Journal of Integrated Sciences
Special Issue, February 2024
ISSN: 2806-4801

EFFECT OF CAPACITY UTILIZATION ON PRODUCTIVITY OF FOOD INDUSTRY IN NIGERIA

Adeniran, A. H.[1], Olalere, J. O.*[2], Raufu, M. O.[2] and Miftaudeen-Rauf, A. A.[3]

[1]Department of Agribusiness Economics, Murray State University, Murray, Kentucky United States.
[2]Department of Agricultural Economics, Ladoke Akintola University of Technology, Oyo State, Nigeria.
[3]Department of Economics, University of Ilorin, Kwara State, Nigeria.

ABSTRACT

The food industry plays a crucial role in Nigeria's economic growth, and understanding the relationship between capacity utilization and productivity is essential for its development. This study investigates the impact of capacity utilization on productivity within the food industry of Nigeria. The research objective is to examine impact of capacity utilization on the productivity of the food industry in Nigeria and identify the factors influencing this capacity utilization. Utilizing quantitative methods, the study examines data collected from 272 observations sourced from the World Bank Enterprise Survey 2014 Data. Multiple linear regression analysis is employed to model the relationship between capacity utilization and productivity while controlling for potential variables. The result of the study reveals a strong positive relationship between employee numbers and sales in the Nigerian food industry. However, there is no significant relationship between capital investment and sales. Efficient material utilization is crucial for higher productivity. The overall regression model is statistically *significant, explaining approximately 26.6% of the variability in sales. The study also examines Total Factor Productivity (TFP) against Capacity utilization, revealing that capacity utilization does not significantly impact TFP in the food industry. The wide range of TFP values within each group suggests diverse operational characteristics or external factors affecting productivity. The regression results show no strong evidence to suggest a significant relationship between capacity utilization and TFP in the food industry in Nigeria. The educational attainment of managers and firm age do not appear to have a statistically significant impact on TFP in these models. In conclusion, the results indicate a lack of significant relationship between capacity utilization and total factor productivity (TFP) in Nigeria's food industry, despite some negative associations. Moreover, variables such as educational attainment of managers and firm age do not show a statistically significant impact on TFP. The findings suggest the need for longitudinal analysis integrating quantitative and qualitative methods to better understand the dynamic relationship between capacity utilization and productivity. Additionally, comprehensive assessments of operational efficiency, workforce training, and resource utilization are recommended to inform interventions aimed at enhancing productivity within Nigeria's food industry.*

Keywords: *Capacity Utilization, Productivity, Total Factor Productivity (TFP), Food Industry, Nigeria.*

Corresponding author: Olalere, J. O. can be contacted at jamiuoolalere@gmail.com

1. INTRODUCTION

Food and beverage production is considered to be the primary component of international economic growth (Nwankwere et al., 2017). They are regarded as Nigeria's leading manufacturers of drinks and consumer products, as well as the biggest segment of the country's manufacturing companies listed on the Nigerian Stock Exchange (Okere, 2012). The food sector in Nigeria is comprised of many kinds of entrepreneurs: huge multinational corporations with foreign backing, government-owned or sponsored businesses, medium-sized indigenous operators, small-scale indigenous operators, and extremely tiny (one-person) operators.

Every economy therefore aspires to greater growth rates along with macroeconomic stability, as demonstrated by the performance of key variables including real interest rates, currency rates, inflation rates, and above all capacity utilization rates (Omenyi, 2017). In an economy, capacity utilization is a key indicator of how well resources are used in a particular industry (Okereke and Onyeabor, 2011).

The ratio of actual output (Y) to a capacity measure, or reference level of output (YR), is commonly used to define capacity utilization (CU) and this level is generally considered to be the maximum or minimum amount that can be produced given the current input base, prices, environmental and technological conditions, and firm management (Squires and Segerson, 2020). Comparably, capacity utilization describes the degree to which a business or a nation uses its installed capacity for output (Omenyi, 2017). Thus, Okunade, (2020) noted that capacity utilization is the ratio of a quasi-fixed input's actual output to its maximal or prospective output.

