DETERMINANTS OF EXPORTS OF U.S. AGRIBUSINESS FIRMS

by

CHUN LI

(Under the Direction of Lewell F. Gunter)

ABSTRACT

We study the "self-selection" effect among U.S. agribusiness firms in an attempt to better understand the export behavior of these firms. We use secondary firm-level financial data on almost 300 agribusiness firms to analyze the relationships between exports and firm size, capital intensity, firm profitability, and classification in one of 21 agribusiness sectors. Our results show that firm size has a small negative effect on the probability that an agribusiness firm exports and on the ratio of export sales to total sales, but capital intensity and recent profitability have little or no impact on export behavior. In contrast, the agribusiness sector in which a firm operates has a strong and robust impact on a firm's export probability and intensity.

INDEX WORDS: Agribusiness, Export, Profitability, Self-selection

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DEDICATION

I would like to dedicate this work to my parents, Jianjun Li and Jinhua Zhong, my grandmother, Meihua Ling and my love boyfriend, Shiyu Ye. My parents and grandmother have given their greatest support for my twenty years' education. My boyfriend has provided me suggestions and encouragement through the whole process. Having them is like having everything.

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

CHAPTER 1

INTRODUCTION

1.1 Exporting Firms are Different

Since the early of 1990's, a number of articles have identified systematic differences between exporting and non-exporting firms. Among manufacturing firms exporters tend to be larger, more productive, more skill-intensive, more capital-intensive and pay higher wages than non-exporting firms. Bernard and Jensen (1995) are pioneers in quantitatively measuring the characteristics of exporters. Their work showed that U.S. manufacturing exporting firms outperformed non-exporting firms in size, labor productivity, labor inputs and capital intensity over time and across broad size categories.

Previous trade theory which assumed a representative firm and focused on understanding "inter-industry" trade and "intra-industry trade" was challenged when it comes to these firm-level heterogeneities. Why there are both exporting and non-exporting firms within a narrowly defined industry? Why are exporters are more productive than non-exporters? Do more productive firms within an industry export? These questions boosted later theoretical and empirical studies on the relationship between firm-level productivity differences and trade behavior.

1.2 Theoretical hypothesis and empirical analysis

There are two theoretical hypotheses that have been formulated to explain why exporters can be more productive than non-exporting firms. One hypothesis is "Self-selection", which argues that only the most productive firms can overcome trade costs such as transportation costs,

distribution costs, marketing costs, production costs and become exporters. The other hypothesis is “Learning by Exporting”, which argues that firms engaged in international trade become more productive after they begin to export. Firms that trade in the international market can have access to a wider variety of intermediate goods and new final products. There are technology diffusions and spillover effects which can help export-starters improve post-entry performance. In addition, the intense competition in the international market will push exporting-firms to keep promoting productivity.

Many empirical papers have investigated the two hypotheses using firm level longitudinal data of various countries and industries. The general conclusion is that more productive firms self-select into export markets, while exporting does not necessarily improve productivity (). Bernard and Jensen (1999) employed linear probability models to study how U.S. manufacturing firms’ prior success impact the its probability to export. The results confirmed that prior success, as measured by total employment, productivity and the level of wages, increases the probability that a firm will export. When they regressed the ex-post change in performance measures of US manufacturing firms on initial export status and initial plant characteristics controls, the results did not show higher productivity and wage growth for exporters after exporting.Another branch of this type of analysis examines prior success in terms of profitability on exporting rather than the effect of productivity on exporting. There are two reasons behind this development. The first is that profitability and productivity are highly correlated (Grazzi, 2012).The second is that profitability should be a more reasonable performance measure at firm level because profit maximization is the central goal all firms ((Foster et al. 2008). There are some but not many studies that have analyzed the relationship between firm profitability and exports (Francesco Serti, 2007; Grazzi, 2012, Yama Temouri,

Alexander Vogel and Joachim Wagner, 2012). Most of the studies focused on European countries and the conclusions vary by country. For example, Grazzi (2012) employed both regression analysis and non-parametric analysis to detect the relation between export and profitability among Italian firms over the period of 1989 to 2004. They did not find evidence that exporting activity is systematically associated with higher firm profitability. Temouri, Vogel, Wagner (2013) used OLS regression to examine the "self-selection" effect of business service firms in France, Germany and the United Kingdom from 2004 to 2007. Profitability of exporters was significantly smaller in Germany, significantly larger in France, and did not differ significantly in UK.

1.3 Research Question

Our research focuses on the U.S. agribusiness sector and we would like to study if larger, more capital intensive and more profitable U.S. agribusiness firms have an advantage in exporting. The relationship between profitability and export is of our particular interests. In this study we employ both Return on Assets (ROA) and Return on Sales (ROS) as profitability measures. We employ an export premia to determine if exporting agribusiness firms have significantly larger levels of Firm Size, Capital Intensity, ROA and ROS than non-exporting agribusiness firms. We employ Probit models to quantify the effect of Firm Size, Capital Intensity, ROA and ROS on the probability that an agribusiness firm exports in a year; and we employ Tobit models to further quantify the effect of Firm Size, Capital Intensity, ROA and ROS on the export intensity (export percentage of total sales) of agribusiness firms.

1.4 Thesis Organization

This thesis is organized into five chapters. Chapter 1 provides a brief introduction to the study background, and the research question. Chapter 2 introduces previous studies contributing

to the theoretical and empirical analysis of the “self-selection” and “learning by exporting” hypotheses. Chapter 3 describes data sources and variable specifications. Chapter 4 states theoretical and empirical specification of the ProbitTobitempirical models. Chapter 5 discusses the results of the three models and presents conclusions from the analysis and implications for future studies.

CHAPTER 2

LITERATURE REVIEW

2.1 Theoretical Background of "Self-Selection" and "Learning by Exporting" Hypothesis

In this part, we will first look at the theoretical background of the "self-selection" hypothesis and then the theoretical background of the "learning by exporting" hypothesis. There are specific theoretical models developed to support the "self-selection" hypothesis. But for the "learning by exporting" hypothesis, there is only broad macroeconomic theory to support it.

There are two types of theoretical models that were developed to emphasize the importance of firm heterogeneity in generating international trade and thus inducing aggregate productivity growth. One framework was developed by Bernard, Eaton, Jensen, and Kortum (2003), which reconciled trade theory with plant-level export behavior and extended the Ricardian model to accommodate many countries, geographic barriers and imperfect competition. Their model indicated that the efficiency of an exporting source in a foreign market comes from either greater average efficiency, greater competiveness, lower input costs or lower costs of delivery. Another framework was developed by Melitz (2003), who embedded Hopenhayn's dynamic industry model within Krugman's model of trade under monopolistic competition and increasing returns. This model indicated that trade induces reallocation of market shares and profits across firms. "The most efficient firms export and increase both their market share and profits. Some less efficient firms remain in the industry but do not export and incur losses of both market share and profit." Melitz's model states not only that prior firm efficiency is one of important incentives to generate trade, but also that trade in turn can increase

market share and profit, while Bernard, Eaton, Jensen, and Kortum's model only emphasizes the first part.

The theoretical support for the "learning by exporting hypothesis" belongs to the broad theoretical category which discusses the relationship between economic growth and international trade. Specifically, there are export-led growth and import-led growth, both of which are discussed from macroeconomic and country level. We can understand the theoretical basis for "Learning by Exporting" from understanding the theoretical basis for export-led growth. First, exports enable growth by increasing relevant market size and thus increasing real output. When a country opens up economy, its country size and relevant population are increased. It needs to promote productivity and increase supply to meet a large demand. Second, exports allow better utilization of economies of scale and increasing specialization. Economies of scale and increasing specialization come from the fact that resources may transfer from inefficient domestic production to the export sector, causing productivity growth. Third, exports drive domestic technological progress. Less developed countries usually learn through imitation and innovation, which in turn leads to domestic technological progress. Connolly and Valderrama (2005) proved this pathway by a quality ladder model of endogenous growth in which North-South trade leads to technological diffusion through reverse engineering of intermediate goods. Fourth, export competition with foreign firms increase the need for domestic innovations and effectiveness, hence lead to increased productivity.

2.2 Empirical Analysis of "Self-Selection" and "Learning by Exporting" Hypothesis

In this part, we will introduce the empirical analysis that has been conducted on "Self-selection" and "learning by exporting" hypothesis. We will organize this part by sequentially introducing the widely used methodologies to test the two hypotheses, so that we can clearly see

the pros and cons of the different methodologies. Meanwhile, we will talk about the conclusions on "self-selection" and "learning by exporting" that have been achieved by these studies.

2.2.1 Empirical Analysis of "Self-Selection" Hypothesis

In general, there are three common approaches to study the "self-selection" hypotheses: OLS regressions, linear probability or Probit models, and non-parametric models. Future exporters are found to be larger in terms of total employment and shipments for various country-level models no matter which methodology is used. But exporting firms in some countries do not show prior advantages in productivity. For example, Bernard and Wagner (1997) and Hahn (2004) did not find significant ex-ante difference in levels and growth rates of total factor productivity between future exporters and non-exporters in German and Korea Manufacturing.

The first common approach to investigate the "self-selection" hypothesis is OLS regression. The longitudinal data is often divided into sub-periods and firm performance measures and growth rates of firm performance measures several years before exporting are regressed on the firm export status in the last year of the sub-period. The rationale of this approach is that if good firms become exporters then significant differences in performance measures several years before they begin to export should be found. One drawback of this approach is that it cannot confirm the causal relationship from success to exporting, which leads to the development of other approaches to further investigate this issue. But this approach provided important evidence confirming that future exporters already have many of the outstanding performance characteristics and it is usually the first step when examining the "self-selection" hypothesis.

Bernard and Wagner (1997) adopted this approach to study the "self-selection" effect in German manufacturing. In terms of levels of performance measures, the coefficient on the export

status dummy was not significant at 10% level. In terms of growth rate of performance measures, they found that employment growth is 1.4 percent faster per year for exporters and shipments grow 2.7 percent faster in the years leading up to export. But they did not find significant positive productivity growth. Hansson and Lunidn (2004) and Silva, Afonsa and Africano (2010) employed this approach to investigate the case in Sweden and Portugal respectively. Hansson and Lunidn (2004) found that Swedish future exporters both have higher TEP levels and significantly higher labor productivity two years before they enter the export market. Exporters' ex-ante TFP growth rates are comparably higher, yet not significantly, than nonexporters' rates. Silva, Alfonsa and Africano (2010) found that, on the five years average, the ex-ante TFP of export starters is around 33% higher than that observed for non-exporters in Portuguese manufacturing.

Hahn (2004) found that Korean manufacturing exporters are larger, more capital-intensive, have higher labor productivity and hire proportionately more non-production workers several years before exporting. But they did not find significant ex-ante difference in levels and growth rates of total factor productivity between future exporters and non-exporters. Haidar (2012) found that Total factor productivity of Indian manufacturing export-starters is on average 30% higher than for non-exporters during 1993-1998 and the productivity gap in favor of export-starters is 33.4% during 1998-2000.

The second common approach to investigate the “self-selection” hypothesis is linear probability models or Probit models. Both of the models estimate the probability of a firm to become an exporter due to some lagged firm performance variables, such as size, labor inputs, sector fixed effects and productivity levels before entry. Econometrically, Probit models are

more widely used than linear probability model because the probability predicted by the latter can fall out of the unit interval.

Bernard and Jensen (1999) and Hansson and Lunidn (2004) employed a linear probability model to quantify how prior success impacted the probability to export in US manufacturing and Swedish manufacturing. The results obtained by Bernard and Jensen (1999) confirmed the hypothesis that prior success, as measured by total employment, productivity and the level of wages, increases the probability that a firm will export. The results obtained by Hansson and Lunidn (2004) also confirmed this hypothesis among Swedish manufacturing firms.

Greenway and Kneller (2004), Alvearez and Lopez (2005) and Silva, Afonsa and Africano (2010) employed a Probit model to examine these relationships in UK, Chile and Portuguese respectively. Greenway and Kneller (2004) found that the productivity growth of UK new exporters is about 1% to 2% higher than non-exporters 5-year before entry, which raised the probability of entry by 0.2 of a percentage point to 1.1 percentage points. Alvearez and Lopez (2005) found that a 1% increase in productivity increases the probability of beginning to export to almost 1%. Median and large plants are 5 and 10% more likely to start exporting than small plants respectively. By including an investment variable in the regression, they also found evidence for conscious self-selection. Silva, Afonsa and Africano (2010) found a significant positive coefficient on the one year lagged TPF.

