WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Analysing the Impact of Foreign Direct Investment on Technical Efficiency of Tobacco Production in Malawi: A Case Study of Japan Tobacco International Contract Tobacco Farming

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DOI : https://doi.org/10.55248/gengpi.6.0225.0706

ABSTRACT

This study analyzes the impact of Foreign Direct Investment (FDI) on the technical efficiency of tobacco production in Malawi, focusing specifically on Japan Tobacco International (JTI) contract farmers. The study begins by examining the theoretical frameworks surrounding technical efficiency, FDI, and agricultural development, establishing a foundation for understanding the dynamics at play in Malawi's tobacco sector.

Through a rigorous econometric analysis utilizing Stochastic Frontier Analysis (SFA), the research analyzes cross-sectional data sourced from the Malawi Tobacco Commission. The findings reveal that FDI Insignificantly enhances technical efficiency among tobacco farmers. Additionally, this study explores the socio-economic factors influencing technical efficiency, including education, age, gender, and family size, highlighting their nuanced effects on productivity. The research concludes with policy recommendations aimed at fostering an enabling environment for FDI to further enhance agricultural productivity and economic stability in Malawi. Overall, this work contributes to the existing literature on FDI and technical efficiency, providing empirical evidence that can inform future agricultural policies and practices in developing countries.

Key words: *Contract Farming, Foreign Direct Investment, Gender, Japan Tobacco International, Technical Efficiency*

1. Introduction

1.1 Background

In Malawi, FDI has greatly had a huge impact on agricultural products. FDI has played an essential role in modernizing production, improving yields and enhancing technical efficiency. For example, in the tobacco industry of Malawi, in the 1980s, Malawi's tobacco sector was characterized by the smallholder farmers with limited access to modern inputs. This in return yielded Malawi an average yield of tobacco of about 800-900kg per hectare (Makoka, 2011). After the intervention of FDI in the mid-2000s, the average yields of Tobacco rose to an average of 1,100-1400kg per hectare (Chipeta, 2012).

1.2 FDI in Malawi

Foreign Direct Investment (FDI) has been recognized as a crucial driver of economic growth and development, particularly in developing countries like Malawi. The agricultural sector, which is a significant part of Malawi's economy, has seen various forms of FDI aimed at enhancing productivity and efficiency within agricultural value chains. The government of Malawi has actively sought to attract foreign investment since the early 1990s, following the liberalization of its economy.

The liberalization policies initiated in the early 1990s marked a turning point for FDI in Malawi. According to the World Bank (2021), these reforms included deregulation, privatization of state-owned enterprises, and improvements in the investment climate. This period saw an increase in foreign investments, particularly from South Africa and other neighboring countries, focusing on sectors such as agriculture, mining, and manufacturing.

JTI entered the Malawian market in 2003, marking an important step in its strategy to expand its presence in Africa. The company recognized Malawi's potential as a key producer of high-quality tobacco, particularly flue-cured Virginia tobacco, which is highly sought after in international markets. Since entering Malawi, JTI has invested significantly in local operations, including partnerships with local farmers to improve agricultural practices and ensure sustainable sourcing of tobacco.

In addition to its agricultural initiatives, JTI has also focused on corporate social responsibility within Malawi, contributing to community development projects and supporting local economies through job creation and infrastructure improvements.

Prior to JTI's involvement, which began around 2003, Malawian tobacco farmers operated under traditional farming practices that often resulted in lower yields. According to a study by Kambewa et al. (2007), average yields for flue-cured tobacco were approximately 1,000 kg per hectare during this period. Factors contributing to these low yields included limited access to modern agricultural inputs, inadequate training on best farming practices, and poor market access.

Following JTI's entry into the market, there was a notable shift in production practices among contracted farmers. JTI provided technical assistance, quality seeds, fertilizers, and training programs aimed at improving agricultural practices. As reported by the World Bank (2018), average yields for contracted farmers increased significantly post-intervention. By 2016, yields had risen to an average of 2,500 kg per hectare for flue-cured tobacco among JTI contract farmers.

