

The Price Impacts on the Canned Peach Industry by the Federal Commodity Procurement Program

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ABSTRACT

This thesis analyzes the effects on the price impacts of the Commodity Procurement Program when canned peaches are purchased. The main objective is to assess the effects of canned peaches purchases on the farm-level price of canning peaches. Interviews of the industries that participate in the Commodity Procurement Program are used to understand how the industry interacts with commodity procurements and to evaluate if the industry feels that commodity procurements have a significant effect on procured fruits' and vegetables' prices to help better judge the overall effectiveness of the commodity procurement program. A theoretical model of the Commodity Procurement Program's effects on the vertically related markets is constructed. Data are collected for the processor-level and farm-level peach markets.

The results provide evidence that the quantity demanded of commodity procurements for canned peaches has a statistically significant negative effect on both the partial and final processor-level price. Also the results indicate that the quantity demanded of commodity procurements for canned peaches does not have a statistically significant effect on the final farm-level price. The results from the Breusch-Pagan tests for the processor-level partial reduced form price equation, the processor-level final reduced form price equation and the farm-level final reduced form price equation indicate that there is no significant evidence that the quantity demanded of commodity procurements stabilizes or destabilizes the farm-level or processor-level price.

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Chapter 1 - Introduction

1.1 Problem Statement

Section 32 of the Act of August 24, 1935 allows for a permanent appropriation of funds to purchase beef, pork, poultry, egg products, fish, fruits and vegetables. The commodities that are purchased are often value-added products such as canned fruit to prevent spoilage. The first goal of Section 32 funds is to meet the food demands of the national feeding programs, such as the Richard B. Russell National School Lunch Program, and this goal is accomplished by purchasing the commodities. The second goal of Section 32 funds is to support farm-level prices of the commodities purchased without impacting future farm-level production. One way to support farm-level prices is to buy commodities to stabilize prices in order to increase farm-level prices or to decrease the rate at which crop prices are decreasing. If farm-level production is impacted by the price support, the price support is lessened, negated, or opposite than intended. If production is impacted, the exact price effects depend on how large the production impact is. Economic theory does not support the possibility of future farm-level production (i.e. quantity supplied) not being impacted by a price change except in a heavily distorted market. The Agricultural Marketing Service (AMS), which manages the Section 32 funds, does not know if Section 32 funds are meeting the second goal of supporting farm-level prices (United States 74th Congress 1935).

Since the start of Section 32 purchasing, other funds have been created to purchase commodities similar to the commodities purchased by Section 32 funds. These funds are known as Food Nutrition Service (FNS) funds. The funds are referred to by the number of the legislative section where the funding is obtained such as 17, 4a, 6e, 104, 311, and 110 funds. The FNS funds are intended solely to meet the needs of the national feeding programs and are

not intended to support farm-level prices. The FNS funds could affect farm-level prices, since the FNS funds are administered by the AMS using a similar procurement process to the Section 32 funds. The effect of the FNS funds on farm-level prices is also unknown. Together the Section 32 funds and FNS funds are the funding sources for all fruit and vegetable purchases under the Commodity Procurement Program (CPP).

The objective of this thesis is to analyze the farm-level price effects resulting from the CPP purchases of canned peaches. Even though, the FNS are not intended to affect farm-level price, since the FNS fund are administered using a similar process to the Section 32 funds, the analysis of the FNS funds are included in this research. While I focus only on the effects of Section 32 funds and FNS funds purchases for canned peaches in this thesis' analysis, a secondary objective of this thesis is to provide a theoretical and empirical framework that is applicable to all fruit and vegetable purchases by the Section 32 funds and FNS funds.

1.2 Justification for Research

Very little research has been done on the CPP and its effects. Currently there is a need to have a better understanding of the CPP and its effects on farm-level prices. The need to have a better understanding of the CPP's effects originates from a major concern by the Federal government to show effective use of funding for different programs. The Office of Management and Budget (OMB) reported in 2005 that "Section 32 had not adequately demonstrated results due to, among other things, unclear purposes, no basic criteria for surplus commodity purchases, and lack of performance measures" (Becker 2007). This unfavorable report of the Section 32 Program has led to a need to measure the performance of the program in meeting its goal of supporting farm-level prices without impacting farm-level production. The OMB report highlights the need for understanding the effects of Section 32 and furthermore the effects of the

FNS funds. In FY 2006, \$1.5 billion of Section 32 and FNS funds were spent on commodity procurements of beef, pork, poultry, fish, fruits and vegetables (Becker 2007). Of the \$1.5 billion, \$238 million was spent on procurements of forty one different types of fruits and vegetables (Hinman 2008). Therefore, the effects of CPP funds should be investigated.

Further attention also has been drawn to the effects of the CPP with respect to fruits and vegetable purchases. The 2008 Farm Bill increased Section 32 and FNS funding for fruits and vegetables by \$550 additional million to the CPP's per annum budget for the life of the 2008 Farm Bill (United States Congress 2008). Since the appropriation for the fruits and vegetable CPP has increased, the importance of understanding the effects of program spending has increased.