The third common approach to investigate the "self-selection" hypothesis is a non-parametric approach. The most widely used non-parametric approach is propensity score matching method, which is a statistical matching technique that estimates the effect of a treatment by accounting for the covariates that predict receiving the treatment. Besides that, there are non-parametric tests that examine the hypothesis of equality of productivity distributions

between exporting and non-exporting firms. Delgado, Farinas and Ruano (2001) compared the cumulative distribution functions of total factor productivity for Spanish exporters, non-exporters, entering exporters and exiting exporters. Their differences are formally tested using Kolmogorov–Smirnov one and two-sided tests. Their null hypothesis of equality of distributions was rejected at 10% level for the group of small firms but not rejected for the group of large firms. Furthermore, existing exporters have lower productivity than continuing exporters among small firms. Yang and Mallick (2010) employed the propensity score matching method to test the hypothesis of selection-into-exporting of Chinese firms one year before entry. Their result indicated that exporters have 32.3 % higher TFP one year before entry. The effect became insignificant when it comes to two years before enter.

2.2.2 Empirical Analysis of "Learning by Exporting" Hypothesis

Many of the articles introduced above also tested "learning by exporting" hypothesis. Similar to the methodologies used to test the "self-selection" hypothesis, there are two common approaches to test "Learning by Exporting" hypothesis: OLS regression and a non-parametric approach. The conclusions have been achieved so far are mixed and the learning effects seem to mostly occur in developing countries.

Bernard and Jensen (1999) regressed the ex-post change in performance measures of US manufacturing firms on initial export status and initial plant characteristics controls. The regression results did not show higher productivity and wage growth for exporters. Exporters only displayed better employment growth and probability of survival. Bernard and Wagner (1997) and Hansson and Lundin (2004) adopted the same approach to examine the "learning by exporting" hypothesis in German and Swedish Manufacturing respectively. Bernard and Wagner (1997) found little evidence that supported the "learning by exporting" hypothesis. Exporters

even showed lower productivity growth in the short term after entry. Hansson and Lundin (2004) found 2% higher TFP growth among exporters, but the effect was not significant.

Another OLS regression method is to further subdivide exporters and compare the OLS regression coefficients of different export status over time. Hahn (2004) grouped the Korean manufacturing firms in their sample into five categories: “always”, “starter”, “stopper”, “Never” and “Other”. He regressed logs of various performance measures on the five dummy variables and other control variables in a five-year window including periods both before and after entry. His regression results showed that the TFP level of export starters after entering the exporting market were close to those of firms that always exported and higher than firms that never exported, which supported the “learning by exporting” hypothesis. Alvarez and Lopez (2005) also grouped Chilean plants in their sample into five categories similar to Hahn’s. They found evidence of “learning by exporting” for plants that entered and stayed in the international market.

Non-parametric approach is a comparably popular approach as OLS regression to test “Learning by Exporting” hypothesis. Delgado, Farinas and Ruano (2001) conducted Kolmogorov–Smirnov non-paramatric tests of “learning by exporting” among Spanish Manufacturing firms. According to their test results, the “learning by exporting” effects only existed among young exporters whose years of operation is equal or less than 5 years. Greenaway and Keller (2004) combined propensity score matching with difference-in-difference analysis to test the post-entry effects of a large sample of UK firms. They found some evidence of further productivity improvement after entry for the unmatched sample. But the effect disappeared when they used a matched sample. The propensity matching result obtained by Yang and Mallick (2010) showed that new entrants have 34% higher TFP growth, 43.8% more sales growth and 14.7% higher employment growth in the second year after entry in China.

2.3 Profitability in Self-Selection Models

In this thesis, we would like to test the "self-selection" exporting effect in the U.S. agribusiness sector. Previous analysis has found little support for the "learning by exporting" effect in developed countries. In the case of U.S., Bernard and Jensen (1999) did not find higher productivity and wage growth among U.S. manufacturing firms after they start exporting. But they confirmed that prior success of manufacturing firms in total employment, productivity, and the level of wages increase their probability of exporting.

Many of the self-selection studies relating productivity to export behavior were based on primary survey data on manufacturing firms. Unfortunately we do not have firm-level productivity data for agribusiness firms for our analysis. We do, however, have access to firm-level profitability data for agribusiness firms in the COMPUSTAT dataset, so we would like to test "self-selection" hypothesis among U.S. agribusiness firms using profitability as a performance measure instead of productivity, based on firm-level data availability.

Studies that use profitability in self-selection models rather than productivity include Amendolagine, Capolupo, and Petragallo (2008), who employed pooled OLS to detect whether Italian manufacturing exporters were more profitable (gross profit per worker) than non-exporters before entry into the export market. The coefficient on the export dummy was positive one year and two years before entry and negative three years before entry but none of the coefficients were significant at 10% level. Grazzi (2012) employed both regression analysis and non-parametric analysis to detect the relation between export and profitability (return on sales) among Italian firms over the period of 1989 to 2004. They did not find evidence that exporting activity is systematically associated to higher firm's profitability. Temouri, Vogel, Wagner (2013) also used OLS regression to examine the "self-selection" effect of business service firms

in France, Germany and the United Kingdom from 2004 to 2007. The results they obtained for profit margin on sales differed across borders. Profitability of exporters was significantly smaller in Germany, significantly larger in France, and did not differ significantly in UK.

Kox and Rojas-Romagosa (2010) employed Probit regressions to test the "self-selection" hypothesis for Dutch manufacturing and service firms. In the manufacturing sector, prior profitability advantage is significantly associated with higher probability of entering the international market. In the service sector, only profitability in year t-1 can significantly predict export start.

The studies on "self-selection" of more profitable firms to export are not many. Almost all of this kind of articles investigates the case of European Union Countries. They adopted different profitability measures and no congruent conclusions have been made yet. We thus can make a contribution to this body of literature by testing the "self-selection" effect of more profitable

CHAPTER 3

DATA

3.1 Data Source

We are interested in studying if larger, more capital intensive and more profitable U.S. agribusiness firms self-select to export. To study this topic requires a data set that can provide firm-level information of firm size, capital intensity and profitability. Previous literatures that studied the relationship between firm profitability and international trade obtained firm-level data from either electronic publisher or government institutions. For example, Temori, Vogel, Wagner (2013) obtained data from ORBIS to investigate self-selection into export markets by business services firms in France, Germany, and the United Kingdom. ORBIS is a firm-level dataset provided by Bureau van Dijk which collects financial, economic and other firm-level information from various sources. Grazzi (2012) searched for evidence on profitability of Italian companies. He obtained data from Micro.3 databank which is based on the census of Italian firms yearly conducted by the Italian Statistical Office.

The United States Census Bureau has a longitudinal Firm Trade Transactions Database (LFTTD) that links individual trade transactions to the U.S. firms that make them. Further, the LFTTD uses the same firm identifier as the Longitudinal Business Database (LBD), which allows the linkage between the two. Bernard, Jensen, Redding and Scott (2007) used LFIID to study U.S. firms in international trade. But there are restrictions to use the two data sets and there are complicate application procedures involved. Due to time constraints, we would like to avoid that. We need a data set that can provide firm-level financial information but are more easily

accessible. Standard & Poor's COMPUSTAT North America Database serves this purpose. Standard & Poor's COMPUSTAT North America Database is a database of financial, statistical and market information covering publicly traded companies in the U.S. and Canada. It provides more than 340 annual and 120 quarterly Income Statement, Balance Sheet, Flow of Funds and supplemental data items on more than 10,000 active and 9,700 inactive companies.

Our study focuses the U.S. agribusiness sector. Agribusiness firms were extracted from COMPUSTAT North America by two digit Standard Industry Classification (SIC) codes. The 27 SIC codes were identified as agribusiness related based on their definitions and Garcia-Fuentes, Ferreira, Kennedy, (2013). For detailed information on the 27 SIC categories, please see Table 3.1 and Table 3.2.

3.2 Variable Specification

Equations 3.1-3.5 show how variables in our study are generated. These variables are generated based on Garcia-Fuentes, Ferreira, Kennedy, (2013) and the availability of COMPUSTAT North America.

For our export measures we used dummy variables which indicated whether or not a firm had export sales in a given year and export intensity which is calculated as annual export sales divided by total sales. Export intensity is the most widely used measure to access export performance (Sousa, 2004).

Firm size and capital intensity are important characteristics that have been used in many previous studies of firm-level export performance. Large firms can achieve economies of scale and thus have more resources and capacity to export. Capital Intensity is a measure of the use of capital relative to other production factors such as labor. It represents a firm's long-term commitment to the modernization and upgrading of its productive capacity.

Return on assets and return on sales are two variables that provide information of companies' effectiveness in generating profit. ROA tells how efficiently a company uses the firm's assets to generate operating profits. ROS provides insight into how much profit is being produced per dollar of sales.

Export Intensity = Export Sales/Total Sales Eq. 3.1

Firm Size= Total Assets Eq. 3.2

Capital Intensity= Net Amount of Plant and Equipment/Total Assets Eq. 3.3

ROA= After Tax Income/Total Assets Eq. 3.4

ROS= After Tax Income/ Total Sales Eq. 3.5

Total Assets, Total Sales, Export Sales, Selling, General and Administrative Expense, Net Amount of Plant and Equipment and After Tax Income are all data items extracted from Compustat North America. The definition of the six data items are based on Compustat User's Guide and are given in the following paragraphs:

Total Assets (AT): total value of assets reported on the Balance Sheet.

Total Sales (SALE): gross sales, the amount of actual billings to customers for regular sales completed during the period, reduced by cash discounts, trade discounts, and returned sales and allowances for which credit is given to customers.

Export Sales (SALEXG): revenue generated by the export of domestically produced goods and/or services provided by domestic offices for companies. Export sales represent sales to customers from outside of a company's home country.

Selling, General and Administrative Expense (XSGA): all commercial expenses of operation incurred in the regular course of business pertaining to the securing of operating income.

Net Amount of Plant and Equipment (PPENT): cost, less accumulated depreciation of tangible fixed property used in the production of revenue.

After Tax Income (NI): income or loss reported by a company after expenses and losses have been subtracted from all revenues and gains for the fiscal period including extraordinary items and discontinued operations.

Instead of directly using the annual Firm Size, Capital Intensity, ROA and ROS as independent variables, we employed simple moving averages of these variables as independent variables. The simple moving averages are generated by first taking 1-year, 2-year and 3-year lags of Firm Size, Capital Intensity, ROA and ROS by firm. The simple moving average of Firm Size, Capital Intensity, ROA and ROS for a firm is the mean of the 1-year, 2-year, 3-year lag of the four variables. The theoretical finding of "self-selection" is that a firm needs to generate efficiency to become exporters prior to exporting (Melitz (2003)). Previous articles studied how firm size, capital intensity and profitability of a firm one year, two years and three years prior to exporting can impact export activity. We used simple moving averages of the independent variables in our Probit and Tobit models to allow for the influence of trends in size, capital intensity, and profitability on exports without requiring constant effects for one, two, or three years over the entire time period and across all firms.

One other data decision we made for the analysis was to replace missing values for export sales with a zero. The primary logic for doing so is that reporting export sales in these data is done voluntarily and most firms that don't export simply leave export sales blank rather than reporting zero values every year. This approach could result in our including firms that do export but don't report it in our dataset but there is no way to identify these firms and it was

thought that this approach would create much less bias than excluding all firms that don't report exports from the analysis.

3.3 Summary Statistics

Table 3.1 and Table 3.2 display the mean and standard deviation for Export Dummy, Export Intensity, Firm Size, Capital Intensity, ROA and ROS by Standard Industry Classification (SIC) code.

There are 298 firms with 4702 observations in our sample. Only 13.08% of the observations are exporting firms. This gives us a low average Export Intensity of the sample, which is 3.31%. However, SIC 2070 Fats and Oils and SIC 2611 Pulp Mills are two industries that have large proportion of exporting firms and high export intensity. 76.47% observations of SIC 2070 Facts and Oils are exporting firms and this industry has an average Export Intensity of 42.29%. 64.58% observations of SIC 2611 Pulp Mills are exporting firms and this industry has an average Export Intensity of 46.19%. SIC 5150 Farm-Product Raw Materials also have a large proportion of exporting firms which is 68.49%. But this industry's Export Intensity is not as high as SIC 2070 and SIC 2611, which is 17.97%. Six sectors that are displayed at the bottom of Table 3.1 and Table 3.2 has no export activity. They are SIC 0700 Agricultural Services, SIC 2052 Cookies and Crackers, SIC 2080 Beverages, SIC 5180 Beer, Wine, and Distilled Beverages, and SIC 5411 Grocery Stores. Some of these sectors, such as grocery stores and agribusiness services operate strictly within local markets due to the nature of the products and services they sell. The other zero-export sectors, however sell products with potential foreign markets but the firms in our sample do not indicate any export activity.

