MEASURING THE PROFITABILITY OF THE UNITED STATES FOOD SUPPLY CHAIN: CROSS-SECTION AND TIME-SERIES EFFECTS

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A THESIS PRESENTED TO THE GRADUATE SCHOOL
OF THE UNIVERSITY OF FLORIDA IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE
MASTER OF SCIENCE

UNIVERSITY OF FLORIDA

2010

To Jingqi Wang, Zhenya Zhao and Qipeng Zheng

ACKNOWLEDGMENTS

I extend my deepest gratitude to the chair of my supervisory committee, Dr. Richard Weldon. Special thanks should be given to my committee member Dr. Carlos J. Trejo-Pech, and Dr. Randle. I acknowledge and express my sincere appreciation for their direction, assistance, guidance, and for their encouragement to successfully complete the Master of Science program.

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August 2010

Chair: Richard N. Weldon
Major: Food and Resource Economics

Over time, agricultural producers and agribusinesses in the U.S. food supply chain have experienced a lot of market changes and restructurings. Agribusiness management is increasingly focusing on the strategy to improve its profitability. There are many key drivers to improve agribusiness's competitiveness and financial performance, such as market demand, technical efficiency, environmental impact, etc. This study concentrates on the operating strategy employed by the U.S. food supply sectors by analyzing groups of financial ratios. Following the framework of the DuPont system, this research classifies financial ratios into three categories to measure agribusiness's operating efficiency, asset use efficiency, and capital structure. Moreover, both fixed cross-section effect and time-series effect are examined though the financial statement analysis with respect to a 23 years panel data. This research aims to: 1) evaluate the critical operating concern for profitability of agribusiness; 2) compare the profitability of sub sectors in the food supply chain; and 3) estimate the time effect of economic recessions on agribusiness's profit rate.

This study provides information regarding the financial performance of agribusiness. And it advances the understanding of operating efficiency and effectiveness of agribusiness.

CHAPTER 1
INTRODUCTION

Profitability is defined as the ability for a firm to generate profits on a consistent basis. In the modern business world, sustaining the profitability becomes a critical success factor that leads to firm survival. The empirical tests in this study are based on the profitability measurement by decomposing critical management factors.

Agribusiness Profitability

In the current dynamic and complex environment, having a good product or service to customer does not guarantee high profitability. Profit is the difference between total revenue and explicit costs. Numerous factors inside and outside the firm could affect the agribusiness profitability. The internal factors that are affecting firm profitability are expressed by management strategies such as business organization, operating management, financial structure, etc. In contrast to those micro decisions, the primary external market factors in determining firm success are macroeconomic in nature, such as fiscal policy, governmental regulation, market competition, and product demand, among others. A number of studies have explored the major determinants of firm's profitability.

The agricultural sector in the United States is important, not only because the agricultural products feed people in this country, but also because it is a supporting industry to the economy of the United States. With the growing concentration of ownership and centralization in food sectors, the agribusiness is the second most profitable industry in the United States, following pharmaceuticals (Magdoff, Foster, and Buttel, 2000). More and more research is expressing interest in the analysis of the

performance of agricultural and food system in terms of profitability (Kennedy, Harrison, and Piedra, 1998; Neibergs, 1998).

Agribusiness and the U.S. Food Supply Chain

Agribusiness has long been recognized as an important industry and supporting component in the U.S. economy. Being the world's leading exporter of agricultural products, the U.S. agribusinesses supply food to the world. The U.S. is the largest agricultural export country and has a surplus in agriculture despite of overall trade deficit. According to the yearly trade data released by the USDA's Economic Research Service and Foreign Agricultural Service, the U.S. exports agricultural products at a value of $98,611 million, which is 11% of its total export goods to the world in 2009[1]. The agricultural sector also plays an important role in the U.S. employment.

Agribusiness spans a wide range of sectors in the U.S. food system. “The food supply chain is a series of links and inter-dependencies, from farms to food consumers’ plates, embracing a wide range of disciplines (Bourlakis and Weightman, 2004).” Generally, the food supply chain is recognized as the value chain in the agribusiness system.

Economic Recession

A recession is defined as a decline in the Gross Domestic Product (GDP) for two or more consecutive quarters. In a recession, business activity slows down, unemployment increases, and the standard of living diminishes. A drop in consumer

[1] Available at USDA's Economic Research Service website: Foreign Agricultural Trade of the United States (FATUS) Data Sets 2010,http://www.ers.usda.gov/Data/FATUS/. Accessed on July 2010.

spending is generally a sign of a recession, which is caused by a mismatch of aggregated demand and aggregate supply.

The fluctuation of production or economic activity between periods is described as a business cycle. It has a sequence of four phases: peak, contraction, trough, and expansion. A peak is defined as the time period when business activity is at its maximum. However, this maximum point does not last forever, and business activity starts to decline and contract. A trough is the time period when business activity reaches a minimum. However, business activities start to pick up, this is the expansionary period.

Since 1854, the U.S. has encountered 32 cycles of expansion and contraction. Significant amount of research has been done to explain the relationship of recession and aggregate demand changes. In this study, however, the impact of the recent three main recessions on the supply side is examined.

The three major recessions considered in this research are: 1) July 1990-March 1991: 8 months (the early 1990s recession), 2) March 2001-November 2001: 8 months (the early 2000s recession), and 3) December 2007-to date: more than 25 months (the late 2000s recession).

From the demand side, a recession reduces consumer's ability and confidence to spend. The consumers, who overspent based on credit secured by bubble priced assets, drove the U.S. economy. With the decline in the bubble assets, consumers' willingness to spend was hit hard, shaking their spending confidence. Industry was adversely affected as sales that depend on consumer's consumption fell. The effect of a recession was catastrophic: GDP, employment, investment spending, capacity

utilization, household incomes, business profits and inflation all fall, while bankruptcies and unemployment rates soar.

From the supply side, a recession causes firm output and sales to fall dramatically. In a competitive market like the U.S., the difference in profitability among firms rises sharply and the weak firms are forced to shut down. With fixed production costs and lower sales, average costs of production rise during a recession. Lower sales and higher costs squeeze profit margins, forcing companies to cut costs where they can. This means purchasing less, closing down inefficient firms, reducing number of stores, and laying off workers. As workers are laid off, unemployment increases, consumer spending and consumer confidence crumbles, which reinforces the recession, and makes it worse.

Research Objectives

There are three main objectives in this research. First, this research aims to explore the variation of agribusiness profitability over a 23 years period and identify variances that influence profitability. To address this objective, I will use the extended DuPont formula as the framework to analyze the financial components that affect firm profits. The extended DuPont has ten sub financial ratios that will help determine agribusiness' profitability.

The above statement leads to the first hypothesis;

Hypothesis 1

The sub component financial ratios of the DuPont expansion are not jointly significant to explain the variation of profitability, and each independent financial ratio has no effect on the profitability among all sub sectors of food supply chain.

The second objective of the study is to examine whether the agribusiness's profitability varies across sub sectors within the U.S. food supply chain. Industrial economists define an industry as a group of firms that produce homogenous products such that consumers consider them substitutes. With similar operating features, agribusinesses in the same sub sector (i.e., same group under 3-digit SIC) might have similar customer groups, production requirements, and organizational structure. From the financial viewpoint, those agribusinesses would tend to have comparable profit margins, asset turnovers and capital structures. The examination of the relationships between the profitability and cross-section effect leads to my second hypothesis:

Hypothesis 2

The estimators for the coefficients of cross-sectional effects are not jointly significant. Profitability does not have cross-sectional effects within the U.S. food supply chain. All sub sectors' profitability levels have no significant difference statistically.

The final objective of this research is to test whether there is a time fixed effect in the agribusiness's profitability. Are there time effects that are common to all sub sectors? For example, do all sub sectors experience a decrease in return in a specific recession? Some economists are of the view that only sales of luxury and non-essential goods will be significantly affected by recessions, while necessary goods like food, water, and clothing will not be affected as severely. The food industry generally supplies necessities and food consumers are very reluctant to forgo consumption even during the hard times. While they might substitute margarine for butter, people will still need to satisfy their basic demands. This study explores whether the profitability fluctuates along with the economic downturns. Additionally, it evaluates the agribusinesses'

financial performance for sub-sectors of food supply chain by performing the fixed effect panel regression.

The third hypothesis takes the following form:

Hypothesis 3

The sub sectors' profitability does not vary across time. There are no uniform time effects to those sub sectors.

The rest of this paper is organized as follows. Chapter 2 reviews the literature, introduces methodology and specifies the model. Chapter 3 summarizes the data selection criteria and provides descriptive statistics. In Chapter 4, hypotheses stated in Chapter 1 are tested. Empirical results are analyzed in Chapter 4. In Chapter 5, a discussion of the limitations of this study and direction for future research ends this thesis.

CHAPTER 2
LITERATURE REVIEW AND RESEARCH METHODOLOGY

This chapter will first provide the reader with a review of literature. The next section explores the DuPont decomposition and measurement proxies for the regression analysis. Finally, the foundation of the two-way fixed effect regression is introduced. Both tools will be used to derive the empirical results based on the agribusiness financial data.

Literature Review

Financial ratios analysis within an industry peer group has been traditionally viewed as a major method that compares and measures firms' performance in the competitive market. A number of historical accounting ratios are viewed as information that can forecast performance. By measuring the typical values and patterns for ratios over time, financial statement analysis is presented as a matter of pro forma analysis of the future (Nissim and Penman, 2001).

Among all the financial performance evaluation models, the DuPont system is the most common used for providing fundamental analysis regarding the total profitability of the firm. The interest in the DuPont system and profitability drivers' analysis is developing the association between current and future financial ratios. It is suggested that by widening the accounting information set, profitability measures, such as return on equity (ROE), will exhibit greater predictive power. The firms' time series behavior and difference in ratios across firms at a given time can be reflected in the changes in earnings (Freeman and Penman, 1982). As two multiplicative components of DuPont analysis, profit margin (PM) and total asset turnover (ATO) have been extensively examined by decomposing from the return on total assets (ROA), which is a sub

component of ROE. In particular, the common form to analyze ROA is performed by focusing on the return on net operating assets (RNOA). RNOA can be decomposed into PM and net operating assets turnover (NOATO)[1]. Previous research has found that there is a negative convex relationship between the level of PM and NOATO. This property tends to cluster by industry and shows stronger when applied to industry averages (Selling and Stickney, 1989). In a view of cross-section industries, pooled firms (regardless of the industries that they belong to) tend to achieve similar levels of RNOA by varying the combination of PM and NOATO. Furthermore, prior studies explore the interpretation power of the changes in PM and NOATO metrics at the same time. Empirical results show that NOATO has more persistent predictive power than PM. That is, the change in NOATO explains a larger portion of the change in RNOA (Fairfield and Yohn 2003).

Nissim and Penman (2001) suggest a residual-income valuation framework without considering the effects of financial leverage. It is commonly believed that the firm's choice of capital structure can be manipulated. Relevant studies isolate the leverage and associated returns as discretional attributes by management but not a desirable operating profitability variable. However, the determination of firms' leverage rate affects their residual returns. Jensen (1998) argues that the cost of leverage, both direct cost and indirect cost, might improve corporate performance by forcing managements to make value-maximizing strategy to avoid debt pressure. For example, a firm with debt cost from borrowings might cut its underperforming production line more

[1] Net operating assets are businesses operating assets minus its operating liabilities. It has been analyzed widely by separating operating activities from financing activities. The purpose of doing that is to evaluate firm's operating performance independently.

readily than a firm that bears no fixed debt cost. In industry downturns, the highly leveraged firms lose substantial market share to their more conservatively financed competitors. There is a positive relationship between financial condition and firm performance (Opler and Sheridan, 1994). Considering the importance of leverage, this study will examine the agribusiness' total profitability decomposing all three DuPont components (PM, ATO and Leverage) and their underlying ratios.

