An Analysis of Factors Affecting Bid of Infant-formula Manufacturers in WIC Rebate Auctions

Raymond Opoku
South Dakota State University

Follow this and additional works at: https://openprairie.sdstate.edu/etd
Part of the Economics Commons

Recommended Citation
https://openprairie.sdstate.edu/etd/2147
AN ANALYSIS OF FACTORS AFFECTING BID OF INFANT-FORMULA MANUFACTURERS IN WIC REBATE AUCTIONS

BY

RAYMOND OPOKU

A thesis submitted in partial fulfilment of the requirements for the

Master of Science

Major in Economics

South Dakota State University

2017
AN ANALYSIS OF FACTORS AFFECTING BID OF INFANT-FORMULA MANUFACTURERS IN WIC REBATE AUCTIONS

RAYMOND OPOKU

This thesis is approved as a creditable and independent investigation by a candidate for the Master of Science degree in Economics and is acceptable for meeting the thesis requirements for this degree. Acceptance of this thesis does not imply that the conclusions reached by the candidate are necessarily the conclusions of the major department.

David Davis, Ph.D
Major Advisor

Eluned Jones, Ph.D.
Head, Department of Economics

Dean, Graduate School
To my parents and siblings – George Travis Opoku and Doris Adjorkor Opoku, Susana Ama Gold Opoku, Lily Diamond Opoku and Israel Opoku – all of whom have supported me through these years.
ACKNOWLEDGEMENTS

First, I would like to express my absolute appreciation to Almighty God, to whom I owe my entire existence. I want to further extend my profound appreciation to my thesis advisor, Dr. David Davis. I couldn’t have completed this scholarly material without his patience and intellectual guidance. Many thanks to Dr. Anna Sadovnikova, Dr. Myoung-Jin Keay and Dr. Nels Troelstrup - Graduate school faculty representative - for their generous acceptance to be on my thesis committee.

Thank you to all my colleagues, friends and family who provided their support and encouragement. My sincere appreciation to members of faculty of the SDSU Economics Department for the training and knowledge I received.
# TABLE OF CONTENTS

LIST OF TABLES ........................................................................................................................................... viii

LIST OF FIGURES ......................................................................................................................................... ix

ABSTRACT ................................................................................................................................................... x

CHAPTER ONE (1)

1.0 INTRODUCTION ..................................................................................................................................... 1

1.1 BACKGROUND ....................................................................................................................................... 2

1.2 STATEMENT OF PROBLEM ...................................................................................................................... 5

1.3 GENERAL OBJECTIVES .......................................................................................................................... 9

1.4 SPECIFIC OBJECTIVES ............................................................................................................................ 9

1.5 STATEMENT OF HYPOTHESES ............................................................................................................... 9

1.6 SIGNIFICANCE OF STUDY ...................................................................................................................... 9

1.7 SCOPE OF THE STUDY ............................................................................................................................ 10

1.8 ORGANIZATION OF THE STUDY ........................................................................................................... 10

CHAPTER TWO

REVIEW OF LITERATURE ............................................................................................................................. 11

2.0 HISTORICAL PERSPECTIVE .................................................................................................................... 11

2.1 PRISONER’S DILEMMA PROBLEM .......................................................................................................... 13

2.2 TRENDS IN INFANT FORMULA REBATE CONTRACTS ........................................................................ 14

2.3 INFANT FORMULA PRICING .................................................................................................................. 14

2.5 REBATE SYSTEM .................................................................................................................................... 15

2.6 REBATES AND PRICE OF INFANT FORMULA ......................................................................................... 16
CHAPTER THREE (3)

METHODOLOGY .................................................................................................................. 21

3.0 INTRODUCTION .......................................................................................................... 21

3.1 RESEARCH METHOD ................................................................................................. 21

3.2 SAMPLE DESIGN ....................................................................................................... 22

3.3 SOURCE OF DATA .................................................................................................... 22

3.4 ESTIMATION PROCESS ............................................................................................ 23

3.5 THE MODEL .............................................................................................................. 23

3.6 TECHNIQUES FOR EVALUATION OF RESULTS ..................................................... 28

3.7 VARIABLE DESCRIPTION ......................................................................................... 29

3.8 MODEL SPECIFICATION .......................................................................................... 30

CHAPTER FOUR (4)

RESULTS AND ANALYSIS ............................................................................................... 31

4.0 INTRODUCTION ........................................................................................................ 31

4.1 STATE-ALLIANCE .................................................................................................... 31

4.2 FIRMS ....................................................................................................................... 37

4.4 FIRM WIC CONTRACT WINS AND THEIR SHARE OF INFANTS ....................... 38

4.5 BIDS WON BY FIRMS VERSUS NON-WINNING BIDS .......................................... 40

4.6 STATE ALLIANCES AND THEIR BIDS BY COUNTS ........................................... 42

4.7 FIRMS AND THEIR BIDDING TREND OVER TIME ............................................. 42

4.8 .1 FIRMS AND THEIR AVERAGE SHARE DISTRIBUTION .................................. 43
LIST OF TABLES

Table 1.1 Wholesale-Rebate Distribution .................................................................6
Table 4.1 Summary Statistics of Firm .....................................................................38
Table 4.2 Table of Firm .........................................................................................39
Table 4.3 Cross Tab of Firm – WIC Contract .........................................................41
Table 4.4 Alliances and State ..................................................................................34
Table 4.5 Cross Tab of Bid – Firm .........................................................................42
Table 4.6 Cross Tab Bid – State Alliance .................................................................42
Table 4.7 A Summary Table ...................................................................................45
Table 4.8 LOGISTIC REGRESSION .......................................................................47
Table 4.9 Marginal Effects .....................................................................................48
Table 4.10 Predicted Probability ............................................................................60
Table 4.11 CORRELATION MATRIX .....................................................................58
LIST OF FIGURES

Figure 1. 1 WIC Food Cost .............................................................................................................17
Figure 3. 1 Comparison of Logistic and Linear Estimation ..........................................................24
Figure 4. 1 SATE-ALLIANCE SIZE DISTRIBUTION OF THE POPULATION ........31
Figure 4. 2 Firm and WICinfants .................................................................................................39
Figure 4. 3 Firm and Average WIC Share ...................................................................................41
Figure 4. 6 Firm- Annual bid distribution respectively .................................................................42
Figure 4. 7 Firm- Annual WIC Share distribution .......................................................................43
Figure 4. 8 State – Bid counts distribution ..................................................................................44
Figure 5.0 Predicted Probability of Bid ......................................................................................58
ABSTRACT

AN ANALYSIS OF FACTORS AFFECTING BID OF INFANT-FORMULA MANUFACTURERS IN WIC REBATE AUCTIONS

RAYMOND OPOKU

2017

This thesis investigates the factors that affect bid decisions of infant-formula manufacturers in WIC rebates auctions. Since its inception in 1972, the WIC program has served more than half of participating women and their infants each year. Today, Infant formula - the most expensive food item on the WIC menu - is accessible to all participants for free through the WIC rebate program. Through the rebate program, firms submit bids to solely supply their infant formula to a state WIC agency at a discount leading to fall in net prices. Yet, the firms in the infant formula market are selective in the auctions they submit bids for. This study investigated the factors that influence firm’s decisions to bid as such the role of state demographics and market share in such decisions using cross sectional data spanning from 1986 to 2016 for analysis. The major findings of research include state alliance membership and firm’s market share are a primary factor when it comes to bidding decisions.

Key words: WIC, Rebate Auctions, Infant formula, Alliances, market share, Sole source, Net prices, Wholesale Price
1.0 INTRODUCTION

Administered nationwide through local offices, the US Department of Agriculture’s (USDA) Special Supplementary Nutritional Program for Women, Infants and Children (WIC) is a federal government funded health and nutrition initiative for lower income to medium level-income women who may be pregnant, lactating or in postpartum, babies and/or kids mostly under five, who are at nutritional risk (NWA, 2011). It is the third largest federal intervention program after the Supplementary Nutritional Assistance Program (SNAP) and School Lunch program (Oliviera and Frazao, 2009; Currie, 2003). The program is structured such that participants receive vouchers to have access to nutritional foods enlisted on the WIC menu of foods. The program offers educational information on the essentials of breastfeeding and its alternatives, health and nutritional support to its members.

Among the federal government’s most successful and cost-efficient intervention programs, WIC did not start until the 1960’s. At the time, low-income American families were falling short on the daily nutritional requirement and this drew concerns from both the federal government and the public. In September 1972, a two-year WIC pilot was begun (Ghefi, Olmested, Racine & Oliviera, 2002). The program was not in full flight until 1974 (USDA, 1999).

According to the Centre for Budget Policy and Priority the eligibility for the program is determined by incomes usually at or beneath the 185% poverty level set by the federal government level plus nutritional risk in at least one of the following
categories: 1) abnormal nutritional conditions (such as anaemia or underweight) detectable by anthropometric measurement (measurements of height and blood test for anaemia); 2) conditions that predispose towards inadequate nutritional intake; 3) nutritional medical conditions such as diabetes; 4) dietary deficiencies endangering health (Abrams, 1993).