The average Firm Size of the sample is 3554.673 millions of dollars. SIC 2111 Cigarettes have the largest average firm size of 26538.14 millions of dollars. SIC 2080 Beverages comes to

the second place in terms of Firm Size, which is 16115.32 millions of dollars. SIC 2211 Broad Woven Fabric Mills is the industry that has the smallest average Firm Size in the sample, which is 195.905 millions of dollars.

Agribusiness firms in the sample have a relatively high average Capital Intensity of 42.74%. SIC 2611 Pulp Mills, SIC 2621 Paper Mills and SIC 2015 Poultry Slaughtering and Processing are three industries that have the highest average Capital Intensity, which are 70.55%, 55.87% and 52.55% respectively. SIC 5180 Beer, Wine, and Distilled Beverages, SIC 3550 Special Industry Machinery and SIC 3523 Farm Machinery and Equipment are three industries that have the lowest average Capital Intensity, which are 5.63%, 16.14% and 17.21% respectively.

For the two profitability measures, ROA has a positive average and ROS has a negative average, which are 0.70% and -14.40% respectively. Three sectors mainly contribute to the negative average ROS: SIC 2086 Bottled and Canned Soft Drinks, SIC 2090 Misc. Food and Kindred Products and SIC 2870 Agricultural Chemicals. The three sectors also have negative average ROA. Their ROS averages are respectively -34.17%, -272.40% and -143.98% and their ROA averages are respectively -16.58%, -30.58% and -32.00%. Despite that, SIC 2000 Food and Kindred Products and SIC 2015 Poultry Slaughtering and Processing also have negative ROS of -6.38% and -5.99% respectively. SIC 2052 Cookies and Crackers is the sector that has the highest ROA, which is 13.23% and SIC 2611 Pulp Mills is the sector that has the highest ROS, which is 11.64%.

The six agribusiness sectors that has no export activity are excluded from later analysis, because the dependent variable of the six sectors has no variations and econometric models cannot capture the relationship between independent variables and dependent variables of the six

sectors. On the other hand, it gives us econometric problems such as severe multicollinearity when we estimate models including the six sectors.

Table 3.1 Variable Means by SIC Industry

SIC Industry	# of Firms	# of Obs	Export Dummy Mean	Export Intensity Mean	Firm Size Mean	Capital Intensity Mean	ROA Mean	ROS Mean
SIC 0100 Agricultural Production Crops	21	257	2.33%	0.17%	1486.903	44.78%	3.50%	7.50%
SIC 2000 Food And Kindred Products	10	199	11.06%	6.06%	13650.31	25.03%	4.17%	-6.38%
SIC 2015 Poultry Slaughtering and Processing	5	85	18.82%	4.20%	628.186	52.55%	3.38%	-5.99%
SIC 2020 Dairy Products	9	70	24.29%	0.91%	2106.857	35.67%	6.67%	5.53%
SIC 2030 Preserved Fruits and Vegetables	11	191	9.42%	1.90%	1008.577	34.72%	5.18%	2.14%
SIC 2033 Canned fruits and vegetables	3	73	13.70%	2.44%	548.997	30.07%	5.37%	3.65%
SIC 2040 Grain Mill Products	10	165	3.64%	0.84%	4200.106	46.89%	6.29%	5.07%
SIC 2060 Sugar and Confectionery Production	10	195	8.72%	1.28%	821.3558	39.56%	6.30%	5.10%
SIC 2070 Fats and Oils	3	68	76.47%	42.29%	5341.796	41.69%	4.60%	2.92%
SIC 2082 Malt beverages	9	140	9.29%	1.00%	4758.919	52.45%	5.12%	5.86%
SIC 2086 Bottled and canned soft drinks	22	293	6.14%	2.13%	2696.896	33.55%	-16.58%	-34.17%
SIC 2090 Misc. Food and Kindred Products	12	177	6.78%	0.21%	351.187	30.34%	-30.58%	-272.40%
SIC 2111 Cigarettes	7	124	46.77%	3.53%	26538.14	18.34%	7.43%	9.45%
SIC 2211 Broad woven fabric mills, cotton	4	85	25.88%	5.99%	195.905	32.49%	1.10%	0.58%
SIC 2611 Pulp mills	2	48	64.58%	46.19%	2094.867	70.55%	5.18%	11.64%
SIC 2621 Paper mills	19	276	21.74%	3.29%	4799.223	55.87%	4.65%	4.54%
SIC 2870 Agricultural Chemicals	17	177	38.42%	7.67%	2245.973	38.16%	-32.00%	-143.98%
SIC 3523 Farm machinery and equipment	8	201	39.80%	7.50%	4426.41	17.21%	4.32%	3.30%
SIC 3550 Special Industry Machinery	5	52	26.92%	6.12%	290.246	16.14%	2.97%	2.97%
SIC 5150 Farm-Product Raw Materials	3	73	68.49%	17.97%	1483.792	23.98%	4.53%	1.98%
SIC 5190 Farm supplies	5	83	28.92%	8.90%	383.484	13.61%	1.93%	0.23%

Table 3.1 Variable Means by SIC Industry (continued)

Industry	# of Firms	# of Obs	Export Dummy Mean	Export Intensity Mean	Firm Size Mean	Capital Intensity Mean	ROA Mean	ROS Mean
SIC 0700 Agricultural Services	3	81	0.00%	0.00%	764.147	30.37%	8.68%	3.42%
SIC 2052 Cookies and crackers	1	23	0.00%	0.00%	226.432	52.16%	13.23%	7.89%
SIC 2080 Beverages	3	71	0.00%	0.00%	16115.32	32.80%	12.09%	11.01%
SIC 5180 Beer, Wine, and Distilled Beverage	2	19	0.00%	0.00%	640.369	5.63%	4.09%	2.80%
SIC 5411 Grocery stores	26	461	0.00%	0.00%	3718.298	47.63%	5.05%	1.77%
SIC 5812 Eating places	68	1015	0.00%	0.00%	1089.001	62.03%	2.57%	1.53%
Whole Sample	298	4702	13.08%	3.31%	3554.673	42.74%	0.70%	-14.40%

Note: the unit of Firm Size is millions of dollars

Table 3.2 Variable Standard Deviations by SIC Industry

SIC Industry	Export Dummy Std.	Export Intensity Std.	Firm Size Std.	Capital Intensity Std.	ROA Std.	ROS Std.
SIC 0100 Agricultural Production Crops	0.151	0.012	2613.649	0.211	0.065	0.154
SIC 2000 Food And Kindred Products	0.314	0.259	19032.980	0.090	0.053	0.506
SIC 2015 Poultry Slaughtering and Proc.	0.393	0.118	753.191	0.125	0.100	0.363
SIC 2020 Dairy Products	0.432	0.026	2563.650	0.146	0.058	0.045
SIC 2030 Preserved Fruits and Vegetables	0.293	0.090	1896.434	0.152	0.077	0.132
SIC 2033 Canned fruits and vegetables	0.346	0.068	770.046	0.099	0.042	0.025
SIC 2040 Grain Mill Products	0.188	0.055	4892.899	0.148	0.074	0.061
SIC 2060 Sugar and Confectionery Prod.	0.283	0.046	1324.960	0.121	0.052	0.050
SIC 2070 Fats and Oils	0.427	0.460	7568.868	0.082	0.060	0.047
SIC 2082 Malt beverages	0.291	0.042	10090.350	0.229	0.048	0.063
SIC 2086 Bottled and canned soft drinks	0.241	0.127	5598.836	0.153	0.830	1.586
SIC 2090 Misc. Food and Kindred Products	0.252	0.011	618.827	0.165	1.302	23.777
SIC 2111 Cigarettes	0.501	0.057	26385.410	0.104	0.084	0.085
SIC 2211 Broadwoven fabric mills, cotton	0.441	0.154	171.564	0.085	0.085	0.048
SIC 2611 Pulp mills	0.483	0.478	1519.775	0.110	0.030	0.103
SIC 2621 Paper mills	0.413	0.110	6419.966	0.135	0.054	0.055
SIC 2870 Agricultural Chemicals	0.488	0.156	3560.904	0.220	1.130	5.393
SIC 3523 Farm machinery and equipment	0.491	0.150	7472.980	0.042	0.057	0.041
SIC 3550 Special Industry Machinery	0.448	0.122	290.920	0.112	0.043	0.047
SIC 5150 Farm-Product Raw Materials	0.468	0.179	1607.323	0.056	0.026	0.011
SIC 5190 Farm supplies	0.456	0.174	547.838	0.065	0.086	0.075

Table 3.2 Variable Standard Deviations by SIC Industry (continued)

SIC Industry	Export Dummy Std.	Export Intensity Std.	Firm Size Std.	Capital Intensity Std.	ROA Std.	ROS Std.
SIC 0700 Agricultural Services	0.000	0.000	1373.815	0.215	0.068	0.025
SIC 2052 Cookies and crackers	0.000	0.000	66.687	0.032	0.036	0.023
SIC 2080 Beverages	0.000	0.000	10774.650	0.087	0.044	0.054
SIC 5180 Beer, Wine, and Distilled Bev.	0.000	0.000	897.248	0.033	0.016	0.015
SIC 5411 Grocery stores	0.000	0.000	5827.419	0.115	0.039	0.015
SIC 5812 Eating places	0.031	0.000	3506.269	0.188	0.107	0.213
Whole Sample	0.337	0.140	8930.236	0.213	0.403	4.705

CHAPTER 4

METHODOLOGY

We have seen in the literature review part that there are three common approaches to test the "self-selection" hypothesis: export premia models, linear probability/Probit models and non-parametric approaches. Export premia models are used to examine characteristics of exporting firms relative to non-exporting firms. Probit models are used to study if more productive or profitable firms have a greater probability to export. To be consistent with previous studies, we estimate export premia models of U.S. agribusiness firms to look for differences in firm size, capital intensity, and firm profitability between exporting and non-exporting firms. We then employ Probit models to analyze if larger, more capital intensive and more profitable U.S. agribusiness firms have a greater probability of exporting. Our study distinguishes from previous studies by further employing Tobit models to study the relationship between export intensity and firm size, capital intensity, firm profitability. Tobit models allow us to quantify the marginal effects of firm size, capital intensity and firm profitability on export intensity.

This chapter is organized by sequentially introducing the theoretical and empirical specification of the export premia models, the Probit models and the Tobit models.

4.1 Export Premia Models

Equation 4.1 shows the empirical specification of the export premia model. We estimated four models, one each for for firm size, capital intensity, ROA and ROS.

$$Y_{it} = \beta_0 + \beta_1 D_{it} + \beta_2 D_{2000i} + \cdots + \beta_{21} D_{5190i} + u_i + e_{it}, \qquad \text{Eq.4.1}$$

$$where\ i = 1,2 \ldots n; t = 1, 2 \ldots T_i$$

Y_{it} represents one of the variables of interest – size, capital intensity, ROA or ROS. Subscript i is for different firms. There are 195 firms in our final dataset. Subscript t is for different years. The longest time span in our data is from 1976 to 2010. So a firm can have a maximum of 36 observations. But only a small fraction of firms has such a long record of data and mostly different firms have different number of observations. We have an unbalanced panel data.

D_{it} is a dummy for exports. It has a value of 1 if a company's export sales is positive in a year and zero otherwise. The export dummy coefficient can help us quantify the difference in Firm Size, Capital Intensity, ROA and ROS between exporting and non-exporting firms. Industry fixed effects are also estimated by dummy variables. D_{2000i} is a dummy for SIC 2000 Food and Kindred Products. D_{2000i} has a value of 1 If a firm belongs to this industry and zero otherwise. We have 21 industry dummies in total, which represent SIC 0100 Agricultural Production Crops, SIC 2000 Food and Kindred Products, SIC 2015 Poultry slaughtering and processing, SIC 2020 Dairy Products, SIC 2030 Preserved Fruits and Vegetables, SIC 2033 Canned fruits and vegetables, SIC 2040 Grain Mill Products, SIC 2060 Sugar and Confectionery Products, SIC 2070 Fats and Oils, SIC 2082 Malt Beverages, SIC 2086 Beverages and Soft Drinks, SIC 2090 Misc. Food and Kindred Products, SIC 2111 Cigarettes, SIC 2211 Broad Woven fabric mills, cotton, SIC 2611 Pulp mills, SIC 2621 Paper mills, SIC 2870 Agricultural Chemicals, SIC 3523 Farm machinery and equipment, SIC 3550 Special Industry Machinery, SIC 5150 Farm-Product Raw Materials, SIC 5190 Farm supplies, respectively. The dummy for SIC 0100 Agricultural Production Crops is used as the base and has been excluded from the regression to avoid perfect multicollinearity problem. Industry dummies vary across firms but do not vary across time.

u_i represents firm-level random effects. Random effects are taken into account because our data is an unbalanced panel data. Observations within a firm can be more homogeneous than they are between firms. There are several assumptions that the model has to satisfy. The first is that both u_i and e_{it} are drawn from normal distribution: $u_i \sim N(0, \sigma_u^2)$, $e_{it} \sim N(0, \sigma_e^2)$. The second is that u_i e_{it}should be independent. The third is that u_i should be independent of any of the explanatory covariates.