The main drawback of the DuPont system, as claimed by Banker, Chang, and Majumdar (1993), is that this system and its underlying ratios provide only a gross aggregate measure for firms' profitability. This system doesn't easily capture the micro-attributes of productivity of firms, like product mix, price recovery, capacity utilization, etc.

With respect to agricultural sectors, the economics literature provides multiple explanations for the profitability measures. Forster (1996) uses the capital asset pricing model (CAPM) to investigate the rate of return, solvency, liquidity and other financial ratio measurements in agribusinesses. Foster found that the capital structure and business risk of agribusiness are interrelated. Both of them are important determinants of stock returns. In addition to the specific within firm financial factors mentioned above, there is an increasing interest regarding agribusiness profitability in response to macroeconomic conditions. Empirical results indicate that macroeconomic conditions (i.e. fiscal policy, business cycles) have differing effects on agribusiness profitability dependent on a firm's financial structure and their market segment (Neibergs, 1998).

Regarding the agribusiness sector, the financial ratio analysis in this study follows from recognition of accounting ratios relationships that determine total profitability.

Besides, using the cross-section time series data, we investigate how earnings components exhibit the time-series properties and cross-section properties.

Total Profitability Measurement

Basic DuPont Formulation

ROE measures the rate of return on the ownership interest in a firm. It is measured as net income (NI) divided by average total equity (ATE). The DuPont Company started using the breakdown of ROE to measure efficiency at generating profits from every unit of shareholders' equity. Basically, the ROE can be decomposed into three parts. The following decomposition, also called the DuPont expansion, is known as a strategic profit model. Mathematically:

$$\text{ROE} = \frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Total Assets}} \times \frac{\text{Total Assets}}{\text{Average stockholder equity}} . \qquad (2\text{-}1)$$

The first ratio in 2-1 refers to the PM; the second ratio refers to ATO, and the third ratio of the DuPont formula reflects the leverage of the firm. Multiplying the first two fractions (PM*ATO) will yield the return on assets (ROA), which provides a picture of the ability of using assets to earn a profit.

Expansion of DuPont Formula

Three ratios are expanded from the DuPont system to measure ROE; PM, ATO and leverage. Those financial ratios will be decomposed to the next level as micro proxies of firm operation conditions. The major variables substitutions are explained in the following sections.

Decomposition of Profit Margin

The PM measures firm's operating efficiency. As an important profitability ratio, the net profit margin is an indicator of a company's pricing policies and its ability to control costs. The DuPont system uses net profit after taxes as net income (NI). In this study, the earnings before tax (EBT) is used as a proxy for NI. Thus the tax burden impact is excluded. EBT is:

EBT = Net sales - Cost of goods sold (COGS) -Selling, general and administrative expenses- Interest expenses- Research and development expenses -Other miscellaneous expenses.

Electing the most important components of EBT, four underlying financial ratios are employed as determinants of PM. The function for profit margin takes the following form:

$$PM = f(GM/S, SG\&A/S, IN/S, R\&D/S, \varepsilon), \quad (2\text{-}1)$$

where GM/S or gross margin rate = (net sales-COGS)/ (net sales); SG&A/S or selling, general and administrative expense rate = (selling, general and administrative expense) / (net sales)[2]; IN/S or interest expenses rate = (interest expenses)/ (net sales); R&D/S or research and development expense rate = (research and development expense)/ (net sales); and ε refers to residuals.

Decomposition of Assets Turnover

The second part of the expansion, net sales over average total assets, refers to ATO which measures efficiency of a company's use of its assets (funded by owners and

[2] Selling expense is combined with general and administrative expense as SG&A/S in this study for the reason that they share the same nature and provide information on whether the management is spending efficiently or wasting cash flow.

borrowers) in generating sales revenue. For an agribusiness, the major *asset* items include accounts receivables; inventory; property, plant and equipment. Thus, those asset turnover ratios play the major role in the determination of total asset turnover. A company may have other forms of assets, like cash and security investment, which are generally not as important as those mentioned. Those major asset items have more important commercial substance in explaining the assets usage performance. Similar to PM, the following expression is used to estimate total asset turnover rate:

$$ATO=f(ARTR, INTR, PP\&ETR, \varepsilon), \quad (2\text{-}2)$$

where ARTR or accounts receivables turnover rate = (net sales)/ (average accounts receivables); INTR[3] or inventory turnover rate= (COGS)/ (average inventory); PP&ETR or property, plant and equipment turnover rate = (nets sales) / (average property, plant and equipment); and ε refers to residuals.

Decomposition and Substitution of Leverage

The third part of the DuPont formula is leverage, which is defined as total assets divided by average equity. Leverage reflects the financial structure of the company and it is highly influenced by the different business environments. Under economic downturn, firms might have to borrow more funds to keep operating. Simultaneously, the financial institutions usually reduce credit which makes it even harder for firm to borrow money during downturns. The leverage ratio will provide a good explanation on the influence of capital structure to a firm's profitability. Firms usually use debt to supplement owner's investment and increase gains. However, these liabilities have fixed payment obligation on a regular basis (i.e., interest expense). Different firms have

[3] Some practitioners prefer using net sales instead of COGS to calculate the INTR. This study adopts COGS because inventories are usually recorded at cost while net sales are recorded at market value.

different acceptable risk level for leverage. The interest expense might become a burden for an overleveraged firm. Many firms find it difficult to repay their fixed interest expense, so that they have to refinance old debt with new debt. This usually increases their interest burden. It is a crucial management strategy to choose a debt and equity mix to maximize profits. In the traditional DuPont system, leverage is measured by assets divided by equity. From the basic accounting equation, assets=equity+ debt, leverage rate can be transformed into total debt/ total assets (D/A).

We use this transformation because the financial debt ratios that involve equity in denominator are unstable. Firms sometimes experience drastic net income fluctuations which create problems in the calculation of equity financial ratios. For example, a current period large net loss might result in two situations shown in the financial statements. In the first situation, the net loss goes to the firm's retained earnings and ends up with a negative equity balance. In the second case, after the firm's equity absorbs the dramatic net loss in the current period, the equity turns to be a small positive number. Thus, all financial ratios involving equity (from the balance sheet) become incomparable with prior years. Besides, the change of debt structure has not been measured consistently by this ratio due to the considerable change in equity. Comparatively, using the total assets as denominator to measure the debt and equity mix in a firm has less numerical disturbances. Given the robustness of total assets, the equity is substituted by total assets for calculation of all debt ratios.

D/A is decomposed into the following function:

$$D/A=f\ (STD/A,\ CD/A,\ LTD/A,\ \varepsilon), \qquad (2\text{-}3)$$

where STD/A or Short-term borrowings (including short-term loan and short-term note-payable) to assets = (short-term borrowings)/ (total assets); CD/A or current portion of long-term debt to assets = (current portion of debt)/ (total assets); Long-term debt to assets (LTD/A) = (long-term debt)/ (total assets); and ε is residuals. Note that the current portion of long-term debt (CD) is presented separately with the short-term debt in this study for the reason that these two types of debt have different interest rates and are representing different financing strategy of firm. The CD is also separated from the long-term debt because it reflects the payment that is due within a year, which might be an element that pushes the management to take action to improve liquidity.

Many studies isolate the financial structure from the DuPont decomposition as a separate research field. They believe that unlike PM and ATO, leverage is a decision that is highly controlled by management. Some profitability valuation studies ignore the leverage factor. Authors believe the firm's profitability is mainly driven by PM and ATO (Fairfield and Yohn 2001; Nissim and Penman 2001; Penman and Zhang 2003; Fairfield, Sweeney and Yohn). These studies argue that the financial structure and associated return should be ignored when performing profitability analysis, because it can be manipulated by management discretionally. In my study, I include the financial leverage ratio to measure the total profitability. The financial structure captures the firm's ability to use available economic resources to increase profit. This phenomenon is often referred to as the multiplier effect because the way of financing of the firm can affect the value of shareholder's equity.

The aforementioned ten determinants are disaggregated from the DuPont framework to measure agribusiness's profitability and perform further financial analysis (Table 2-1).

EBTOCE in Profitability Measurement

Similar to previous studies, average shareholders' equity is not a stable measurement due to the net earning fluctuation that can occur over time. In this study, the earnings before tax on capital employed (EBTOCE) is substituted for ROE. The calculation of EBTOCE is earnings before tax divided by capital employed. The EBTOCE is a relative more comprehensive measure of a firm's ability to generate returns to pay for its cost of capital employed.

Capital employed may be defined in a number of ways. Here, I use the average net capital employed, which is the summation of fixed assets, investments, and net working capital. It represents the capital investment necessary for a business to operate.

This substitution is made for three reasons. First, interest expense is one of the research concerns in this study, which depicts the management financing strategy and affects agribusiness's performance. Whereas, as a fixed portion of net income, tax expense is excluded from the measurement of profitability. Second, the earnings in the numerator match the range of denominator: capital employed. Because the "capital employed" includes borrowings, so that the earnings should consider the interest cost to match the funds sources. Third, as long as EBTOCE is consistently computed for all firms, it has comparison power to interpret the profitability in terms of ratio EBTOCE.

The overall approach of this study is based on the framework provided by the DuPont expansion. However, the financial ratios are not exactly derived from DuPont

formula but are proxies of micro aspects of firm's operating condition. There are numerous ratios that can be used to make comparisons across firms. It is feasible to adopt any measurement with respect to the return on capital as long as this benchmark is used consistently across all the samples. The above ratio substitutions are computed over all firms consistently. Variable definitions and associated formulas are presented in Table 2-2.

Statistical Model

Basic Regression Model

To test the linear relationship of the sub component ratios and the firm's total profitability, those ten underlying ratios are treated as independent variables. The firm's operating condition is reflected in the financial ratios in all aspects (operating efficiency, asset use efficiency and financial leverage). Consequently, the ten financial ratios contribute to the total profitability. The following regression is used as foundation of later cross-sectional and time effect analysis:

$$Y_{it} = \alpha_0 + \beta' X_{it} + \varepsilon_{it}. \quad (2\text{-}4)$$

$$EBTOCE_{it} = \alpha_0 + \beta 1\ GM/S_{it} + \beta 2\ SG\&A/S_{it} + \beta 3\ IN/S_{it} + \beta 4 R\&D/S_{it} + \beta 5\ ARTR_{it} + \beta 6 INTR_{it} + \beta 7 PP\&ETR_{it} + \beta 8 STD/A_{it} + \beta 9 CD/A_{it} + \beta 10 LTD/A_{it} + \varepsilon_{it}. \quad (2\text{-}5)$$

Where:

Y_{it} = EBTOCE of the industry i in the year t,

α_0 = Intercept coefficient,

β' = Slope coefficient of regressors,

X_{it} = Independent financial ratios of industry i in the year t, and

ε_{it} = Residual error for industry i in year t.

Panel Data

Panel data sets usually include multiple cross-sectional data (i.e. country, blocks, and firms) which are observed over two or more time periods. The characteristic of panel data was summarized by Yaffee, (2003), “Panel data analysis endows regression analysis with both a spatial and temporal dimension.” Panel data has become widely analyzed to understand social and economic changes over a time span. When both the space and time span is considered, the panel data analysis provides a number of ways to improve the interpretation of data.

The OLS regression assumes that the residuals are independent. However, in a typical panel data set, the residual components ε, in (2-5), are highly likely to be correlated both with the cross-section error and the time-series errors. That violates the assumptions of OLS regression and can lead to biased estimates of coefficients and biased estimates of the standard errors. To avoid that common problem of the OLS model, a two-way fixed effects panel model is used in this research, which assumes that the error structure is corresponding to both cross-section and time effect simultaneously.