The WIC program does not only cater for the need of breastfeeding mothers but also non-lactating mothers. Infant formula has become the highest priced food item on the WIC menu and as such is made available at a reduced price to WIC members. Though the program has enjoyed enormous praise for its effectiveness and efficiency in the improvement of the health of women and children nationwide, it has come under criticism for its most popular component - infant formula. Scholars have argued that the free provision of infant formula has been the cause of the low breastfeeding rates among WIC mothers (Davis, 2011).

1.1 BACKGROUND

WIC which currently aids over 8 million women who are pregnant, or lactating mothers and young children under five, began over 40 years ago as a pilot program according to Review of WIC Food Packages in 2016. The program saw its implementation in 1972 and has grown ever since (Betson, 2007). It currently serves more than half of the infants and more pregnant women in the US (Betson, 2007). In 2016, the WIC had an annual budget of about $6.6 billion.
WIC is the United States’ attempt to reach the nation-wide nutritional policy target for majority of Americans; it is a support program aimed at providing the nutritional support to lower income to medium level-income women who may be pregnant, lactating or in postpartum, babies and/or kids mostly under five, who are at nutritional risk (Davis & Oliviera, 2015), (NWA, 2011).

The WIC program provides foods including milk, cereal, cheese, eggs, fruit juice, peanut butter and infant formula, among other foods. The program encourages and endorses breast-feeding as the best nutritional source for infants (Davis & Oliviera, 2015). Among the nutritional foods provided by the WIC program, infant formula remains the most expensive food item. According to Davis (2009), government agencies are the largest purchasers of the product. The United State Department of Agriculture (USDA) estimated that WIC procures about 57% to 68% of infant formula (Oliviera et al. 2010). In the past, the cost of infant formula placed a constraint on the annual congressional appropriations received by the program, making it difficult to serve all participants. In view of the high cost of infant formula, WIC state agencies are mandated by law to run a cost-containment scheme for buying of infant formula (Davis & Oliviera, 2015) after its initiation and success in the states of Tennessee and Oregon.

The cost-containment system is an auction-based process, where infant formula manufacturers compete through a sealed bid auction by offering rebates to become the WIC state agency’s sole supplier (Davis,2008). They receive the exclusive market rights to sell their product to the state WIC participants in return for giving the state a per-can rebate on infant formula sold through the program (Davis, 2008).
The higher the rebate offered, the lower the net price of the infant formula is. The firm with the lowest net price offer wins the sole-source contract.

According to Carlson et. al. (2015), the WIC rebate process has been cost-effective, and its competitive bidding process for purchasing infant formula is essential to its efficiency (Carlson et. al, 2015). The authors estimated that since the introduction of the WIC rebate program, WIC has been generating $1.5 billion to $2 billion annually in savings and with its annual federal appropriations serves 2 million more participants.

Without its cost containment system, WIC would have required more funding support from other sources to serve as many participants, or would run the risk of serving a smaller number of participants thereby hindering the achievement of nutritional goal. (Carlson et. al, 2015).

Initially, infant-formula producers did not forcefully compete for WIC rebate contracts. Davis and Oliveira (2015) assessed various infant formula manufacturers bids for different State agency contracts granted from 2003 to 2013 and found that only three infant formula producers bid on rebate contracts throughout the period. As such manufacturers bid submission varied differently across the various contracts. The nature of this market makes it oligopolistic such that a few firms exist in a market with a large demand. There has been a huge gap between the real winning net price bid and the next closest competitor. Davis and Oliviera (2015) further suggested that infant formula producers forcefully competed during WIC auctions. The increase in these rebates recently was attributed to contracts receiving numerous bids, as well as an increase in contracts turn-over among manufacturers (Davis and Oliveira, 2015).
1.2 STATEMENT OF PROBLEM

Although bidding is entirely voluntary, infant formula manufacturers routinely compete aggressively on WIC contracts and offer substantial rebates. According to the Centre on Budget and Policies priorities, $1.5 billion to $2 billion annual revenue rebate is generated from the nationwide competitive bidding. As a result, WIC’s cost is decreased considerably to the federal government in comparison to full retail value incurred by non-WIC members (CBPP, 2017).

In 2006, the U.S. General Accounting Office (GAO) report confirmed that a spill-over influence by which the contract WIC brand becomes the favourite of both non-WIC customers and WIC customers could be a motivation to secure the WIC contract regardless of whether manufactures make losses selling to WIC. The GAO report in 2016 further mentioned that the major infant formula producers agree to the importance of shelf space and product placement in marketing strategies. Many WIC agency directors who responded to a survey mentioned that they strongly agreed with the shelf space findings and that it was an essential factor when firm submitted bids (GAO, 2006).

Under WIC’s competitive bidding scheme, infant formula producers offer discounts- rebates to various state WIC programs in hopes to be chosen as that state’s sole infant formula supplier to all WIC members in the state (Carlson, Greenstien & Neuberger, 2017). Winning the WIC contract secures a manufacturer’s brand as the most readily available brand which receives favourable shelf space in stores. When a producer wins a state’s WIC contract, *non*-WIC participants purchase more of that producer’s infant formula compared to their WIC counterparts (Huang and Perloff, 2007).
Davis (2009) found that, out of several auctions available at any given time, infant formula manufacturing firms do not all submit bids for these auctions. Firms are selective in the auctions in which they participate to maximizing their chances by strategically choosing the most promising ones. From Table 1.1 below it is observed that, with 172 representing the number of auctions, Ross leads the chart with the highest number of submitted bids (166). Mead Johnson comes in second with 158 followed by Wyeth with a total of 79 and Carnation with 42. This inspires an interesting question as to why firms act this way in a purely oligopolistic market. This thesis seeks to examine factors influencing infant formula manufacturers’ decisions to bid in WIC rebate auctions and why firms aggressively contend for WIC contracts.

**Table 1. 1 Wholesale and Rebate Distribution of Firms in 2019**

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mead Johnson Rebate</td>
<td>2.60</td>
<td>158</td>
</tr>
<tr>
<td>Mead Johnson Wholesale Price</td>
<td>3.28</td>
<td>158</td>
</tr>
<tr>
<td>Ross Rebate</td>
<td>2.61</td>
<td>166</td>
</tr>
<tr>
<td>Ross Wholesale Price</td>
<td>3.27</td>
<td>166</td>
</tr>
<tr>
<td>Wyeth Rebate</td>
<td>1.82</td>
<td>79</td>
</tr>
<tr>
<td>Wyeth Wholesale Price</td>
<td>2.90</td>
<td>79</td>
</tr>
<tr>
<td>Carnation Rebate</td>
<td>2.46</td>
<td>42</td>
</tr>
<tr>
<td>Carnation Wholesale price</td>
<td>2.92</td>
<td>42</td>
</tr>
<tr>
<td>Birth</td>
<td>13.20</td>
<td>172</td>
</tr>
<tr>
<td>WIC Infants</td>
<td>5.59</td>
<td>172</td>
</tr>
</tbody>
</table>

Source:(Davis, 2009). All variables mean in dollars except Birth and WIC infants which are in thousands.

In Table 1.1, it is observed that the means for rebates and wholesale prices in constant 2007 dollars. Interestingly wholesale prices are almost the same for the largest firms, Ross and Mead Johnson as well as Carnation and Wyeth.
Economically important auctions are not isolated. Just as the "general equilibrium" tradition in economic theory has highlighted interrelations across markets in the economy, auctions take place in a larger context. Single, isolated auctions are easier to analyse. Rothkopf & Harstad (1994) suggested that models of isolated auctions may serve as useful building blocks, but the isolation can obscure important impacts. According to Rothkopf & Harstad (1994), behaviours in auctions normally tend to be changed by the context of those auctions. The authors further stipulate that outcomes of such competitive bidding are affected by various economic relationships mainly alien to the market (Rothkopf & Harstad, 1994).

Bidding decisions can be complex and time consuming process and involve the utilization of a company’s resources. They also generate expenses that can be damaging for other company business areas (Buzby, 2002; Cova, Salle, & Vincent, 2000). On the other hand, decisions to bid or not to bid or the overall engagement in the tender process can be based on subjective evaluation and decision making (Ahmad, 1990). To avoid situations where too many resources are used or where decision making is based only on a gut feeling, a pre-bid screening and analysis procedures can become a strategic tool (Cova et al., 2000). Garrett (2005) points out that an effective bidding decision making process is important to manufacturers for cost reduction and revenue generating reasons.

Most of the research done on bidding decisions and the factors influencing the decisions concern the construction industry and huge contracts (Bagies & Fortune, 2006; Stark & Rothkopf, 1979). Nonetheless, effective bidding cannot be over emphasised in every industry as bad bids do affects firms’ resources.
The preceding works have identified factors important in the bidding decisions, however with large projects there is the need for highly secured financial power and minimal risk (Bagies & Fortune, 2006). For a manufacturing company the factors can differ as the number of tenders gets higher, the tenders get smaller and as such the relationship with the customer can influence the long-term decision making.