Squires and Segerson, (2020) stated that As CUY = Y/Y0 < 1, capacity utilization is always less than or equal to one. Given K, the company can potentially produce more when CUY < 1 without having to make significant investments in new machinery or capital. This suggests that some capital stock is underutilized, whereas Y0 would result from complete capital utilization and technological efficiency. The greatest output (Y0) that can be generated given the firm's short-run capital stock K is, thus, the reference level of output YR. Alternatively, this definition may be used more broadly, assuming that some elements of production, such as labour and other components, are fixed in the short run and include K. Although the theoretical maximum level of efficiency for capacity utilisation is 100%, in practise it may not reach 90%, particularly in developing nations where there are various production process setbacks like inadequate labour monitoring and supervision, process waste, and machine failure (Afroz and Roy, 1976).

Total Factor Productivity (TFP) is the percentage of output that cannot be accounted for by the quantity of inputs utilised in manufacturing (Comin, 2006). Therefore, the degree of it depends on how effectively and intensively the inputs are used in the manufacturing process. Typically, TFP growth is calculated using the Solow residual. Capacity utilization, particularly in the context of food industry has garnered attention lately. This is due to the observation that capacity utilization and production are positively correlated (Adeyemi and Olufemi, 2016).

Therefore, this study investigated the relationship between capacity utilization and productivity within the Nigerian food industry.

2. LITERATURE REVIEW

2.1 Theoretical Background

A key term in economics, productivity is used to assess the competitiveness and financial success of a production unit, such as a company, an industry, or a nation. Productivity quantifies the amount of an item or service that can be produced with a specific set of inputs. (Syverson, 2004).

Production function theory serves as the basis for the standard framework used to estimate changes in productivity. According to Hulten (1986), The general production function often has the following form: F(Y(t), X(t), t) = 0, where Y(t) is a vector of output quantities at time t, X(t) is a vector of input quantities, and t is a shift parameter introduced to allow for changes in productive efficiency. For ease of exposition, however, it is convenient to specialize this general representation to the one output - two input case:

Q(t) = A(t)F(K(t), L(t)) -------------------------- (1)

Q(t) denotes output at time t, K(t) denotes the flow of capital services used at time t, L(t) is the flow of labor services, and A(t) is an efficiency parameter which allows for a Hicks'-neutral shift in the production function.

Hajihassaniasl (2021) stated that Changes in total factor productivity and technical efficiency can be measured using one of two different approaches: The econometric approach of frontier function estimation forms the basis of the first parametric technique put forward by Nishimizu and Page (1982). Farrell (1957) provided the initial model for the second technique, which is also referred to as the nonparametric method. The data envelopment analysis method is a linear programming method. Similarly, Koç, et al., (2023) agreed that TFP growth may be measured using either of two methods: frontier or non-frontier (Figure 1). Additionally, both methods are divided into parametric and non-parametric categories. Using input quantities and prices as well as the estimation of a boundary function, the frontier approach seeks to identify the optimal locations.

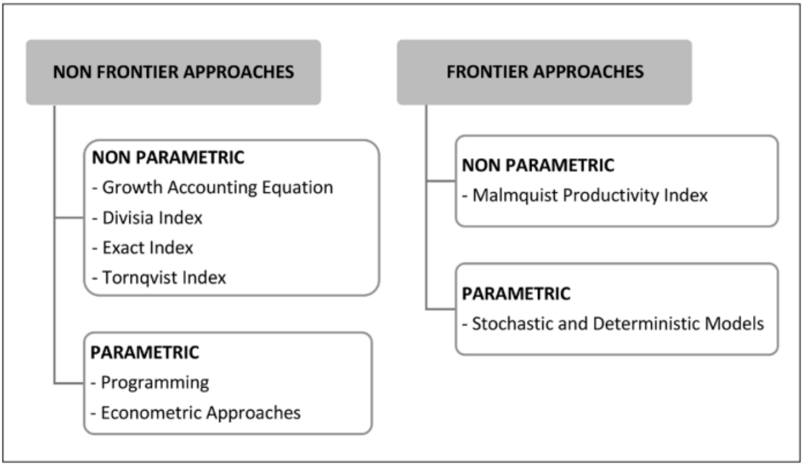

Figure 1. Classification of methodology for measuring total factor productivity

Source: Frija et al., 2015.

Thus, total factor productivity (TFP), which compares the overall output of land, labor, capital, and material resources to the total production of crops and livestock, is an essential measure of agricultural productivity. It takes a broader view of inputs and displays the average productivity of all inputs utilized in the production process (USDA/ERS, 2021). To measure productivity, the total factor productivity (TFP) approach assumes that the real output's total growth rate is made up of two parts: a residual that represents shifts in the aggregate production function caused by variations in production efficiency or total factor productivity, and a component that moves along the aggregate production function due to growth rates of the factor inputs (Squires and Segerson 2020).