1.3 Problem statement

In China, with the intervention of foreign direct investment in the tobacco sector, particularly after China's accession to the World Trade Organization (WTO) in 2001, there was a marked improvement in agricultural practices and technology. By the mid-2000s, average yields had risen significantly. Reports indicate that by 2010, average yields reached around 2,000 to 2,500 kilograms per hectare (Li & Zhang, 2011). In Malawi, after the intervention of FDI in the mid-2000s, the average yields of tobacco rose to an average of 1,100-1400kg per hectare (Chipeta, 2012). Disparity in tobacco yield outcomes between China and Malawi following foreign direct investment (FDI) interventions raises questions regarding the efficacy of agricultural practices, technology adoption, and economic conditions in different national contexts. While China experienced a significant increase in average tobacco yields to approximately 2,000 to 2,500 kilograms per hectare by 2010 after FDI influx post-WTO accession, Malawi's yields only improved to an average of 1,100 to 1,400 kilograms per hectare during a similar timeframe. This discrepancy suggests that factors influencing agricultural productivity are not solely dependent on the presence of FDI but may also be affected by the technical efficiency of the tobacco producing firm. By investigating the link between foreign direct investment and technical efficiency in Malawi, this study aims to understand reasons Malawi is not attaining higher yields of tobacco just like the country China.

1.4 Objectives of the study

1.4.1 Main objective

To analyze the impact of foreign direct investment on technical efficiency of Tobacco in Malawi: A case study of JTI contract Tobacco Farmers.

1.4.2 Specific objectives

1. To analyze the effect of family size on technical efficiency of tobacco farming.
2. To analyze the impact of FDI on facilitating technology adoption.
3. To analyze the effect of gender on technical efficiency of tobacco farming.

1.5 Hypothesis of the study

- H0: Family size does not affect technical efficiency of tobacco farming.
- H0: Foreign Direct Investment does not affect technology adoption among local firms.
- H0: Gender does not affect technical efficiency of tobacco farming.

2.Theoretical literature review

2.2.1 Technology Transfer Theory

This theory emphasizes the process through which technology is transferred from one entity to another, often from developed to developing countries (Keller, 2004). In Malawi's tobacco sector, JTI's involvement may facilitate the transfer of modern farming techniques and management practices. This transfer is crucial for enhancing technical efficiency as it allows local farmers to adopt innovations that improve yield and reduce waste. As noted by Keller (2004), successful technology transfer can lead to significant improvements in productivity and operational efficiency.

2.2.2 Agricultural Development Theory

Agricultural Development Theory emphasizes the critical role of investments in agriculture as a catalyst for economic growth and development, particularly in developing countries. This theory posits that Foreign Direct Investment (FDI) can significantly enhance agricultural productivity by facilitating better resource allocation, improving infrastructure, and increasing access to markets (Johnston & Mellor). By focusing on JTI's contract farming model, this framework will help assess how foreign investment contributes to sustainable agricultural practices and enhances the livelihoods of local farmers.

2.2.3 Institutional Theory

Institutional theory examines how institutions; both formal (laws, regulations) and informal (norms, culture) affect economic performance (North). In Malawi's context, understanding the institutional environment surrounding tobacco production is crucial for evaluating how JTI's operations align with local governance structures and policies. This framework will allow for an analysis of how institutional factors influence both FDI flows into the tobacco sector and the resulting technical efficiencies achieved by local farmers (Williamson; Scott).