Responding to all possible tender requests takes time and overloads the team working with tenders in several states. This may affect the quality of all bids and decrease the overall win rate of bids. The amount of effort put into the specification and estimation process can differ according to the customer request. The firm can choose to concentrate more efforts on larger in terms of volume, more profitable tenders (i.e. profit margin) and prepare a quick estimate with high margins for other tenders where later negotiations with the customer are expected (B. G. Kingsman, Hendry, L., Mercer, A., & de Souza, A., 1996). However, the main goal of a manufacturing firm would be to concentrate efforts on bids that would be successful in the end and bring in customer orders and generate profit. As a part of the bid/no bid decision making the company could evaluate tenders according to the critical factors and identify auctions that are more likely to be successful. Therefore, the second objective of this study is to identify which factors are likely to predict the success of a bid in WIC industry in the USA. Based on this, the research question of thesis is:

*What factors influence the entry decisions of a bid of an infant-formula manufacturer in the WIC rebate auctions in the USA?*
1.3 GENERAL OBJECTIVES.

The main objective of this study is to examine the factors influencing the bid decisions of infant formula manufacturers in WIC rebate auctions.

1.4 SPECIFIC OBJECTIVES

Specifically, the study attempted:

• to examine the factors influencing rebate bid decision-making by infant formula manufacturers.

• to identify the relationship between a firm’s share of WIC market and a bid decision.

1.5 STATEMENT OF HYPOTHESES

The main objective of the study is to examine factors responsible for firms’ decision to bid in rebate auctions. Considering reviewed literature and the theoretical underpinnings; the following were the hypotheses were tested;

\[ H_0: \] There is no relationship between firm market share and bid decisions.

\[ H_0: \] There is no relationship between State Alliance and bidding decisions.

1.6 SIGNIFICANCE OF STUDY

This study should inform policymakers and practitioners in WIC markets on how best to operate infant formula contract auctions. Given the characteristics of the population represented in this study, results from this study can be generalized to other low income countries’ populations, where applicable.
1.7 SCOPE OF THE STUDY

The purpose of this research is to identify factors influencing rebate decision making by infant formula manufacturers in the U.S. A logistic regression model was used to establish the empirical relationship between bid decisions and market share. Other control variables believed to influence bid decisions were considered to infer the importance of profit in a firm’s behaviour.

The source of data is secondary and cross-sectional time series (Panel Data) which was obtained from a compilation of losing and winning rebate bids from 1986 to 2016 for thirteen-ounce cans of milk-based liquid concentrate (Davis, 2016). The data already have baseline demographic information about the WIC participants from all 50 states and D.C.

1.8 ORGANIZATION OF THE STUDY

This study has been divided into five chapters. Chapter one considers an introduction of this research with background of the study, problem statement, objectives of study, significance of the study, and statement of hypotheses and scope of research. Chapter two reviews both the theoretical and empirical literature available for the study. The literature review examines related articles to provide information in relation to this study to look for a better approach to this research. Chapter three discusses the methodology, and issues relating to analysis of data for the study. Chapter four specifies the model, analysis and presentation of empirical results. Finally, chapter five deals with the conclusions, policy implications, limitations of the study and directions for further research.
CHAPTER TWO (2)

REVIEW OF LITERATURE

2.0 HISTORICAL PERSPECTIVE.

Three years prior to the establishment of WIC in 1972, the United States Department of Health, Education and Welfare and the United States Department of Agriculture received reports of various ailments among young women, breastfeeding mothers, their infants and particularly pregnant women across the country who visited the hospital due to malnutrition, and the lack of food. These findings were alarming. In 1969, a recommendation from the White House Conference on Food, Nutrition and Health prompted the government to take the nutritional needs of low-income pregnant and lactating mothers as well as their infants and children seriously (White House Conference on Food, Nutrition, and Health, 1970).

WIC established officially in 1972 by a congressional legislation (P. L. 92-433, was sponsored by the Senator Hubert Humphrey (D) of Minnesota) as a preliminary two-year pilot program. By the end of 1975, the program operated in 45 states expanding eligibility to include non-lactating women who were up to 6 months postpartum as well as children up to 5 years of age. It is currently the third largest federal food intervention initiative after Supplemental Nutrition Assistance Program (SNAP) or Food Stamps and The School Lunch program.

WIC foods are marketed through various retail outlets across the US where participants obtain food vouchers redeemable at state authorized retail stores.
The voucher system insulates them from the normal cost considerations, when buying nutritional supplementary items. According to Davis (2012), the Federal mandate demands quantities allowable which are written on food vouchers. The states reimburse all the retail stores for every food sold to WIC members based on their redeemable vouchers (Davis, 2012).

WIC only provides specific food types to low income mothers and their young who may be lacking this food nutrition from their diets. WIC provides foods including whole-grain bread, infant formula, fruits and vegetables. Every now and then the USDA revises the WIC food list. According to Centre of Budget and Policy Priorities (2007), over 47,000 grocery stores nationwide received approval to accept WIC food vouchers based on their prices and the variety of foods offered (Centre of Budget and Policy Priorities, 2017) (Carlson, Greenstien & Neuberger, 2017).

In their address in 2015, Carlson and Neuberger provided an overview of the efficiency of the WIC program stating that WIC was cost-effective, and its competitive bidding process for purchasing infant formula was essential to its efficiency. Currently, federal regulations are specific on what WIC State agencies needed to operate a cost-containment system for infant formula. They are required to make use a single-supplier competitive system unless an alternative system provides equal or greater savings (7 CFR 246.16a).
2.1 PRISONER’S DILEMMA PROBLEM

Betson (2007) argued that for infant formula suppliers, the rebate program has eroded an immense amount of profitability from the market. Before the sole source contract system was implemented, manufacturers enjoyed increasing revenues because infant formula prices kept increasing and input cost stayed the same. In its initial roll out, Betson (2007) identified that the government paid for consumer’s preferences of all WIC participants. The rebate initiative marked an end to this relationship as government demanded discounts for all their purchases (Betson, 2007).

The producers certainly were not happy with such an arrangement and fought the rebate system. Davis (2011) questioned what manufactures would do having been faced with in this sole source contract. Refusing to bid was their option which was not viable unless demand from WIC mothers was unmet. (Davis, 2011)

All firms could not enter into a binding cooperative agreement not to bid due to federal legislation so that the government is forced to abandon the program all together. In the absence this consensus, each manufacturer had a short-term incentive of greatly profiting from each bid they submitted. This was where Wyeth (an infant-formula manufacturing firm owned by American Home Products) got its big breakthrough.

Wyeth owned a very small market share and would jump at such an opportunity to expand. After Wyeth submitted bids and won contracts, it did not take long for the others to participate. This is a classic case of the prisoner’s dilemma problem in game theory. The prisoner’s dilemma is a situation where player can maximise their gains and optimize their strategy by observing strategies of other players or market participants. Betson
(2007) stresses that in the prisoner’s dilemma problem, while it is in the best interests of all firms not to bid, each manufacturer has a huge incentive to do so if they expect other firms to not bid.

2.2 TRENDS IN INFANT FORMULA REBATE CONTRACTS

As the largest buyer of infant formula in the United States, the federal government requires all WIC agencies to operate a system that reduce the cost of infant formula (Davis & Oliviera, 2015). According to Oliviera et al. (2013) and Davis and Oliviera (2015), usually State WIC agencies receive huge rebate discounts from the infant formula producers for every unit of formula bought through the initiative (Davis & Oliviera, 2015). WIC contracts are awarded to the lowest net price offering manufacturer. The net price is the difference between the wholesale price and the rebate offered. A study conducted by the Economic Research Service based on a 2008 data identified that net prices kept rising, raising concern that this trend could constrain the WIC program’s ability to serve all participants. The study based on a February 2013 data allayed similar concerns (Oliveira et al. 2013).

2.3 INFANT FORMULA PRICING

Prices of infant formula has generated contentions among various stakeholders over the years (Davis D., 2014). Davis (2014) mentions that beginning in the 1990s, industry stakeholders had identified a rise in WIC participation as well as the price of infant formula. According to the General Accounting Office (GAO, 1998), after the rebate introduction, some industry players conjectured that the source of the huge rebates offered by manufacturers were results of higher prices at which the formula is sold to non-WIC participants (GAO, 1998). Oliveira et. al. (2004) revealed that the speculations in the
1990’s led the US Senate Subcommittee on Antitrust, Monopolies, and Business Rights to launch an inquiry into the behaviour of formula producers at the time.

2.5 REBATE SYSTEM

The WIC rebate auction system has been very profitable to states’ WIC agencies, as the cost of procuring infant formula has declined (Davis D., 2014). Producers are forced to sell unlikely below or near their cost of production limiting their profit gains. As such, producers yearn to subsidize their losses with increased revenues accrued from non-WIC participants. Davis (2014) argues that because the WIC contract brands become favourites of both WIC participants and non-WIC participants, manufactures are motivated to submit bids for contract regardless of whether they make losses. Davis (2014) terms this as the “spill-over effect”. A GAO report in 1998, revealed that recommendations of WIC brands to WIC participants by doctors to WIC mothers and the preference received by WIC brands in terms of retail store locations and shelf space were the two potential sources for a spill-over effect.

Infant formula accounts for over 40 percent of the total cost of WIC food in the mid-1980s. As the cost kept rising, it became harder for state agencies to serve women, infants, and children on program. As such many participants were placed on waiting lists (Carlson, Greenstein, & Neuberger, 2017).

According to Carlson et. al. (2017), several state agencies adopted the competitive free market bidding approach to manage the cost by obtaining best deals on infant formula prices. Tennessee and Oregon were the pioneers of this initiative.