2.2 Capacity Utilization

The link between actual production and maximum or prospective output is explained by capacity utilization, an essential economic metric that also suggests the degree of market demand (i.e., capacity utilization will increase as market demand increases). In contrast, capacity utilization will decrease as demand declines Lai (2015). Utilizing a plant's capacity too much or too little might lower its competitiveness by raising operational expenses (Seguin and Sweetland, 2014). Shiamwama et al. (2022) added that the proportion of the total capacity that has been reached at a given moment in time is one approach to characterize capacity utilization, which is always measured in terms of production units. Good capacity utilization starts with making the most use of a company's current assets, including buildings and resources. Squires and Segerson (2020) argued that in productivity studies, capacity utilization is important because productivity measurements in the Denison-Kendrick-Jorgenson-Griliches-Solow framework assume that businesses and producers are in a long-run equilibrium, with output at the point where the long-run and short-run cost curves tangent.

2.3 Empirical Review

In their research, Koç et al. (2023) investigate the factors influencing agricultural TFP in 32 developed and developing nations using panel data analysis spanning the years 2002–2016. The findings indicate that while increases in gross fixed capital creation and arable land positively contribute to TFP, TFP grows in developing nations with strong human capital. However, TFP declines in both industrialized and developing nations as rates of agricultural employment rise.

The performance and capacity utilization of Kenya's public sugar producing companies are investigated in the research by Shiamwama et al. (2022). The study employed Dynamic Capabilities Theory and had 450 participants, including 384 sugar cane producers, 6 operations managers, and 60 department heads. The study employed a mixed research approach, specifically utilizing an explanatory and cross-sectional research methodology. The findings demonstrated that capacity utilization has a significant impact on public sugar firms' performance.

Hajihassaniasl (2021) examines the productivity and efficiency of a subset of Turkish food processing companies between 2015 and 2019. Numbers for employees and equity are used as inputs in the study, and the outcome is net sales values. Estimates were made using the Data Envelopment Analysis technique and the Malmquist index methodology. The findings demonstrate that while technical efficiency and productivity are rising, all businesses operate below ideal sizes. Technical change was the primary cause of the decline in productivity, however most businesses saw a decline in technical advancement. The study emphasizes the significance of industry-wide technology development.

Using time series data spanning the years 1981 to 2016, Okunade (2020) investigated the impact of capacity utilization on the production of manufacturing enterprises in Nigeria using an Autoregressive Distributed Lag (ARDL) model technique. The study discovered a positive but negligible correlation between manufacturing businesses' production and capacity utilization since almost all productive firms in Nigeria significantly underutilized their capacity. The research findings indicate that there exists a notable underutilization of capacity in Nigerian manufacturing businesses. This underutilization reduces the significance of the beneficial impact of capacity utilisation on the growth of manufacturing firms in Nigeria.

Using an Autoregressive Distributed Lag (ARDL) model technique, Adeyemi and Olufemi's 2016 study investigated capacity utilization in Nigeria's industrial industry from 1975 to 2008. A number of independent variables were employed in the study, including the Real Manufacturing Output Growth Rate, Real Interest Rate, Consumer Price Index, Fixed Capital Formation in Manufacturing Sector, and Electricity Generation on Rate, which is a proxy for energy. The findings indicated that capacity utilization and the consumer price index were positively correlated, but there was a negative correlation between the rate of productivity growth and power generation, which led to poor growth.

2.4 Gap in Literature

The literature review offers significant insights into the correlation between productivity and capacity utilization in many settings; nonetheless, it falls short in its detailed analysis of Nigeria's food industry. Studies now in existence concentrate on general manufacturing, sugar production, and agriculture; however, there is a lack of research specifically addressing the interplay between capacity utilization and productivity in the Nigerian food industry. Therefore, this study filled the existing gap by investigating effect of capacity utilization on productivity of food industry in Nigeria.

3. METHODOLOGY

3.1 Research Design

This study used a quantitative research approach to examine how capacity utilization affects the productivity of Nigeria's food sector. This design enables the structured gathering and examination of numeric information to identify trends and connections.

3.2 Population

The population of this study consist of food industry with 272 observations.

3.3 Data Collection

Secondary data was sourced from World Bank Enterprise Survey 2014 Data.

