credit on agricultural output highlight the need for reforms in credit delivery systems. The gap between commercial banks and farmers should be filled in order to ensure the accessibility of credit to our farmers on both small and large scales. Policymakers should also streamline loan disbursement procedures to make the systems for credit more comprehensible for illiterate or less-educated Filipino Farmers so that investment through credit would be more encouraged in the agricultural sector.

D. Agricultural Exports and Agricultural Output

With the aim of enhancing agricultural resilience, policymakers need to create and formulate strategic policies

that would minimize or mitigate the negative effects brought about by external shocks, such as the COVID-19 pandemic. These strategic policies could include encouraging value addition in agricultural products, assisting farmers to adapt to the ever-changing consumer preferences, and engaging in more diversified export markets.

E. Land Ownership of Farmers and Agricultural Output

The findings imply a positive relationship between land ownership of farmers and agricultural output. Therefore, policymakers should focus more on land consolidation in land reforms and policies. This ensures that farmers would have secure property rights in their farming lands that would, in turn, positively affect their agricultural production. It is imperative to emphasize problems regarding unregistered farming lands and inefficient land market prices. Focusing on these aspects would ensure that steps towards agricultural growth would be taken and self-sufficiency would surface.

F. Raw Material Imports and Agricultural Output

Policymakers should prioritize the integration of technological practices into agricultural and farming methods in order to ensure that raw materials are maximized and fully utilized to their fullest potential, providing development for the Agricultural Sector. Since there is a positive correlation between raw material imports and agricultural output, it further enhances the importance of the transfer of technology in translating resources into more favorable outcomes. Moreover, more focus should be placed on encouraging research and development initiatives to enhance and innovate farming methods that could increase agricultural productivity and efficiency.

Appendix

A. Unit Root Test Results

1) Agricultural Output

```
Augmented Dickey-Fuller test for d_l_AGRICULTURALOUTPUT
testing down from 3 lags, criterion AIC
sample size 13
unit-root null hypothesis: a = 1

  test without constant
  including 2 lags of (1-L)d_l_AGRICULTURALOUTPUT
  model: (1-L)y = (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -0.692292
  test statistic: tau_nc(1) = -3.20573
  asymptotic p-value 0.001317
  1st-order autocorrelation coeff. for e: 0.355
  lagged differences: F(2, 10) = 2.391 [0.1417]
```

2) Private Investment

```
Augmented Dickey-Fuller test for d_l_PRIVATEINVESTMENT
testing down from 3 lags, criterion AIC
sample size 15
unit-root null hypothesis: a = 1

  test without constant
  including 0 lags of (1-L)d_l_PRIVATEINVESTMENT
  model: (1-L)y = (a-1)*y(-1) + e
  estimated value of (a - 1): -1.25774
  test statistic: tau_nc(1) = -4.7907
  asymptotic p-value 2.01le-06
  1st-order autocorrelation coeff. for e: -0.005
```

3) Private Credit

```
Augmented Dickey-Fuller test for d_d_l_PRIVATECREDIT
testing down from 3 lags, criterion AIC
sample size 13
unit-root null hypothesis: a = 1

  test without constant
  including one lag of (1-L)d_d_l_PRIVATECREDIT
  model: (1-L)y = (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -2.8651
  test statistic: tau_nc(1) = -6.77364
  asymptotic p-value 6.462e-11
  1st-order autocorrelation coeff. for e: -0.240
```

4) Agricultural Exports

```
Augmented Dickey-Fuller test for d_l_AGROBASEDEXPORTS
testing down from 3 lags, criterion AIC
sample size 14
unit-root null hypothesis: a = 1

  test without constant
  including one lag of (1-L)d_l_AGROBASEDEXPORTS
  model: (1-L)y = (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -2.3675
  test statistic: tau_nc(1) = -5.67194
  asymptotic p-value 2.608e-08
  1st-order autocorrelation coeff. for e: 0.196
```