4.2 Probit Models

A Probit model is applied when the dependent variable is binary response variable. A Probit model can estimate the probability that an observation with particular characteristics will fall into a specific one of the categories. In our study, Probit models are employed to understand if larger, more capital intensive and profitable firm have a greater probability to export. The dependent variable is the Export dummy as specified in the Section 4.1.

4.2.1 Model Specification

Probit model can be derived from an underlying latent variable model. Let y^* be a latent variable determined by Equation 4.2. The function $1[y^* > 0]$ is an indicator function, which takes on the value one if the event in brackets is true and zero otherwise. $\boldsymbol{X}$ is a full set of explanatory variables and $\boldsymbol{X\beta}$ is written as $\boldsymbol{X\beta} = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \cdots + \beta_k x_{ki}$. $\boldsymbol{X}$ in our case are Firm Size, Capital Intensity, Firm Profitability and their quadratic terms. Equation 4.3 shows how the probability a firm exports in a year is modeled by the explanatory variables. G is the cumulative distribution function of the standard normal distribution taking on values strictly between zero and one. This ensures that the estimated response probabilities are strictly between zero and one.

$$y_i^* = \boldsymbol{X\beta} + e, y_i = 1[y_i^* > 0] \qquad Eq.4.2$$

$$P(y = 1|\boldsymbol{X}) = P(y_i^* > 0|\boldsymbol{X}) = P(e_i > -\boldsymbol{X\beta}|\boldsymbol{X}) = 1 - G[-(\beta_0 + \boldsymbol{X\beta})] = G(\boldsymbol{X\beta}) \qquad Eq.4.3$$

$$G(z) = \phi(z) = \int_{-\infty}^{z} \emptyset\,(z)$$

$$\emptyset\,(z) = (2\pi)^{-\frac{1}{2}}\exp(-z^2/2)$$

4.2.2 Marginal Effects

Equation 4.4 displays the partial effect of roughly continuous variables on the response probability. g is a standard normal probability density function. Unlike linear model, the partial effect of which is simply β_j, the partial effect of a continuous variable of Probit model depends on $\boldsymbol{X}$ through the positive quantity $g(\beta_0 + \boldsymbol{X\beta})$.

$$\frac{\partial p(y = 1|\boldsymbol{X})}{\partial x_j} = g(\beta_0 + \boldsymbol{X\beta})\beta_j, where\ g(z) = \frac{dG(z)}{dz} \qquad Eq.4.4$$

4.2.3 Empirical Specification

Equation 4.5 displays the empirical specification of the latent variable model underlying the Probit model in our study. y_{it} is the observed export dummy and it is the response variable. x_{1it}, x_{2it}, x_{3it} represent Firm Size, Capital Intensity and ROA/ROS. We also include the quadratic term of the three variables in the model. The remaining explanatory variables are industry dummies. u_i represents firm level random error and e_{it} represents overall error. u_i and e_{it} has to satisfy three assumptions: (1) $u_i \sim N(0, \sigma_u^2)$, $e_{it} \sim N(0, \sigma_e^2)$; (2) u_i and e_{it} are independent; (3) u_i is independent of the explanatory covariates $\boldsymbol{X}$.

Equation 4.6 displays the partial effect of x_{1it}. The partial effect of a variable with quadratic term is more complicate. Compared with Equation 4.4, there is an extra part of $g(\beta_0 + \boldsymbol{X\beta}) * 2\beta_2 x_{1it}$.

$$y_{it}^* = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{1it}^2 + \beta_3 x_{2it} + \beta_4 x_{2it}^2 + \beta_5 x_{3it} + \beta_6 x_{3it}^2 + D_{2000i} + \cdots + D_{5190i} + u_i + e_{it},$$

$$y_{it} = 1[y_{it}^* > 0] \qquad Eq.4.5$$

$$\frac{\partial p(y=1|\boldsymbol{X})}{\partial x_{1it}} = g(\boldsymbol{X\beta})(\beta_1 + 2\beta_2 x_{1it}), where\ g(z) = \frac{dG(z)}{dz} \qquad Eq.4.6$$

4.3 Tobit Models

The Tobit model was proposed by James Tobin (1958) to describe the relationship between a non-negative response variable and a vector of explanatory variables. The dependent variable usually has value of zero for a nontrivial fraction of the population but is roughly continuously distributed over positive values.

Export Intensity is the dependent variable in our Tobit models. It represents the proportion of a firm's sales that are exported. Some firms in our data are non-exporting firms. They have zero export intensity in all years. Even exporting firms in our data have zero export intensity in some years. Because of the large number of zero values for export intensity and the continuous nature of non-zero export intensity, the Tobit model is appropriate and necessary if we want to analyze the relationship between Export Intensity and a set of explanatory variables.

4.3.1 Model Specification

Similar to Probit model specification, Tobit model expresses the observed response, y, in terms of an underlying latent variable y*, which has a normal, homoskedastic distribution with a

linear conditional mean. The observed value y is equal to y* when y* is greater or equal to zero. The observed value y is equal to zero when y* is smaller than zero. Equation 4.7 displays the latent variable model underlying Tobit model. $\boldsymbol{X\beta}$ is written as $\boldsymbol{X\beta} = \beta_0 + x_{1i}\beta_1 + x_{2i}\beta_2 + \cdots + x_{ki}\beta_k$

Because y* is normally distributed, y has a continuous distribution over strictly positive values. In particular, the density of y given x is the same as the density of y* given x for positive values. Equation 4.8 gives the density function for non-negative y. For y=0, the density is discrete with mass equal to the probability of observing y*<0. Equation 4.9 displays the probability of observing $y = 0$.

$$y_i^* = \boldsymbol{X\beta} + \mu_i, \mu_i|\boldsymbol{X} \sim Normal(0, \sigma_u^2) \quad Eq.4.7$$

$$y_i = \begin{cases} y_i^*, & if\ y_i^* \geq 0 \\ 0\ , & if\ y_i^*\ < 0 \end{cases}$$

$$f(y_i|\boldsymbol{X}) = \frac{1}{\sqrt{2\pi\sigma_u^2}} \exp\left(-\frac{(y_i - \boldsymbol{X\beta})^2}{2\sigma^2}\right) = \frac{1}{\sigma}\emptyset\left(\frac{y_i - \boldsymbol{X\beta}}{\sigma}\right), y > 0 \quad Eq.4.8$$

$$P(y = 0|\boldsymbol{X}) = P(y_i^* < 0|\boldsymbol{X}) = P(\boldsymbol{X\beta} + \mu_i < 0|\boldsymbol{X_i}) = P\left(\frac{\mu_i}{\sigma_u} < \frac{-\boldsymbol{X\beta}}{\sigma_u}\middle|\boldsymbol{X}\right) = \phi\left(\frac{-\boldsymbol{X\beta}}{\sigma_u}\right)$$

$$= 1 - \phi\left(\frac{-\boldsymbol{X\beta}}{\sigma_u}\right) \quad Eq.4.9$$

4.3.2 Conditional and Unconditional Expectation

Tobit model has two important expectations: conditional and unconditional expectation. $E(y|y > 0, \boldsymbol{X})$ is called conditional expectation. It tells us, for given values of $\boldsymbol{X}$, the expected value of y for the subpopulation where y is positive. Equation 4.10 displays the equation of the conditional expectation. $\lambda(c) = \frac{\emptyset(c)}{\phi(c)}$ is called inverse mills ratio. It is the ratio between the

standard normal pdf and standard normal cdf, each evaluated at c. $E(y|\boldsymbol{X})$ is called unconditional expectation and the equation is displayed in Eq.411. Different from linear model, $E(y|\boldsymbol{X})$ of a Tobit model is a nonlinear function of $\boldsymbol{X}$ and $\boldsymbol{\beta}$. Since $\phi\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)$ and $\emptyset\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)$ are both positive terms, $E(y|\boldsymbol{X})$ should have the same sign as $\boldsymbol{\beta}$ but the magnitude of the effects depends on the values of all the explanatory variables and parameters including σ_u.

$$E(y|y>0,\boldsymbol{X}) = \boldsymbol{X\beta} + \boldsymbol{E}(\mu_i|\mu_i > -\boldsymbol{X\beta}) = \boldsymbol{X\beta} + \sigma_u E\left[\frac{\mu_i}{\sigma_u}\middle|\frac{\mu_i}{\sigma_u} > -\frac{\boldsymbol{X\beta}}{\sigma}\right] = \boldsymbol{X\beta} + \frac{\sigma_u \emptyset\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)}{\phi\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)}$$

$$= \boldsymbol{X\beta} + \sigma_u \lambda\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right) \quad where, \lambda\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right) = \frac{\emptyset\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)}{\phi\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)} \qquad Eq.4.10$$

$$E(y|\boldsymbol{X}) = P(y>0|\boldsymbol{X}) * E(y|y>0) = \phi\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right) * E(y_i|y_i>0,\boldsymbol{X}) = \phi\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)\boldsymbol{X\beta} + \sigma\emptyset\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right)$$

$$Eq.4.11$$

4.3.3 Marginal Probability and Marginal Effect

If X_j is continuous, we can find the partial effect of X_j on $P(y|y>0,\boldsymbol{X})$ and $E(y|\boldsymbol{X})$ by using calculus. Equation 4.12 is the equation of marginal probability of a continuous variable in Tobit and Equation 4.13 is the equation of marginal effect of a continuous variable in Tobit. Marginal probability tells us how one unit increase in X_j increases the probability that the dependent variable have non-zero values, while marginal effect tells us how one unit in X_j affects the expected value of y. if we substitute Equation 4.9 in Equation 4.13, we can see that the marginal effect of a continuous variable is actually its parameter times the probability that the dependent variable is positive.

$$\frac{\partial P(y|y>0,\boldsymbol{X})}{\partial X_j} = \left(\frac{\beta_j}{\sigma_u}\right)\emptyset\left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right) \quad Eq.4.12$$

$$\frac{\partial E(y|\boldsymbol{X})}{\partial X_j} = \frac{\partial P(y>0|\boldsymbol{X})}{\partial X_j} * E(y|y>0,\boldsymbol{X}) + P(y>0|\boldsymbol{X}) * \frac{\partial E(y|y>0,\boldsymbol{X})}{\partial X_j}$$

$$= \beta_j \phi\left(\frac{\boldsymbol{X\beta}}{\sigma}\right) \quad Eq.4.13$$

4.3.4 Empirical Specification

Equation 4.14 gives the empirical specification of the latent variable underlying Tobit model in our study. The dependent variable is export intensity, which is the ratio of export sales to total sales. x_1, x_2 and x_3 represent Firm Size, Capital Intensity and ROA/ROS respectively. Their quadratic terms are also included in the model. D_{2000ji} is an dummy for SIC Industry j. Industry dummies are included to take account of industry fixed effects. u_i is for firm level random error. e_{it} is the overall error for the model. u_i and e_{it} are identically and independently distributed. u_i and e_{it} are also independent of each other.

Equation 4.15 and Equation 4.16 respectively show the marginal probability and marginal effect of a continuous variable in our study. Since we include both linear and quadratic terms of the continuous variables, the marginal effect and marginal probability of our empirical Tobit model have an extra term of $2\beta_2 x_{1it}$ compared with the marginal probability given in Equation 4.12 and marginal effect given in Equation 4.13.

$$y_{it}^* = \beta_0 + \beta_1 x_{1it} + \beta_2 x_{1it}^2 + \beta_3 x_{2it} + \beta_4 x_{2it}^2 + \beta_5 x_{3it} + \beta_6 x_{3it}^2 + D_{2000i} + \cdots + D_{5190i} + u_i + e_{it}$$

$$y_{it} = \begin{cases} y_{it}^*, & if\ y_{it}^* \geq 0 \\ 0\ , & if\ y_{it}^* < 0 \end{cases} \quad \text{Eq.4.14}$$

$$\frac{\partial P(y|y>0,\boldsymbol{X})}{\partial X_1} = \left(\frac{\beta_1 + 2\beta_2 x_{1it}}{\sigma_u}\right) \emptyset \left(\frac{\boldsymbol{X\beta}}{\sigma_u}\right) \quad Eq\ 4.15$$

$$\frac{\partial E(y|\boldsymbol{X})}{\partial X_1} = \frac{\partial P(y>0|\boldsymbol{X})}{\partial X_1} * E(y|y>0,\boldsymbol{X}) + P(y>0|\boldsymbol{X}) * \frac{\partial E(y|y>0,\boldsymbol{X})}{\partial X_1}$$

$$= (\beta_1 + 2\beta_2 x_{1it})\phi\left(\frac{\boldsymbol{X\beta}}{\sigma}\right)$$

Eq 4.16

CHAPTER 5

RESULTS AND CONCLUSIONS

In this Chapter, we will discuss the estimation results of the ProbitTobitempirical models and our conclusions from the analysis.