1.3 Theoretical Development

The theoretical framework is developed using economic theory to provide an understanding of how the CPP is expected to affect farm-level supply, farm-level demand, processor-level supply, and processor-level demand. The processor-level is included because peaches are only purchased processed. While purchasing fresh peaches would have a more direct impact on the farm-level prices, fresh peaches are perishable and do not store well for the feeding programs. Spoilage is a problem for most fruits and vegetables and consequently almost all purchased fruits and vegetables are processed. Economic theory is used to explain the relationship between the farm-level and processor-level supply and demand shifts. The theoretical framework draws on the economic theory to help define the variables that could be affecting farm-level supply, farm-level demand, processor-level supply, and processor-level demand.

1.4 Hypotheses

The first hypothesis this thesis tests is that the quantity demanded of commodity procurements has a positive effect on the farm-level price of canning peaches and on the processor-level price of canned peaches. The estimation of a farm-level final reduced form price equation can be used to determine if the quantity demanded of commodity procurements has a statistically significant positive effect on the farm-level price. The estimation of a processor-level partial reduced form price equation can be used to determine if the quantity demanded of commodity procurements has a statistically significant positive effect on the processor-level price before the input price of the raw products has a chance to adjust. The estimation of a processor-level final reduced form price equation can be used to determine if the quantity demanded of commodity procurements has a statistically significant positive effect on the processor-level price given the opportunity for input prices to adjust.

The second hypothesis is that the quantity demanded of commodity procurements decreases the variance of the farm-level price and the processor-level price; or in other words that the quantity demanded of commodity procurements stabilizes the farm-level price and processor-level price. The estimation of a Breusch-Pagan test for the farm-level final reduced form price equation can be used to test if the quantity demanded of commodity procurements has a statistically significant decreasing effect on the variance of the farm-level price. The estimation of a Breusch-Pagan test for the processor-level partial reduced form price equation can be used to test if the quantity demanded of commodity procurements has a statistically significant decreasing effect on the variance of the processor-level price before the adjustment in input price is controlled. The estimation of a Breusch-Pagan test for the processor-level final reduced form price equation can be used to test if the quantity demanded of commodity procurements has a

statistically significant decreasing effect on the variance of the processor-level price once the adjustment in input price is taken into account.

1.5 Model

The empirical model has been constructed to test the effects of the CPP on farm-level prices. The farm-level quantity supplied is assumed perfectly inelastic. Consequently, farm-level supply side effects are not included in this thesis. The farm-level quantity supplied and farm-level quantity demanded equations are set equal and are solved for the farm-level price to create the farm-level partial reduced form price equation. The processor-level quantity supplied and quantity demanded equations are set equal and are solved for the processor-level price to create the processor-level partial reduced form price equation. The farm-level partial reduced form price equation and the processor-level partial reduced form price equation are combined to create the processor-level final reduced form price equation and the farm-level final reduced form price equation. Processor-level partial reduced form price equation, processor-level final reduced form price equation, and the farm-level final reduced price equation are estimated to test the hypotheses.

1.6 Data

Canned peaches are analyzed as an example of the fruits and vegetables purchased by the CPP. Canned peaches have been chosen because of data availability. The data for the canned peaches model are from multiple sources. The sources include the ERS Fruit and Tree Nut Spreadsheet Data, NASS Noncitrus Fruit and Tree Nut Annual Summary, the Food Institute, and the Bureau of Labor Statistics. Data exist for the variables of the farm-level price, processor-level price, processor-level input cost, the farm-level quantity supplied, price of substitutes,

income, population, and commodity procurements. The collected data are used to estimate the equations described in the empirical model.

1.7 Results

The results from the estimated equations are used to interpret how much and what type of an effect, if any, the CPP has on the farm-level price of canning peaches and the processor-level price of canned peaches. The results indicate that the quantity demanded of commodity procurements for canned peaches does have a statistically significant negative effect on both the partial and final processor-level price. Also, the results indicate that the quantity demanded of commodity procurements for canned peaches does not have a statistically significant effect on the final farm-level price. The results from the Breusch-Pagan tests for the processor-level partial reduced form price equation, the processor-level final reduced form price equation and the farm-level final reduced form price equation indicate that there is no significant evidence that the quantity demanded of commodity procurements stabilizes or destabilizes the farm-level or processor-level price.

1.8 Implications

The results of this thesis have implications as to whether the CPP is meeting its goals of supporting farm-level prices. The results may have implications about the price effects from the CPP on other fruit and vegetables purchased by the AMS. The results of this thesis are potentially valuable to the administrators of the CPP at the AMS. This thesis provides them with insight into how the program affects the canned peach industry, which may allow them to improve the program to better support farm-level prices. Also industries that participate in the CPP are interested in how the program affects prices; and the research results could have implications whether the industries participate in the program in the future.

1.9 Thesis Structure

The remainder of this thesis is divided into five chapters. Chapter 2 is the background of the CPP. The background includes the legislative history, the CPP's structure, the commodity purchasing process, the industries' structure, the industries' selling process, and the industries' perceived effects of the CPP. Chapter 3 is the description of the theoretical economic justification for the CPP, which is then applied to create an empirical model. Chapter 4 is a description of conceptual issues that limit the model as well as a presentation of the data. Chapter 5 is a description of the empirical implementation of the empirical model, the results, and the implications of results. Chapter 6 is a summary of the conclusions and limitations of the model and also contains suggestions for future studies on the topic.