The fixed effects model is one of several types of panel analytic models. If the specification is dependent only on the cross section to which the observation belongs, such a model is referred to as a one-way model. When a data structure depends on both the cross sections and the time periods to which the observation belongs, it is called a two-way model. Additionally, if the data structure provides non-random effect pattern, it is called fixed-effects model. Otherwise it is the random-effects models. The

only difference is that random effects assume the intercept is uncorrelated with each explanatory variable.

In this study, we assume that the agribusiness profitability is non-randomly affected by both the cross-section and time-series. Because of the assumption that the cross-section and time-series effects are fixed, the models are essentially regression models with dummy variables that correspond to the specified effects. This two-way fixed effects model is also refers to the two-way least square dummy variable model (two-way LSDV).

The two-way fixed effects regression model applies to the DuPont components are as follows:

$$Y_{it} = \alpha_0 + \beta' X_{it} + u_i + v_{t+} \varepsilon_{it} \ . \qquad (2\text{-}6)$$

Where

Y_{it} = EBTOCE of the industry i in the year t,

α_0 = Intercept coefficient of dropped dummy industry i in the dropped year t,

β' = Slope coefficient of regressors,

X_{it} = Independent financial ratios of industry i in the year t,

u_i = cross-section effects that are constant over time,

v_t = time effects that are common to all groups, and

ε_{it} = Residual error for industry i in year t.

This panel regression assumes that slopes are constant, only intercepts vary according to cross-section and time. This model specifies i-1 sub sector dummies, t-1 time dummies to avoid perfect multicollinearity (the dummy variable trap). Multicollinearity refers to excessive correlation of the predictor variables. When

correlation is excessive, the coefficients and standard errors of the independent variables become large, making it difficult or impossible to assess the relative importance of the predictor variables. Using the panel procedure, you do not need to create dummy variables and compute deviations from the group means. After sorting the cross-section and year, it will drop the last sub sector and year dummy automatically. This procedure would report correct MSE, SEE, R2, and standard errors, and conducts the F test for the fixed group effect as well.

Table 2-1. Sub components of profitability measurement

Total profitability measurement	Components ratios
Profitability	EBTOCE
Operating efficiency	GM/S
	SG&A/S
	IN/S
	R&D/S
Asset use efficiency	ARTR
	INTR
	PP&ETR
Financial leverage	STD/A
	CD/A
	LTD/A

Table 2-2. Variable definition

Abbreviation	Description	Formula
ROE	Return on equity	Net income/ equity
ROA	Return on assets	Net income/ total assets
EBT	Earnings before tax	Pretax income
EBTOCE	Return on capital employed	Earnings before tax / capital employed
PM	Net profit margin rate	Pretax income/ net sales
GM/S	Gross margin rate	(Net sales-COGS)/ net sales
SG&A/S	Selling,general and administrative expense rate	General and administrative expense / net sales
IN/S	Interest expenses rate	Interest expenses/ net sales;
R&D/S	Research and development expense rate	Research and development expense/ net sales.
ATO	Total assets turnover	Net sales/average total assets
NOATO	Net operating assets turnover	Net sales/average net operating assets
ARTR	Accounts receivables turnover rate	Net sales/ average accounts receivable
INTR	Inventory turnover rate	COGS/ average inventory;
PP&ETR	Property, plant and equipment	Nets sales / average property, plant and equipment.
STD/A	Short term debt to assets ratio	Short term debt/ total Assets
CD/A	Current portion of long-term debt to assets ratio	Current portion of long-term debt/ total assets
LTD/A	Long-term debt to assets ratio	Long-term debt/ total assets

CHAPTER 3
DATA SOURCES AND DESCRIPTION

Data and Trends

Data Sources

The financial statement data for this study is derived from the CRSP/Compustat Merged Database (CCM), accessed from the Wharton Research Data Services (WRDS). The financial data of the U.S. agribusinesses food supply chain obtained covers 23 years from 1986 to 2008. During the 23 years, the U.S. went through three economic recessions: the early 1990s, the early 2000s, and the late 2000s recession. The major financial items used to calculate the financial ratios, the variables of main interest in this study, are drawn from the firms' annual income statements and annual balance sheets.

The Economic Research Service (ERS) is a primary source of economic information and research in the U.S. Department of Agriculture. The ERS classifies the farm and farm-related industries based on Standard Industry Classification (SIC) codes. According to the ERS, there are six major industry groups which satisfy the demand for agricultural products. These six major groups are:

- Farm production,
- Agricultural services, forestry, and fishing,
- Agricultural inputs industries,
- Agricultural processing and marketing,
- Agricultural wholesale and retail trade, and
- Indirect agribusinesses.

To be consistent with other food supply chain studies, the selection of agribusiness in this research is based on the 3-digit SIC code. Two major industries and their thirteen sub sectors are considered to comprise the U.S. food supply chain. One major industry is agricultural processing and marketing (referred to food processing and beverage, or FPB). This industry belongs to the manufacturing division. The second industry is agricultural wholesale and retail trade (referred to food wholesale, retail, and service, or FWRS). This group is classified as part of the wholesale trade and retail trade division.

The ten sub sectors in the FPB include: meat (SIC 201); dairy (SIC 202); canned, frozen, and preserved fruits, vegetables, and food specialties (SIC 203); grain mill (SIC 204); bakery (SIC 205); sugar and confectionery (SIC 206); fats and oils (SIC 207); beverages (SIC 208); miscellaneous food preparations and kindred (SIC 209); and tobacco (SIC 21). The three sub sectors of the FWRS are; wholesalers (SIC 514), retailers (SIC 54), and the food service industry (SIC 581). This classification follows Trejo-Pech, Weldon, and House (2008).

The sample contains 6157 firm-year observations for the 1986-2008 time period. 88 firms had missing values for major financial items and were removed from the sample. The final sample includes 6069 firm-year observations. 49.11% of the total observations belonged to the FPB, and 52.79% to the food wholesale, retail, and services.

Firm Number Fluctuations

Figures 3-1 and 3-2 show the change in the number of agribusinesses in the food supply chain over the past 23 years. The number of firms fluctuates within the years according to the business peaks and troughs (business cycles). Table 3-1 summarizes

the decrease of market players during economic downturns. For example, the average number of firm over the 23 years for the FPB is 125. The number of firms decreased by ten during the early 1990s recession (calculated as the average number of firms in the time period minus number of firms in 1990). Table 3-1 shows that the number of firms in each recession period is apparently lower than the average firm number over the past 23 years. Since it is difficult to get the firm number for the specific month during the recession, the number of firm number at the end of 1999 is used to represent the firm number in the early 1990s recession. Similarly, firm numbers at the end of 2001 and 2008 are used to represent the early 2000s recession and the late 2000s recession respectively.

Weighted Average Method

In every stage of an industry, new firms enter while distressed firms leave. This causes the panel data to be variable and unbalanced. Additionally, particularly for the agribusiness sample, some firms operated for only a few periods during the past 23 years and then were merged or acquired. This is another reason for the unbalanced nature of the data set. Considering that the purpose of this study is to explore the sub sectors effects and time effect on the sub sectors' EBTOCE as opposed to the individual firms', the sub sector average is obtained to perform the two-way fixed effect panel regression.

The majority of past research employs the arithmetic mean of financial ratios as proxy of industry performance. But the straight average value does not reflect the industry objectively since it assumes that all firms have equal influence on that industry. It is felt that a weighted mean of financial ratios to measure the industry's primary financial condition is a better proxy of industry performance. In a competitive market,

large firms tend to achieve economies of scale to gain competitive advantage. Emphasizing the resource efficiencies, productivity, and product quality, large firms dominate the development of industries. This can be justified because even though an industry may have many market players of all sizes, the market share is usually dominated by a single large firm or a few large firms. In my model, the net sales variable is applied as the base to calculate the weighted average.

The final sample includes 6069 firm-year observations. After taking the weighted method to calculate the sector average, there are 299 (or 13*23) sector-year samples in the data set. Each variable in each sub sector is calculated as an average value yearly. By industries, there are 230 and 69 data lines in FRB and FWRS respectively after taking the weighted average by net sales. The unbalanced firm-year panel data is transformed into a balanced sub sector-year panel data. Tables 3-3 and 3-4 report the summary statistics based on weighted average method regarding the sub sectors over 23 years.

Summary Statistics and Accounting Variables

Summary statistics for all dependent and independent variables are provided in the Tables 3-2 to 3-4 based on 3-digit SIC sub sectors and their respective industry groups. Mean values are weighted by net sales. EBTOCE of the two industries are presented by sub sectors and year in the Table 3-2 and Table 3-3, respectively. For a better understanding of the EBTOCE fluctuation during the period of 1986-2008, Figures 3-3 and 3-4 present the corresponding graphs for EBTOCE. Mean and standard deviation of the ten explanatory ratios for all sub sectors in two industries of food supply chain are shown by pooled years in Table 3-4.

The average profitability measured in terms of EBTOCE for the entire food wholesale, retail, and services over past 23 years was 11.39% with a standard deviation of 2.70%. Breaking down the three sub sectors, the food wholesale sub sector has the highest profitability of 13.85 %, followed by food services with profitability of 10.5 % and finally the food retail sub sector with profitability of 9.81%. Their standard deviations have the same order with EBTOCE. The food wholesale sub sector is the most variable and food retail sub sector is relatively stable in return rate.

For a better comparison, ten sub sectors within the FPB industry are classified into two groups according to their SIC order. Each group presents 5 sub sectors. Figure3-4 shows yearly EBTOCE fluctuations for these ten sub sectors respectively. The EBTOCE in FPB (Table 3-3) by year shows that all ten sub sectors have higher than 10 % profitability in terms of EBTOCE. The average EBTOCE of the entire FPB during the past 23 years is 15.48% with a standard deviation of 2.33%. Average EBTOCE for the FPB is 4.09% higher than the FWRS. Among the ten sub sectors of FPB, sugar and confectionery is the most profitable sub sector with an average EBTOCE of 21.16%, followed by the canned, frozen, and preserved fruits, vegetables, and food specialties (C,F, and PF and V) and grain mill with EBTOCE of 19.86% and 19.31%, respectively. The diary sub sector is more variable in profitability in terms of EBTOCE during the time period, shown by a standard deviation of 6.83 %. Furthermore, all sub sectors except the tobacco and “fats and oils” sub sectors have relatively slightly downward trend meaning that the average EBTOCE has been decreasing over the years. One possible explanation of falling profits is that both competition and technology have been increasing steadily which is shrinking profits.

Table 3-4 provides the mean and standard deviation of the ten explanatory variables by all sub sectors among food supply chain over the 23 years. Overall, in terms of gross margin rate, FPB industry outperforms the FWRS with 36.49% (standard deviation of 3.56%) compared to 22.08% (2.21%). The most profitable sub sectors in the food supply chain, like tobacco, sugar and confectionery, and beverage are all components of FPB. Besides, FPB operates more “aggressively” than FWRS by spending a larger portion of net sales on selling expense, G&A expense, interest expense, and R&D expenditure. From the perspective of assets use efficiency, companies with low profit margins usually tend to have high asset turnover. This is true in food supply chain as well. FWRS has the higher assets turnover rate (means faster in times per year) than FPB. In comparison, the accounts receivable turnover rate in FWRS industry (33.89) is 2.97 times higher than FPB (11.43). That might be because the trading and services industry are dealing with final customers so that it involves less receivables. The inventory turnover rate in FWRS (18.76) is 2.83 times faster than FPB (6.62), indicating that FWRS has better inventory management than manufactures in FPB. PP&E turnover rate in FWRS (7.83) is 1.86 times more than FPB (4.21), because the former industry requires less manufacturing equipments than the latter. The above indicates that the FWRS has higher assets usage efficiency in generating sales. With respect to capital structure, FPB has a similar portion of short-term debt mixture but a slightly larger scale of long-term debt mixture. It is worth to mention that long-term debt is the main financing source for agribusiness. For the entire food supply chain, the short-term debt (exclude current-portion of long-term debt) is only 1.11%, compared with a long-term debt to assets ratio of 27.32%.