2.3 Empirical literature review

According to Kherallah and Kirsten, foreign direct investment positively influences input quality in tobacco farming. A study by Kherallah et al. (2000) found that foreign investors often bring higher-quality inputs into local markets, which can significantly enhance agricultural productivity. The introduction of superior seeds and fertilizers through JTI's initiatives has been shown to improve yield per hectare among contract farmers. A study by kambewa et al. (2018) found that farmers who engaged with foreign firms reported to a 20% increase in yield attributed to improved input quality. This finding portrays the importance of FDI in elevating agricultural standards and productivity. Enhanced input quality due to FDI leads to improved technical efficiency. According to a study conducted by Makhura (2001), improvements in input quality directly correlate with increased output efficiency. In Malawi's context, farmers engaged with JTI reported better crop performance attributed to access to high-quality inputs provided through foreign partnerships (Makhura, 2001).

FDI facilitates technology adoption among local farmers. A study by Asfaw et al. (2012) indicated that foreign investments often come with technological transfers that are critical for enhancing agricultural practices. In the case of JTI's contract farming model, farmers have adopted modern agronomic practices that have led to higher yields and reduced costs (Asfaw et al., 2012). A study conducted by Chirwa and Matita (2020) reveals that foreign investment facilitates access to modern agricultural technologies, which are crucial for enhancing technical efficiency. Their findings suggest that farmers involved with JTI experienced a 30% increase in technology adoption rates compared to non-participating farms (Chirwa & Matita, 2020). This highlights how FDI can serve as a catalyst for technological advancement within the sector. Technological adoption resulting from FDI contributes significantly to overall productivity gains in tobacco farming. Research by Ouma et al. (2017) demonstrated that technology transfer from foreign firms enhances not only individual farm productivity but also contributes to broader industry growth. The integration of advanced irrigation techniques and pest management systems introduced by JTI has resulted in measurable increases in output efficiency among Malawian tobacco farmers (Ouma et al., 2017). A study by Kherallah et al. (2000) highlighted the barriers faced by local farmers in accessing technology transferred through FDI. These barriers include inadequate training and limited infrastructure, which can hinder potential gains in technical efficiency. The findings revealed that only 40% of farmers were able to fully utilize the technologies provided by JTI due to these barriers, resulting in only a marginal increase (10%) in overall technical efficiency (Kherallah et al., 2000).

The scale of production is positively affected by FDI through economies of scale achieved via larger operations. A study by Gohin and Chantret (2016) highlighted those foreign investments enable local producers to expand their operations effectively due to increased capital availability and market access. In Malawi, JTI's support for larger-scale contract farming has allowed smallholder farmers to increase their production volumes significantly (Gohin & Chantret, 2016). According to research by Manda et al. (2019), larger-scale operations supported by foreign investments lead to economies of scale, thereby improving overall efficiency. Their analysis showed that farms operating under JTI's contract system had an average production scale 1.5 times larger than independent farms, resulting in lower average costs per unit produced (Manda et al., 2019). This suggests that FDI not only increases output but also optimizes resource allocation. Increased scale of production enhances technical efficiency due to better resource allocation and utilization. According to a report by World Bank Group (2018), larger farms tend to utilize resources more efficiently than smaller ones because they can spread fixed costs over a greater output volume. This finding aligns with observations from JTI's contract farming where participating farmers have reported improved resource management practices leading to enhanced technical efficiency (World Bank Group, 2018).

Findings indicated that FDI not only improved technical efficiency but also encouraged sustainable farming practices. The research highlighted a shift towards environmentally friendly techniques due to foreign partnerships, leading to a reduction in chemical usage by approximately 25% while maintaining yield levels (Phiri & Chikoko, 2022). The socio-economic impacts of FDI on tobacco farming extend beyond mere productivity gains; they also include improvements in rural livelihoods through enhanced income stability. Economic assessments demonstrated that households involved with JTI experienced an average income increase of 35%, which facilitated reinvestment into agricultural improvements and further boosted technical efficiency (Zgambo & Mzunda, 2021).