Chapter 2 – Background

Since there has been very little research done on the CPP, a theoretical model of the effects of the CPP on the farm-level price has not been defined well. An extensive amount of research has been completed on the legislative history, the CPP's structure and purchasing process, background on the canned peach industry, the industries' structure, selling process to the CPP, and the industries' perceived effects of the CPP to provide a working knowledge of the CPP. This background also is used to construct an accurate theoretical model and to help interpret the results. The information provided in the background also is useful to understand the previous literature written. Once the background has been discussed, the previous literature on this topic is reviewed.

2.1 Legislative History

The historical setting, in which the CPP began, provides an understanding of goals of the program. Further discussion of the legislation related to the CPP provides greater insight into the program's goals and how the CPP has developed over time. These goals created by the legislation provide standards to judge the success of the commodity procurement programs.

In *The Great Depression: America 1929-1941* (1961), Robert McElvaine details the effects of the Great Depression on American farmers. In this section, I summarize his work. Robert McElvaine identifies the Great Depression as a time of economic problems for American farmers. During this time, many farmers could not financially support their farms and were forced to sell their farms. Other farmers, who strived to remain financially solvent, started planting more crops in an attempt to sell more and recover money lost due to the low prices they received for their crops. The increase in planting only caused the price of crops to drop even further. While the farmers faced economic hardship during the Great Depression, so

did many other people in the United States. Many individuals lost their jobs as a result of the Great Depression and in turn lost their resources to sustain themselves and their families. The Federal Government worried about malnutrition of its citizens. These were the conditions that caused the Federal Government to create Section 32 of the Agricultural Act of 1935 to provide food for the hungry while removing commodities from the market to alleviate the downward pressure on prices.

Section 32 of the Agricultural Act of 1935 (also known as P.L. 74-320) is the original source for funding for the fruits and vegetable CPP. Commodities purchased by Section 32 funds include meats, poultry, fish, fruits, and vegetables. The goals outlined in Section 32 are to promote exportation, to promote domestic consumption, and to restore farmers' purchasing power (United States 74th Congress 1935). Through Clause Two of Section 32, which reads "to promote domestic consumption (United States 74th Congress 1935), the first funding source of CPP is established. The AMS promotes domestic consumption by only purchasing American perishable "non-basic agricultural commodities" in surplus (United States 74th Congress 1935).

Section 32 was amended or had funds added in later legislative acts. These acts include the Act of June 28, 1937, the Agricultural Adjustment Act of 1938, the Act of June 30, 1939, the Agricultural Act of 1948, the Agricultural Act of 1956, the January 21, 1961 Executive Order by John F. Kennedy, the Farm Security and Rural Investment Act of 2002, and the 2008 Farm Bill (AMS 2001). The most important amendments to Section 32 are from the Act of June 30, 1939 and the January 21, 1961 Executive Order by John F. Kennedy. In the Act of June 30, 1939 a passage was added to Clause Two of Section 32 that reads "to encourage domestic consumption or by increasing their utilization through benefits, indemnities, donations or by other means, among persons in low-income groups"(AMS 2001). This change clarified

the meaning of domestic consumption and defined the group of recipients to receive the commodities (United States 74th Congress 1935). One of the first Executive Orders from John F. Kennedy as President was the January 21, 1961 Executive Order, where he commanded an increase in donated foods for food distributions. It states:

“The Secretary of Agriculture shall take immediate steps to expand and improve the program of food distribution throughout the United States, utilizing funds and existing statutory authority available to him, including section 32 of the Act of August 24, 1935, as amended (7 U.S.C. 612), so as to make available for distribution, through appropriate State and local agencies, to all needy families a greater variety and quantity of food out of our agricultural abundance” (Woolley and Peters 1999-2009).

Through this executive order, the primary goal of the Act of August 24, 1935 changed from surplus removal of food from the market to increasing the amount of nutritious food given to the needy families of America. This change represents a major turning point in the purpose of the CPP (Consroe 2006). While this ideological shift happened, the overall requirements from Section 32 purchases were unchanged.

Following Section 32 other acts were created. In these acts, national feeding programs with separate funding sources from Section 32 to purchase food were created for different disadvantaged groups. The additional funds added with each act were created for the purchase of a wider range and larger amount of commodities to help supply food to national feeding programs. The funds created by the acts following Section 32 are known jointly as FNS funds. The acts that initiated the new national feeding programs and created the new funding sources are the Richard B. Russell National School Lunch Act of 1946, the Agricultural Act of 1949, the

Older Americans Act of 1965, the Child Nutrition Act of 1966, the Agricultural and Consumer Protection Act of 1973, the Emergency Food Assistance Program of 1983, the Hunger Prevention Act of 1988, the Robert T. Stafford Disaster Relief Act of 1988, and the Healthy Meals for Healthy Americans Act of 1994 (Consroe 2006).