The biggest players in this industry, Mead Johnson and Ross Laboratories, resisted the idea of a competitive bidding process. They both refrained from submitting bids when
the first state auctions were opened. It took third and smaller producer, Wyeth, to submit and win bids in Tennessee to save the program. The Tennessee WIC agency ended up securing huge sums in savings. This success story drove other states to follow the competitive bidding process (Carlson, Greenstein, & Neuberger, 2017).

2.6 REBATES AND PRICE OF INFANT FORMULA

Since the employment of rebate scheme, Oliveira, et. al. (2004) argues that the infant formula prices has risen consistently. The scheme left a few customers who are price sensitive to pay for formula, and producers in return charged higher retail prices. Davis (2004) identified in a multiple regression analysis and concluded that the rising retail prices increased as a brand wins the WIC contract and that retail prices rose with the size of the WIC market (Davis, 2004).

In contrast with Oliveira et.al (2014), a study conducted by the Centre for Budget Priority (CBPP) analysis of the US Department of Agriculture administration data, found that rebate discounts may have caused a decline in the cost of the WIC menu after controlling for inflation (Carlson, Greenstein, & Neuberger, 2017). Between 1990 and 2014, the cost of food sold to WIC participants rose half as much as the total cost of food ie. 45 percent versus 82 percent as shown in figure 1.1 below.
Betson (2009) developed a model that captures the behaviour of firms with regards to wholesale prices, WIC initiative and rebate auction. With the WIC initiative, because WIC mothers become perfectly inelastic customers, firms cannot ignore their behaviour when setting wholesale prices (Davis, 2014).

Davis (2014) further noted that one would expect WIC’s implementation to result in wholesale prices rising in comparison to an alternative situation without the program, but the difference in wholesale prices in both cases is unknown.
2.7 DECISION-MAKING IN BIDDING-PROCESSES

A great volume of literature has focused on bidding strategies and bidding decision making since Friedman (1956) introduced his mathematical model (Friedman, 1956; Skitmore, 2002). This led to the emergence of the school of research that has focused on mark-up decisions, and maximizing the expected profit from a tender (Parvar, Lowe, Emsley, & Duff, 2000). Another research stream has concentrated on the bid decision making processes (Ahmad, 1990; Paranka, 1971) and on factors that affect the bid/no bid decisions (Dulaimi & Shan, 2002; Lowe & Parvar, 2004; Shash, 1998).

As bidding strategies or mark-up decision are not the focuses of this thesis, the following paragraphs concentrate first on some of the studies describing the decision making in bid processes. This is followed by a selection of studies in which the factors that influence bid and no bid decision-making were identified.

Paranka (1971) defines the bidding strategy as including a pre-bidding analysis stage and a bidding determination stage. According to Paranka (1971), it is crucial first to evaluate the pay-off value of a bid opportunity before placing an actual bid.

According to Betson (2007), bids by the “big two” Mead Johnson and Ross Labs were as high as 117 sole source contracts from 1981 through 2002. In analysing rebates-wholesale price relationship, Betson (2007) acknowledges the essential consequence of a theoretical model on which a manufactures’ rebate offers decisions are separated. If for some reason, according to Betson (2007), the manufacturer choses to increase their wholesale price by a dollar, rebate offers would rise by an equal dollar to keep net prices to the government same. Betson (2007) found wholesale prices statistically significant which confirmed his theoretical model’s result on the wholesale prices and rebates.
relationships based on the bids submitted by the “big two”- Ross and Mead Johnson during the same period.

Betson (2007) again identified that forms of rebates offered in early solicitations were different from following ones, and that the difference in rebate discounts submitted by Mead Johnson and by Ross did not differ greatly.

Smaller states which are unable to secure similarly sized rebates as larger states group themselves into alliances in hope that as the alliances grow bigger they may attract equal rebates as larger states. The elasticities of the rebates submitted by both Mead Johnson and Ross were inelastic in nature i.e. a ten-percentage increase in the size of the contract yielded less than a percentage increase in the size of the rebate offered (Betson 2007) statistically lending evidence to the claim of these small states. States that formed alliances obtained rebates that were statistically equivalent to stand alone states (Betson 2007), (Davis, 2011).

Upon further investigation of the rebates bid in subsequent solicitations, Betson (2009) found that whoever held the current contract was a crucial element in determining the rebates offered by either Mead Johnson or Ross. In cases where smaller firms with a small market share (Wyeth and Carnation) held the current contract, Mead Johnson and Ross Labs submitted bids for the contract with rebates 3.3 percent higher than what they would have bid if one of them held the contract. Again, a 2.7 percent rebate lower than what they would have bid is offered by the other dominant firm not holding the contract. This behaviour according to Betson (2007) can be interpreted as a firm bidding to maintain their contract or not caring much about a major competitor (Betson, 2007).
2.9 WINNING BIDDERS’ MARGIN OF VICTORY

Davis and Oliviera (2015) postulated that in several instances, a winning net price bid offer differed immensely from that of the closest competitor. In thirteen instances, the second lowest net price bid was twice as large as the winning bid. Davis and Oliviera (2015) referred to this net price gap as the “margin of victory”. Margins of victory according to Davis and Oliviera (2015) are essential as they are indicators of the auction outcome and eventually cost of the infant formula if the closest competitor had won.

Recently, the three major infant formula manufacturers have all submitted bids for every state or alliance WIC infant formula contracts. This means manufacturers valued many contracts differently and this is measured by the various net prices offered (Davis and Oliviera 2015).
CHAPTER THREE (3)

METHODOLOGY

3.0 INTRODUCTION

This chapter presents the model for the study. It mainly consists of the methods of study, the specification of the model, the estimation procedure and describes the process of the data analysis.

3.1 RESEARCH METHOD

There are several alternative methods for social science research. Numerous studies have employed panel data techniques, cross sectional and time-series methods examining bid/no bid decisions. However, the decision to apply any of the possible alternative methods for research depends on data, more variability and usefulness of research, and the objective of the approach in studying the effects of predictor variables on bid decisions.

This research employs cross-sectional time-series data on WIC from 1986 to 2016. To achieve the objectives of the study, the logistic regression econometric method is adopted for the data estimation and analysis using Stata software package.

The data used in this research was secondary data drawn from 1986 to 2016. The data (Davis, 2016) include baseline information about the participants so there is no need to create a survey instrument.
3.2 SAMPLE DESIGN

The database was described by Davis (2016) and the data were obtained from different sources. A word of caution should be issued here as the data were gathered from different historical sources. Efforts were made by Davis (2016) to ensure its accuracy, however due to the minimalist information provided inaccuracies may still exist.

The database was organized in a flat file format, and each row observation represented a US state, District of Columbia, Puerto Rico and some Indian Tribal Organizations, and other territories were not included.

Davis (2016) acknowledges that at the time of his writing, the database captured almost all thirteen-ounce milk-based liquid concentrate winning and losing rebate bids from 1987 to 2016. Both soy-based and mild-based liquid concentrate bids were used as they were available.

Many state WIC agencies form some type of alliances to jointly contract with infant-formula manufacturers, which is included in the data as an indicator variable for whether a state stood alone or was a member of an alliance (Davis 2016).

3.3 SOURCE OF DATA

The study used existing sources as its basis. It is also made use of secondary data from which analysis was conducted to achieve the objective of the study. This is because the verification process is more rapid and the reliability of information and conclusion is greatly enhanced. The data contain several variables which were obtained from different sources. To appropriately consider all factors that through extensive research performed and the literature are believed to affect the bidding decisions by infant formula
manufacturers in rebate auctions, the following was done. In the initial selection of variables, factors that clearly demonstrated risk and decision to enter auctions were identified.

Other sources will include the USDA’s Food and Nutrition Services (FNS). The choice of this period was informed by the availability of data for the variables of interest.

The secondary data “was readily available and hence convenient to use” (Ghauri et al, 2002). Also, it provided enough information to test the hypothesis of this study.

3.4 ESTIMATION PROCESS

The maximum likelihood estimation (MLE) was used to build the logit model to test the listed hypothesis. This enabled me to identify those variables which significantly impact bidding decisions. Stata software was used for data analysis.

3.5 THE MODEL

A logistic regression model below was used. Profit is one key motivation to bid in a WIC rebate auction. The response variable is Bid which takes on binary values of zero and one. A zero for no bid in WIC rebate auctions and one for the decision to place a bid in WIC rebate auctions.

Logistic regression models are relatively simple but extremely powerful. Like linear regression models, the goal is to predict a dependent or target variable using various independent variables. The graph below compares how linear and logistic regression fit a binary target variable.
A Graph Comparing Logistic Vs. Linear Fit

Source: (Thomas, Edelman, & Crook, 2002)

Figure 3. 1 Comparison of Logistic and Linear Estimation

Logistic regression accounts for the horizontal asymptotes in the binary distribution. Since the probability of an event is bounded by zero and one, logistic regression is more appropriate because it transforms the expected value of the dependent variable into a distribution with the correct range using the log-odds or logit function (Thomas, Edelman, & Crook, 2002). The logit function is simply the natural log of the odds, where the odds are the probability of an event divided by the complement of that probability.
3.5.1 BINARY LOGISTIC REGRESSION MODEL

Let \( Y_i \) represent response variable, \( x_i \) represent covariates, we get:

\[
P(Y_i = 1) = \pi_i = \frac{\exp(\beta_0 + \beta_1 x_i)}{1 + \exp(\beta_0 + \beta_1 x_i)}
\]

(1)

The \( \beta \)'s in (1) represent parameters of the linearized generalized linear form \( \beta_0 \) representing the estimate on the average of the response variable if all other predictor variables are constant. \( \beta_1 \) is the estimate of the response as a result of a unit change in a covariate holding all other variables constant.