5.1 Export Premia Results

We estimated two linear models for each variable of Firm Size, Capital Intensity, ROA and ROS. One model is estimated with industry fixed effects and one without. Table 5.1 presents coefficients on the export dummy estimated from the regressions with and without industry fixed effects.

From table 5.1 we can see that the coefficient on Export Dummy does not change much whether industry fixed effects are included or not. Exporting firms have significantly smaller Firm Size and greater Capital Intensity. Exporting firms tend to have higher ROA and ROS, but the difference with regard to ROA and ROS is not significant at 10% level. Specifically, exporting firms are on average 24.6% units smaller in Firm Size and 2.8% greater in Capital Intensity, when industry fixed effects are excluded. We take log of Total Assets as the measure for Firm Size when estimating models so that Firm Size can be explained in percentages. Exporting firms are 25.1% smaller in Firm Size and 2.8% greater in Capital Intensity, when industry fixed effects are included.

Table 5.2 presents the export premia estimation results for Firm Size, Capital Intensity, ROA and ROS.. The industry fixed effects presented in Table 5.2 are of our interest to look at. It

tells us the average level of an industry's Firm Size, Capital Intensity, ROA and ROS after a firm's export status in a particular year has been taken into account.

SIC 0100 Agricultural Production Crops is used as the base group and excluded from the regression when it is estimated to avoid perfect multicollinearity. The average Firm Size, Capital Intensity, ROA and ROS of SIC 0100 is reflected by the coefficient of the constant, and coefficients of other industries should compare with the base group. SIC 0100 Agricultural Production Crops has an average Firm Size of 158.7 ($e^{5.067}$) millions of dollars, Capital Intensity of 39.3%, ROA of 2.1% and ROS of -10.9%. The average Firm Size and Capital Intensity of SIC 0100 are statistically significant from zero while ROA and ROS are not. SIC 2000 Food and Kindred Products, SIC 2040 Grain Mill Products, SIC 2082 Malt Beverages, SIC 2111 Cigarettes and SIC 2621 Paper Mills respectively have 3.160%, 2.278%, 2.443%, 4.080%, 2.884% and 2.199% greater Firm Size than SIC 0100 Agricultural Production Crops. SIC 2090 Misc. Food and Kindred Products is the only industry that has significantly smaller Firm Size than SIC 0100. Its Firm Size is 1.669% smaller.

Most industries have lower Capital Intensity compared with SIC 0100 Agricultural Production Crops. For example, SIC 2000 Food and Kindred Products, SIC 2020 Dairy Products, SIC 2030 Preserved Fruits and Vegetables, SIC 2033 Canned Fruits and Vegetables, SIC 2086 Bottled and Canned Soft Drinks, SIC 2090 Misc. Food and Kindred Products, SIC 2111 Cigarettes, SIC 3523 Farm Machinery and Equipment and SIC 5190 Farm Supplies respectively have 16%, 12.1%, 12%, 16.2%, 9%, 9.4%, 25.2%, 22.7%, 28.7% significantly less Capital Intensity than SIC 0100 Agricultural Production Crops. Two industries have significantly greater Capital Intensity than SIC 0100 Agricultural Production Crops. Capital Intensity of SIC 2611 Pulp Mills is 24.1% greater and Capital Intensity of SIC 2621 Paper Mills is 19.2% greater.

Most industries' ROA and ROS are not significantly different from that of SIC 0100 Agricultural Production Crops. Two exceptions are SIC 2086 Bottled and Canned Soft Drinks and SIC 2090 Misc. Food and Kindred Products. SIC 2086 Bottled and Canned Soft Drinks have 104.7% smaller ROA than SIC 0100 Agricultural Production Crops. SIC 2090 Misc. Food and Kindred Products have 79.8% smaller ROA and 1800.910% smaller ROS than SIC 0100 Agricultural Production Crops.

To sum up, SIC 2611 Pulp Mills and SIC 2621 Paper Mills are industries of large firm size and high capital intensity. SIC 2000 Food and Kindred Products and SIC 2111 Cigarettes are industries of large firm size but less capital intensity. SIC 2086 Bottled and Canned Soft Drinks and SIC 2090 Misc. Food and Kindred Products are industries of small firm size and less capital intensity. The average ROA and ROS of the two industries are significantly negative.

Table 5.1 Exporter Premia in U.S. Agribusiness Firms, 1976-2010

	Export Premia	
	Without Industry Fixed Effects	**With Industry Fixed Effects**
Firm Size	-0.246***	-0.251***
Capital Intensity	0.028***	0.028***
ROA	0.066	0.063
ROS	0.136	0.098

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table 5.2 Export Premia with Industry Fixed Effects, 1976-2010

	Firm Size	Capital Intensity	ROA	ROS
Export Dummy	-0.251***	0.028***	0.063	0.098
SIC 0100 Agricultural Production Crops	5.067***	0.393***	0.021	-0.109
SIC 2000 Food And Kindred Products	3.160***	-0.160***	0.013	-0.011
SIC 2015 Poultry Slaughtering and Proc.	0.773	0.111	0.009	0.062
SIC 2020 Dairy Products	0.833	-0.121*	0.036	0.155
SIC 2030 Preserved Fruits and Vegetables	0.062	-0.120**	0.050	0.134
SIC 2033 Canned fruits and vegetables	1.001	-0.162*	0.017	0.135
SIC 2040 Grain Mill Products	2.278**	0.028	0.002	0.127
SIC 2060 Sugar and Confectionery Prod.	-0.524	-0.021	0.027	0.139
SIC 2070 Fats and Oils	1.653	0.019	-0.018	0.067
SIC 2082 Malt beverages	2.443***	0.055	0.035	0.181
SIC 2086 Bottled and canned soft drinks	-0.582	-0.090*	-1.047***	-0.687
SIC 2090 Misc. Food and Kindred Prod	-1.669*	-0.094*	-0.798*	-18.910***
SIC 2111 Cigarettes	4.080***	-0.252***	0.087	0.224
SIC 2211 Broad woven fabric mills, cotton	-0.007	-0.069	-0.030	0.088
SIC 2611 Pulp mills	2.884*	0.241**	-0.010	0.185
SIC 2621 Paper mills	2.199***	0.192***	-0.010	0.118
SIC 2870 Agricultural Chemicals	-0.303	-0.045	-0.430	-2.177
SIC 3523 Farm machinery and equipment	1.221	-0.227***	0.001	0.108
SIC 3550 Special Industry Machinery	0.086	-0.123	-0.069	0.040
SIC 5150 Farm-Product Raw Materials	2.221	-0.159	-0.014	0.066
SIC 5190 Farm supplies	-0.405	-0.287***	0.005	0.104

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

5.2 Probit Model Results

We estimated four Probit models for a firm's probability to export in a year. Two Probit models use ROA as profitability measure; one model was estimated with industry fixed effects and the one was estimated without industry fixed effects. We also estimated Probit Models with and without industry fixed effects using ROS as profitability measure. Since the estimated Probit coefficients cannot be directly interpreted as marginal effects, we will not discuss those results here but they are reported in Appendix Tables A1-A2. We focus here on discussing the marginal effects of the explanatory variables on the probability that a firm exports.

Table 5.3 presents the marginal effects estimated by Probit using ROA as profitability measure. Specifically, the second column of the table lists marginal effects estimated by Probit without industry fixed effects and the third column of the table lists marginal effects estimated by Probit with industry fixed effects. For both Probit models, the linear and quadratic term of Firm Size and ROA have significant impact on firm's probability to export in a year. The linear and quadratic marginal effect of firm size both change when we control for SIC sector, as shown at the bottom of Table 5.4, it changes from -2% to -4.5%. The combined linear and quadratic effect of Firm Size, Capital Intensity and ROA is calculated by specifying these variables at their means. Though the marginal effect of the linear and quadratic term of ROA is significant at 10% level, its magnitude is very small. Neither the linear nor quadratic term of Capital Intensity show a significant impact on the firms' probability to export. SIC 2000 Food and Kindred Products, SIC 2060 Fats and Oils, SIC 2111 Cigarettes, SIC Pulp Mills, SIC Farm Machinery and Equipment, SIC 5150 Farm-Product Raw Materials respectively have 29.9%, 81.9%, 75%, 64.7%, 40.5%, 69.3% significantly greater probability to export compared with SIC 0100 Agricultural Production Crops.

Table 5.4 presents the marginal effects estimated by Probit using ROS as profitability measure. The marginal effects of the linear and quadratic term of Firm Size, Capital Intensity, ROS and the marginal effects of agribusiness sectors change slightly compared with that estimated by the Probit using ROA as profitability measure. The combined linear and quadratic effect of Firm Size is -1.7% and -4.6% respectively estimated by Probit without and with industry fixed effects. The combined marginal effect of Capital Intensity is positive and tiny and the combined marginal effect of ROS is negative and tiny.

Table 5.3 Probit Marginal Effects Using ROA as Profitability Measure

		Without Industry Fixed Effects	With Industry Fixed Effects
	Firm Size	0.018**	0.043***
	(Firm Size)^2	-0.003**	-0.007***
	Capital Intensity	-0.001	-0.001
	(Capital Intensity)^2	0.00001	0.00003*
	ROA	-0.00004*	-0.0007**
	(ROA)^2	0.0000004*	0.000001*
SIC 2000	**Food And Kindred Products**		0.299*
SIC 2015	**Poultry Slaughtering and Proc.**		0.101
SIC 2020	**Dairy Products**		0.208
SIC 2030	**Preserved Fruits and Vegetables**		0.031
SIC 2033	**Canned fruits and vegetables**		0.024
SIC 2040	**Grain Mill Products**		0.010
SIC 2060	**Sugar and Confectionery Prod.**		0.013
SIC 2070	**Fats and Oils**		0.819***
SIC 2082	**Malt beverages**		0.009
SIC 2086	**Bottled and canned soft drinks**		0.005
SIC 2090	**Misc. Food and Kindred Prod.**		0.000
SIC 2111	**Cigarettes**		0.750***
SIC 2211	**Broad woven fabric mills, cotton**		0.014
SIC 2611	**Pulp mills**		0.647***
SIC 2621	**Paper mills**		0.043
SIC 2870	**Agricultural Chemicals**		0.173
SIC 3523	**Farm machinery and equipment**		0.405**
SIC 3550	**Special Industry Machinery**		0.072
SIC 5150	**Farm-Product Raw Materials**		0.693***
SIC 5190	**Farm supplies**		0.044
	Combined linear and quadratic effect at mean		
	Firm Size	-0.020	-0.045
	Capital Intensity	-0.0003	0.001
	ROA	-0.00004	-0.001

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table 5.4 Probit Marginal Effects Using ROS as Profitability Measure

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.021**	0.054***
(Firm Size)^2	-0.003**	-0.008***
Capital Intensity	-0.0006	-0.001
(Capital Intensity)^2	0.00001	0.00002*
ROS	-0.00005*	-0.0001**
(ROS)^2	0.000000002**	0.000000003*
SIC 2000 Food And Kindred Products		0.295*
SIC 2015 Poultry Slaughtering and Proc.		0.092
SIC 2020 Dairy Products		0.197
SIC 2030 Preserved Fruits and Vegetables		0.028
SIC 2033 Canned fruits and vegetables		0.019
SIC 2040 Grain Mill Products		0.009
SIC 2060 Sugar and Confectionery Prod.		0.012
SIC 2070 Fats and Oils		0.817***
SIC 2082 Malt beverages		0.007
SIC 2086 Bottled and canned soft drinks		0.007
SIC 2090 Misc. Food and Kindred Prod.		0.001
SIC 2111 Cigarettes		0.757***
SIC 2211 Broad woven fabric mills, cotton		0.012
SIC 2611 Pulp mills		0.637**
SIC 2621 Paper mills		0.035
SIC 2870 Agricultural Chemicals		0.135
SIC 3523 Farm machinery and equipment		0.410**
SIC 3550 Special Industry Machinery		0.067
SIC 5150 Farm-Product Raw Materials		0.691***
SIC 5190 Farm supplies		0.045
Combined linear and quadratic effect at mean		
Firm Size	-0.017	-0.046
Capital Intensity	0.0001	0.0005
ROS	-0.00005	-0.0001

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

5.3 Tobit Model Results

We also estimated four Tobit models: one Tobit with industry fixed effects and one Tobit without industry fixed effects using each profitability measure, ROA and ROS. After the Tobit model has been fitted, STATA reports the coefficients of the latent variable model. These coefficients are not intuitively interpretable and are not of our primary interests. We present estimation results of the four Tobit models in Appendix Tables B1-B2.