The main goal of the Section 32 funds is currently to provide food to national feeding programs. The secondary goal of the Section 32 funds is to support farm-level prices. The only goal of the FNS funds is to provide food to national feeding programs.

2.2 CPP's Structure and Purchasing Process

The current CPP goals are based on the previously discussed legislation. To understand how the CPP may be meeting the goal of supporting farm-level prices, a theoretical model needs to be constructed. To construct a theoretical model, the factors affecting the demand of the CPP need to be discussed. A discussion of the CPP's structure and purchasing process is needed to determine the factors affecting the demand. It is discussed in this section. Those factors affecting supply are developed in the industry discussion. Since there is a lack of written material on the CPP, much of the discussion of the CPP's structure and purchasing process is based on personal communication with the AMS's Commodity Procurement Branch and the Economic Analysis and Program Planning Branch.

2.2.1 Commodity Procurement Program Structure

The current CPP's funds are divided into FNS funds and Section 32 funds. The Section 32 funding is subdivided into 32A, 32C, and 32R funding (Hinman 2008). The subdivision of the funds is important because the funds were created with different goals and hence different spending requirements. These requirements have implications for factors affecting demand and may be useful in the explanation of the results.

The 32C funds are bonus buys or unanticipated purchases of commodities in “extreme surplus”. Usually surplus is defined as when the quantity supplied exceeds the quantity demanded at a given price, causing downward pressure on prices. However the determination of an “extreme surplus” by government analysts is based on previous years’ prices, previous years’ yields, changes in the industries, changes in the market and their analysts’ basic judgment. It is a comparative surplus of quantity to previous years. To purchase commodities with 32C funds an “extreme surplus” must be declared by the Federal Government.

The 32R funds help make stable amounts of food available for the feeding programs, while still meeting the basic goals of the Section 32 funding (AMS 2001). The 32R funds, also known as Entitlement buys, are a non-surplus product purchased from American grown/raised products which are at least in adequate supply while the industry is in slight or worse distress than most years.

The 32A funds are additional Section 32 funding (Hinman 2008). Occasionally extra funds are appropriated to Section 32. As previously mentioned in the introduction, the 2008 Farm Bill added \$550 million to the CPP’s annual budget to Section 32 for the life of the 2008 Farm Bill. This funding is an example of 32A funding. The 32A funds are treated in a similar fashion to the 32R funds except the industries do not need to be in slight distress.

The FNS funds, which are managed by the FNS and the AMS, also are called Entitlement buys and follow similar requirements for purchase and utilize the same process as the 32R funds. The main difference between Section 32 funds and FNS funds is the goal of the funding. The FNS funds only have the goal of meeting the national feeding programs’ demands while Section 32 funds are meant to support farm-level prices and meet the demands of the national feeding programs. The FNS funds can be used to buy commodities that are in-demand by feeding

program outlets, provided that there are adequate supplies, with no abnormally high prices. With FNS funds, the commodity markets may or may not have signs of economic distress. The similarity between the FNS and Section 32 funding implies that the FNS funds could have an effect on farm-level prices.

The requirements for each subdivision of funding are all different. All of the spending requirements have a price threshold at which the USDA declares that the price is abnormally high and the USDA no longer purchases the commodity until the price has lowered. The definition of abnormally high for each commodity is not defined specifically. This understanding of the subdivision is useful in understanding the theoretical model. This discussion supports the factors affecting the USDA's demand for commodity procurements.

2.2.2 Commodity Purchasing Process

A further understanding of the CPP's purchasing process is necessary to show which commodities are demanded by USDA for the CPP. The CPP structure of Section 32 is administered by three USDA agencies: the FNS, the AMS, and the FSA. The commodity procurement process begins with the FNS.¹ The FNS surveys the feeding programs to determine what the programs need to receive from the CPP. The FNS decides if there is a demand from the national feeding program for a commodity and lets the AMS know which commodities are in demand. If there is no demand for a commodity, the commodity is not purchased.² If there is a demand for the commodity, commodities can be purchased (depending on market conditions) with 32C funds, other 32 funds, or FNS funds. Once the AMS decides which funding source to use, an invitation to buy is posted. Only "approved vendors" have the opportunity to bid on the invitations. The vendor must satisfy several criteria to become an "approved vendor"(AMS

¹ Based on personal communication with Commodity Procurement Branch of the AMS

² Based on personal communication with Commodity Procurement Branch of the AMS

2007). An example of one criterion is that the vendor must show proof that the commodities being sold are 100% American. After the closing of the bidding, the AMS awards the contracts to the lowest bidders (AMS 2007). The winning vendors then deliver the amount contracted of the commodity at the time and destination specified in the invitation.

2.3 Canned Peach Industry

The United States canned peach industry is mainly located in California. The farmers mainly provide clingstone peaches for the canning industry (California Cling Peach Board 2009). Clingstone peaches are not normally sold on the fresh market (California Cling Peach Board 2009). Close to 100 percent of the cling peach industry is located in California (California Cling Peach Board 2009). There are only four processors in California that process canned peaches (California Canning Peach Association 2009). The farmers' association that is associated with the California canned peach industry is the California Canning Peach Association. Since the United States canned peach industry is highly localized, the industry is fairly homogenous. The farmers and processors have approximately the same the input costs and face the same demand for their product from the processors.