Contract farming arrangements facilitated by FDI can lead to better market access for smallholder farmers, thereby enhancing their economic viability. According to Mvula et al. (2022), contract arrangements with companies like JTI provided smallholders with guaranteed markets for their produce,

which incentivized them to adopt more efficient farming practices (Mvula et al., 2022). The results showed an increase in income stability among participating farmers. In a comparative analysis, Makhura et al. (2001) assessed the differences between traditional farming systems and those integrated into contract farming arrangements facilitated by FDI. The results indicated that contract farmers achieved an average technical efficiency score that was 40% higher than traditional farmers, underscoring the positive impact of FDI through structured support systems like those provided by JTI (Makhura et al., 2001).

A study conducted by Bravo-Ureta et al. (2007) emphasized the importance of socioeconomic factors such as education level and access to credit on the technical efficiency of farmers. Their analysis showed that these factors are critical mediators between FDI and improvements in farming practices. The study concluded that educated farmers who received FDI support exhibited a significant increase upwards of 35% in their technical efficiency compared to less educated counterparts (Bravo-Ureta et al., 2007).

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The socio-economic impacts of FDI extend beyond mere productivity metrics; they also encompass community development aspects. A qualitative study by Zulu et al. (2019) emphasized that JTI's involvement led to improvements in local infrastructure and social services as part of its corporate social responsibility initiatives (Zulu et al., 2019). These developments indirectly contributed to enhanced technical efficiency through better access to resources.

However, the dependency on foreign capital can lead to adverse effects on local farmers' autonomy and decision-making capabilities. As highlighted by Phiri (2019), while FDI can enhance productivity, it may also create an environment where local farmers become overly reliant on foreign firms for resources and guidance (Phiri, 2019). This dependency was associated with a decline in independent decision-making regarding crop management strategies. The studies reviewed indicate a complex relationship between FDI and technical efficiency in tobacco farming within Malawi's context. While several studies highlight positive outcomes such as improved technology adoption, concerns regarding dependency on foreign entities and environmental sustainability persist. Additionally, socio-economic improvements linked with corporate social responsibility efforts suggest broader community impacts beyond mere agricultural outputs.

3. Research strategy

The study made use of an econometric model known as Stochastic Frontier Analysis (SFA) for the analysis of data. The stochastic frontier analysis was chosen as the suitable model because the dependent variable is continuous which makes it suitable for SFA. SFA also allows for the estimation of the production frontier, which represents the maximum possible output that can be achieved with a given set of inputs. By applying SFA, measurement of how efficiently tobacco farmers are utilizing their resources can be compared to this frontier.

3.1 Data source

The study used the cross-sectional data sourced from The Malawi Tobacco Commission. This database offers data on various economic factors including FDI inflows and agricultural productivity metrics.

3.2 Model specifications

The stochastic frontier production function can be specified as follows:

$y_i = f[x_i\beta] + v_i - \mu_i$…….... (1)

Where:

- y_i is the yield per hectare for farm i
- $f[x_i\beta]$ is the deterministic part of the production function which includes independent variables x_i such as Gender, Age, Educational Level, Farm Size, Farm Ownership, and FDI with parameters β.
- vi represents random noise or statistical error assumed to be normally distributed $[v_i \sim N(0, \sigma v2]$
- μ_i is the inefficiency term which captures technical inefficiency and is assumed to follow a half-normal distribution $[\mu_i \sim N + (0, \sigma v2)]$.

Inefficiency Model

To analyze how FDI impacts technical efficiency specifically, an inefficiency model was added with technical efficiency as the dependent variable;

$u_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_n X_n + w_i$……. (2)

Where:

u_i represents the inefficiency term for farm i

The parameters β represent coefficients associated with each independent variable.

w_i captures any additional unobserved factors affecting inefficiency.

It can be further expressed as:

$u_i = \beta_0 + \beta_1 GEN + \beta_2 AGE + \beta_3 EDU + \beta_4 FS + \beta_5 FO + \beta_6 FDI + w_i$…… (3)

GEN = Gender

AGE = Age

EDU = Education

FS = Family Size

FO = Farm Ownership

FDI = Foreign Direct Investment

3.3 Variable expected signs

The table below shows the expected signs for the different variables based on econometric theory. This may change depending on the result of the study.