5) Land Ownership of Farmers

```
Augmented Dickey-Fuller test for d_l_ARABLELAND
testing down from 3 lags, criterion AIC
sample size 14
unit-root null hypothesis: a = 1

  test without constant
  including one lag of (1-L)d_l_ARABLELAND
  model: (1-L)y = (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -1.01278
  test statistic: tau_nc(1) = -3.1834
  asymptotic p-value 0.001424
  1st-order autocorrelation coeff. for e: -0.173
```

6) Import of Raw Materials

```
Augmented Dickey-Fuller test for d_l_IMPORTOFRAWMATERIALS
testing down from 3 lags, criterion AIC
sample size 14
unit-root null hypothesis: a = 1

  test without constant
  including one lag of (1-L)d_l_IMPORTOFRAWMATERIALS
  model: (1-L)y = (a-1)*y(-1) + ... + e
  estimated value of (a - 1): -2.06773
  test statistic: tau_nc(1) = -3.86306
  asymptotic p-value 0.0001
  1st-order autocorrelation coeff. for e: 0.104
```

7) OLS Regression Result

```
Model 2: OLS, using observations 2006-2021 (T = 16)
Dependent variable: d_l_AGRICULTURALOUTPUT

                     coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------------
  const                0.0100211    0.0253688     0.3950   0.7011
  d_l_PRIVATEINVES~   -0.104024     0.0404182    -2.574    0.0277   **
  d_l_PRIVATECREDIT    0.124935     0.0983103     1.271    0.2326
  d_l_AGROBASEDEXP~    0.0302218    0.0136418     2.215    0.0511   *
  d_l_ARABLELAND       4.49285      1.03786       4.329    0.0015   ***
  d_l_IMPORTOFRAWM~    0.267591     0.102173      2.619    0.0256   **

Mean dependent var   0.062950   S.D. dependent var   0.089485
Sum squared resid    0.035216   S.E. of regression   0.059343
R-squared            0.706810   Adjusted R-squared   0.560215
F(5, 10)             4.821515   P-value(F)           0.016713
Log-likelihood       26.24772   Akaike criterion    -40.49544
Schwarz criterion   -35.85991   Hannan-Quinn        -40.25807
rho                  0.227380   Durbin-Watson        1.506058

Excluding the constant, p-value was highest for variable 12 (d_l_PRIVATECREDIT)
```

B. Diagnostic Test Results

1) Multicollinearity (Variance Inflation Factors)

```
Variance Inflation Factors
Minimum possible value = 1.0
Values > 10.0 may indicate a collinearity problem

   d_l_PRIVATEINVESTMENT    1.223
      d_l_PRIVATECREDIT     1.085
   d_l_AGROBASEDEXPORTS     1.098
         d_l_ARABLELAND     1.363
d_l_IMPORTOFRAWMATERIALS    1.256

VIF(j) = 1/(1 - R(j)^2), where R(j) is the multiple correlation coefficient
between variable j and the other independent variables

Belsley-Kuh-Welsch collinearity diagnostics:

  variance proportions

    lambda      cond     const d_l_PRIV~ d_l_PRIV~ d_l_AGRO~ d_l_ARAB~ d_l_IMPO~
     2.083     1.000     0.065     0.045     0.059     0.007     0.054     0.002
     1.255     1.288     0.009     0.184     0.058     0.181     0.115     0.003
     1.225     1.304     0.003     0.003     0.002     0.145     0.056     0.420
     0.808     1.606     0.002     0.268     0.065     0.509     0.024     0.086
     0.424     2.217     0.001     0.463     0.104     0.098     0.584     0.351
     0.205     3.184     0.920     0.036     0.712     0.060     0.167     0.138

  lambda = eigenvalues of inverse covariance matrix (smallest is 0.205428)
  cond   = condition index
  note: variance proportions columns sum to 1.0

According to BKW, cond >= 30 indicates "strong" near linear dependence,
and cond between 10 and 30 "moderately strong".  Parameter estimates whose
variance is mostly associated with problematic cond values may themselves
be considered problematic.

Count of condition indices >= 30: 0
Count of condition indices >= 10: 0

No evidence of excessive collinearity
```