The United States canned peach industry faces two major challenges to remain competitive. The first challenge is to continue to have competitive prices on the world market. The cost of inputs on both the farm-level and the processor-level of the canned peach industry such as labor have significantly increased over time. Other countries such as China and Greece have gained a larger portion of the world market by having lower price (U.S. International Trade Commission 2007). The second challenge is to maintain or increase demand for canned peaches. The consumer demand for canned items has significantly decreased over the years. More consumers are demanding fresh peaches since there is an increased availability of fresh fruit throughout the year

because of increased trading with countries with different growing seasons (ERS 2008). Also there has been a decrease in demand for larger sized cans and an increase in demand for plastic cups (ERS 2008).

2.4 Industries' Organization, Selling Process to the CPP, and Perceived Effects of the CPP

The industries provide the supply of the commodities which the USDA procures. To understand how the CPP may be theoretical by affecting the farm-level prices, a working knowledge of the industries' structure and industries' selling process to the CPP are needed. Also the industries' perceived effects of CPP on their production and price are useful in creating assumptions necessary to construct the theoretical model. Since there is a lack of printed material on the CPP especially on the industries' role in the commodity procurement process and their perspective on the program, I interviewed eight farmers, seven processors and six associations in Pennsylvania and California involved in the fruit and vegetable industries. The questions asked during the interviews were developed to assess how the industries were structured, how the industries participated in the CPP, and to test hypotheses of how the CPP affected the different levels of the industries. The hypotheses and the justification of hypotheses can be found in Appendix A. The questions asked to the associations, processors, and farmers during the interviews can be found in Appendix B. The responses to the questions from the interviewees were not conflicting. The responses provided had overarching and reoccurring themes. The conclusions, which are relevant to developing the factors affecting the supply of commodity procurements to the USDA, are drawn from the responses and are summarized in the industries' structure, industries' selling process to the CPP, and the industries' perceived effects of the CPP sections. This discussion follows below.

2.4.1 Industries' Organization

The industries' organization section is an introduction to the general organization of the fruit and vegetable industries with a focus on canned peaches. The industries' organization is used in the theoretical model to develop the factors that affect the amount of supply available to the CPP. The industries' structure has three levels: the associations, the processors, and the farmers. In many industries, associations are formed by the farmers as a representative group. Prior to harvest, associations negotiate on behalf of the farmers with the processors to determine the price for the raw fruits and vegetables.³ The California Canning Peach Association provides this service to the member of the association (California Canning Peach Association 2009). Farmers and processors normally create a contract which includes the amount of the commodity being sold and the negotiated price.⁴ The farmers deliver the contracted amount during harvest. The way the amount is specified in the contract depends on the industry. For example, with canning peaches, the processors contract the amount with farmers based on a number of acres. While for other commodities, the processors contract the amount with the farmers based on a number of tons. Either approach allows contractual agreements between farmers and processors to provide a guarantee for both parties that there are sellers and buyers. Some processors create contracts with farmers that last only a year. Other processors have term contracts with farmers that last multiple years. Processors also use spot buys in conjunction with contracts. Spot buys are purchases that happen without a contract.⁵ Spot buys are used normally when the processors have underestimated their demand. Spot buys can be a processor's main purchasing mechanism but that is abnormal.

³ Based on responses to associations' questions (7) and (8)

⁴ Based on responses to processors' question (9)

⁵ Based on responses to processors' question (9)

2.4.2 Industries' Selling Process to the CPP

The associations' or processors' role in the procurement process begins with two sets of meetings promoting the processed product. If the association is presenting the product, it is because the processed product contains their raw product as an input. In the first set of meetings the processed product is promoted to the USDA. According to the AMS, the meetings with AMS of the USDA are to exhibit a new product that could be purchased by the USDA for the feeding programs. These products are assessed on nutritional value, storability, and ease of preparation. In the second set of meetings the associations or processors promote the processed product to the feeding programs' administrators. The second set of meetings is meant to provide the feeding program administrators with new ideas of how to include their products in meals and ways that they can prepare their product easily.⁶ The new ideas help the feeding programs' administrators decide which products to request on the FNS surveys.

The next step for the industries in the procurement process is that the associations collect data to see if there is a possible upcoming government-defined surplus. The associations collect an estimate of how much of the crops are contracted before the beginning of harvest. If there is a large amount of the crop that is not contracted and may go to waste, the associations use the amount contracted compared to the amount available as a signal of an upcoming need for a bonus buy.⁷

If there are signs of government-defined surplus, the industries send the data showing the government-defined surplus to the AMS and the industries' congressional representatives to request a bonus buy.⁸ According to the associations, requests are normally granted, although the

⁶ Based on responses to associations' question (10)

⁷ Based on responses to associations' question (17)

⁸ Based on responses to associations' question (17)

associations feel they do not ask unless a bonus buy is truly needed.⁹ If there are no signs of a surplus, the industries can take part in the commodity procurement under entitlement buys. Some products are not in high demand by the national feeding programs, and for that reason are only purchased under bonus buys, for example asparagus. Industries that lack associations rely on the processors or other industry groups to undertake these responsibilities.