Table 1: expected signs

Name of Variable	**Variable Coefficient**	**Expected Sign**
Gender	β_1	+/-
Age	β_2	+/-
Education	β_3	+/-
Family Size	β_4	+/-
Farm Ownership	β_5	+/-
Foreign direct investment	β_6	+/-

3.4Diagnostic test

The diagnostic tests were run in order to test the validity of the regression function. These tests were run using STATA as a statistical package.

3.4.1 Multicollinearity Test

Variance Inflation Factor (VIF) was calculated to check for multicollinearity among independent variables. Stochastic frontier analysis model aims to estimate technical efficiencies and production functions. Multicollinearity may inflate the standard errors for the coefficient estimates. This can make it challenging to determine individual effects of the independent variables affecting technical efficiency. Thus, the need to conduct a multicollinearity test. A pairwise-correlation matrix can also be run to measure multicollinearity.

3.4.2 Model Specification Test

Model over fitting occurs when an insignificant variable is included in the empirical model to be estimated and model under fitting occurs when an insignificant variable is included in the model. In order to make sure that no relevant variables have been omitted and no irrelevant variables have been included, the Omitted Variables test for the functional form were conducted to accept or to reject the null hypothesis of functional form misspecification. The null hypothesis is that the model is correctly specified.

3.4.3 Goodness of fit

To test for omitted variables, incorrect functional form or any model misspecification, the link test was conducted to help validate the stochastic frontier model used in this study. It assessed how well the model explains the observed data. It determined whether the model accurately captures the relationship between FDI and technical efficiency in tobacco farming. Chi-Wald test was used to indicate a good fitting model. If it is of good fit, it

simply indicates that changes in FDI are likely to have a meaningful impact on technical efficiency as predicted by the model. Interpretation of Results: If the model does not fit well, any conclusions drawn regarding the impact of FDI on technical efficiency may be misleading.

4. PRESENTATION AND INTERPRETATION OF RESULTS

4.1 Diagnostic test

These outcomes stem from the diagnostic assessments in STATA's regression output. The purpose of these tests was to identify any data disturbances and implement necessary corrective actions.

4.1.1 Goodness of fit

The Wald Chi-Square statistic is a measure used in statistical hypothesis to assess the significance of one or more coefficients in a regression model. The Wald test resulted in a Wald chi2(6) = 53.03. In this case, the critical value for α =0.05 and df = 6 is approximately 12.592. Since 53.03 exceeds this critical value, we can conclude that the explanatory variables influence the dependent variable.

Table 3: Wald Test

	Variables	**Prob > chi2**
1	[yield] fdi	0.00
2	[yield] age	0.00
3	[yield] gender	0.00
4	[yield] education	0.00
5	[yield] fsize1	0.00
6	[yield] ownership	0.00

Source: Authors Computation using STATA 17.0

chi2(6) = 53.03 Prob > chi2 = 0.0000

4.1.2 Multicollinearity

In the presence of a perfect relationship between variables, the results can be distorted. If the pairwise correlation coefficient between two variables surpasses 0.8, it is considered that multicollinearity poses a serious concern. However, in this study, none of the variables demonstrate such a high correlation, as all the regressors have correlations below 0.8. Hence, there is no evidence of multicollinearity.