3.4 Method of Data Analysis

Multiple linear regression was employed to model the relationship between capacity utilization (independent variable) and productivity (dependent variable) while controlling for potential other variables. R-programming language was the analytical package used for data analysis.

3.5 Model Specification

Model I:

Log(sales) = $\beta 0$ + log$\beta 1$Employee+ log$\beta 2$Material + log$\beta 3$Capital + μi

Model II:

TFP = $\beta 0$ + $\beta 1$Capacity fullyutilized + $\beta 1$Capacity underutilized + μi

Model III:

TFP = $\beta 0$ + $\beta 1$Capacity + $\beta 2$Man_educ + $\beta 3$Formal + $\beta 4$Formal + Firm_ age + $\beta 5$Man_exp + $\beta 6$Sales + $\beta 7$Capital + $\beta 8$Employee + $\beta 9$Materials + $\beta 10$Loss_pwr + $\beta 11$Size_grp + $\beta 12$Legal_statusgrp + $\beta 13$ fem_leader + μi

4. RESULT AND DISCUSSION

Table 1.0 depict the regression of log of sales against employee, capital and materials. The regression analysis result shows that there is a strong positive relationship between the number of employees and sales. Higher employment levels are associated with greater productivity in the food industry 0.889*** (0.122). There is no significant relationship between capital investment and sales -0.025 (0.029). Changes in capital investment do not strongly influence sales in this analysis. There is a positive and significant relationship between materials usage and sales. Efficient material utilization is crucial for higher productivity. The model fit statistics indicate that approximately 26.6% of the variability in sales can be explained by the independent variables. The overall regression model is statistically significant.

Table 2.0 represents the regression of Total Factor Productivity (TFP) against Capacity utilization. From the result it was revealed that Capacity fully utilized (95 instances) and Capacity under-utilized (177 instances), with a total of 272 instances. The statistical analysis includes a p-value of 0.853 for total factor productivity (TFP). Capacity fully utilized group has a mean TFP of 485.290, while the Capacity under-utilized group has a slightly higher mean TFP of 609.381. However, this difference is not statistically significant given the p-value of 0.853. This suggests that the level of capacity utilization does not appear to have a substantial impact on TFP in the food industry. Additionally, the wide range of TFP values within each group, as indicated by the range values (min. and max.). The range spans from 0.002 to 43897.102 for the Capacity fully utilized group and from 0.013 to 71382.411 for the Capacity under-utilized group. This variability could reflect diverse operational characteristics or external factors affecting productivity within each group.

Table 3.0 shows the regression of TFP against several independent variables that are expected to influence productivity. The regression results presented in table 3.0 aim to examine the effect of capacity utilization on the productivity of the food industry in Nigeria. The dependent variable in the analysis is the natural logarithm of total factor productivity (tfp), which is often used as a measure of productivity. The regression model includes several independent variables that are expected to influence productivity.

In Model 1, the coefficient estimate for capacity is -0.006. This suggests that a one-unit increase in capacity utilization is associated with a decrease in tfp by 0.006 units, holding other variables constant. However, the coefficient is not statistically significant at conventional levels ($p > 0.05$). In Model 2, the coefficient estimate for capacity is -0.001, this suggests a negative relationship between capacity utilization and tfp, but the estimate is not statistically significant. In Model 3, the coefficient estimate for capacity is -0.006, which is similar to the previous models. The estimate is not statistically significant. Hence, based on the regression results, there is no strong evidence to suggest a significant relationship between capacity utilization and tfp in the food industry in Nigeria. Furthermore, the educational attainment of managers and firm age also do not appear to have a statistically significant impact on tfp in these models.

5. CONCLUSION AND RECOMMENDATIONS

The result reveals no significant relationship existed between capacity utilization and total factor productivity in Nigeria's food industry regardless of the negative relationship that suggest an adverse effect. In addition, the educational attainment of managers and the age of the firm do not show a statistically significant impact on tfp in these models.

Based on the findings of this study, it is therefore recommended that longitudinal analysis of capacity utilization and productivity using both quantitative and qualitative methods may provide valuable insights into the dynamic relationship. Also, a comprehensive analysis of operational efficiency, workforce training, and resources utilization can inform interventions to enhance productivity in Nigeria.

REFERENCES

Adeyemi, P. and Olufemi, O. (2016). 'The Determinants of Capacity Utilization in the Nigerian Manufacturing Sector'. Journal of Economics and Sustainable Development, 7(5), pp. 20 – 31.