Once the invitations are sent out for bids for the sale of the processed product, the processors create their bids based on the current inputs costs such as labor, shipping costs, time of year and weather conditions of where the product is being shipped, freight, special requirements of the destination, quantity, specifications of the purchase, the processors' current inventories, overhead costs, and inspection costs.¹⁰ The processors have an overall profit maximizing objective in selling their commodities according to economic theory. The processors also have the objective to create a competitive bid to win the auction. The processors must harmonize these two objectives into one bid price.¹¹ The bidding system causes many firms' bonus buy and entitlement buy bids to be below the commercial market prices on a regular basis.¹² Entitlement buys occur when less supply is available on the market than when bonus buys occur (Hinman 2008). Since the entitlement buys occur when less supply available, the prices bid for entitlement buys tend to be higher than bonus buy bids for the same products. According to processors, the profits from bonus buys are less than profits from entitlement buys; and entitlement buy profits are less than if the product had sold on the commercial market.¹³

Once the processors have submitted their bids and the bids have been awarded, the processors change their production decisions because of the award. This change in production

⁹ Based on responses to associations' question (18), which tests the first association-level hypothesis

¹⁰ Based on responses to processors' question (28)

¹¹ Based on responses to processors' question (28)

¹² Based on responses to processors' question (21)

¹³ Based on responses to processors' question (21)

decisions would not happen before the bid is awarded for both bonus buys and entitlement buys because the processors have no guarantee that they will win the bid.¹⁴ The processors change their production decision in two ways once awarded the bid. The first change is that they may need to buy more from farmers to meet the quantity required in the bid if they do not have enough of the raw product already contracted through a spot buy.¹⁵ For this to happen, the awards would need to happen right before harvest or during harvest. This is the case for many processors since they normally do not contract initially more than they know that they can sell on the commercial market. If the processors do not need to purchase more from the farmers, it is because the processors already have purchased enough of the raw product to supply the extra demand for the procurement market. The associations were asked if the increase in quantity demand from the spot buys would cause an increase on the farm-level production.¹⁶ Then, the associations explained that if a farmer is having trouble contracting all of his product, and has his product purchased through a spot buy late in harvest it does not encourage a farmer to produce more in the future. The second change is the processors need to process their commodity to USDA specification¹⁷ if they are different from commercial specifications.¹⁸ For example the commercial specifications may be for small can sizes, which are packaged in heavy syrup. The USDA specifications may be for larger can sizes, which are packaged in pear juice.

It is important to note that in the industry selling process to the CPP, the processors are the only group that has been described as selling to the USDA. There are cases where the USDA purchases fresh or which are lightly processed commodities such as nuts. When the USDA

¹⁴ Based on responses to processors' question (22), which tests the first and second processor-level hypotheses

¹⁵ Based on responses to processors' question (22), which tests the first and second processor-level hypotheses

¹⁶ Based on responses to associations' question (14), which tests the second and third farm-level hypotheses

¹⁷ A specification is a term used within the industries. Examples of specifications are the packaging size, the cut of the fruit, the labeling, and the medium (Heavy Syrup, Light Syrup, Pear Juice, etc.) in which the fruit is packaged.

¹⁸ Based on responses to processors' question (22), which tests the first and second processor-level hypotheses

purchases fresh or lightly processed commodities, the interactions that are described in the industry selling process happen between the USDA and the farmers and/or handlers instead of between the USDA and the processors. In industries where commodities are not purchased fresh, the farmers have very little knowledge of the CPP.

2.4.3 Industries' Perceived Effects of the CPP

The associations and processors are the two levels of the industry that understand the CPP and the CPP's process due to their regular participation in the CPP.¹⁹ The farmers do not have direct contact with the CPP and consequently very few farmers are aware the CPP exists. The farmers base their production decisions on the processors' demand.²⁰ Since the associations and processors understand the CPP and the CPP's process, only their perceived effects of the CPP are discussed.²¹ The associations and processors were asked the questions, how do you feel the CPP has impacted price and production in the industry and what sort of price and production impacts do you feel commodity procurements have on farmers.²² The hypothesized impacts were that price on the farm-level and processor-level would increase from an increase in demand on the farm and processor-levels and production would increase from entitlement buys but not bonus buys on the farm and processor-levels. The associations and processors did not respond to these questions in a manner that validated or rejected the hypotheses. The associations and processors responded to how the CPP impacts the farm-level and processor-level profits positively or negatively. Profit is a function of the price multiplied by quantity minus the marginal cost multiplied by the quantity. How the CPP impacts the farm-level and processor-

¹⁹ Based on responses to associations' questions (11-19), processors' questions (20-28), and farmers' questions (16-22), which tests the second industry-level hypothesis

²⁰ Based on responses to farmers' questions (16-22), which tests the first, second, third and fourth farm-level hypotheses

²¹ Based on responses to the farmers' question (16)

²² Based on responses to the processors' questions (21) and (24) and the associations' questions (12) and (14)

level profits depends on the timing for the awarding of each bid in relation to harvest. The timing of the awarding of the bids is important. Bids can be awarded ahead of harvest, during harvest, or post-harvest. All of the different possible times at which bids can be awarded have positive and negative effects on the industries' profits. This discussion follows below.