It is more informative to look at the marginal effects on export intensity and marginal probabilities of exporting estimated by the Tobit models. As introduced in the chapter of methodology, marginal effects estimated by a Tobit model tells us how one unit increases in the explanatory variables impact the response variable. Here the marginal effects tell us how one unit increase in firm size, capital intensity, profitability and agribusiness sector affect Export Intensity. The marginal probability effects tell us how one unit increase in the explanatory variables affect the probability of having non-zero Export Intensity in a year, i.e. the probability to export in a year. Tables 5.5 through Table 5.7 present marginal effects estimated by Tobit using ROA as profitability measure. Since the marginal effect and probability estimates are non-linear, they vary depending on the value of the continuous variables and these tables report the marginal impacts when they are evaluated at the 25%, 50% and 75% percentiles for firm size, respectively, and at mean levels of the other continuous variables.

All the linear and quadratic terms of Firm Size, Capital Intensity and ROA have statistically significant marginal effects estimated by Tobit with and without industry fixed effects. The magnitude of the marginal effects of the linear and quadratic terms of Capital Intensity and ROA are quite small, however, in terms of their impact on export intensity.

One the other hand, there are several agribusiness sectors that have significant impacts on Export Intensity. When Firm Size is specified at the 25th percentile, SIC 2000 Food and Kindred Products, SIC 2070 Facts and Oils, SIC 2111 Cigarettes, SIC 2611 Pulp Mills, SIC 2621 Paper Mills, SIC 2870 Agricultural Chemicals, SIC 3523 Farm Machinery and Equipment, SIC 5150 Farm-Product Raw Materials respectively have 17%, 74.9%, 24.2%, 76.4%, 4.7%, 9.0%, 19.0% and 39.2% greater Export Intensity than SIC 0100 Agricultural Production Crops. When Firm Size is specified at 50% percentile, these industries respectively have 12.7%, 65%, 18.7%, 66.4%, 6.4%, 14.3%, 31.7% greater Export Intensity than SIC 0100 Agricultural Production Crops. When Firm Size is specified at 75% percentile, these industries respectively have 7.2%, 49.2%, 11.2%, 50.5%, 33%, 8.3%, 20.9% greater Export Intensity than SIC 0100 Agricultural Production Crops. The effect that an agribusiness sector a firms belongs on export intensity decreases as a firm's size gets bigger.

We report the combined linear and quadratic effect for each continuous variable at the bottom of each table. We can see from the three tables that Firm Size and ROA have a negative effect on Export Intensity. The negative effect of Firm Size increases as a firm's size gets bigger. ROA has the smallest negative marginal effect when Firm Size is specified at 50^{th} percentile. The marginal effect of Capital Intensity is negative when Firm Size is specified at 50^{th} percentile. It turns positive when Firm Size is specified at 25^{th} and 50^{th} percentile. Specifically, when Firm Size is specified at its 25th percentile, 1% increase in Firm Size decreases Export Intensity by 0.6% and 1.2% estimated respectively by Tobit without and with industry fixed effects. 1% increase in Capital Intensity increases Export Intensity by 0.02% and 1% increase in ROA decreases Export Intensity by 0.1% estimated by Tobit both without and with industry fixed effects. Compared with marginal effects when Firm Size is specified at 25th percentile, when

Firm Size is specified at 75th percentile, 1% increase in Firm Size decrease Export Intensity by 2% estimated by Tobit without industry fixed effects and 1.9% estimated by Tobit with Industry Fixed Effects. 1% increase in Capital Intensity increase Export Intensity by 0.05% and 1% increase in ROA decreases Export Intensity by 0.03% estimated by Tobit both with and without industry fixed effects.

Table 5.8-5.10 presents marginal probability estimated by Tobit using ROA as profitability measure. The linear and quadratic term of Firm Size, Capital Intensity and ROA show significant impact on the probability that a firm has non-zero Export Intensity in a year, whether Firm Size is specified at 25^{th} percentile, 50^{th} percentile and 75^{th} percentile.

The marginal probabilities of agribusiness sectors decrease as a firm's size increases. When Firm Size is specified at 25^{th} percentile, SIC 2000 Food and Kindred Products, SIC 2015 Poultry Slaughtering and Processing, SIC 2020 Dairy Products, SIC 2030 Preserved Fruits and Vegetables, SIC 2070 Fats and Oils, SIC 2111 Cigarettes, SIC 2611 Pulp Mills, SIC 2621 Paper Mills, SIC 2870 Agricultural Chemicals, SIC 3523 Farm Machinery and Equipment, SIC 5150 Farm-Product Raw Materials respectively have 42.4%, 27.7%, 28.3%, 15.7%, 89.7%, 53.5%, 90.1%, 15.9%, 26.7%, 45.8% and 70.1% greater probability to export than SIC 0100 Agricultural Production Crops. The marginal probability of SIC 2015 Poultry Slaughtering and Processing, SIC 2020 Dairy Products and SIC 2030 Preserved Fruits and Vegetables turns insignificant at 10% when Firm Size is specified at 50% percentile and 75% percentile. The remaining industries of SIC 2000 Food and Kindred Products, SIC 2070 Fats and Oils, SIC 2111 Cigarettes, SIC 2611 Pulp Mills, SIC 2621 Paper Mills, SIC 2870 Agricultural Chemicals, SIC 3523 Farm Machinery and Equipment, SIC 5150 Farm-Product Raw Materials respectively have 35.1%, 87.2%, 45.9%, 87.8%, 20.8%, 38.3%, 63.5% greater probability to export than SIC 0100

Agricultural Production Crops when Firm Size is specified at 50th percentile. The marginal probability of the eight industries become 23.3%, 79.6%, 32.7%, 80.5%, 12.4%, 26.0% and 50.2% when Firm Size is specified at 75% percentile.

The combined linear and quadratic effect of Firm Size, Capital Intensity and ROA are presented at the bottom of Table 5.8, Table 5.9 and Table 5.10 when Firm Size is specified at 25%, 50% and 75% percentile respectively. We calculated the combined effect based on Eq. 4.15 with Firm Size specified at certain percentile and other variables at their means. Firm Size, Capital Intensity and ROA all show negative marginal probability. The marginal probability of ROA does not change when Firm Size is specified at different percentiles. 1% increase in ROA decreases the probability to export by 0.1%. The marginal probability of Capital Intensity and ROA changes along with a firm's size. Specifically, when Firm Size is specified at 25th percentile, 1% increase in Firm Size decreases the probability to export by 1.4% and 1.7% estimated respectively by Tobit without and with industry fixed effects. 1% increase in Capital Intensity decreases the probability to export by 0.04% and 0.1% estimated respectively by Tobit without and with industry fixed effects. When Firm Size is specified at 50th percentile, 1% increase in Firm Size decreases the probability to export by 3.1% and 3.7% estimated respectively by Tobit without and with industry fixed effects. 1% increase in Capital Intensity decreases the probability to export by 0.1% estimated both by Tobit without and with industry fixed effects. When Firm Size is specified at 75th percentile, 1% increase in Firm Size decreases the probability to export by 3.7% and 3.5% estimated respectively by Tobit without and with industry fixed effects. 1% increase in Capital Intensity decreases the probability to export by 0.009% estimated both by Tobit without and with industry fixed effects.

Appendix Table B3-B8 presents marginal effect and marginal probability estimated by Tobit using ROS as profitability measure. The significance and magnitude of the estimated marginal effect and marginal probability does not change much compared with that estimated by Tobit model using ROA as profitability measure. With regards to that, we decide not to discuss the results presented in Appendix Table C3-C8 in detail here.

Table 5.5 Tobit Marginal Effects Using ROA as Profitability Measure: Firm Size Specified at 25% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.021**	0.024**
(Firm Size)^2	-0.003***	-0.004***
Capital Intensity	-0.002***	-0.002**
(Capital Intensity)^2	0.00003***	0.00003***
ROA	-0.0006*	-0.0006**
(ROA)^2	0.0000008***	0.0000008***
SIC 2000 Food And Kindred Products		0.170**
SIC 2015 Poultry Slaughtering and Proc.		0.095
SIC 2020 Dairy Products		0.097
SIC 2030 Preserved Fruits and Vegetables		0.047
SIC 2033 Canned fruits and vegetables		0.036
SIC 2040 Grain Mill Products		0.022
SIC 2060 Sugar and Confectionery Prod.		0.029
SIC 2070 Fats and Oils		0.749***
SIC 2082 Malt beverages		0.023
SIC 2086 Bottled and canned soft drinks		0.020
SIC 2090 Misc. Food and Kindred Prod.		0.002
SIC 2111 Cigarettes		0.242**
SIC 2211 Broad woven fabric mills, cotton		0.032
SIC 2611 Pulp mills		0.764***
SIC 2621 Paper mills		0.047*
SIC 2870 Agricultural Chemicals		0.090**
SIC 3523 Farm machinery and equipment		0.190**
SIC 3550 Special Industry Machinery		0.069
SIC 5150 Farm-Product Raw Materials		0.392**
SIC 5190 Farm supplies		0.044
Combined linear and quadratic effect		
Firm Size	-0.006	-0.012
Capital Intensity	0.0002	0.0002
ROA	-0.001	-0.001

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table 5.6 Tobit Marginal Effects Using ROA as Profitability Measure: Firm Size Specified at 50 % Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.0173**	0.019**
(Firm Size)^2	-0.003***	-0.003***
Capital Intensity	-0.002***	-0.002**
(Capital Intensity)^2	0.00002***	0.00002**
ROA	-0.00005**	-0.0005**
(ROA)^2	0.000006***	0.0000006**
SIC 2000 Food And Kindred Products		0.127**
SIC 2015 Poultry Slaughtering and Proc.		0.067
SIC 2020 Dairy Products		0.069
SIC 2030 Preserved Fruits and Vegetables		0.031
SIC 2033 Canned fruits and vegetables		0.024
SIC 2040 Grain Mill Products		0.014
SIC 2060 Sugar and Confectionery Prod.		0.019
SIC 2070 Fats and Oils		0.650***
SIC 2082 Malt beverages		0.015
SIC 2086 Bottled and canned soft drinks		0.013
SIC 2090 Misc. Food and Kindred Prod.		0.001
SIC 2111 Cigarettes		0.187**
SIC 2211 Broad woven fabric mills, cotton		0.021
SIC 2611 Pulp mills		0.664**
SIC 2621 Paper mills		0.032
SIC 2870 Agricultural Chemicals		0.064**
SIC 3523 Farm machinery and equipment		0.143**
SIC 3550 Special Industry Machinery		0.047
SIC 5150 Farm-Product Raw Materials		0.317**
SIC 5190 Farm supplies		0.030
Combined linear and quadratic effect		
Firm Size	-0.020	-0.018
Capital Intensity	-0.0005	-0.0005
ROA	-0.00007	-0.00007

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table 5.7 Tobit Marginal Effects Using ROA as Profitability Measure: Firm Size Specified at 75% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.012**	0.013***
(Firm Size)^2	-0.002***	-0.002***
Capital Intensity	-0.001***	-0.001**
(Capital Intensity)^2	0.00002***	0.00002**
ROA	-0.0003**	-0.0003**
(ROA)^2	0.0000004***	0.0000004**
SIC 2000 Food And Kindred Products		0.072*
SIC 2015 Poultry Slaughtering and Proc.		0.035
SIC 2020 Dairy Products		0.036
SIC 2030 Preserved Fruits and Vegetables		0.015
SIC 2033 Canned fruits and vegetables		0.011
SIC 2040 Grain Mill Products		0.006
SIC 2060 Sugar and Confectionery Prod.		0.009
SIC 2070 Fats and Oils		0.492**
SIC 2082 Malt beverages		0.006
SIC 2086 Bottled and canned soft drinks		0.006
SIC 2090 Misc. Food and Kindred Prod.		0.001
SIC 2111 Cigarettes		0.112*
SIC 2211 Broad woven fabric mills, cotton		0.009
SIC 2611 Pulp mills		0.505**
SIC 2621 Paper mills		0.015
SIC 2870 Agricultural Chemicals		0.033*
SIC 3523 Farm machinery and equipment		0.083*
SIC 3550 Special Industry Machinery		0.023
SIC 5150 Farm-Product Raw Materials		0.209**
SIC 5190 Farm supplies		0.014
Combined linear and quadratic effect		
Firm Size	-0.020	-0.019
Capital Intensity	0.0005	0.0005
ROA	-0.0003	-0.0003