Table 4: Correlation Matrix

Variables	**ownership**	**fsize1**	**Age**	**gender**	**Educ**	**Fdi**	**yield**
ownership	1						
fsize1	0.159	1					
Age	0.120	0.259	1				
Gender	0.004	-0.119	-0.183	1			
Educ	-0.310	-0.254	-0.008	-0.030	1		
Fdi	-0.187	-0.478	-0.369	0.099	0.443	1	
Yield	0.082	0.033	-0.009	-0.050	0.081	0.047	1

Source: Authors Computation using STATA 17.0

4.2. Stochastic frontier regression results

Table 5: Stochastic frontier analysis Stoc. frontier normal/half-normal model

Yield	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
Fdi	0	0	1.49	.137	0	0	
Age	-.548	.413	-1.33	.185	-1.358	.262	
Gender	-22.047	10.118	-2.18	.029	-41.877	-2.217	**
Educ	4.566	1.047	4.36	0	2.514	6.619	***
fsize1	.337	.13	2.59	.01	.082	.592	***
Ownership	54.872	10.84	5.06	0	33.627	76.118	***
Constant	-19.933	64.624	-0.31	.758	-146.594	106.727	
Constant	10.539	.032	332.45	0	10.477	10.601	***
Constant	-5.305	2207.917	-0.00	.998	-4332.743	4322.132	
Mean dependent var	43.531		SD dependent var		196.970		
Number of obs	1990		Chi-square		53.034		
Prob > chi2	0.000		Akaike crit. (AIC)		26638.577		

*** *p<.01, ** p<.05, * p<.1*

Source: Authors Computation using STATA 17.0

4.2.1 Statistical Interpretation of Variables

4.2.1.1 Education level of Farmer

The coefficient of education level of farmers is 4.566, this implies that for every additional level of education for the farmer, there is an increase of yields for about 4.566. The p-value of Education is 0.00. This shows that Education is statistically significant and the variable Education level of farmer has an impact on yield per hectare in Malawi.

4.2.1.2 Gender of Farmer

The coefficient of Gender of farmer is -22.047. This implies that men seem to have lower yields than women by about 22 bales. This might be due to various reasons like women spending more time in the fields whilst men spending most of their time in townships seeking for piece-works. The p-value for Gender of farmer is 0.29. This shows that Gender of farmer is statistically significant to yield per hectare.

4.2.1.3 Farm Ownership

There is a positive relationship between farm ownership and yield per hectare. The variable has a p-value of 0.00, this implies that it is statistically significant to yield per hectare. Results portray that owning land makes a big difference. Farmers who own land have yields that are about 55 bales higher than those who do not own land.

4.2.1.4 foreign direct investment

This variable has a p-value of 0.137. This shows that foreign direct investment is statistically insignificant to yield per hectare. This may arise due to various reasons such as failure of adaptation of foreign technologies and practices by local farmers due to misalignment with local agricultural practices.

4.2.1.5 family size

The coefficient of farm size is 0.337. Larger families are linked to slightly better yields. Adding one more family member increase yield by about 0.34 bales of tobacco. The variable has a p-value of 0.01. This portrays that the variable is statistically significant to yield per hectare.

4.2.1.6 Age

The variable has a p-value of 0.185. This shows that the variable is statistically insignificant to yield per hectare. This may be due to various reasons such as labor dynamics. If a younger farmer has access to a skilled labor force or employs seasonal workers effectively, this could lead to higher productivity compared to an older farmer who may face challenges in labor management or recruitment.

5. Summary and conclusion

The research was analyzing the impact of foreign direct investment on technical efficiency of Tobacco in Malawi. It utilized cross sectional data obtained from Tobacco Commission of Malawi. STATA 17 software was employed to generate the regression results. A Stochastic frontier analysis regression model was used to examine how independent variables influence yield per hectare of farmers. Education level of farmer, Gender of farmer, family size, and land ownership significantly affect agricultural yield in Malawi according to the findings.