Among all sub sectors, tobacco sub sector and beverage sub sector have the highest gross margin rate of 51.73% and 51.04% respectively. The bakery and beverage sub sector spends the highest amount on interest, selling and G&A per dollar of sales. The tobacco sub sector spends the highest amount on R&D per dollar of sales. The food store and retailer have the best accounts receivable control. The food services sub sector and food wholesaler enjoy the highest inventory turnover rate and highest PP&E turnover rate respectively. The canned, frozen, and preserved fruits, vegetables, and food specialties sub sector employs highest scale of short-term debt comparing with other sub sectors. The top three sub sectors with the highest long-term debt rates are retailer, tobacco, and food services. They all have a LTD/A of approximately 30%.

One would expect that an economic recession would negatively affect the EBTOCE of industries. However, the EBTOCE fluctuations in figures 3-3 and 3-4 indicate that this is not necessarily true in the food supply chain. The figures show a lot of variation of EBTOCE among the different sub sectors, some of which can be explained by economic booms and busts, but there are other factors that need to be considered, like operating strategies.

In Figure 3-3, EBTOCE changes in food wholesale, retail, and services show that, in the early 1990s recession, only the food wholesale sub sector (SIC 514) exhibited a sharp decrease in returns. In the recession of 2007-2008, all industries except the food wholesale sub sector experienced a fall in their EBTOCE. For the early 2000s recession, it appears that recession did not have much impact on EBTOCE for the three sub sectors in FWRS. Clearly, other factors are more important in determining variation

in EBTOCE such as debt pressure, acquisition, cost control, exchange rate, etc. Taking the food wholesale sub sector (SIC 514) as an example, this sub sector has the highest return rate and volatility in its industry. The average EBTOCE for wholesale sub sector is 13.85% with a standard deviation rate of 7.64% over past 23 years. The wholesale sub sector experienced a trough in 1990. Seven out of eighteen wholesalers in that sub sector had negative returns. Those seven firms were all middle to small size wholesalers, and all had negative margin ratios along with increased financial leverage. Some middle size wholesalers like Balfour Maclaine have exited the market since 1990. From the year 1998, the largest wholesaler Fleming Companies started shrinking their market shares due to three consecutive net operating losses. Increased competition and failure to achieve necessary cost savings were mentioned as causes of net operating losses. In 1998, its EBTOCE was as low as -24.00%, which pulled down the weighted average EBTOCE of the wholesale sub sector.

By contrast, another major market player SYSCO CORP was successful in increasing their market share in sales. SYSCO CORP started dominating the wholesale industry from 1999 by increasing its return rate steadily from 22% to over 30 percent. The strong growth of EBTOCE for the whole sub sector from year 2002 can be attributed to the high return rate of SYSCO CORP.

The meat sub sector (SIC 201), as another example, experienced a huge decrease in return starting in 2007. However, this decrease cannot be attributed to the late 2000's recession, but rather to a bad acquisition and a huge debt load held by Pilgrim's Pride, which was the largest chicken producer in the U.S. The Pilgrim's Pride acquisition of rival Gold Kist for $1.3 billion in 2006 is the main reason for the company's

debt load. In 2008, the Pilgrim's Pride filed for bankruptcy, due to debt and high commodity prices of feed inputs.

Those examples of the agribusiness' performance indicate that the return on capital employed is more sensitive to management's strategies than to business cycles. The cross section and time effects to the food supply sectors will be tested in Chapter 4.

Table 3-1. Firm number change during the past three recessions

Entire food supply chain

	FPB			FWRS		
	Firm number	Mean	Reduced	Firm number	Mean	Reduced
1990	115	125	10	126	139	13
2001	115	125	10	122	139	17
2008	95	125	30	78	139	61

Table 3-2. EBTOCE of FWRS industry by year and sub sector

Sector	Retailers	Food wholesalers	Food service	
SIC	54	514	581	Mean
1986	14.09%	12.45%	7.23%	11.26%
1987	16.82%	11.78%	11.01%	13.20%
1988	11.34%	9.94%	10.89%	10.72%
1989	10.27%	10.69%	9.11%	10.02%
1990	12.45%	-0.50%	8.23%	6.73%
1991	12.38%	10.95%	9.26%	10.86%
1992	10.02%	10.55%	8.86%	9.81%
1993	10.27%	10.26%	-3.86%	5.56%
1994	9.09%	10.90%	11.17%	10.39%
1995	12.03%	10.71%	8.35%	10.36%
1996	11.86%	9.45%	8.36%	9.89%
1997	11.48%	9.79%	7.36%	9.54%
1998	10.52%	0.76%	14.26%	8.51%
1999	11.49%	9.70%	11.94%	11.04%
2000	8.18%	7.48%	13.76%	9.81%
2001	8.28%	16.54%	13.08%	12.63%
2002	6.32%	24.43%	11.78%	14.18%
2003	3.97%	24.24%	11.14%	13.12%
2004	2.48%	25.08%	12.59%	13.38%
2005	6.66%	25.52%	14.12%	15.43%
2006	9.57%	20.41%	15.11%	15.03%
2007	10.89%	22.53%	15.27%	16.23%
2008	5.23%	24.96%	12.56%	14.25%
MEAN	9.81%	13.85%	10.50%	11.39%
Std	3.28%	7.64%	3.98%	2.70%

Table 3-3. EBTOCE of FPB industry by year and sub sector

SIC	201	202	203	204	205	206	207	208	209	21	
Year	Meat	Diary	C.F, and PF and V	Grain mill	Bakery	Sugar and confectionery	Fats and oils	Beverages	Miscellaneous food	Tobacco	Mean
1986	15.92%	21.87%	18.44%	24.97%	15.48%	18.34%	13.41%	14.65%	12.39%	21.30%	17.68%
1987	14.63%	19.76%	21.20%	29.64%	14.77%	42.88%	15.13%	17.23%	15.19%	24.76%	21.52%
1988	11.89%	24.10%	20.49%	25.19%	17.73%	24.13%	16.22%	18.76%	11.45%	15.02%	18.50%
1989	9.90%	20.30%	18.11%	22.04%	18.70%	24.58%	17.13%	17.52%	14.06%	13.84%	17.62%
1990	12.81%	19.40%	18.04%	24.54%	16.28%	24.78%	16.96%	18.10%	15.30%	15.40%	18.16%
1991	7.57%	16.56%	23.39%	24.98%	9.09%	21.26%	14.11%	17.98%	16.79%	15.67%	16.74%
1992	9.56%	13.41%	21.49%	23.87%	9.48%	19.95%	12.67%	18.86%	16.82%	18.69%	16.48%
1993	12.04%	13.36%	18.83%	21.84%	4.76%	22.43%	10.63%	19.62%	14.60%	13.80%	15.19%
1994	17.12%	12.12%	20.78%	21.49%	6.51%	21.32%	9.68%	20.76%	9.08%	17.79%	15.66%
1995	18.96%	-4.75%	20.14%	30.72%	7.48%	21.23%	14.48%	19.94%	12.72%	20.13%	16.11%
1996	11.79%	12.05%	29.46%	21.24%	4.76%	21.90%	11.92%	18.98%	6.89%	23.47%	16.25%
1997	8.77%	10.29%	19.64%	8.82%	6.74%	28.18%	7.06%	21.66%	13.79%	22.26%	14.72%
1998	11.27%	5.23%	20.14%	20.05%	3.01%	20.34%	6.03%	18.50%	16.33%	18.18%	13.91%
1999	15.14%	9.06%	25.05%	24.36%	6.63%	25.71%	3.70%	16.47%	17.64%	21.72%	16.55%
2000	10.57%	8.14%	21.44%	24.92%	8.96%	19.69%	2.88%	15.21%	24.31%	19.45%	15.56%
2001	8.31%	4.08%	24.84%	9.51%	6.52%	19.83%	3.67%	18.75%	20.20%	16.92%	13.26%
2002	6.12%	8.68%	17.60%	11.84%	4.01%	21.61%	7.05%	18.71%	18.85%	19.28%	13.38%
2003	7.60%	9.90%	19.49%	12.55%	1.21%	15.87%	5.73%	16.32%	18.46%	12.78%	11.99%
2004	11.34%	7.07%	16.31%	13.78%	13.43%	17.04%	5.91%	17.68%	17.10%	15.84%	13.55%
2005	10.60%	6.01%	14.24%	10.59%	14.13%	17.12%	11.64%	17.16%	22.75%	16.72%	14.10%
2006	1.13%	9.73%	16.13%	11.05%	15.46%	16.89%	12.95%	16.81%	12.09%	17.55%	12.98%
2007	6.61%	7.52%	16.32%	13.56%	17.08%	12.46%	19.50%	18.62%	14.20%	20.06%	14.59%
2008	-9.20%	5.08%	15.22%	12.51%	15.49%	9.20%	13.37%	9.55%	12.66%	31.43%	11.53%
MEAN	10.02%	11.26%	19.86%	19.31%	10.34%	21.16%	10.95%	17.73%	15.38%	18.78%	15.48%
Std	5.75%	6.76%	3.51%	6.83%	5.37%	6.36%	4.84%	2.42%	4.04%	4.20%	2.33%

Table 3-4. Summary statistics of explanatory variables

Explanatory Variables / Industries	SIC	GM/S Mean	GM/S Std	IN/S Mean	IN/S Std	S,G&A/S Mean	S,G&A/S Std	R&D/S Mean	R&D/S Std	ARTR Mean	ARTR Std
Food processing and beverage:		36.49%	3.56%	2.04%	0.64%	22.40%	3.00%	0.41%	0.15%	11.43	1.49
Meat	201	11.93%	1.75%	0.98%	0.17%	6.50%	0.85%	0.03%	0.02%	18.93	2.29
Diary	202	26.28%	1.51%	1.47%	0.61%	18.11%	1.34%	0.01%	0.01%	12.22	0.95
C.F, and PF and V	203	39.18%	3.12%	2.28%	0.44%	22.58%	2.24%	0.46%	0.06%	9.77	1.15
Grain mill	204	39.70%	10.36%	2.05%	0.49%	25.68%	8.69%	0.81%	0.15%	11.52	0.93
Bakery	205	48.58%	3.56%	2.64%	2.21%	34.60%	5.61%	0.24%	0.35%	11.76	2.60
Sugar and confectionery	206	44.26%	4.51%	2.05%	0.51%	28.10%	2.15%	0.46%	0.22%	8.63	1.13
Fats and oils	207	11.91%	2.57%	1.55%	0.55%	3.35%	0.80%	0.11%	0.04%	10.79	2.49
Beverages	208	51.04%	1.95%	2.66%	0.35%	31.47%	2.22%	0.25%	0.09%	9.30	1.05
Miscellaneous food kindred	209	40.26%	2.73%	2.12%	0.36%	27.37%	1.92%	0.83%	0.28%	8.76	1.02
Tobacco	21	51.73%	3.53%	2.59%	0.69%	26.26%	4.21%	0.87%	0.32%	12.60	1.28
Food wholesale, retail, and services:		22.08%	2.21%	1.45%	0.47%	13.64%	1.47%	0.01%	0.01%	33.89	8.39
Food wholesalers	514	14.92%	2.86%	0.60%	0.19%	11.04%	2.00%	0.01%	0.02%	19.06	3.10
Food store-retail	54	25.43%	1.61%	1.14%	0.21%	20.07%	1.12%	0.00%	0.00%	52.70	15.35
Food service	581	25.88%	2.17%	2.62%	1.01%	9.82%	1.30%	0.02%	0.01%	29.92	6.72
Total food supply chain		29.28%	2.88%	1.74%	0.55%	18.02%	2.24%	0.21%	0.08%	22.66	4.94