If bids are awarded far ahead of harvest, there is a tradeoff in the costs that the processor incurs. There can be a positive effect on profit for the processor if the bids are awarded early because the processors that are participating in the CPP could purchase the right amount of packaging needed for processing and have the right amount of fruit or vegetables contracted. Having the right amount of packaging and fruit or vegetables contracted early would allow for lower planning costs for the participating processors and possibly lower costs associated with having the raw fruits and vegetables contracted early instead of having to purchase through spot buys. The participating processors see early decision making as possibly having a positive effect on the processor-level profit because the processor-level costs are relatively lower than they would have been if the bidding had been later. The processors could only gain the cost lowering benefit of early decision making if the contracts for the raw fruits and vegetables are for a given amount of weight and not by acre, given that there is variability in yield per acre. Canned peaches are contracted by acre. Other aspects of early awarding of bids can either increase or decrease profit margins as well. With early decision making, the processors have very limited information on which to make their bid price. Whether profit margins increase or decrease depends on what happens to the costs of inputs in the future. All of the inputs could increase or decrease in price, which creates either a positive or negative effect on the processors' profits. If the inputs increase in price from the time when the processors made their bid, the processors lose profits. If the inputs decrease in price from the time when the processors make their bid, the

processors gain larger profits. Whether the input price increases or decreases in the future, the processors are obligated to deliver what they bid for the price that they bid to the USDA. For example, a large percentage of the crop could freeze, which would drive up input costs of the raw fruits and vegetables. Even if the crops freeze, the processors are obligated to fill their contracts with the USDA. The increase in the raw fruits and vegetable input costs from the freeze would cause processors to suffer a financial loss or a reduced profit from the USDA contracts. The processors face the tradeoff of having lower planning costs and raw fruit and vegetable input costs from early decision making or having increased or decreased input costs because of the limited knowledge of future markets. According to processors, the financial loss that could be incurred from increased input costs outweighs the cost reducing benefits of early decision making and possible profit gains from the lowering input costs in the future. If the bid is awarded far ahead of harvest, the overall effects on the industry are seen as negative. Since there is the potential for such a great loss to the processors given the USDA's procurement process, bids are not normally awarded months ahead of harvest. Bids are sometimes awarded ahead of harvest but by a short amount of time such as a week.

If the bids are awarded post-harvest, there are positive profit effects from the CPP purchases on the processor-level and farm-level. However, the timing is not ideal for the industry because the positive profit effects are not directly to be passed on to the farmers and only some of the processors can participate in the bidding process. The farmers' profits are increased when there is an increase in the processor-level price which increases the farm-level quantity demanded by the processors. The reason it is believed that benefits are not directly passed on to the farmer with post-harvest bids is that there is no way for the processors to pack more from the farmers unless the raw product is storable, and most fruits and vegetables are not

able to be stored. Since the extra spot buys would not have occurred, the direct benefits would not be passed onto the farmers, especially in years of surplus. Indirectly the post harvest purchases could have a positive effect on the farmers' profits in the following year. Commodity procurements that deplete supplies in storage allow for less carry-over for the next year. Less carry-over does not allow the processors to cut back on their contracts for the following year due to the standing inventories. When the contracts are not cut back for the following year, farmers benefit through the ample amount of contracts, which increase farmers' sales and consequently their revenue. Some processors cannot bid in the bidding process with post harvest bidding because the processors only can offer what they have already packed in their warehouses. This means that processors may not have the correct specification for the USDA packs and therefore some processors are not able to bid. Not having the correct specifications causes the processors to forego any opportunities of earning revenues in the procurement market. The reason post-harvest bids are still seen as a positive for the industry is because some processors have the correct specifications in storage. Post-harvest awarding has positive effects on the industry when the processors have over contracted the raw product and have large supplies in their storage so that they are unable to move on the commercial market without greatly lowering their prices.

The ideal time for bids to be awarded is during the beginning of harvest or immediately before harvest for both the farm-level and processor-level. While this gives processors little time to prepare more packing components, which could cause an increase in planning costs and costs of the raw fruits and vegetables, it allows the processors time to make more accurate bids. With more accurate bids, the processors' profits are not depleted by unforeseen increases in input costs and the processors gain the expected profits. The positive effects of the CPP are passed onto

farmers directly, when the processors need to purchase more of the raw product from the farmer through spot buys. The spot buys are a source of extra revenue for the farmers.

The background information provided is used in the construction of the model and the interpretation of the model's results. The CPP has been evaluated previously in the literature. The background presented above allows for an understanding of the limitations of the literature and shows that the literature needs to be expanded.