2) Autocorrelation (Durbin Watson)

```
Model 2: OLS, using observations 2006-2021 (T = 16)
Dependent variable: d_l_AGRICULTURALOUTPUT

                     coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------
  const                0.0100211    0.0253688    0.3950   0.7011
  d_l_PRIVATEINVES~   -0.104024     0.0404182   -2.574    0.0277   **
  d_l_PRIVATECREDIT    0.124935     0.0983103    1.271    0.2326
  d_l_AGROBASEDEXP~    0.0302218    0.0136418    2.215    0.0511   *
  d_l_ARABLELAND       4.49285      1.03786      4.329    0.0015   ***
  d_l_IMPORTOFRAWM~    0.267591     0.102173     2.619    0.0256   **

Mean dependent var   0.062950   S.D. dependent var   0.089485
Sum squared resid    0.035216   S.E. of regression   0.059343
R-squared            0.706810   Adjusted R-squared   0.560215
F(5, 10)             4.821515   P-value(F)           0.016713
Log-likelihood       26.24772   Akaike criterion    -40.49544
Schwarz criterion   -35.85991   Hannan-Quinn        -40.25807
rho                  0.227380   Durbin-Watson        1.506058

Excluding the constant, p-value was highest for variable 12 (d_l_PRIVATECREDIT)
```

3) Autocorrelation (Breusch-Godfrey LM Test)

```
Breusch-Godfrey test for first-order autocorrelation
OLS, using observations 2006-2021 (T = 16)
Dependent variable: uhat

                     coefficient  std. error  t-ratio   p-value
  ---------------------------------------------------------------
  const                0.00789593  0.0274877   0.2873   0.7804
  d_l_PRIVATEINVES~    0.00350223  0.0412884   0.08482  0.9343
  d_l_PRIVATECREDIT   -0.0223844   0.103495   -0.2163   0.8336
  d_l_AGROBASEDEXP~   -0.00394990  0.0146609  -0.2694   0.7937
  d_l_ARABLELAND      -0.442790    1.18260    -0.3744   0.7168
  d_l_IMPORTOFRAWM~   -0.0232198   0.107548   -0.2159   0.8339
  uhat_1               0.311153    0.376023    0.8275   0.4294

  Unadjusted R-squared = 0.070702

Test statistic: LMF = 0.684728,
with p-value = P(F(1,9) > 0.684728) = 0.429

Alternative statistic: TR^2 = 1.131229,
with p-value = P(Chi-square(1) > 1.13123) = 0.288

Ljung-Box Q' = 0.991322,
with p-value = P(Chi-square(1) > 0.991322) = 0.319
```

4) Specification Error (Ramsey's RESET)

```
RESET test for specification (squares and cubes)
Test statistic: F = 0.464970,
with p-value = P(F(2,8) > 0.46497) = 0.644

RESET test for specification (squares only)
Test statistic: F = 0.100806,
with p-value = P(F(1,9) > 0.100806) = 0.758

RESET test for specification (cubes only)
Test statistic: F = 0.000029,
with p-value = P(F(1,9) > 2.92941e-005) = 0.996
```

5) Heteroskedasticity (White's Test)

```
White's test for heteroskedasticity
OLS, using observations 2006-2021 (T = 16)
Dependent variable: uhat^2

                     coefficient   std. error   t-ratio   p-value
  ---------------------------------------------------------------
  const                0.00410011   0.00154654    2.651    0.0454   **
  d_l_PRIVATEINVES~   -0.000341656  0.00227552   -0.1501   0.8865
  d_l_PRIVATECREDIT   -0.0171760    0.00837920   -2.050    0.0957   *
  d_l_AGROBASEDEXP~    0.000145157  0.000584391   0.2484   0.8137
  d_l_ARABLELAND      -0.0268487    0.0541070    -0.4962   0.6408
  d_l_IMPORTOFRAWM~   -0.00386557   0.00483429   -0.7996   0.4602
  sq_d_l_PRIVATEIN~   -0.00309285   0.00639524   -0.4836   0.6491
  sq_d_l_PRIVATECR~    0.0456079    0.0336129     1.357    0.2329
  sq_d_l_AGROBASED~   -0.000248707  0.000300339  -0.8281   0.4453
  sq_d_l_ARABLELAND   -0.240188     4.41801      -0.05437  0.9587
  sq_d_l_IMPORTOFR~   -0.00551179   0.0176114    -0.3130   0.7669

  Unadjusted R-squared = 0.598872

Test statistic: TR^2 = 9.581948,
with p-value = P(Chi-square(10) > 9.581948) = 0.477903
```