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table 5.8 Tobit Marginal Probabilities Using ROA as Profitability Measure: Firm Size Specified at 25% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.053***	-0.045***
(Firm Size)^2	-0.007***	-0.007***
Capital Intensity	-0.004***	-0.005***
(Capital Intensity)^2	0.00005***	0.00005***
ROA	-0.0002***	-0.001**
(ROA)^2	0.000000007***	0.000001***
SIC 2000 Food And Kindred Products		0.424***
SIC 2015 Poultry Slaughtering and Proc.		0.277*
SIC 2020 Dairy Products		0.283*
SIC 2030 Preserved Fruits and Vegetables		0.157*
SIC 2033 Canned fruits and vegetables		0.126
SIC 2040 Grain Mill Products		0.082
SIC 2060 Sugar and Confectionery Prod.		0.106
SIC 2070 Fats and Oils		0.897***
SIC 2082 Malt beverages		0.085
SIC 2086 Bottled and canned soft drinks		0.076
SIC 2090 Misc. Food and Kindred Prod.		0.011
SIC 2111 Cigarettes		0.535***
SIC 2211 Broad woven fabric mills, cotton		0.114
SIC 2611 Pulp mills		0.901***
SIC 2621 Paper mills		0.159**
SIC 2870 Agricultural Chemicals		0.267***
SIC 3523 Farm machinery and equipment		0.458***
SIC 3550 Special Industry Machinery		0.216
SIC 5150 Farm-Product Raw Materials		0.701***
SIC 5190 Farm supplies		0.150
Combined linear and quadratic effect		
Firm Size	-0.015	-0.0107
Capital Intensity	-0.0004	-0.001
ROA	-0.001	-0.001**

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table 5.9 Tobit Marginal Probabilities Using ROA as Profitability Measure: Firm Size Specified at 50% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.035**	0.039***
(Firm Size)^2	-0.005***	0.006***
Capital Intensity	-0.004***	-0.004***
(Capital Intensity)^2	0.00005***	0.00005***
ROA	-0.001***	-0.001**
(ROA)^2	0.000001***	0.000001***
SIC 2000 Food And Kindred Products		0.351***
SIC 2015 Poultry Slaughtering and Proc.		0.217
SIC 2020 Dairy Products		0.222
SIC 2030 Preserved Fruits and Vegetables		0.116
SIC 2033 Canned fruits and vegetables		0.091
SIC 2040 Grain Mill Products		0.058
SIC 2060 Sugar and Confectionery Prod.		0.076
SIC 2070 Fats and Oils		0.872***
SIC 2082 Malt beverages		0.060
SIC 2086 Bottled and canned soft drinks		0.053
SIC 2090 Misc. Food and Kindred Prod.		0.007
SIC 2111 Cigarettes		0.459***
SIC 2211 Broad woven fabric mills, cotton		0.082
SIC 2611 Pulp mills		0.878***
SIC 2621 Paper mills		0.117*
SIC 2870 Agricultural Chemicals		0.208**
SIC 3523 Farm machinery and equipment		0.383***
SIC 3550 Special Industry Machinery		0.164
SIC 5150 Farm-Product Raw Materials		0.635***
SIC 5190 Farm supplies		0.111
Combined linear and quadratic effect		
Firm Size	-0.03	-0.036
Capital Intensity	-0.0004	-0.0004
ROA	-0.001	-0.001

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table 5.10 Tobit Marginal Probabilities Using ROA as Profitability Measure: Firm Size Specified at 75% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.027**	0.029**
(Firm Size)^2	-0.004***	-0.004***
Capital Intensity	-0.003***	-0.003***
(Capital Intensity)^2	0.00004***	0.00004***
ROA	-0.0008***	-0.0008**
(ROA)^2	0.000001***	0.0000009***
SIC 2000 Food And Kindred Products		0.233**
SIC 2015 Poultry Slaughtering and Proc.		0.130
SIC 2020 Dairy Products		0.134
SIC 2030 Preserved Fruits and Vegetables		0.063
SIC 2033 Canned fruits and vegetables		0.048
SIC 2040 Grain Mill Products		0.029
SIC 2060 Sugar and Confectionery Prod.		0.039
SIC 2070 Fats and Oils		0.796***
SIC 2082 Malt beverages		0.030
SIC 2086 Bottled and canned soft drinks		0.026
SIC 2090 Misc. Food and Kindred Prod.		0.003
SIC 2111 Cigarettes		0.327**
SIC 2211 Broad woven fabric mills, cotton		0.043
SIC 2611 Pulp mills		0.805***
SIC 2621 Paper mills		0.064*
SIC 2870 Agricultural Chemicals		0.124**
SIC 3523 Farm machinery and equipment		0.260***
SIC 3550 Special Industry Machinery		0.094
SIC 5150 Farm-Product Raw Materials		0.502***
SIC 5190 Farm supplies		0.060
Combined linear and quadratic effect		
Firm Size	-0.037	-0.035
Capital Intensity	-0.00009	-0.00009
ROA	-0.001	-0.001

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

5.4 Conclusions and Discussions

Our study examined the "self-selection" hypothesis among U.S. agribusiness firms. We first used OLS regression to study the characteristics of exporting agribusiness firms. A Probit model was then employed to analyze the effect of firm size, capital intensity, profitability and agribusiness sector classification on a firm's probability of exporting. In addition, we also analyzed the effect of the factors mentioned above on a firm's intensity of export (i.e. the ratio of export sales to total sales) with a Tobit model.

Our results show that firm size and profitability have statistically significant but quite small negative effects on the export probability and intensity of U.S. agribusiness firms. Capital Intensity has no statistically significant impact on the export behavior of these firms estimated by Probit Models and a statistically significant but tiny effect estimated by Tobit Models. The finding of a small negative effect of firm size on export behavior contradicts findings for manufacturing firms in previous literature. Although the firm size effects found in this study are too small to be of practical significance, the negative relationship may be due to the limitations of the data used in the analysis. The COMPUSTAT data includes only publically traded firms and does not include data on the level of foreign direct investment (FDI) of these firms. If larger firms are more likely to use FDI to reach foreign markets instead of exports, that could contribute to our findings of a small negative relationship between firm size and exports. Additional joint analysis of both export and FDI behavior would be very useful if such data can be developed.

The small negative effect of profitability on the export behavior of U.S. agribusiness firms is consistent with the findings of some previous studies. Temouri, Vogel and Wagner (2013) had similar findings for German business service firms. Amendolagine, Capolupo, and

Petragallo (2007) and Grazzi (2012) found no evidence of higher profitability for Italian exporters. Why both our study and previous studies did not find positive effects of profitability or productivity on exports is a question that worth further investigating, since a productivity premium is generally expected in theoretical models and found in some empirical studies, and productivity and profitability are highly correlated.

The agribusiness sector in which a firm operates is by far the most important factor explaining the export behavior of agribusiness firms in our analysis. The sectorial effect is strong and robust across all three types of models we estimated. SIC 2000 Food and Kindred Products, SIC 2070 Fats and Oils, SIC 2111 Cigarettes, SIC 2611 Pulp Mills, SIC 3523 Farm Machinery and Equipment and SIC 5150 Farm-Product Raw Materials are six agribusiness sectors that have significantly greater probability and intensity to export. This fact reveals information of comparative advantage of U.S. agriculture. Corn, soybean, tobacco, and livestock are major agricultural products of the U.S. and U.S. has a relative high yield in these products relative to other countries. Three out of the six sectors: SIC 2070 Fats and Oils, SIC 2111 Cigarettes, SIC 5150 Farm-Product Raw Materials, either directly export these agricultural products or process these agricultural products. The comparative advantage of SIC 2611 Pulp Mills comes from U.S.'s rich forestry resources and the prime export behavior of SIC 2000 Food and Kindred Products and SIC 3523 Farm Machinery and Equipment is based on U.S.' outstanding agricultural manufacturing ability.

Agribusiness sectors with no exporting firms include grocery stores and agricultural services. The market for these sectors is very localized so the export behavior of these sectors is explained by the natural market for the products and services they sell rather than by factors such as firm size and capital intensity.

The sectorial findings suggest that one of the most productive areas for further investigation of exports of agribusiness firms would be an analysis of firms within sectors with considerable firm-level diversity in export behavior. This type of study would provide insights in firm characteristics which affect export behavior in sectors where the potential for exports is evident but export behavior is different. As with other suggestions for future research, this too is dependent on the availability of adequate data.

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APPENDIX

Table A1 Probit Model Estimation Results: Using ROA as Profitability Measure

	without Industry Fixed Effects	with Industry Fixed Effects
Firm Size	0.480***	0.493***
	(0.168)	(0.0161)
(Firm Size)^2	-0.082***	-0.084***
	(0.015)	(0.014)
Capital Intensity	-0.023	-0.016
	(0.015)	(0.015)
(Capital Intensity)^2	0.000**	0.000*
	(0.000)	(0.000)
ROA	-0.010**	-0.008*
	(0.000)	(0.004)
(ROA)^2	0.000**	0.000**
	(0.000)	(0.004)
Constant	-2.170***	-4.169***
	(0.575)	(0.999)
SIC 2000 Food And Kindred Products		3.859***
SIC 2015 Poultry slaughtering and processing		2.841**
SIC 2020 Dairy Products		3.459***
SIC 2030 Preserved Fruits and Vegetables		2.089*
SIC 2033 Canned fruits and vegetables		1.936
SIC 2040 Grain Mill Products		1.515
SIC 2060 Sugar and Confectionery Products		1.638
SIC 2070 Fats and Oils		6.457***
SIC 2082 Malt beverages		1.432
SIC 2086 Bottled and canned soft drinks		1.213
SIC 2090 Misc. Food and Kindred Products		0.359
SIC 2111 Cigarettes		5.931***
SIC 2211 Broad woven fabric mills, cotton		1.655
SIC 2611 Pulp mills		5.330***
SIC 2621 Paper mills		2.278**
SIC 2870 Agricultural Chemicals		3.287***
SIC 3523 Farm machinery and equipment		4.284***
SIC 3550 Special Industry Machinery		2.604*
SIC 5150 Farm-Product Raw Materials		5.579***
SIC 5190 Farm supplies		2.285*
σ_u	2.730	1.772
rho	0.759	0.759
N	2450	2450

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table A2 Probit Model Estimation Results: Using ROS as Profitability Measure

	without Industry Fixed Effects	with Industry Fixed Effects
Firm Size	0.670***	0.637***
	(0.171)	(0.162)
(Firm Size)^2	-0.096***	-0.095***
	(0.015)	(0.014)
Capital Intensity	-0.020	-0.013
	(0.015)	(0.015)
(Capital Intensity)^2	0.000**	0.000*
	(0.000)	(0.000)
ROS	-0.002***	-0.001**
	(0.001)	(0.000)
(ROS)^2	0.000**	0.000*
	(0.000)	(0.000)
Constant	-2.852***	-4.713***
	(0.592)	(1.018)
SIC 2000 Food And Kindred Products		3.900***
SIC 2015 Poultry slaughtering and processing		2.858**
SIC 2020 Dairy Products		3.475***
SIC 2030 Preserved Fruits and Vegetables		2.130*
SIC 2033 Canned fruits and vegetables		1.917
SIC 2040 Grain Mill Products		1.523
SIC 2060 Sugar and Confectionery Products		1.669
SIC 2070 Fats and Oils		6.475***
SIC 2082 Malt beverages		1.412
SIC 2086 Bottled and canned soft drinks		1.390
SIC 2090 Misc. Food and Kindred Products		0.498
SIC 2111 Cigarettes		6.001***
SIC 2211 Broad woven fabric mills, cotton		1.671
SIC 2611 Pulp mills		5.303***
SIC 2621 Paper mills		2.254**
SIC 2870 Agricultural Chemicals		3.151***
SIC 3523 Farm machinery and equipment		5.587***
SIC 3550 Special Industry Machinery		2.400*
SIC 5150 Farm-Product Raw Materials		5.579***
SIC 5190 Farm supplies		2.285*
σ_u	2.748	1.790
rho	0.883	0.762
N	2445	2445

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B1 Tobit Model Estimation Results: Using ROA as Profitability Measure

	without Industry Fixed Effects	with Industry Fixed Effects
Firm Size	0.092**	0.093***
	(0.036)	(0.035)
(Firm Size)^2	-0.014***	-0.014***
	(0.003)	(0.003)
Capital Intensity	-0.011***	-0.009***
	(0.004)	(0.004)
(Capital Intensity)^2	0.000***	0.000***
	(0.000)	(0.000)
ROA	-0.003***	-0.002**
	(0.001)	(0.001)
(ROA)^2	0.000***	0.000***
	(0.000)	(0.000)
Constant	-0.486***	-0.961***
	(0.137)	(0.253)
SIC 2000 Food And Kindred Products		0.925***
SIC 2015 Poultry slaughtering and processing		0.725**
SIC 2020 Dairy Products		0.733**
SIC 2030 Preserved Fruits and Vegetables		0.526*
SIC 2033 Canned fruits and vegetables		0.462
SIC 2040 Grain Mill Products		0.355
SIC 2060 Sugar and Confectionery Products		0.417
SIC 2070 Fats and Oils		1.723***
SIC 2082 Malt beverages		0.363
SIC 2086 Bottled and canned soft drinks		0.338
SIC 2090 Misc. Food and Kindred Products		0.074
SIC 2111 Cigarettes		1.066***
SIC 2211 Broad woven fabric mills, cotton		0.435
SIC 2611 Pulp mills		1.739***
SIC 2621 Paper mills		0.528**
SIC 2870 Agricultural Chemicals		0.710***
SIC 3523 Farm machinery and equipment		0.968***
SIC 3550 Special Industry Machinery		0.630*
SIC 5150 Farm-Product Raw Materials		1.299***
SIC 5190 Farm supplies		0.513
σ_u	0.631	0.413
σ_e	0.295	0.295
rho	0.821	0.663
N	2450	2450