Table 3-4. Continued

Explanatory Variables / Industries	SIC	INTR Mean	INTR Std	PP&ETR Mean	PP&ETR Std	STD/A Mean	STD/A Std	CD/A Mean	CD/A Std	LTD/A Mean	LTD/A Std
Food processing and beverage:		6.62	1.39	4.21	0.75	1.55%	2.40%	6.27%	3.16%	24.18%	5.97%
Meat	201	11.25	2.66	6.67	1.43	1.63%	2.48%	4.39%	2.41%	26.08%	3.54%
Diary	202	12.46	2.50	5.29	0.58	0.39%	0.68%	3.42%	2.24%	32.03%	13.60%
C.F, and PF and V	203	4.30	0.22	3.84	0.48	3.68%	3.80%	9.96%	4.18%	27.04%	8.11%
Grain mill	204	6.30	0.56	3.79	0.88	2.61%	3.52%	9.70%	2.77%	25.31%	4.18%
Bakery	205	7.44	4.44	3.31	0.45	0.53%	0.82%	3.31%	3.77%	22.47%	11.09%
Sugar and confectionery	206	4.59	0.38	3.54	0.34	0.59%	0.67%	9.20%	3.66%	16.52%	4.22%
Fats and oils	207	7.39	1.26	4.50	1.91	0.55%	0.83%	4.20%	4.22%	19.81%	2.98%
Beverages	208	5.57	0.83	2.74	0.20	1.44%	2.01%	6.85%	2.14%	24.33%	2.05%
Miscellaneous food kindred	209	4.03	0.51	4.11	0.72	1.41%	3.32%	6.99%	4.18%	22.37%	3.20%
Tobacco	21	2.86	0.55	4.34	0.50	2.65%	5.86%	4.74%	2.05%	25.88%	6.71%
Food wholesale, retail, and services:		18.76	1.83	7.83	1.12	0.67%	0.94%	4.29%	1.81%	30.45%	5.43%
Food wholesalers	514	14.47	1.17	15.57	1.90	1.05%	1.60%	3.44%	1.55%	25.25%	5.88%
Food store-retail	54	10.02	0.74	6.25	1.25	0.52%	0.76%	5.83%	2.60%	33.48%	5.39%
Food service	581	31.78	3.58	1.67	0.22	0.44%	0.47%	3.59%	1.29%	32.61%	5.02%
Total food supply chain		12.69	1.61	6.02	0.94	1.11%	1.67%	5.28%	2.49%	27.32%	5.70%