6) Stability (Chow Breakpoint)

```
Augmented regression for Chow test
OLS, using observations 2006-2021 (T = 16)
Dependent variable: d_l_AGRICULTURALOUTPUT

                     coefficient  std. error  t-ratio   p-value
  ---------------------------------------------------------------
  const                0.0877773   0.0537563   1.633    0.1778
  d_l_PRIVATEINVES~   -0.107361    0.0685138  -1.567    0.1922
  d_l_PRIVATECREDIT   -0.00500136  0.152965   -0.03270  0.9755
  d_l_AGROBASEDEXP~   -0.0281822   0.135023   -0.2087   0.8449
  d_l_ARABLELAND       3.40227     1.51882     2.240    0.0886   *
  d_l_IMPORTOFRAWM~    0.454299    0.327176    1.389    0.2373
  splitdum            -0.112391    0.0766634  -1.466    0.2165
  sd_d_l_PRIVATEIN~   -0.00976334  0.167751   -0.05820  0.9564
  sd_d_l_PRIVATECR~    0.286038    0.501431    0.5704   0.5989
  sd_d_l_AGROBASED~    0.0616285   0.136671    0.4509   0.6754
  sd_d_l_ARABLELAND   -3.45154    46.0521     -0.07495  0.9439
  sd_d_l_IMPORTOFR~   -0.159035    0.428484   -0.3712   0.7293

Mean dependent var   0.062950   S.D. dependent var   0.089485
Sum squared resid    0.018554   S.E. of regression   0.068106
R-squared            0.845530   Adjusted R-squared   0.420737
F(11, 4)             1.990451   P-value(F)           0.265006
Log-likelihood       31.37428   Akaike criterion    -38.74855
Schwarz criterion   -29.47749   Hannan-Quinn        -38.27380
rho                  0.106557   Durbin-Watson        1.753478

Chow test for structural break at observation 2013
  F(6, 4) = 0.59869 with p-value 0.7267
```

7) Normality of Residuals

```
Frequency distribution for residual, obs 2-17
number of bins = 7, mean = 3.46945e-018, sd = 0.0593431

       interval          midpt   frequency    rel.     cum.

          < -0.066629 -0.079735       2     12.50%   12.50% ****
-0.066629 - -0.040418 -0.053523       2     12.50%   25.00% ****
-0.040418 - -0.014206 -0.027312       2     12.50%   37.50% ****
-0.014206 -  0.012006 -0.0011000      3     18.75%   56.25% ******
 0.012006 -  0.038218  0.025112       4     25.00%   81.25% *********
 0.038218 -  0.064429  0.051323       2     12.50%   93.75% ****
       >=    0.064429  0.077535       1      6.25%  100.00% **

Test for null hypothesis of normal distribution:
Chi-square(2) = 0.825 with p-value 0.66212
```

8) Test for ARCH

```
Test for ARCH of order 1

            coefficient   std. error    t-ratio   p-value
  ---------------------------------------------------------
  alpha(0)   0.00208058    0.000900821   2.310     0.0380  **
  alpha(1)   0.0750359     0.285395      0.2629    0.7967

  Null hypothesis: no ARCH effect is present
  Test statistic: LM = 0.0793396
  with p-value = P(Chi-square(1) > 0.0793396) = 0.778194
```

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