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B2 Tobit Model Estimation Results: Using ROS as Profitability Measure

	without Industry Fixed Effects	with Industry Fixed Effects
Firm Size	0.123***	0.117***
	(0.036)	(0.035)
(Firm Size)^2	-0.016***	-0.016***
	(0.003)	(0.003)
Capital Intensity	-0.010***	-0.008**
	(0.004)	(0.004)
(Capital Intensity)^2	0.000***	0.000**
	(0.000)	(0.000)
ROS	0.000***	0.000***
	(0.000)	(0.000)
(ROS)^2	0.000***	0.000***
	(0.000)	(0.000)
Constant	-0.618***	-1.067***
	(0.139)	(0.254)
SIC 2000 Food And Kindred Products		0.917***
SIC 2015 Poultry slaughtering and processing		0.717**
SIC 2020 Dairy Products		0.722**
SIC 2030 Preserved Fruits and Vegetables		0.530*
SIC 2033 Canned fruits and vegetables		0.455
SIC 2040 Grain Mill Products		0.350
SIC 2060 Sugar and Confectionery Products		0.417
SIC 2070 Fats and Oils		1.705***
SIC 2082 Malt beverages		0.351
SIC 2086 Bottled and canned soft drinks		0.370
SIC 2090 Misc. Food and Kindred Products		0.099
SIC 2111 Cigarettes		1.055***
SIC 2211 Broad woven fabric mills, cotton		0.438
SIC 2611 Pulp mills		1.712***
SIC 2621 Paper mills		0.513**
SIC 2870 Agricultural Chemicals		0.657**
SIC 3523 Farm machinery and equipment		0.970***
SIC 3550 Special Industry Machinery		0.635*
SIC 5150 Farm-Product Raw Materials		1.284***
SIC 5190 Farm supplies		0.537*
σ_u	0.622	0.410
σ_e	0.294	0.294
rho	0.817	0.660
N	2445	2445

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B3 Tobit Marginal Effects s Using ROS as Profitability Measure:

Firm Size Specified at 25% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.027***	0.030***
(Firm Size)^2	-0.004***	-0.004***
Capital Intensity	-0.002**	-0.002**
(Capital Intensity)^2	0.00003***	0.00003**
ROS	-0.0001***	-0.0001***
(ROS)^2	0.000000004***	0.000000003***
SIC 2000 Food And Kindred Products		0.170**
SIC 2015 Poultry Slaughtering and Proc.		0.095
SIC 2020 Dairy Products		0.097
SIC 2030 Preserved Fruits and Vegetables		0.047
SIC 2033 Canned fruits and vegetables		0.036
SIC 2040 Grain Mill Products		0.022
SIC 2060 Sugar and Confectionery Prod.		0.029
SIC 2070 Fats and Oils		0.749***
SIC 2082 Malt beverages		0.023
SIC 2086 Bottled and canned soft drinks		0.020
SIC 2090 Misc. Food and Kindred Prod.		0.002
SIC 2111 Cigarettes		0.242**
SIC 2211 Broad woven fabric mills, cotton		0.032
SIC 2611 Pulp mills		0.764***
SIC 2621 Paper mills		0.047*
SIC 2870 Agricultural Chemicals		0.090**
SIC 3523 Farm machinery and equipment		0.190**
SIC 3550 Special Industry Machinery		0.069
SIC 5150 Farm-Product Raw Materials		0.392**
SIC 5190 Farm supplies		0.044
Combined linear and quadratic effect		
Firm Size	-0.009	-0.006
Capital Intensity	0.00002	0.00002
ROA	-0.0001	-0.0001

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B4 Tobit Marginal Effects Using ROS as Profitability Measure:

Firm Size Specified at 50% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.024***	0.024***
(Firm Size)^2	-0.003***	-0.003***
Capital Intensity	-0.002**	-0.002**
(Capital Intensity)^2	0.00002***	0.00002**
ROS	-0.00009***	-0.00008***
(ROS)^2	0.000000003***	0.000000002***
SIC 2000 Food And Kindred Products		0.170**
SIC 2015 Poultry Slaughtering and Proc.		0.095
SIC 2020 Dairy Products		0.097
SIC 2030 Preserved Fruits and Vegetables		0.047
SIC 2033 Canned fruits and vegetables		0.036
SIC 2040 Grain Mill Products		0.022
SIC 2060 Sugar and Confectionery Prod.		0.029
SIC 2070 Fats and Oils		0.749***
SIC 2082 Malt beverages		0.023
SIC 2086 Bottled and canned soft drinks		0.020
SIC 2090 Misc. Food and Kindred Prod.		0.002
SIC 2111 Cigarettes		0.242**
SIC 2211 Broad woven fabric mills, cotton		0.032
SIC 2611 Pulp mills		0.764***
SIC 2621 Paper mills		0.047*
SIC 2870 Agricultural Chemicals		0.090**
SIC 3523 Farm machinery and equipment		0.190**
SIC 3550 Special Industry Machinery		0.069
SIC 5150 Farm-Product Raw Materials		0.392**
SIC 5190 Farm supplies		0.044
Combined linear and quadratic effect		
Firm Size	-0.014	-0.014
Capital Intensity	-0.0005	-0.0005
ROA	-0.00009	-0.00008

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B5 Tobit Marginal Effects Using ROS as Profitability Measure:
Firm Size Specified at 75% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.016***	0.016***
(Firm Size)^2	-0.002***	-0.002***
Capital Intensity	-0.001**	-0.001**
(Capital Intensity)^2	0.00002**	0.00001**
ROS	-0.00006***	-0.00005***
(ROS)^2	0.000000002***	0.000000002***
SIC 2000 Food And Kindred Products		0.170**
SIC 2015 Poultry Slaughtering and Proc.		0.095
SIC 2020 Dairy Products		0.097
SIC 2030 Preserved Fruits and Vegetables		0.047
SIC 2033 Canned fruits and vegetables		0.036
SIC 2040 Grain Mill Products		0.022
SIC 2060 Sugar and Confectionery Prod.		0.029
SIC 2070 Fats and Oils		0.749***
SIC 2082 Malt beverages		0.023
SIC 2086 Bottled and canned soft drinks		0.020
SIC 2090 Misc. Food and Kindred Prod.		0.002
SIC 2111 Cigarettes		0.242**
SIC 2211 Broad woven fabric mills, cotton		0.032
SIC 2611 Pulp mills		0.764***
SIC 2621 Paper mills		0.047*
SIC 2870 Agricultural Chemicals		0.090**
SIC 3523 Farm machinery and equipment		0.190**
SIC 3550 Special Industry Machinery		0.069
SIC 5150 Farm-Product Raw Materials		0.392**
SIC 5190 Farm supplies		0.044
Combined linear and quadratic effect		
Firm Size	-0.016	-0.016
Capital Intensity	0.0005	-0.0003
ROA	-0.00006	-0.00005

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B6 Tobit Marginal Probability Effects Using ROS as Profitability Measure

Firm Size Specified at 25% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.053***	0.057***
(Firm Size)^2	-0.007***	-0.008***
Capital Intensity	-0.004***	-0.004**
(Capital Intensity)^2	0.00005***	0.00005**
ROS	-0.0002***	-0.0002***
(ROS)^2	0.000000007***	0.000000006***
SIC 2000 Food And Kindred Products		0.170**
SIC 2015 Poultry Slaughtering and Proc.		0.095
SIC 2020 Dairy Products		0.097
SIC 2030 Preserved Fruits and Vegetables		0.047
SIC 2033 Canned fruits and vegetables		0.036
SIC 2040 Grain Mill Products		0.022
SIC 2060 Sugar and Confectionery Prod.		0.029
SIC 2070 Fats and Oils		0.749***
SIC 2082 Malt beverages		0.023
SIC 2086 Bottled and canned soft drinks		0.020
SIC 2090 Misc. Food and Kindred Prod.		0.002
SIC 2111 Cigarettes		0.242**
SIC 2211 Broad woven fabric mills, cotton		0.032
SIC 2611 Pulp mills		0.764***
SIC 2621 Paper mills		0.047*
SIC 2870 Agricultural Chemicals		0.090**
SIC 3523 Farm machinery and equipment		0.190**
SIC 3550 Special Industry Machinery		0.069
SIC 5150 Farm-Product Raw Materials		0.392**
SIC 5190 Farm supplies		0.044
Combined linear and quadratic effect		
Firm Size	-0.009	-0.014
Capital Intensity	-0.0004	-0.0004
ROA	-0.0002	-0.0002

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B7 Tobit Marginal Probability Effects Using ROS as Profitability Measure

Firm Size Specified at 50% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.048**	0.050***
(Firm Size)^2	-0.006***	-0.007***
Capital Intensity	-0.004***	-0.004**
(Capital Intensity)^2	0.00005***	0.00005**
ROS	-0.0002*	-0.0002***
(ROS)^2	0.000000006***	0.000000005***
SIC 2000 Food And Kindred Products		0.170**
SIC 2015 Poultry Slaughtering and Proc.		0.095
SIC 2020 Dairy Products		0.097
SIC 2030 Preserved Fruits and Vegetables		0.047
SIC 2033 Canned fruits and vegetables		0.036
SIC 2040 Grain Mill Products		0.022
SIC 2060 Sugar and Confectionery Prod.		0.029
SIC 2070 Fats and Oils		0.749***
SIC 2082 Malt beverages		0.023
SIC 2086 Bottled and canned soft drinks		0.020
SIC 2090 Misc. Food and Kindred Prod.		0.002
SIC 2111 Cigarettes		0.242**
SIC 2211 Broad woven fabric mills, cotton		0.032
SIC 2611 Pulp mills		0.764***
SIC 2621 Paper mills		0.047*
SIC 2870 Agricultural Chemicals		0.090**
SIC 3523 Farm machinery and equipment		0.190**
SIC 3550 Special Industry Machinery		0.069
SIC 5150 Farm-Product Raw Materials		0.392**
SIC 5190 Farm supplies		0.044
Combined linear and quadratic effect		
Firm Size	-0.027	-0.038
Capital Intensity	-0.0004	-0.0004
ROA	-0.0002	-0.0002

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively

Table B8 Tobit Marginal Probability Effects Using ROS as Profitability Measure

Firm Size Specified at 75% Percentile

	Without Industry Fixed Effects	With Industry Fixed Effects
Firm Size	0.039***	0.037***
(Firm Size)^2	-0.005***	-0.005***
Capital Intensity	-0.003***	-0.003**
(Capital Intensity)^2	0.00004***	0.00003**
ROS	-0.0001***	-0.0006***
(ROS)^2	0.000000005***	0.0000008***
SIC 2000 Food And Kindred Products		0.170**
SIC 2015 Poultry Slaughtering and Proc.		0.095
SIC 2020 Dairy Products		0.097
SIC 2030 Preserved Fruits and Vegetables		0.047
SIC 2033 Canned fruits and vegetables		0.036
SIC 2040 Grain Mill Products		0.022
SIC 2060 Sugar and Confectionery Prod.		0.029
SIC 2070 Fats and Oils		0.749***
SIC 2082 Malt beverages		0.023
SIC 2086 Bottled and canned soft drinks		0.020
SIC 2090 Misc. Food and Kindred Prod.		0.002
SIC 2111 Cigarettes		0.242**
SIC 2211 Broad woven fabric mills, cotton		0.032
SIC 2611 Pulp mills		0.764***
SIC 2621 Paper mills		0.047*
SIC 2870 Agricultural Chemicals		0.090**
SIC 3523 Farm machinery and equipment		0.190**
SIC 3550 Special Industry Machinery		0.069
SIC 5150 Farm-Product Raw Materials		0.392**
SIC 5190 Farm supplies		0.044
Combined linear and quadratic effect		
Firm Size	-0.041	-0.043
Capital Intensity	-0.00009	-0.00008
ROA	-0.0001	-0.0006

Note: *, **, *** denote significant at 10%, 5%, and 1% levels, respectively