3.5.2 MULTIPLE LOGISTIC REGRESSION MODEL

We can extend the simple logistic regression model easily to more than one predictor variable.

Let us define,

\[
\beta = \begin{bmatrix} \beta_0 \\ \beta_1 \\ \vdots \\ \beta_{p-1} \end{bmatrix}_{p \times 1}
\]

\[
X = \begin{bmatrix} 1 \\ X_1 \\ \vdots \\ X_{p-1} \end{bmatrix}_{p \times 1}
\]

\[
X_i = \begin{bmatrix} 1 \\ x_{i1} \\ \vdots \\ x_{i,p-1} \end{bmatrix}_{p \times 1}
\]

we get,

\[
X'\beta = \beta_0 + \beta_1 X_1 + \cdots + \beta_{p-1} X_{p-1}
\]

(2)

\[
X_i'\beta = \beta_0 + \beta_1 x_{i1} + \cdots + \beta_{p-1} x_{i,p-1}
\]

(3)

So

\[
E(Y_i) = \pi_i = \frac{\exp(X_i'\beta)}{1 + \exp(X_i'\beta)}
\]

(4)
3.5.3 MAXIMUM LIKELIHOOD

Recall that the joint probability function for binary logistic regression is:

\[ g(Y_1, ..., Y_n) = \prod_{i=1}^{n} f_i(Y_i) = \prod_{i=1}^{n} \pi_i^{Y_i} (1 - \pi_i)^{1-Y_i} \] (5)

\[ \log_e g(Y_1, ..., Y_n) = \log_e \prod_{i=1}^{n} f_i(Y_i) = \log_e \prod_{i=1}^{n} \pi_i^{Y_i} (1 - \pi_i)^{1-Y_i} \] (5b)

\[ = \sum_{i=1}^{n} [Y_i \log_e \pi_i + (1 - Y_i) \log_e (1 - \pi_i)] \] (5c)

\[ = \sum_{i=1}^{n} [Y_i \log_e \left(\frac{\pi_i}{1 - \pi_i}\right)] + \sum_{i=1}^{n} \log_e (1 - \pi_i) \] (5d)

Since

\[ 1 - \pi_i = \frac{1}{1 + \exp(\beta_0 + \beta_1 x_i)} \] (6)

and

\[ \log_e \left(\frac{\pi_i}{1 - \pi_i}\right) = \beta_0 + \beta_1 x_i \] (6b)

Therefore,

\[ \log_e L(\beta_0, \beta_1) = \sum_{i=1}^{n} Y_i (\beta_0 + \beta_1 x_i) - \sum_{i=1}^{n} \log_e [1 + \exp(\beta_0 + \beta_1 x_i)] \] (7)

We are trying to find \( \beta_0 \) and \( \beta_1 \) to maximize the log-likelihood function:

\[ \ln = \log_e L(\beta_0, \beta_1) = \sum_{i=1}^{n} Y_i (\beta_0 + \beta_1 x_i) - \sum_{i=1}^{n} \log_e [1 + \exp(\beta_0 + \beta_1 x_i)] \] (8)
Define:

\[
\bar{y}_U = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_N \end{bmatrix}, \quad X_U = \begin{bmatrix} X_1^T \\ X_2^T \\ \vdots \\ X_N^T \end{bmatrix}
\]

The model is

\[ Y = X^T \beta \] (9)

The estimator of \( \beta \) is

\[
\hat{\beta} = (X_U^T \sum_{i=1}^{N} X_U)^{-1} X_U^T \sum_{i=1}^{N} y_U
\]

(9b), where \( \sum_u \) is a diagonal matrix with \( i \)th diagonal element \( \sigma^2_i \).

To estimate the parameters (9b) for linear regression, least squares (9) approximation is used, and the explicit solutions for the estimates can be calculated. In logistic regression using least squares approximation usually does not result in an explicit solution for the estimates. Therefore, maximum likelihood estimation is used. Maximum likelihood estimation maximizes the likelihood function. Based on the data, the likelihood function calculates the probability that the parameters are correct. Thus, when the likelihood function is maximized, the probability that the parameters chosen are correct based on the modeling data is maximized (Faraway, 2006). Since the dependent variable is binary, it is a Bernoulli random variable. The probability is evaluated by substituting the observed values of the independent variables into the equation.
3.6 TECHNIQUES FOR EVALUATION OF RESULTS

The estimation technique used for this research is a multivariate maximum likelihood estimation technique; specifically, the study employs a logit model. This nature of econometric analysis is used to determine the probability that an individual or entity with certain characteristics belongs or does not belong to a phenomenon under study. Logit models are binary classification models where the dependent variable is dichotomous and takes the value 0 or 1. In this analysis, I specify the dependent variables as 1 if firm bids in an auction (and zero otherwise). I therefore specify the logit models for bidding decisions as follows (8), (9) and (10).

Let

\[ \pi^{No\ Bid} = \text{No bid profit} \]  
(10)

\[ \pi^{Bid} = \text{bid profit} \]  
(10b)

Bid if \( \pi^{Bid} > \pi^{No\ Bid} \)  
(10c)

The firm bids in (10) if profit made is greater than a no bidding counterpart. The reverse occurs in (10b) below, where the firm has no incentive to bid should profit gained by doing so falls below a no bid counterpart.

No Bid if \( \pi^{Bid} < \pi^{No\ Bid} \)  
(11)

\[ \pi^{Bid} - \pi^{No\ Bid} \geq 0 \rightarrow \text{Bid} = 1 \]  
(11b)

The response variable Bid will take on the value 1 if the difference between bid profit and no bid profit is greater than zero (10c). If the difference is less than zero, the firm is less likely to submit a bid in the WIC rebate contract.

\[ \pi^{Bid} - \pi^{No\ Bid} < 0 \rightarrow \text{Bid} = 0 \]  
(12)

Specifying the logistic regression model from (10c) and (11) produces (12)

\[ \pi^{Bid} - \pi^{No\ Bid} = f(X'\beta) \]  
(12a)
Bid = Entry = f(X′β)

(13)

f(X′β) is defined to be the logistic function, then

\[ Pr(y = 1|X_i) = \frac{e^{X_i(\beta_1 - \beta_2)}}{1 + e^{X_i(\beta_1 - \beta_2)}} \]

(14)

\[
y = \begin{cases} 
1 & \text{if } \pi^{Bid} - \pi^{No\ Bid} \geq 0 \rightarrow Bid \\
0 & \text{if } \pi^{Bid} - \pi^{No\ Bid} < 0 \rightarrow No\ Bid
\end{cases}
\]

(15)

Since the predictions can be either > 1 or < 0 i.e. binary choice (15). I assessed the model’s prediction power with Receiver Operating Characteristic (ROC) curve and tested for Misspecification using the RESET Test. The estimated model takes the form;

\[ Prob(\ Bid = 1) = f(\alpha, MarketShare, MarketShareSq, StateAlliance, PreviousHolder, Firm) \]

The definitions of the variables in the model are shown below, which also offers several comments about their specification.

3.7 VARIABLE DESCRIPTION

Bid: The response variable is a dummy variable for whether a firm bid or not. Since Bid decisions may be influenced by several factors, it is important to control for as many of these confounding factors as possible when analysing the bidding decisions by the firm. Therefore, the model included several independent variables to represent economic and WIC program factors thought to influence the bid decision of infant formula producers. These independent variables included market share, market share squared, State Alliance, Previous holder.
Share: All four firms have individual share of the WIC market. The variable Share was calculated by dividing each firm’s annual infants by annual WIC infants and multiplying by 100.

share2: share * share.

State Alliance: Variable indicates whether a state is part of a multistate alliance or not. 1 = Yes and 0 = No

Previous Provider or Holder: This variable note whether a bidder held the state’s contract the previous time it was up for bid.

Firm: Carnation (1), Mead Johnson (1), Ross (2), Wyeth (4) Firm dummy variable

3.8 MODEL SPECIFICATION

\[
\log \left( \frac{P_i}{1-P_i} \right) = \alpha + \beta_1 \text{MARKET\_SHARE} + \beta_2 \text{STATE\_ALLIANCE} + \beta_4 \text{PREVIOUS\_PROVIDER} + \beta_5 \text{MARKET\_SHARE}^2 + \beta_6 \text{CARNATION} + \beta_7 \text{MEADJOHNSON} + \beta_8 \text{ROSS} + \epsilon
\]

Where, \(\alpha\) is a constant term, \(\beta_n\) are the coefficients to be determined, and \(\epsilon\) is the error term.
CHAPTER FOUR (4)

RESULTS AND ANALYSIS

4.0 INTRODUCTION

This chapter presents and evaluates the empirical estimation of the model. The chapter also presents the results of hypotheses tests to know what influences infant formula manufactures’ bid decisions in the WIC Market.

4.1 STATE-ALLIANCE

The essence of research depends largely on state – alliance features of the population. An essential understanding of the different alliance features of the states involved cannot be over-looked. Alliance refers to state agencies and offices that have joined together for a mutual benefit of purposely putting up auctions for competitive WIC bids.