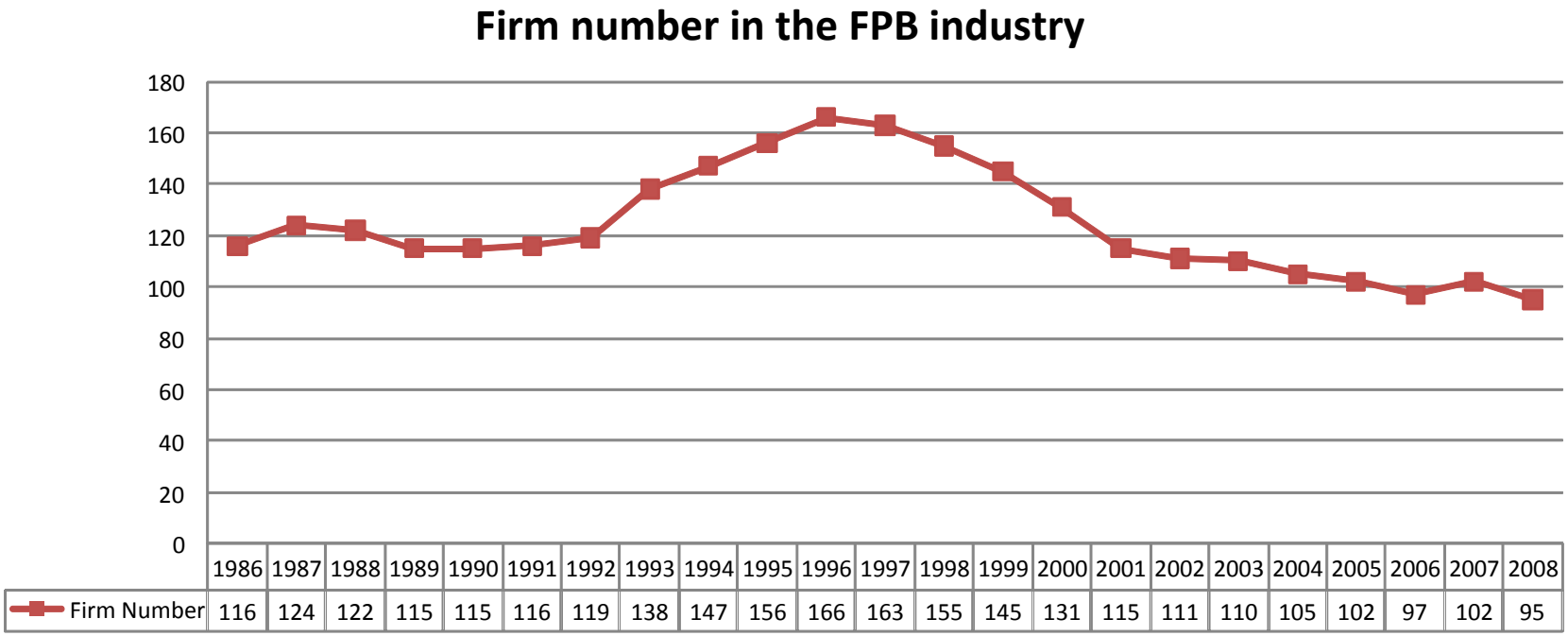

Figure 3-1. Firm number in FPB industry

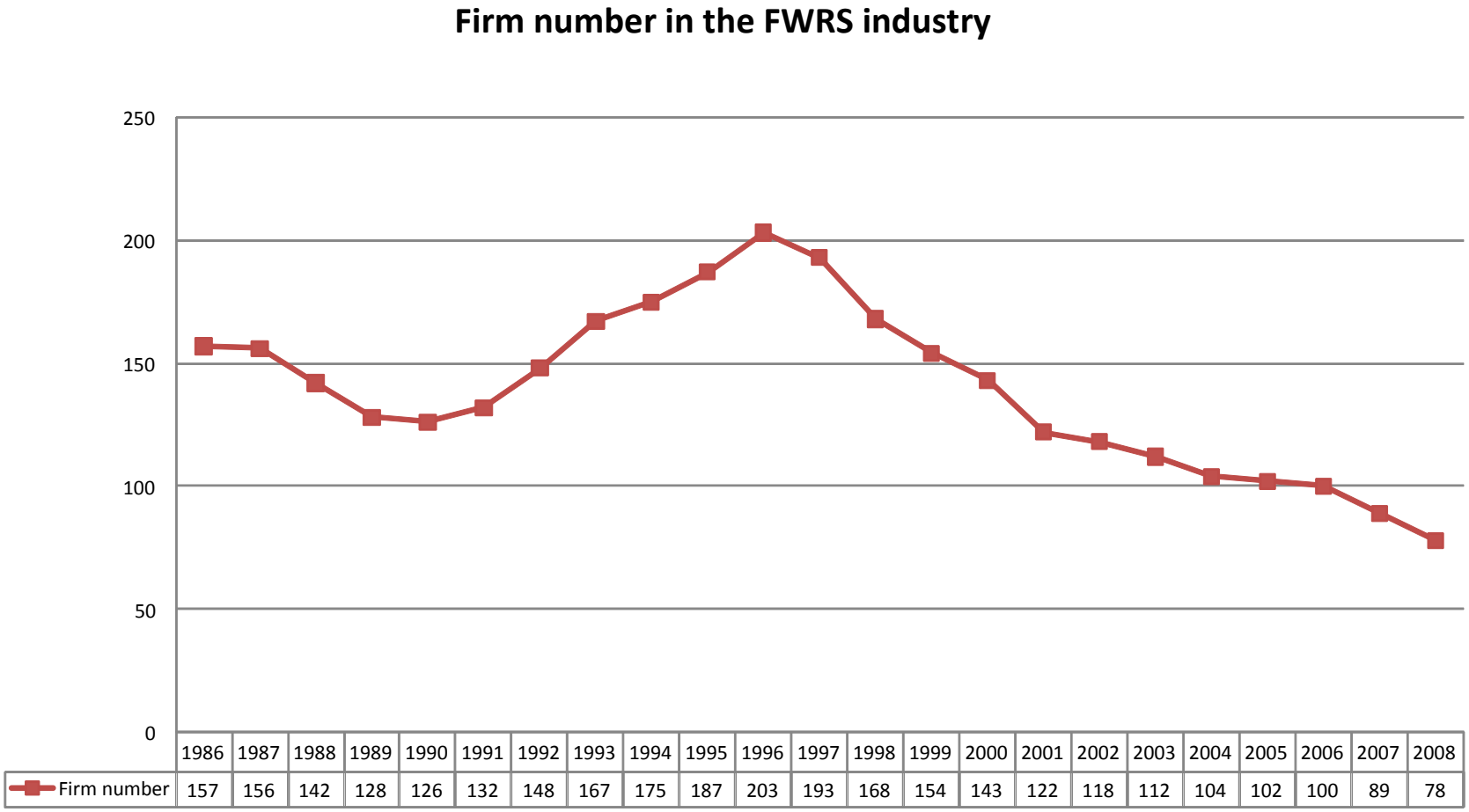

Figure 3-2. Firm number in the FWRS industry

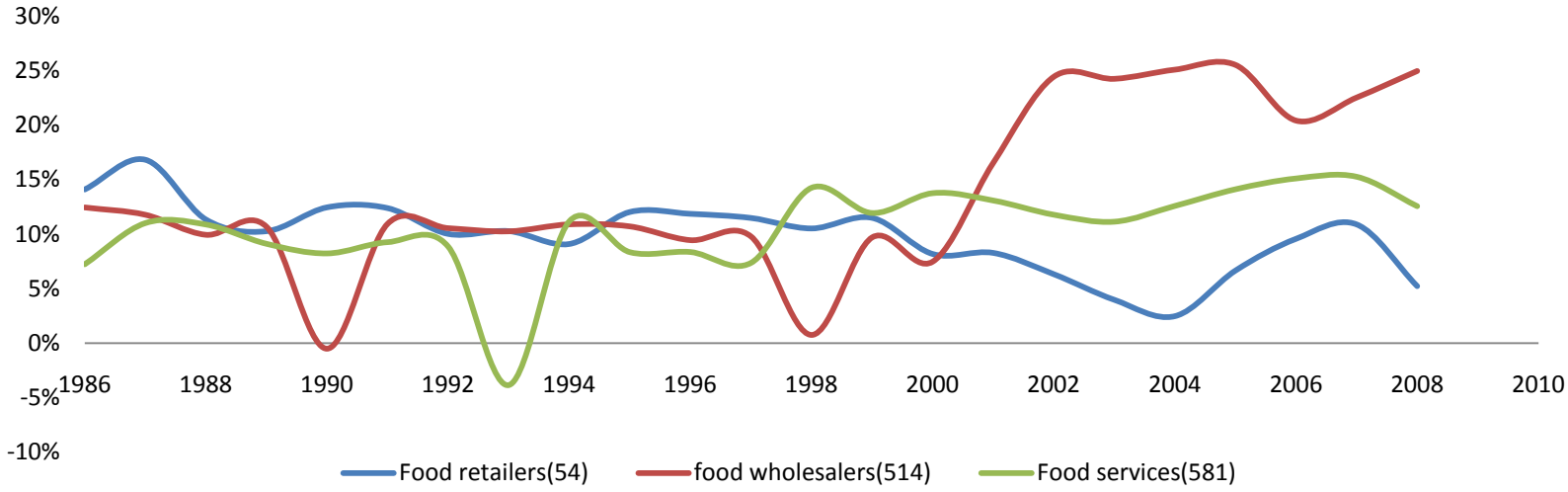

Figure 3-3. EBTOCE fluctuation by weighted average in the FWRS industry

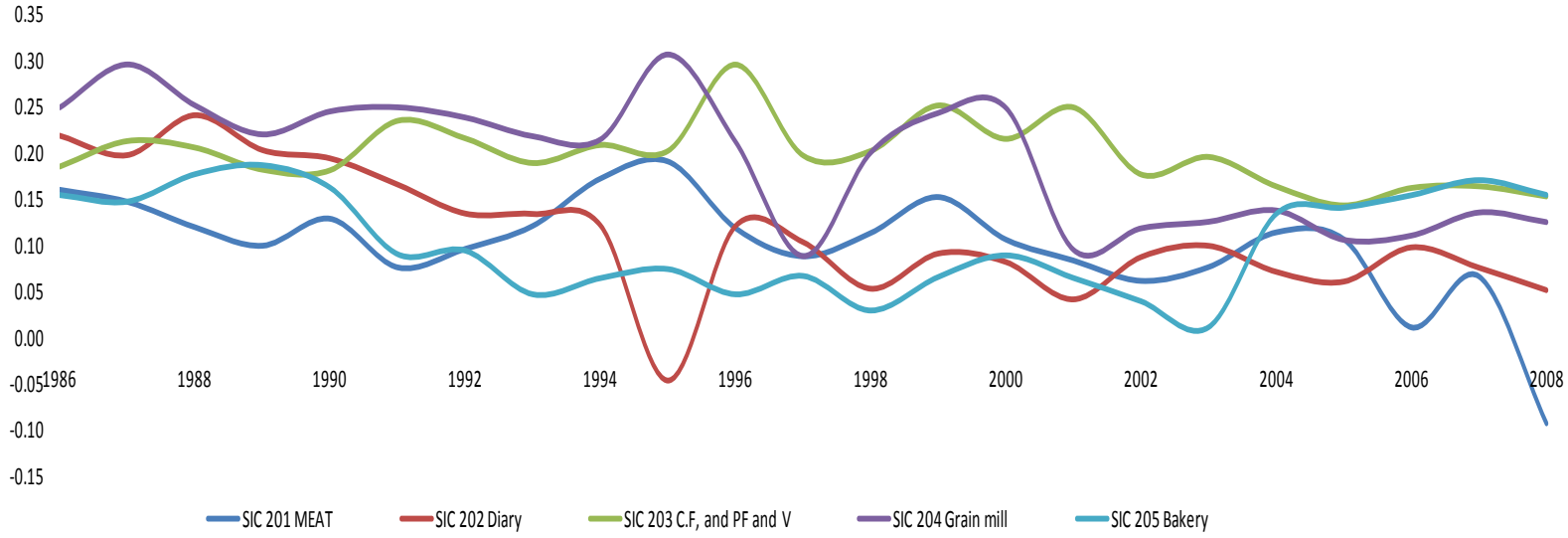

Figure 3-4. EBTOCE fluctuation by weighted average in the FPB industry

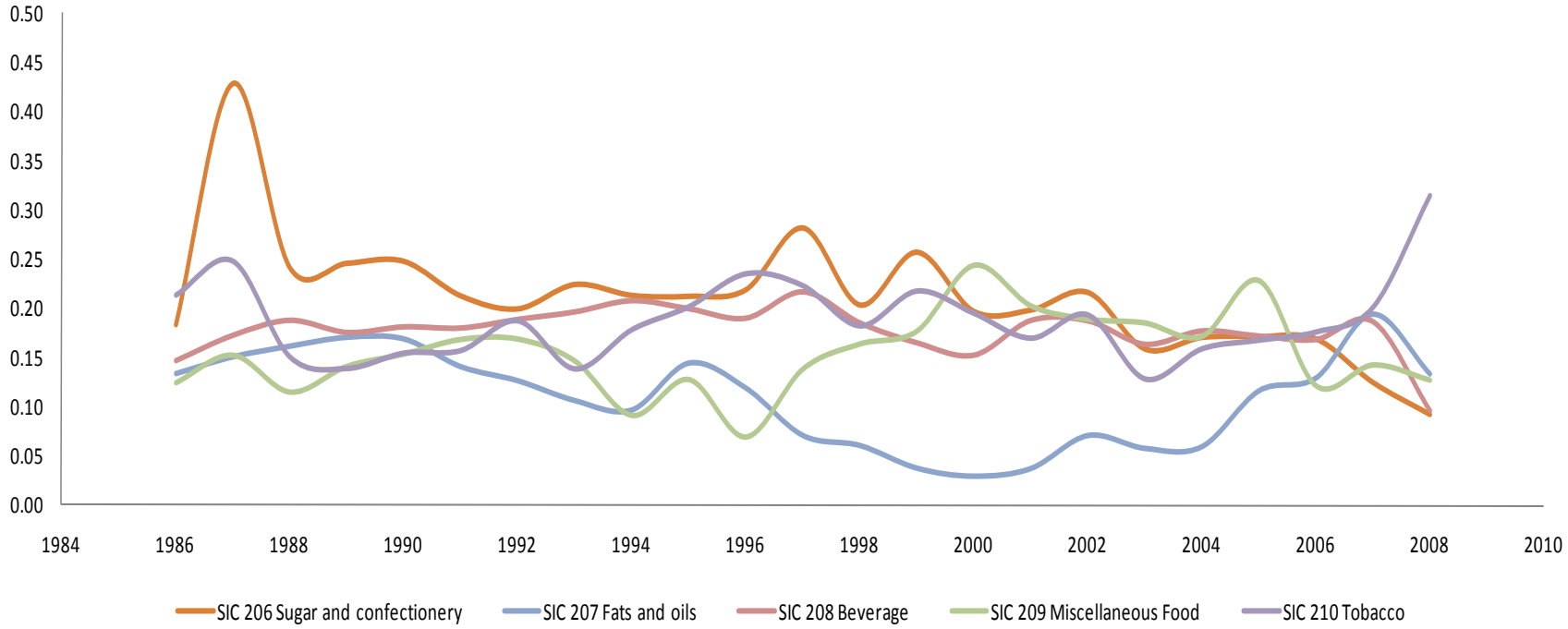

Figure 3-4. Continued

CHAPTER 4
EMPIRICAL RESULTS

Before performing the regression, the regression of residuals for the fixed effect panel model is tested. Without the obvious heteroskedastic error and autocorrelation, the model exhibits an overall linear good fit.

Regression results for testing the model

After checking the residuals of the model, hypothesis 1 proposed in the Chapter 1 is tested.

Test hypothesis 1- the component financial ratios of the DuPont expansion have the same effects on the profitability, in terms of EBTOCE, among all sub sectors that comprise of the food supply chain.

Considering the different management strategies will be adapted to different industries, regression tests are performed separately for the FPB and the FWRS, which comprise ten and three sub sectors respectively.

As stated in the Chapter 2, each DuPont component financial ratio is measuring one proxy variable of sub sector's performance. The two-way fixed effects panel regression is based on the weighted average mean using net sales as the weight. The empirical results are reported in Tables 4-1 and 4-2 for the two main industries. Since this research is carried out in two stages, the cross-section and time effects results will be shown later as part of the testing of hypotheses 2 and 3.

The F-test for the two-way fixed effects model focuses only on the presence of the fixed effects, not on the significance of the explanatory variables. Thus, the OLS regression was run to obtain the F-statistics for the ten component financial ratios

model. It aims to evaluate the null hypothesis that all regression coefficients are equal to zero versus the alternative that at least one is not.

The results for the food processing and beverage (FPB) industry are shown in Table 4-1. The two-way fixed effects regression model for the FPB has an R-squared of 0.7182. F-statistics for the independent variables in the model is 19.23, with a p-value of 0.000. This indicates that 71.82% of a change in EBTOCE can be explained by the changes of independent regressors. In other words, the ten sub components financial ratios in this model explain 71.81% of EBTOCE's fluctuation in their linear relationship. The F test from the OLS regression shows the usefulness of this model. The proposed relationship between the EBTOCE and the set of financial ratios is statistically reliable.

The F test shows overall significance of this model. However, not all the ratios are statistically significant. GM/S, IN/S, SG&A/S and R&D/S, proxies of profit margin rate, are all statistically significant at 5% level. In the FPB industry, EBTOCE is very sensitive to the change of profit margin, which is reflected by a coefficient of 0.798. This means, one percent increase in the gross margin rate will increase the EBTOCE by 0.798 percent. Similarly, one percent increase in IN/S, SG&A/S and R&D/S will decrease the firm's EBTOCE by 1.488, 0.581 and 2.329 percent, respectively. It is worth mentioning that the research and development expense in agribusiness has a negative impact in its profitability. R&D expenses in the food processing and beverage sector have not been effectively increasing contemporaneous profitability. That might be attributed to the lagged effect of research and development expenditures.

The second component tested is the statistical significance of the asset turnover. Under this, there are three ratios- ARTR, INTR and PP&ETR. Out of these three, only

PP&ETR (net sales/ average PP&E) is statistically significant at the 5% level. It means that one unit of higher PP&E turnover (annual rate in times) increases EBTOCE by 0.01 percent. Keeping net sales constant, the lower investment in PP&E leads to lower capital employed, which is total assets minus current liability. Thus the higher PP&E turnover rate, the higher is the EBTOCE.

The final component of the DuPont expansion is Leverage. Under this, three interest bearing debts are tested: STD/A, CD/A, and LTD/A. The long term debt to assets ratio (LTD/A) is statistically significant, while the other two are not. LTD/A has a coefficient of -0.142 and P-value of 0.011 which shows an inverse relationship with EBTOCE. One percent increase in long term debt results in a decrease in EBTOCE by 0.142 percent. That inverse relationship indicates that the debt to equity capital mix in the current FPB industry should be reduced to improve return on capital employed.

The results for the food wholesale, retail and service (FWRS) industry are provided in Table 4-2. The regression model with respects to the FWRS has an R-squared of 0.7955 and an F-statistics of 9.77 with a probability value of 0.00. It means that the model measures 79.55 % of EBTOCE's variability. In contrast with the FPB, only interest expense over sales (IN/S) and long term debt to assets ratio (LTD/A) are statistically significant at 5% level, with a coefficient of -4.46% and -0.56%. Debt load is significantly affecting the profitability of FWRS inversely. One percent increase in LTD/A ratio will result in a decrease in EBTOCE by -0.56% and one percent increase in interest expense per dollar of sales will decrease EBTOCE by -4.46%.

Besides above ratios, GM/S and INTR are significant at 15% level, and STD/A is significant at 10% level. It is surprising to see the statistical insignificance of other

financial ratios. It might be attributed to the relative small business scale in FWRS. Table 3-1 shows that there are, on average, 125 firms in ten sub sectors of FPB, while there are139 firms in the three sub sectors of FWRS. Especially, the food services sub sector (SIC 581) has, on average, 89 firms per year. Many of those restaurants and food providers are small-scale enterprises, which might be managed differently than large firms. The high variability in production planning and action strategies for these small businesses makes it difficult to predict their profitability using a specific model. The change in EBTOCE is not majorly reflected by their financial ratios.