Akpan, S., Akpan, O., Udoka, S. and John, D. (2013). 'Analysis of the Physical Capacity Utilization in the Sugar Industry in Nigeria'. British Journal of Economics, Management & Trade, 3(2), pp. 123 - 140.

Comin, D., Quintana, J., Schmitz, T. and Trigari, A. (2021). 'Measuring TFP: The Role of Profits, Adjustment Costs, and Capacity Utilization'. Banco de españa, pp. 7 – 94.

Comin, D. (2006).'Total Factor Productivity'. pp.1-5. https://www.researchgate.net/publication/228665597 (Accessed: August 15, 2023)

Farrell, M. (1957), 'The measurement of productive efficiency'. *Royal Statistical Society. Journal. Series A: General*, 120(3), pp. 253- 281. pp. 253 – 281.

Frija A., Dhehibi B. and Aw-Hassan A. (2015). 'Total factor productivity growth of the Tunisian agricultural sector: a review of historical trends and main determinants'. *African Journal of Economic and Sustainable Development*, 4(4), pp. 293-307.

Hajihassaniasl, S. (2021). A comparative analysis of the efficiency and total factor productivity of selected food processing companies in Turkey. Journal of Economics Business and Political Researches, 6(16), pp. 383-397.

Hulten, C. (1986). 'Productivity change, capacity utilization, and the sources of efficiency growth'. *Journal of Econometrics*, 33(1-2), pp. 31–50.

Koç, A., Giovanis, Ö. and Uysal, P. (2023) 'What explains total factor productivity in agriculture: An empirical investigation using panel data analysis,' New Medit, 22(2).

Lai, Z. (2015). 'Capacity Utilization and Productivity Analysis in the Canadian Food Manufacturing Industry'. Available at: https://atrium.lib.uoguelph.ca/server/api/core/bitstreams/7886dcaf-3bf8-4071-bfa6-81b58fab3227/content (accessed: July 2021).

Nishimizu, M., and Page, J. M. (1982). 'Total factor productivity growth, technological progress and technical efficiency change: dimensions of productivity change in Yugoslavia, 1965-78'. *The Economic Journal*, 92(368), pp. 920-936.

Nwankwere, A., Asikhia, U. and Adebola, A. (2017). Technological Capability and Firm Efficiency of Selected Food and Beverages Manufacturing Companies in Lagos State, Nigeria. BJMASS, 12(1&2), pp. 143–156.

Ofonyelu, C. (2014). 'Strategic capacity utilization and competition: An analysis of competitions in Nigerian flour industry'. Issues in Business Management and Economics, 2(10), pp. 186–192.

Okere, R. (2012). Nigeria's food, beverage industry riding above the storm. Guadian. Retrieved on December 3,2014 from http://www.ngrguadiannews.com (Accessed: August 15, 2023)

Okereke, C. and Onyeabor, E. (2011). 'Assessing Capacity Utilization of Agro-Allied Industry in Nigeria'. Continental Journal of Social Sciences, 4(2), pp. 14–22.

Okunade, S. (2020). 'Effect of Capacity Utilisation on Manufacturing Firms' Production in Nigeria.' *Global Journal of Management and Business Research: B Economics and Commerce*, 18(1), pp. 29–38.

Omenyi, T. (2017). 'Industrial Capacity Utilization in Nigeria'. pp. 1 – 30. https://doi.org/10.13140/RG.2.2.16654.38724 (Accessed: August 15, 2023)

Salimonu, K., Gafar, A and Akintola, J. (2006). 'Trend analysis of capacity utilization of agro based industries in Nigeria'. Medwell Online Agricultural Journal, 1(4), pp. 311-316.

Seguin. B., and J. Sweetland. (2014) 'Drivers of Canadian Food Processing Competitiveness Macro Factors and Micro Decisions'. George Morris Centre, Available at: http://www.georgemorris.org/publications/Project_2_-_Drivers_of_Canadian_Food_Processing.pdf (accessed: July 2021).

Shiamwama, S., Otieno, S. and Museve, E. (2022) 'An Assessment of Capacity Utilization and Performance of Public Sugar Manufacturing Firms in Kenya,' *International Journal of Recent Research in Commerce Economics and Management (IJRRCEM)*, 9(4), pp. 107 – 118.