Alliance by States

![Map of Alliance by States](image_url)

**Figure 4.1 STATE-ALLIANCE SIZE DISTRIBUTION OF THE POPULATION**

Source: Computed from Data (2008) using Tableau
From the figure 4.1 above is a figure I created to understand WIC-Multi-State Alliance memberships, it is observed that alliances change from year to year with others repeating or switching alliances all together. The numbers on the map represent state alliances over the years from 1987 to 2016. The colours represent the different alliances. These alliances do not depend on the state size or geographic location. From the map, Texas and Minnesota regardless of their land size are a part of the same alliance.

Table 4.0.1: Alliances Name and Their States Membership Over the Years

<table>
<thead>
<tr>
<th>Alliance Name</th>
<th>Year</th>
<th>States</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC_DE_MD</td>
<td>1989</td>
<td>Maryland, DC and Delaware</td>
</tr>
<tr>
<td>AR_NM</td>
<td>1991</td>
<td>Arkansas and New Mexico</td>
</tr>
<tr>
<td>NEW_ENG &amp; Northwest</td>
<td>1991</td>
<td>Maine, Connecticut, Massachusetts, New Hampshire</td>
</tr>
<tr>
<td>TX_IA_MN</td>
<td>1992</td>
<td>Texas, Iowa and Minnesota</td>
</tr>
<tr>
<td>IN_MI</td>
<td>1992</td>
<td>Indiana and Michigan</td>
</tr>
<tr>
<td>DC_DE_MD_VI_WV</td>
<td>1993</td>
<td>District of Columbia, Delaware, and Maryland,</td>
</tr>
<tr>
<td>Region</td>
<td>Year</td>
<td>States</td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>NE_SD</td>
<td>1993</td>
<td>Nebraska and South Dakota</td>
</tr>
<tr>
<td>TX_IA_MN1</td>
<td>1993</td>
<td>Texas, Iowa and Minnesota</td>
</tr>
<tr>
<td>AR_NM_NC</td>
<td>1994</td>
<td>Arkansas, New Mexico and North Carolina</td>
</tr>
<tr>
<td>NEATO_1</td>
<td>1994</td>
<td>Connecticut, Maine, Massachusetts and New Hampshire</td>
</tr>
<tr>
<td>TX_IA_MN1</td>
<td>1995</td>
<td>Texas, Iowa and Minnesota</td>
</tr>
<tr>
<td>NEATO_1</td>
<td>1996</td>
<td>Connecticut, Maine, Massachusetts and New Hampshire</td>
</tr>
<tr>
<td>NE_SD</td>
<td>1996</td>
<td>Nebraska and South Dakota</td>
</tr>
<tr>
<td>IN_MI</td>
<td>1996</td>
<td>Indiana and Michigan</td>
</tr>
<tr>
<td>Region Code</td>
<td>Year</td>
<td>Description</td>
</tr>
<tr>
<td>--------------</td>
<td>------</td>
<td>------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>AR_NM_NC</td>
<td>1997</td>
<td>Arkansas, New Mexico and North Carolina</td>
</tr>
<tr>
<td>Mid-Atlantic</td>
<td>1997</td>
<td>Maryland, Delaware, DC</td>
</tr>
<tr>
<td>TX_IA_MN2</td>
<td>1998</td>
<td>Texas, Iowa and Minnesota</td>
</tr>
<tr>
<td>NE_SD_CHRV</td>
<td>1999</td>
<td>Nebraska, South Dakota and Cheyenne River Indian Reservation</td>
</tr>
<tr>
<td>SW_Region(South West Region)</td>
<td>1999</td>
<td>Oklahoma</td>
</tr>
<tr>
<td>Mid Atlantic</td>
<td>1999</td>
<td>Maryland, Delaware, DC</td>
</tr>
<tr>
<td>NEATO_1</td>
<td>1999</td>
<td>Connecticut, Maine, Massachusetts and New Hampshire</td>
</tr>
<tr>
<td>AR_NM_NC</td>
<td>2000</td>
<td>Arkansas, New Mexico and North Carolina</td>
</tr>
<tr>
<td>NEATO_1</td>
<td>2001</td>
<td>Connecticut, Maine, Massachusetts and New Hampshire</td>
</tr>
<tr>
<td>The Western States Contracting Alliance. (WSCA3)</td>
<td>2001</td>
<td>Alaska, Arizona, Delaware, Hawaii, Idaho, Kansas, Maryland, Montana, Nevada, Oregon, Utah, Washington, DC and Wyoming</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>NE_SD_CHRV</td>
<td>2002</td>
<td>Nebraska, South Dakota and Cheyenne River Indian Reservation</td>
</tr>
<tr>
<td>TX_IA_MN2</td>
<td>2002</td>
<td>Texas, Iowa and Minnesota</td>
</tr>
<tr>
<td>NE_SD_MO</td>
<td>2003</td>
<td>Nebraska, South Dakota and Missouri</td>
</tr>
<tr>
<td>AR_NM_NC</td>
<td>2003</td>
<td>Arkansas, New Mexico and North Carolina</td>
</tr>
<tr>
<td>SW_Region(South West Region)</td>
<td>2003</td>
<td>Oklahoma</td>
</tr>
<tr>
<td>NEATO_1</td>
<td>2004</td>
<td>Connecticut, Maine, Massachusetts and New Hampshire</td>
</tr>
<tr>
<td>WSCA3</td>
<td>2004</td>
<td>Alaska, Arizona, Delaware, Hawaii, Idaho, Kansas, Maryland, Montana, Nevada, Oregon, Utah, Washington, DC and Wyoming</td>
</tr>
<tr>
<td>Region</td>
<td>Year</td>
<td>States/Regions</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>SW_Region(South West Region)</td>
<td>2005</td>
<td>Oklahoma</td>
</tr>
<tr>
<td>TX_IA_MN2</td>
<td>2005</td>
<td>Texas, Iowa and Minnesota</td>
</tr>
<tr>
<td>AR_NM_NC</td>
<td>2006</td>
<td>Arkansas, New Mexico and North Carolina</td>
</tr>
<tr>
<td>NEATO_1</td>
<td>2006</td>
<td>Connecticut, Maine, Massachusetts and New Hampshire</td>
</tr>
<tr>
<td>TX_IA_MN2</td>
<td>2007</td>
<td>Texas, Iowa and Minnesota</td>
</tr>
<tr>
<td>SW_Region</td>
<td>2008</td>
<td>Oklahoma</td>
</tr>
<tr>
<td>AR_NM_NC</td>
<td>2009</td>
<td>Arkansas, New Mexico and North Carolina</td>
</tr>
<tr>
<td>NE_SD_MO</td>
<td>2009</td>
<td>Nebraska, South Dakota and Missouri</td>
</tr>
</tbody>
</table>
NEATO_2 2011 Connecticut, Maine, Massachusetts and New Hampshire

Source: Computed from Data (2016) using Tableau.

4.2 FIRMS

From Table 4.1, it is observed that 32 percent of total sample size in the data are Mead Johnson and Ross respectively, and 24 percent of sample size is Carnation and Wyeth with 13 percent. The observations in the table represent the total number of bids the firms considered- both ones they submitted bids and ones they didn’t; a combination of bid and no bid auctions for each firm from 1987 to 2016.

Table 4.1 Summary Statistics of Firm Bids

<table>
<thead>
<tr>
<th>Firm</th>
<th>Counts</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnation</td>
<td>283</td>
<td>24.00</td>
</tr>
<tr>
<td>Mead Johnson</td>
<td>372</td>
<td>31.55</td>
</tr>
<tr>
<td>Ross</td>
<td>372</td>
<td>31.55</td>
</tr>
<tr>
<td>Wyeth</td>
<td>152</td>
<td>12.89</td>
</tr>
<tr>
<td>Total</td>
<td>1179</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Computed from Data (2016) STATA
4. 3 FIRMS AND THEIR AUCTION COUNTS

From Table 4.2, it is observed that, Mead Johnson has a total of 144 wins i.e. 46% of auctions. Ross follows in second place with a total of 35% auction wins. Carnation has won 15% of total auction and Wyeth with a total of 5% auction wins.