Regression results for testing the cross-section and time effects

The two-way fixed effect panel model is constructed to test hypotheses 2 and 3 at the same time.

Test hypothesis 2: EBTOCE does not have cross-section effects within the U.S. food supply chain. All sub sectors' profitability levels have no significant difference statistically.

Test hypothesis 3: Sub sector's EBTOCE does not vary across time. There are no uniform time effects to those sub sectors.

The null hypothesis is that parameters of sub sectors and time dummies are zero. It is a twofold test. The first test is the cross sectional effect test. It captures the sub sector effects which are constant over time. In this study, this refers to the within differences of the component sub sectors in the FPB and FWRS. The second test aims to capture the differences over 23 years that is common to all component sub sectors in the U.S. food supply chain and to explore whether the time effect pattern follows the recent three economic recessions. As stated in the Chapter 2, to avoid the perfect

multicollinearity (the dummy variable trap), the model drops one cross-section and one time-series dummy variables in a two-way fixed effect model.

Table 4.3 describes the basic output of the two-way fixed-effects model for the food processing and beverage industry. Panel A shows that there are ten cross-sections and twenty three time observations. Ten cross sections refer to the 3-digit SIC code that starts with 20 and the tobacco sub sector with SIC code 21. The 23 time observations cover the periods from 1986 to 2008. The F test for the fixed effects, shown in Table 4-3 Panel B, tests the null hypothesis that there are no fixed effects. The P value for the F-statistic is almost zero. So we reject the null hypothesis which indicates that we cannot use OLS to estimate the parameters. There are sub sector effects, time effects, or both. The test is highly significant. To explore the detail of fixed effects, two separate one-way fixed effect regressions are developed regarding the sub sector difference and time impact, respectively. Table 4-3 Panel C provides the results of two separate F-tests, their small P values are indicating the existence of both sub sector effects and time effects.

Table 4-4 presents the two-way fixed effects regression results with respect to FPB. There are ten cross-section and 23 time series in that model. Variables d1, d2 to d10 are assigned to ten sub sector dummies; φ 1, φ 2 to φ 23 are assigned to the 23 year dummies. SAS sorts the dummy variables by an ascending order and drop the last cross-section dummy and time dummy automatically. The 230 regression equations (23x10) can be drawn on the combinations of ten sub sectors and 23 years. The two-way fixed effect panel regression model assumes that independent variables have constant slopes, only intercepts vary according to cross-section and time. The

parameter estimate of sub sector tobacco (SIC 21) (d10) in year 2008 (φ 23) is the intercept (-0.038), a reference point. The other dummy parameter coefficients are computed using this reference point as follows: intercept+ sub sector dummy coefficient + year dummy coefficient+ other dummy coefficients*0. The actual intercept of meat sub sector (d1) in year 2007 (φ 22), for example, is computed as intercept+d1 coefficient + φ 22 coefficient +other dummy estimates*0. That is 0.043=-0.038+0.06+0.021+0. The coefficient 0.043 means, holding other explanatory variables constant, the EBTOCE of meat sub sector in 2007 is 4.3% higher than tobacco sub sector in 2008. The coefficients of other sub sectors - years can be estimated similarly.

Looking at the parameters in Table 4-4, most of the cross-section effects are highly significant (with the exception of sub sectors 202, 205, 207 and 208). Tobacco sub sector (SIC 21) as a controlling group is sorted and dropped by SAS as a default. The small P value of F-statistics means that the other sub sectors are significantly different from the tobacco sub sector. A significant influence of sub sector-specific factors is present.

Even thought in 12 out of 23 time periods the time effect is statistically significant, the time series effects have no uniform pattern in FPB. It is shown that there are some significant fluctuations occurred in the past 23 years, but not all sub sectors experienced the significant decrease in return in a same certain year. Holding other independent variables constant, the profitability of a sub sector in a specific recession period does not exhibit the significant decrease in return comparing with other time periods. From year 2000, however, the year dummy variables lose their significance. The parameters values decrease in size. The interesting fact is, the visible time effects pattern do not

match with the three economic recessions during the observation range. Corresponding to the fluctuation analysis of data in the Chapter 3, the change of EBTOCE attributes to the management strategy of agribusiness rather than economic downturns. Generally, the overall demand shrinks along with the recession. However, it seems to have no statistically significant impact to the FPB industry's profitability, in terms of EBTOCE.

The two-way fixed-effects model output is provided in Table 4-5 for FWRS industry. Panel A shows that there are three cross sections and 23 time observations. Three cross sections are sub sector SIC 54, SIC 514 and SIC 581. Identical with previous definition, 23 time observations cover the periods from 1986 to 2008. The F test for fixed effects is shown in the Table 4-5 Panel B provides evidence that there are no fixed effects. With the F-statistic of 1.27 and associated P value of 0.259, the null hypothesis is not rejected. There are no sub sector effects, or time effects. To explore the details of fixed effects, two separate one-way fixed effect regression models are developed regarding the sub sector difference and time impact respectively. Table 4-5 Panel C reports two separate F-test. Both the p value for the F-Statistic is above 10% significant level, which indicates an absence of any sub sector effect and time effects. The sub sector dummies and year dummies are not statistically significant in this industry. In essence, there is no statistical difference in EBTOCE among sub sectors in FWRS over the past 23 years. The statistic output of FWRS in the Table 4-6 corroborates this conclusion. Twenty of the P values of coefficient estimates are greater than 5%. That result might be attributed to the fact that there are too many small-scale agribusinesses in FPB groups, like groceries and restaurants. They are more variable and complex in profitability than large companies. There might be no common operating

practice or a specific time period that are influencing those small businesses persistently.

Table 4-1. Two-way fixed effects panel regression in FPB industry

Model Description and Estimation				
Total sample	230	Degree of freedom	186	
Fit Statistics (F-statistics: 19.23, p-value: 0.000)				
R-Square	0.7182	MSE	0.0013	
Parameter Estimates				
	Estimate	Standard Error	t Value	Pr > |t|
Intercept	-0.038	0.056	-0.690	0.494
GM/S	0.798	0.113	7.040	<.0001
IN/S	-1.488	0.508	-2.930	0.004
SG&A/S	-0.581	0.141	-4.110	<.0001
R&D/S	-2.329	0.990	-2.350	0.020
ARTR	-0.002	0.002	-0.810	0.419
INTR	0.001	0.002	0.390	0.698
PP&ETR	0.010	0.004	2.760	0.006
STD/A	-0.013	0.125	-0.100	0.921
CD/A	0.055	0.099	0.560	0.579
LTD/A	-0.142	0.055	-2.570	0.011

Table 4-1 presents the statistical output of the regression for the independent variables in FPB. Since the hypothesis 1, 2, and 3 are tested separately, the two-way fixed effects F test and results are moved to Table 4-3. The regression takes the form that EBTOCE(it) = α(i)+β1 GM/S(it)+ β2 SG&A/S(it)+ β3 IN/S(it)+ β4R&D/S(it)+ β5 ARTR(it)+ β6INTR(it) + β7PP&ETR(it)+ β8STD/A(it)+ β9CD/A(it) + β10LTD/A(it)+ ui+ vt+ ε(it). Independent variables are defined as following: GM/S is gross margin rate; SG&A/S is selling and general and administrative Expense rate; IN/S is Interest Expenses rate; R&D/S is research and development expense rate; ARTR is accounts receivables turnover rate; INTR is inventory turnover rate; PP&ETR is property, plant and equipment turnover rate; STD/A, CD/A and LTD/A represent short term debt, current portion of long-term debt and long-term debt to assets ratio respectively.

Table 4-2. Two-way fixed effects panel regression in FWRS industry

Model Description and Estimation				
Total sample	69	Degree of freedom	33	
Fit Statistics (F-statistics 9.77; p-value: 0.00)				
R-Square	0.7955	MSE	0.0011	
Parameter Estimates				
	Estimate	Standard Error	t Value	Pr > |t|
Intercept	-0.141	0.211	-0.670	0.510
GM/S	1.337	0.846	1.580	0.124
IN/S	-4.460	1.378	-3.240	0.003
SG&A/S	-0.600	1.119	-0.540	0.596
R&D/S			.	.
ARTR	0.000	0.001	-0.350	0.728
INTR	0.008	0.005	1.500	0.142
PP&ETR	0.001	0.007	0.200	0.843
STD/A	-1.824	0.970	-1.880	0.069
CD/A	-0.038	0.370	-0.100	0.919
LTD/A	-0.558	0.138	-4.050	0.000

Table 4-2 presents the statistical output of the regression for the independent variables in FWRS INDUSTRY. Since the hypothesis 1, 2, and 3 are tested separately, the two-way fixed effects F test and results are moved to Table 4-3. The regression takes the form that $EBTOCE(it) = \alpha(i)+\beta1\ GM/S(it)+ \beta2\ SG\&A/S(it)+ \beta3\ IN/S(it)+ \beta4 R\&D/S(it)+ \beta5\ ARTR(it)+ \beta6 INTR(it) + \beta7 PP\&ETR(it)+ \beta8 STD/A(it)+ \beta9 CD/A(it) + \beta10 LTD/A(it)+ ui+ vt +\varepsilon(it)$. Independent variables are defined as following: GM/S is gross margin rate; SG&A/S is selling and general and administrative Expense rate; IN/S is Interest Expenses rate; R&D/S is research and development expense rate; ARTR is accounts receivables turnover rate; INTR is inventory turnover rate; PP&ETR is property, plant and equipment turnover rate; STD/A, CD/A and LTD/A represent short term debt, current portion of long-term debt and long-term debt to assets ratio respectively.

R&D/S coefficient estimate and standard error are 0 because there is no R&D expense in FWRS industry.

Table 4-3. Hypothesis test for fixed cross-section effects and time effects in the FPB

Panel A: Model Description	
Estimation Method	Fix Two
Number of Cross Sections	10
Time Series Length	23

Table 4-3 provides the regression results of cross-section effects and time effects in model: EBTOCE(it) = α0+β1 GM/S(it)+ β2 SG&A/S(it)+ β3 IN/S(it)+ β4R&D/S(it)+ β5 ARTR(it)+ β6INTR(it) + β7PP&ETR(it)+ β8STD/A(it)+ β9CD/A(it) + β10LTD/A(it)+ ui+ vt +ε(it).

Table 4-3. Continued

Panel B : Fixed effect F test					
Model	Fixed effect	Sample Size	F Test	Prob value	Result
Two-way	Both sectors and time: I =201, 202, 203…, 21 T =1986, 1987, 1988…..,2008	230	F(31,186)=5.15	<.0001	Null hypothesis for both sector and time effect are not rejected

Table 4-3 provides the regression results of cross-section effects and time effects in model: EBTOCE(it) = α0+β1 GM/S(it)+ β2 SG&A/S(it)+ β3 IN/S(it)+ β4R&D/S(it)+ β5 ARTR(it)+ β6INTR(it) + β7PP&ETR(it)+ β8STD/A(it)+ β9CD/A(it) + β10LTD/A(it)+ ui+ vt +ε(it).