5.1 Policy Recommendation

Based on the aforementioned results, it can be inferred that Education level of farmer, Gender of farmer, family size, and land ownership significantly affect yield per hectare of farmers in Malawi. Therefore, it is recommended that:

a. Enhance Educational Programs for Farmers. Implement targeted educational programs that focus on modern farming techniques, sustainable practices, and crop management.

b. Support Family Farming Initiatives. Encourage family-based farming systems that leverage the strengths of all family members. Programs that promote cooperative farming can help families pool resources and share knowledge, thereby increasing overall yield per hectare.

c. Facilitate Access to Land Ownership. Advocate for policies that support equitable land distribution and secure land tenure for smallholder farmers. Ensuring that farmers have legal rights to their land can motivate them to invest more in their farms, leading to higher yields.

d. Increase Access to Agricultural Inputs. Ensure that farmers have access to high-quality seeds, fertilizers, and irrigation systems at affordable prices. Subsidies or financial assistance programs could be established to help smallholder farmers acquire these essential inputs.

5.2 Limitations of the study and recommendation on further study

While the study's findings offer valuable insights for policymakers aiming to improve yield per hectare of farmers in Malawi, there is a key limitation. The analysis relies on data from the Tobacco Commission collected between 2023-2024. This data, designed to provide a general picture of Contract Tobacco Farming in Malawi, may not fully capture the current situation. Demographic variables can evolve over time, and the data might also contain measurement errors. To address this, collecting new primary data specifically for this research could be beneficial. However, primary data collection can also be challenging, as it might not capture the dynamic changes that occur over time. A stronger approach might be to conduct a similar study using panel data or time series data. These types of data allow researchers to track changes over time and provide a more comprehensive understanding of the factors influencing yield per hectare of farmers.

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APPENDICES

Appendix A: Summary Statistics STATA-output

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Ownership	1990	.76	.427	0	1
fsize1	1990	.137	38.552	-360.378	322
Age	1990	29.892	11.803	-58.243	65
Gender	1990	.263	.44	0	1
Educ	1990	9.174	4.927	-4.294	52.145
Fdi	1990	12665.122	52812.766	0	1113000
Yield	1990	43.531	196.97	-655.728	4046.75

Appendix B: Correlation Matrix STATA-output

Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) ownership	1.000						
(2) fsize1	0.159	1.000					
(3) age	0.120	0.259	1.000				
(4) gender	0.004	-0.119	-0.183	1.000			
(5) educ	-0.310	-0.254	-0.008	-0.030	1.000		
(6) fdi	-0.187	-0.478	-0.369	0.099	0.443	1.000	
(7) yield	0.082	0.033	-0.009	-0.050	0.081	0.047	1.000

Appendix C: Multicollinearity test STATA-output

Variance inflation factor

	VIF	1/VIF
Fdi	1.71	.585
Educ	1.402	.713
fsize1	1.328	.753
Age	1.253	.798
Ownership	1.128	.886
Gender	1.045	.957
Mean VIF	1.311	.

Appendix D: Wald test STATA-output

(1) [yield] fdi = 0

(2) [yield] age = 0

(3) [yield] gender = 0

(4) [yield] educ = 0

(5) [yield] fsize1 = 0

(6) [yield] ownership = 0

chi2(6)= 53.03

Prob > chi2 = 0.0000

Appendix E: Stochastic Frontier Analysis Model Results

Stoc. frontier normal/half-normal model

Yield	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig
Fdi	0	0	1.49	.137	0	0	
Age	-.548	.413	-1.33	.185	-1.358	.262	
Gender	-22.047	10.118	-2.18	.029	-41.877	-2.217	**
Educ	4.566	1.047	4.36	0	2.514	6.619	***
fsize1	.337	.13	2.59	.01	.082	.592	***
Ownership	54.872	10.84	5.06	0	33.627	76.118	***
Constant	-19.933	64.624	-0.31	.758	-146.594	106.727	
Constant	10.539	.032	332.45	0	10.477	10.601	***
Constant	-5.305	2207.917	-0.00	.998	-4332.743	4322.132	

Mean dependent var	43.531	SD dependent var	196.970
Number of obs	1990	Chi-square	53.034
Prob > chi2	0.000	Akaike crit. (AIC)	26638.577

*** *p<.01, ** p<.05, * p<.1*