Table 4.2 Summary of Auction Winning Firms

<table>
<thead>
<tr>
<th>Firm</th>
<th>Frequency</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnation</td>
<td>46</td>
<td>14.56</td>
</tr>
<tr>
<td>Mead Johnson</td>
<td>144</td>
<td>45.57</td>
</tr>
<tr>
<td>Ross</td>
<td>109</td>
<td>34.49</td>
</tr>
<tr>
<td>Wyeth</td>
<td>17</td>
<td>5.38</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>316</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Computed from Data (2016) STATA

4. 4 FIRM WIC CONTRACT WINS AND THEIR SHARE OF INFANTS

The Figure 4.3 shows contract winning firm and their share of all WIC infants on the average. The figure shows that Carnation has an average of 40% of all WIC infants. Mead John has the highest of 48% of all WIC infants, Ross follows with 40.3%. Wyeth has the least WIC alliance share of infants of 18%. This can be seen in the figure 4.3.
Figure 4.3: Firms and Average Share of WIC Market Over The Years. 
Source: Computed from Data (2016) STATA

4.5 FIRMS AVERAGE WIC INFANTS UNDER CONTRACTS

In Figure 4.3 below it is observed that a total of 34,717 infants average were under contract to Carnation and 40,321 total infants were under contract to Ross and Mead Johnson had a total of 46,455 under contracts as shown below in Figure 4.3

Table 4. 3 Cross Tabulation of Firms and WIC Infants

<table>
<thead>
<tr>
<th>Firm</th>
<th>Mean</th>
<th>Standard Deviation.</th>
<th>Freq.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnation</td>
<td>34716.691</td>
<td>28941.456</td>
<td>24</td>
</tr>
<tr>
<td>Mead Johnson</td>
<td>46455.338</td>
<td>65453.943</td>
<td>84</td>
</tr>
<tr>
<td>Ross</td>
<td>40321.373</td>
<td>45898.553</td>
<td>71</td>
</tr>
<tr>
<td>Wyeth</td>
<td>25996.923</td>
<td>14194.142</td>
<td>13</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>41334.513</td>
<td>52732.906</td>
<td>192</td>
</tr>
</tbody>
</table>

Source: Computed from Data (2016) STATA
Figure 4. 4 Firms WIC Infants Over the Years

Source: Computed from Data (2016) STATA

4. 5 BIDS WON BY FIRMS VERSUS NON-WINNING BIDS

Table 4. 4 Cross Tabulation of Bid Firms Won Against Non-Winning Bids

<table>
<thead>
<tr>
<th>Firm</th>
<th>Bid 0</th>
<th>Bid 1</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carnation</td>
<td>149</td>
<td>134</td>
<td>283</td>
</tr>
<tr>
<td>Mead Johnson</td>
<td>26</td>
<td>346</td>
<td>372</td>
</tr>
<tr>
<td>Ross</td>
<td>20</td>
<td>352</td>
<td>372</td>
</tr>
<tr>
<td>Wyeth</td>
<td>49</td>
<td>103</td>
<td>152</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>244</td>
<td>935</td>
<td>1179</td>
</tr>
</tbody>
</table>

Source: Computed from Data (2016) STATA
From Table 4.4 above, it is observed that Carnation had a total of 283 auctions from 1987 to 2006 in which to bid, with 149 no bids and 134 bids. Mead Johnson bids in 346 out of 372 total auctions. Ross bids 352 out of 372 auctions. Wyeth bids 103 out of 152 total auctions. This is clearly observed in the chart below. Wyeth, Ross and Carnation all have 85% probability of bidding and winning. Mead Johnson has about 90% probability of bidding.

**Figure 4.5 Bid Distribution For Each Firms.**
*Source: Computed from Data (2016) using Stata*
4.6 STATE ALLIANCES AND THEIR BIDS BY COUNTS

Table 4.5 Cross Tabulation of State Alliances and Number of Bids Received By States.

<table>
<thead>
<tr>
<th>Bid</th>
<th>State Alliance</th>
<th>0</th>
<th>1</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>173</td>
<td>618</td>
<td></td>
<td>791</td>
</tr>
<tr>
<td>1</td>
<td>71</td>
<td>317</td>
<td></td>
<td>388</td>
</tr>
<tr>
<td>Total</td>
<td>244</td>
<td>935</td>
<td></td>
<td>1,179</td>
</tr>
</tbody>
</table>

Source: Computed from Data (2016) using STATA

From Table 4.5, it is observed that States who are not in any alliances receive 618 out of 935 bids compared to states in alliances. It is also observed that Non-Alliance states receive more bids than alliance states.

4.7 FIRMS AND THEIR BIDDING TREND OVER TIME

Figure 4.6 Trend of Firms Annual bid distribution over Time
Source: Computed from Data (2016) using Tableau
The figure 4.6 above shows the number of bids annually by each of the firms. In 2012, it is observed that, Carnation, Mead Johnson, and Ross all places a total of 25 bids in various states. Mead Johnson and Ross may have increased their bid submissions to respond to the market competition from Carnation. This indicates that the number of auctions varies from year to year.

4. 8 .1 FIRMS AND THEIR AVERAGE SHARE DISTRIBUTION

![Firms and WIC Share Distribution](image)

**Figure 4.7 Firm and Their Average Annual WIC Share distribution over Time**

**Source:** Computed from Data (2016) using Tableau
The figure 4.7 shows the average share of each firm over the years. Mead Johnson has the largest share in 2015 with an average share 42.5 percent followed by Carnation with an average of 37 percent and Ross with 20.6% of market share.

### 4. 8. 2 STATES AND THEIR BID COUNTS

Figure 4.8 States and their Bid counts distribution over the years.

Source: Computed from Data (2016) using Tableau

The chart above in figure 4.8 shows the states and the number of bids they record over the years under consideration. The highest recorded is New Mexico with 34 bids. Delaware, DC and Illinois received the lowest of 15 bids each.
Table 4. 6 A summary Table (for all variables in the model)

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>mean</td>
<td>Standard Deviation</td>
<td>minimum</td>
<td>maximum</td>
</tr>
<tr>
<td>Bid</td>
<td>372</td>
<td>0.9301</td>
<td>0.2553</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Share</td>
<td>372</td>
<td>38.9565</td>
<td>18.8209</td>
<td>0</td>
<td>78.2282</td>
</tr>
<tr>
<td>Share Squared</td>
<td>372</td>
<td>1870.886</td>
<td>1501.657</td>
<td>0</td>
<td>6119.66</td>
</tr>
<tr>
<td>State Alliance</td>
<td>372</td>
<td>.3252</td>
<td>.4691</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Source: Computed from Data (2016) using STATA

The summary statistics above in Table 4.6 shows that, there are a maximum of 317,808, a minimum of 17,860 and a mean of 37,283 total WIC infants’ participants from 1972 to 2016. There is a maximum of 78% and a mean of 38% market share among all four firms.

4. 9. REGRESSION ANALYSIS OF FACTORS INFLUENCING INFANT FORMULA MANUFACTURERS BID OR NO BID DECISIONS.

The focus of this study is to find the relationship between factors that affected bidding decisions of infant formula manufactures in WIC rebate auctions. In this section, the study presents the main findings from the logistic regression analysis and the logit model. Bidding decisions are hypothesized to be dependent on Market share, state alliance membership and Previous Contract holder. The results of the estimations conducted in this study are presented in Table 4.7 below.
At a one percent significant level, the result shows that a state in some alliances increases the probability of bidding. The odds of receiving a bid for an alliance state is 80% more likely than a non-alliance state.

At one percent significance level, the result showed that for a unit increase in Market Shares we expect to see about 11% increase in the odds of submitting a bid holding all other variables constant. This implies that the greater the WIC market share, the higher the chances of bidding. The odds ratio measures the relationship between events and their occurrences. The odds represent the chances of an event outcome in the face of a circumstance or exposure in comparison to the same occurring outcome in the absence of the circumstance. In this study, the odds ratio captures a firm’s decision to bid in auction given other variables. My decision to make use of the odds ratio instead of the logit coefficient stems from the fact that, the logit coefficient will need to be exponentially transformed to mean anything. The odds ratio makes interpretation easier. The variables share and share2 were used as proxy for manufacturing capacity. As observed, an increase in the Share2 decreases the odds of bidding by 9%. The intuition behind this decrease is that, firms will only bid as much as their productive capacity could take beyond which their production and gains begins to decline as such the probability of bidding will decline.

At one percent, significant level the result shows that Previous Contract holder has no significant effect on bidding decisions. This could because a previous holder of the contract does not affect the prices of infant formula in an auction year.
The results for the firms had a positive relationship with bidding decision with regards to the base firm Wyeth. Holding all other factors constant, Mead Johnson has higher odds of bidding by 2.9 times more than Wyeth. Ross odds of submitting a bid is 2.1 times more than Wyeth and Carnation’s odds of bidding is 0.3 times more likely than Wyeth. These are also shown in table 4.7.

Table 4.7. LOGISTIC REGRESSION OUTPUT OF ALL VARIABLES.