Table 4-3. Continued

Panel C: separate F-test for individual effect					
Model	Fixed effect	Sample Size	F Test	Prob value	Result
One-way	Single sectors effect I =201, 202, 203…, 21	230	F(9,208)= 9.21	<.0001	Null hypothesis for sector effect is not rejected
One-way	Single time effect T =1986, 1987, 1988…..,2008	230	F(22, 195)=2.82	<.0001	Null hypothesis for time effect is not rejected

Table4-3 provides the regression results of cross-section effects and time effects in model: EBTOCE(it) = α0+β1 GM/S(it)+ β2 SG&A/S(it)+ β3 IN/S(it)+ β4R&D/S(it)+ β5 ARTR(it)+ β6INTR(it) + β7PP&ETR(it)+ β8STD/A(it)+ β9CD/A(it) + β10LTD/A(it)+ ui+ vt +ε(it).

Table 4-4. Parameter estimates in the fixed effects model for the FPB

Parameter Estimates								
Variable		Variable	Estimate	Standard Error	t Value	Pr > |t|	Label	
Sub Sector	201	d1	0.060	0.030	2.010	0.046	Cross Sectional Effect	1
Sub Sector	202	d2	0.046	0.027	1.680	0.094	Cross Sectional Effect	2
Sub Sector	203	d3	0.070	0.017	4.040	<.0001	Cross Sectional Effect	3
Sub Sector	204	d4	0.092	0.018	5.130	<.0001	Cross Sectional Effect	4
Sub Sector	205	d5	-0.025	0.022	-1.130	0.261	Cross Sectional Effect	5
Sub Sector	206	d6	0.057	0.019	2.960	0.003	Cross Sectional Effect	6
Sub Sector	207	d7	0.056	0.031	1.820	0.070	Cross Sectional Effect	7
Sub Sector	208	d8	0.012	0.019	0.620	0.539	Cross Sectional Effect	8
Sub Sector	209	d9	0.046	0.020	2.260	0.025	Cross Sectional Effect	9
Year	1986	φ 1	0.061	0.019	3.200	0.002	Time Series Effect	1
Year	1987	φ 2	0.098	0.019	5.170	<.0001	Time Series Effect	2
Year	1988	φ 3	0.063	0.019	3.380	0.001	Time Series Effect	3
Year	1989	φ 4	0.059	0.019	3.040	0.003	Time Series Effect	4
Year	1990	φ 5	0.060	0.019	3.170	0.002	Time Series Effect	5

Table 4-4. Continued

Parameter Estimates							
Variable		Variable	Estimate	Standard Error	t Value	Pr > |t|	Label
Year	1991	φ 6	0.053	0.020	2.690	0.008	Time Series Effect 6
Year	1992	φ 7	0.044	0.019	2.270	0.024	Time Series Effect 7
Year	1993	φ 8	0.035	0.019	1.810	0.072	Time Series Effect 8
Year	1994	φ 9	0.037	0.019	2.010	0.046	Time Series Effect 9
Year	1995	φ 10	0.056	0.019	2.970	0.003	Time Series Effect 10
Year	1996	φ 11	0.040	0.019	2.150	0.033	Time Series Effect 11
Year	1997	φ 12	0.024	0.018	1.340	0.183	Time Series Effect 12
Year	1998	φ 13	0.014	0.018	0.760	0.448	Time Series Effect 13
Year	1999	φ 14	0.045	0.019	2.390	0.018	Time Series Effect 14
Year	2000	φ 15	0.025	0.019	1.320	0.190	Time Series Effect 15
Year	2001	φ 16	0.020	0.018	1.080	0.282	Time Series Effect 16
Year	2002	φ 17	0.017	0.018	0.960	0.339	Time Series Effect 17
Year	2003	φ 18	0.001	0.018	0.030	0.976	Time Series Effect 18
Year	2004	φ 19	0.008	0.018	0.440	0.659	Time Series Effect 19
Year	2005	φ 20	0.018	0.018	1.030	0.302	Time Series Effect 20
Year	2006	φ 21	0.003	0.018	0.180	0.860	Time Series Effect 21
Year	2007	φ 22	0.021	0.017	1.200	0.233	Time Series Effect 22
Sector 21 in 2008		d10φ 23	-0.038	0.056	-0.690	0.494	Intercept
Ten explanatory variables parameter estimates are shown in table4-1							

SIC groups classifications follows: Meat (201); diary (202); canned, frozen, and preserved fruits and vegetables (203); grain mill (204); bakery (SIC 205); sugar and confectionery (206); fats and oils (207); beverages (208);miscellaneous food preparations and kindred (209); tobacco (21); food service (5810 and 5812); retailers (5400 and 5411); and wholesalers (5140, 5141, and 5180).

Table 4-5. Hypothesis test for the fixed cross-section effects and time effects in the FWRS industry

Panel A: Model Description	
Estimation Method	Fix Two
Number of Cross Sections	3
Time Series Length	23

Table 4-5. Continued

Panel B : Fixed effect F test

Model	Fixed effect	Sample Size	F Test	Prob value	Result
Two-way	Both sectors and time: I =54,514,581 T =1986, 1987, 1988…..,2008	69	F(24,33)= 1.27	0.2588	Null hypothesis of both sector and time effect are not rejected

Table 4-5. Continued

Panel C: separate F-test for individual effect					
Model	Fixed effect	Sample Size	F Test	Prob value	Result
One-way	Single sectors effect I =54,514,581	69	F(2,55)= 1.57	0.2167	Null hypothesis for sector effect is not rejected
One-way	Single time effect T =1986, 1987, 1988…..,2008	69	F(22, 35)=1.21	0.3079	Null hypothesis for time effect is not rejected

Table4-5 provides the regression results of cross-section effects and time effects in model: EBTOCE(it) = α0+β1 GM/S(it)+ β2 SG&A/S(it)+ β3 IN/S(it)+ β4R&D/S(it)+ β5 ARTR(it)+ β6INTR(it) + β7PP&ETR(it)+ β8STD/A(it)+ β9CD/A(it) + β10LTD/A(it)+ ui+ vt +ε(it).

Table 4-6. Parameter estimates in the fixed effects model for FWRS industry

Parameter Estimates

Variable		Variable	Estimate	Standard Error	t Value	Pr > |t|	Label	
Sub Sector	54	d1	0.151	0.176	0.860	0.398	Cross Sectional Effect	1
Sub Sector	514	d2	0.175	0.106	1.650	0.109	Cross Sectional Effect	2
Year	1986	φ 1	0.092	0.067	1.360	0.182	Time Series Effect	1
Year	1987	φ 2	0.116	0.067	1.740	0.090	Time Series Effect	2
Year	1988	φ 3	0.129	0.050	2.590	0.014	Time Series Effect	3
Year	1989	φ 4	0.153	0.052	2.970	0.006	Time Series Effect	4
Year	1990	φ 5	0.179	0.056	3.200	0.003	Time Series Effect	5
Year	1991	φ 6	0.123	0.047	2.650	0.012	Time Series Effect	6
Year	1992	φ 7	0.083	0.039	2.130	0.041	Time Series Effect	7
Year	1993	φ 8	0.061	0.039	1.550	0.132	Time Series Effect	8
Year	1994	φ 9	0.052	0.043	1.220	0.232	Time Series Effect	9
Year	1995	φ 10	0.030	0.036	0.840	0.407	Time Series Effect	10
Year	1996	φ 11	0.024	0.036	0.660	0.511	Time Series Effect	11
Year	1997	φ 12	0.009	0.032	0.270	0.789	Time Series Effect	12
Year	1998	φ 13	0.015	0.034	0.430	0.670	Time Series Effect	13
Year	1999	φ 14	0.009	0.031	0.310	0.762	Time Series Effect	14
Year	2000	φ 15	0.008	0.031	0.270	0.790	Time Series Effect	15
Year	2001	φ 16	0.020	0.028	0.730	0.468	Time Series Effect	16
Year	2002	φ 17	0.023	0.028	0.830	0.410	Time Series Effect	17
Year	2003	φ 18	0.001	0.029	0.030	0.976	Time Series Effect	18
Year	2004	φ 19	-0.018	0.029	-0.630	0.533	Time Series Effect	19
Year	2005	φ 20	-0.010	0.030	-0.320	0.749	Time Series Effect	20
Year	2006	φ 21	-0.012	0.030	-0.410	0.683	Time Series Effect	21
Year	2007	φ 22	0.011	0.027	0.420	0.680	Time Series Effect	22
Sector 581 in year 2008		d3 φ 22	-0.141	0.211	-0.670	0.510	Intercept	

Ten explanatory variables parameter estimates are shown in table4-2.

SIC groups classifications follow: meat (201); diary (202); canned, frozen, and preserved fruits and vegetables (203); grain mill (204); bakery (SIC 205); sugar and confectionery (206); fats and oils (207); beverages (208);miscellaneous food preparations and kindred (209); tobacco (21); food service (5810 and 5812); retailers (5400 and 5411); and wholesalers (5140, 5141, and 5180).

CHAPTER 5
CONCLUSION

This research aims to examine the U.S. agribusiness's profitability based on the decomposition of the DuPont system with consideration of the recent three U.S. economic recessions. The overall approach is to derive the financial variables that stem from the DuPont formula as independent variables, to measure the dependent variable which is the return on capital employed for agribusinesses. The effects of different financial aspects to EBTOCE are tested by this regression. Additionally, the cross-sectional effects and time effects of the U.S. food supply chain over past 23 years are tested. Through the analysis of profitability fluctuation, this study provides an insight into the agribusiness financial performance.

This research is a financial statement analysis based on the DuPont system with respect to U.S. food supply system. Three hypotheses are tested with respect to two major food industries and subordinate 13 sub sectors.

In terms of the first hypothesis test, the empirical result indicates that agribusiness' profitability among all sub sectors is negatively affected by long-term debt. The higher the long term debt to asset mix, the lower return on capital employed. That conclusion can be applied to both FPB and FWRS. Furthermore, the profit margin (including four major components: GM/S, SG&A/S, IN/S, R&D/S) have significant impact on the profitability of all the sub sectors in the FPB industry. However, except for the IN/S, other profit margin components which are proxies of the firm's operating efficiency exhibit statistical insignificance in the FWRS industry. Assets turnover ratios have three major components: ARTR, INTR and PP&ETR. Except the PP&ETR in FPB, coefficient estimations of other assets turnover ratios provide evidence that assets usage efficiency

is not statistically affecting the EBTOCE for almost all sub sectors in the food supply chain. In other words, the profitability change, in terms of EBTOCE, cannot be explained by the variations of assets turnover rate.

In terms of the second and third hypotheses, the two different industries have different test results. Significant cross-section effects are present in the FPB industry. It indicates that the profitability is significantly different across sub sectors in that industry. However, FWRS's profitability is less relevant to its sub sectors, because the cross-section effect is not reported from the panel data regression statistical test.

It is shown that the economic downturns do have an impact on the number of market participants. The reduced number of market participants is highly associated with economic recessions. Especially small agribusinesses, which drop out the market, file for bankruptcy or merge. However, in this model, the time effect has been tested on surviving firms. Even though there are significant time effects exhibits in the FPB, the fluctuation of EBTOCE is not associated with recession periods, which indicates that there are other factors or reasons that are playing a more important role in the fluctuation of firm's profitability. EBTOCE haven't been affected materially by the well recognized recession periods. A decrease in profitability might stem from various factors or reasons. By analyzing the individual firms' performance closely, it is found that decreases in return are mainly attributed to ineffective or inefficient management, such as fail to control manufacturing cost, bad acquisition, failure to hedge the foreign exchange risk, stronger competitors, etc. Ultimately, this study concludes that the profitability of the food supply chain is mainly affected by management operating

strategy. Economic recessions do not have significant impact on profitability of the U.S. food supply chain statistically.

The major research limitation of this study was the failure to collect the market variables, such as stock prices, price earnings rates (PE) and earnings per share (EPS). These are indicators of a company's profitability as perceived by investors. That is also the drawback of DuPont formula, which is the main focus on the internal measurement of firm’s performance.

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