Squires, D. and Segerson, K. (2020). 'Capacity and Capacity Utilization in Production Economics'. pp. 1 – 36. https://link.springer.com/content/pdf/10.1007/978-981-10- 3450-3_7-1.pdf (Accessed: August 15, 2023)

Syverson. C. (2004). 'Product Substitutability and Productivity Dispersion'. *The Review of Economics and Statistics*, 86(2), pp. 534 – 550.

USDA/ERS - United States Department of Agriculture, Economic Research Service, (2021). Productivity Growth in U.S. Agriculture (1948-2019). Available At: https://www.ers.usda.gov/data-products/agricultural-productivity-in-the-u-s/productivity-growth-in-u-s-agriculture-1948-2019/ (accessed: July 2021).

APPENDICES

Table 1. Regression of log of sales against employee, capital and materials

	Dependent variable:
	log(Sales)
log(Employee + 0.1)	0.889***
	(0.122)
log(Capital + 0.1)	-0.025
	(0.029)
log(Materials + 0.1)	0.171***
	(0.036)
Constant	10.503***
	(0.572)
Observations	272
R^2	0.266
Adjusted R^2	0.258
Residual Std. Error	2.612 (df = 268)
F Statistic	32.405*** (df = 3; 268)
Note:	*p**p***p<0.01

Table 2. Regression of TFP against Capacity utilization

	Capacity fully_utilized (N=95)	Capacity under_utilized (N=177)	Total (N=272)	p value
tfp				0.853
Mean	485.290	609.381	566.040	
(SD)	(4503.016)	(5612.948)	(5243.839)	
Range	0.002 - 43897.102	0.013 - 71382.411	0.002 - 71382.411	

Table 3. Regression of TFP against several independent variables that are expected to influence productivity

	Dependent variable:		
	log(tfp)		
	(1)	(2)	(3)
Sales	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Capital	0.000*	-0.000	0.00000***
	(0.000)	(0.000)	(0.000)
Employee	-0.001	0.0001	0.0001
	(0.0004)	(0.001)	(0.0005)
Materials	0.000**	0.000	0.000**
	(0.000)	(0.000)	(0.000)
loss_pwr	-0.009	-0.014	-0.004
	(0.007)	(0.011)	(0.008)
Sizegrp Medium	-0.989*	-2.246**	0.010
	(0.597)	(1.042)	(0.671)
Sizegrp Micro	2.915**		2.609**
	(1.332)		(1.244)
Sizegrp Small	-0.162	-2.013*	1.329*
	(0.606)	(1.067)	(0.690)
legal_statusgrp Company with traded share	-0.542	-4.382*	0.078
	(0.990)	(2.417)	(0.999)
legal_statusgrp Others	1.057	3.647**	0.569
	(0.846)	(1.552)	(0.918)

Sizegrp Medium	-0.989*	-2.246**	0.010
	(0.597)	(1.042)	(0.671)
Sizegrp Micro	2.915**		2.609**
	(1.332)		(1.244)
Sizegrp Small	-0.162	-2.013*	1.329*
	(0.606)	(1.067)	(0.690)
legal_statusgrp Company with traded share	-0.542	-4.382*	0.078
	(0.990)	(2.417)	(0.999)
legal_statusgrp Others	1.057	3.647**	0.569
	(0.846)	(1.552)	(0.918)
Sales	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)
Capital	0.000*	-0.000	0.00000***
	(0.000)	(0.000)	(0.000)
Employee	-0.001	0.0001	0.0001
	(0.0004)	(0.001)	(0.0005)
Materials	0.000**	0.000	0.000**
	(0.000)	(0.000)	(0.000)
loss_pwr	-0.009	-0.014	-0.004
	(0.007)	(0.011)	(0.008)

legal_statusgrp Partnership	-0.179	2.214	-0.959
	(0.906)	(1.810)	(0.921)
legal_statusgrp Sole Proprietorship	0.721	3.160**	0.076
	(0.613)	(1.312)	(0.616)
fem_leaderYes	-0.081	-0.725	0.206
	(0.458)	(0.734)	(0.537)
Constant	0.613	-1.673	-0.747
	(1.307)	(1.938)	(1.802)
Observations	272	95	177
R^2	0.292	0.446	0.490
Adjusted R^2	0.230	0.296	0.417
Residual Std. Error	2.280 (df = 249)	2.195 (df = 74)	1.978 (df = 154)
F Statistic	4.676*** (df = 22; 249)	2.977*** (df = 20; 74)	6.725*** (df = 22; 154)
Note:			*p**p***p<0.01