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Logit coefficients</td>
<td>Odds ratio</td>
</tr>
<tr>
<td>Bid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Alliance</td>
<td>0.589**</td>
<td>1.802**</td>
</tr>
<tr>
<td></td>
<td>(0.268)</td>
<td>(0.482)</td>
</tr>
<tr>
<td>Share</td>
<td>0.0967***</td>
<td>1.101***</td>
</tr>
<tr>
<td></td>
<td>(0.0214)</td>
<td>(0.0236)</td>
</tr>
<tr>
<td>share2</td>
<td>-0.000837**</td>
<td>0.999**</td>
</tr>
<tr>
<td></td>
<td>(0.000379)</td>
<td>(0.000379)</td>
</tr>
<tr>
<td>Previous Holder</td>
<td>0.104</td>
<td>1.110</td>
</tr>
<tr>
<td></td>
<td>(0.0758)</td>
<td>(0.0841)</td>
</tr>
<tr>
<td>1.Carnation</td>
<td>-1.165***</td>
<td>0.312***</td>
</tr>
<tr>
<td></td>
<td>(0.277)</td>
<td>(0.0864)</td>
</tr>
<tr>
<td>2.Mead Johnson</td>
<td>0.720**</td>
<td>2.054**</td>
</tr>
<tr>
<td></td>
<td>(0.356)</td>
<td>(0.732)</td>
</tr>
<tr>
<td>3.Ross</td>
<td>1.046***</td>
<td>2.846***</td>
</tr>
<tr>
<td></td>
<td>(0.371)</td>
<td>(1.055)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.686*</td>
<td>0.503*</td>
</tr>
<tr>
<td></td>
<td>(0.406)</td>
<td>(0.204)</td>
</tr>
<tr>
<td>Observations</td>
<td>756</td>
<td>756</td>
</tr>
</tbody>
</table>

Standard errors in parentheses

NOTE: All standard Errors are robust
*** p<0.01, ** p<0.05, * p<0.1

Source: Computed from Data (2016) using STATA
\[
\log \left( \frac{P_i}{1-P_i} \right) = \alpha + 1.10 (\text{MARKET\_SHARE}) + 1.802*(\text{STATE\_ALLIANCE}) + 1.110^*(\text{PREVIOUS\_PROVIDER}) + 0.999*(\text{MARKET\_SHARE}_2) + 0.31*\text{CARNATION} + 2.1*\text{MEADJOHNSON} + 2.8*\text{ROSS} (1)
\]

Table 4.8 Marginal Effects of Explanatory Variables On Bid

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Marginal Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Alliance</td>
<td>0.0682* (0.22)</td>
</tr>
<tr>
<td>Share</td>
<td>0.0112*** (4.83)</td>
</tr>
<tr>
<td>Share2</td>
<td>-0.000968*** (-2.26)</td>
</tr>
<tr>
<td>Previous Holder</td>
<td>0.0121 (1.38)</td>
</tr>
<tr>
<td>Carnation</td>
<td>-0.204*** (-4.28)</td>
</tr>
<tr>
<td>Mead Johnson</td>
<td>0.0856* (2.02)</td>
</tr>
<tr>
<td>Ross</td>
<td>0.114** (2.02)</td>
</tr>
<tr>
<td>Wyeth</td>
<td>0 (.)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Observations</th>
<th>756</th>
</tr>
</thead>
</table>

t statistics in parentheses
*** p<0.05, ** p<0.01, * p<0.5

Source: Computed from Data (2016) using STATA

4.9.1 PROBABILITIES OF FIRMS SUBMITTING BIDS.

The marginal effects above show that the change in probability for each relative bid relative to the base firm-Wyeth, Carnation is 20% more likely to bid than Wyeth, all other factors held constant. Ross is 11% more likely to bid than Wyeth, all other factors held constant. Mead Johnson is 8% more likely to bid, that Wyeth, all other factors held constant.
4. 9. 2 HYPOTHESES TESTING OF THE COEFFICIENTS OF BID

\( H_0 \): There is no relationship between firm’s market share and bid decision.

From the test conducted in the logit model, we reject the null hypothesis at a one per cent significance level. Thus, the coefficient of market share is statistically different from zero in the model. Hence, we conclude that market share has a significant influence on the bid decisions in WIC rebate auctions.

PREDICTED PROBABILITY OF BID

Figure 5.0 WIC Share and The Probability of Firms Submitting Bids

Source: Computed from Data (2016) using STATA

Figure 5.0 The Figure 5.0 above shows that the probability of bidding at various market shares. The probability of bidding peaks at about 60% market share. Beyond 60%, the probability of bidding decreases. The decline in bid probability might be attributed to
productive capacity being reached. As such, the firms are unable to meet the demand associated with extra bids and thus are less likely to bid.

\[ H_0: \text{There is no relationship between state alliances and bid decisions.} \]

From the test conducted in the logit model, we reject the null hypothesis at a one per cent significance level. Thus, the coefficient of State alliance is statistically different from zero in the model. Hence, we conclude that State Alliance statistically has a significant influence on bid decisions in WIC rebate auctions. Being in a State alliance increases bids submitted by 60% more than if they are unaligned, holding all other factors constant and as such, bids increases with the alliances size. Dana (2012) identified it is not the size of buyers but the differences in buyers’ characteristics that influences the bargaining power of alliances.

**4. 9. 3 RESULTS FOR MODEL MISSPECIFICATION**

The logit model was tested for misspecification with a RESET statistic. If the model really is specified correctly, should I regress Bid on the prediction and the prediction squared, the prediction squared should have no explanatory power. This is observed as the prediction squared returned an insignificant p-value.
Table 4.9 RESET Test

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bid_Predicted</td>
<td>.9454552***</td>
<td>(.1462865)</td>
</tr>
<tr>
<td>Bid_PredictedSquared</td>
<td>.0248621</td>
<td>(0.44)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.014527</td>
<td>(0.1306236)</td>
</tr>
<tr>
<td>Observations</td>
<td>756</td>
<td></td>
</tr>
</tbody>
</table>

Source: Computed from Data (2016) using STATA

4.9.4 RESULTS FOR ROC (Receiver Operating Characteristic) Curve

The Receiver Operating Characteristic Curve is a standard technique for summarizing the performance over some range of trade-offs between true positives (TP) and false positive (FP) error rates (Sweets, 1988). It plots the sensitivity (the ability of the model to predict and event correctly) versus specificity (a model’s ability to predict wrongly).

The ROC curve is a graph that captures of specificity against sensitivity. According to Archer, K. J., and S. Lemeshow (2006) this is guaranteed to be a monotone non-decreasing function because the number of correctly predicted successes increases and the number of correctly predicted failures decreases as the classification cut-off decreases.
The area under the ROC curve is determined by integrating the curve. The vertices of the curve are determined by sorting the data according to the predicted index, and the integral is computed using the trapezoidal rule (Archer, K. J., & S. Lemeshow 2006). The area under the curve of approximately 0.8 indicates acceptable discrimination for the model. The area under the curve indicates predictive power of the model as shown in figure 5.1 below.

Figure 5.1 The ROC (Receiver Operating Characteristic) Curve

Source: Computed from Data (2016) using STATA
CHAPTER FIVE (5)

SUMMARY, CONCLUSION AND RECOMMENDATION

5. 0 INTRODUCTION

This chapter presents a summary of key findings of the study on bidding decisions in WIC rebate auctions. This is followed by the conclusions from the study and the possible recommendations for policymakers and future research.

5. 1 SUMMARY

This study examined the factors influencing bidding decisions by infant formula manufacturers in WIC rebate auctions. A logit model was used to estimate the model.

The study showed that the market share size of all firms influenced bidding decisions of these firms.

To achieve the specific objectives of the study, the stated hypotheses were tested; bid was regressed on market share and market share squared holding other factors as other control variables. The independent variables showed that market share increases the probability of bidding among infant formula manufacturers up to about 60% market share. The hypothesis test shows that the coefficients of share is statistically different from zero. The study revealed the manufacturing firm will bid up to the point optimal capacity, beyond which their bid probability declines.
5. 2 CONCLUSIONS

Market Share is revealed to have a positive effect on the bidding decision among Infant formula manufacturers in US. Thus, an increase in market share increases the probability of firms bid for WIC contracts. Carefully analysing the results of the effect of market share on firms bidding decisions in the US, it was found that an increase in market share increases the probability of firms bidding until a firm reaches about 60% market share holding all other factors constant.

Further, the study showed that alliances membership of state affects the bids they receive. Some states size and previous contract holder may not be significant determinants of bidding decisions in infant formula manufacturing market.

5. 3 RECOMMENDATIONS

Based on the findings and conclusions of this study, the following recommendations can be deduced:

From the study, market share is essential to firms submitting bids for infant formula as such efforts should be made by the federal government through policies to encourage the entry of more firms in the WIC market breaking the oligopoly that currently exits and reduce the market share held by the existing firms. The federal government has a role to play enacting policies towards enticing other firms into the industry.
5. 4 RESEARCH LIMITATION

- Every research has some limitations. The first limitation associated with this study was data availability.

- Another limitation was that some variables that would have also made meaningful explanations to the model may be ignored. Variables such as contract length and contract type could have explained the model but were ignored. This is because of inconsistency of results and time constraints.

5. 5 SUGGESTIONS FOR FURTHER STUDY

Based the limitations of this study, the following suggestions are made for future studies:

a. Researchers can consider using dataset that has income and other demographics of WIC participant measured as a continuous variable.

b. Researchers should also consider other variables including supply-side variables in estimating their bid model.
BIBLIOGRAPHY


APPENDIX

Table 4.2 CORRELATION MATRIX

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>(1) Bid</th>
<th>(2) State Alliance</th>
<th>(6) Share</th>
<th>(7) Share2</th>
<th>(8) Previous Holder</th>
<th>(9) Firm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bid</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>State Alliance</td>
<td>0.0414</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>share</td>
<td>0.3997</td>
<td>0.1009</td>
<td>1.000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Share2</td>
<td>0.3127</td>
<td>0.0814</td>
<td>0.9523</td>
<td>1.000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Previous Holder</td>
<td>0.0175</td>
<td>-0.1184</td>
<td>-0.0653</td>
<td>-0.0440</td>
<td>1.000</td>
<td></td>
</tr>
<tr>
<td>Firm</td>
<td>0.2400</td>
<td>-0.0909</td>
<td>0.0324</td>
<td>-0.0200</td>
<td>0.0809</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Source: Computed from Data (2008) using STATA
Figure 4. 2 Predictive Margins

![Graph showing Predictive Margins of Firm with 95% CIs]

Source: Computed from Data (2008) using STATA