2.5 Literature Review of the Effects of the CPP on Prices

After an extensive literature search, only two pieces of literature were found that examine the price effects of the CPP. These two pieces are by Nicks (2004) and the National Food and Agricultural Policy Project (2001). One other piece written by Traub (1984) has been reviewed as well because of its significance to the theoretical portion of the research. The review of Traub's (1984) work is discussed in Chapter 3, because Traub's (1984) work is most applicable to the theoretical model presented in Chapter 3. The lack of literature on this topic further adds to the importance of this thesis.

In *An Assessment of Government Purchases in the Potato and Tomato Industries*, Nicks (2004) examines the effect of the government purchases on the farm-level and retail-level prices for potatoes and tomatoes. Nicks (2004) provides a brief background of food distribution programs, of the commodity procurement process, and the potato diversion program. Nicks' (2004) theoretical framework provides a formulation of the theory of supply and demand. Nicks (2004) provides separate sections on tomatoes and potatoes.

In the tomato section, Nicks (2004) provides hypotheses on how all the variables affect the farm-level demand for fresh tomatoes, the farm-level supply of fresh tomatoes, and the retail partial reduced form price for fresh tomatoes. Nicks (2004) hypothesizes that government

purchases have a positive effect on the farm-level demand and retail-level price, although she does not include government purchases as a factor affecting farm level supply.

Nicks (2004) estimates three equations for the tomato industry. The first is the inverse farm-level demand equation for fresh tomatoes. The second is the structural supply equation for fresh tomatoes. The third appears to be a partial reduced form retail price equation.

The tomato data's span is from FY1990 to FY2002. The frequency of the tomato data Nicks (2004) uses is quarterly. Nicks (2004) only estimates equations related to fresh tomatoes and fresh tomato purchases due to data limitations. In the farm-level inverse demand equation, the average seasonal deflated tomato grower price for product (in dollars per pound) is a function of the amount of fresh tomatoes the government purchases (in 10,000 pounds), the average seasonal deflated tomato retail price for the product (in dollars per pound), the amount of farm output available for market use (in 10,000 pounds), the last year's farm price (dollars per pound), the last year's retail price (in dollars per pound), the spring season dummy variable, the summer season dummy variable, and the fall season dummy variable. In the fresh tomato supply equation, the amount of farm output available (in 10,000 pounds) for market is a function of the average seasonal deflated tomato grower price (in dollars per pound), the area harvested of tomatoes (in 1,000 acres), last year's farm price (in dollars per pound), the spring season dummy variable, the summer season dummy variable, and the fall season dummy variable. In the reduced form retail price equation, the average seasonal deflated tomato retail price for the product (in dollars per pound) is a function of the average seasonal deflated tomato grower price (in dollars per pound), the amount of output available for market use (in 10,000 pounds), the annual lettuce retail price (in dollars per pound), the seasonal fresh-market tomato import volume (in 10,000 pounds), the population as of January 1 of the market year, personal consumption

expenditures, the spring season dummy variable, the summer season dummy variable, the fall season dummy variable, and last season's retail price (in dollars per pound). Nicks (2004) estimates the three previously described equations.

For the equation estimating farm-level price of fresh tomatoes, Nicks (2004) finds an R-squared of 0.44 and an adjusted R-squared of 0.33. The variables that are found to be statistically significant are average seasonal deflated tomato retail price, the previous year's retail price, and the fall season dummy variable. The government purchases are found to be statistically insignificant.

For the farm-level supply of fresh tomatoes, Nicks (2004) finds an R-squared of 0.95 and an adjusted R-squared of 0.94. The variables that are statistically significant are harvested area, and the spring season, summer season, and fall season dummy variables.

For the retail-level price for fresh tomatoes, Nicks (2004) finds an R-squared of 0.4 and an adjusted R-squared of 0.3. The variables that are found to be statistically significant are imports, fresh tomato farm price, and previous season's retail price. The government purchases are found to have a negative coefficient and are statistically insignificant. This result is also opposite of what is hypothesized.

Nicks (2004) proceeds to her potato model. Nicks (2004) hypothesizes that government purchases have a positive effect on the farm-level demand. For the fresh retail price equation, Nicks (2004) hypothesizes that fresh government purchases have a positive effect on the retail price. Nicks (2004) also hypothesizes that processed potato government purchases have a negative effect on farm prices for processed potato. The reasoning for hypothesizing a negative effect from processed potato government purchases is not given. Nicks (2004) does not include government purchases as a factor affecting farm-level supply and the demand for storage.

Nicks (2004) estimates a set of simultaneous equations using three stage least squares for the potato industry. The set of equations include the fresh farm-level inverse demand equation, farm-level supply equation, the fresh retail prices equation, processed grower price equations, and the demand for storage equation. The data's span for the potato model is not specified. The frequency of the data for the potato model also is not specified. It might be assumed that the frequency and span of the data for the potato model is the same as for the tomato model. In the fresh farm-level inverse demand equation, the average seasonal deflated potato grower price for all potatoes (in dollars per cwt) is a function of the average seasonal deflated retail price for fresh potatoes (in dollars per cwt), the amount of potato inventory at the beginning of the period t (in tons), the amount of farm potato output supplied to the market (in tons), last year's potato farm-level price (in dollars per cwt), and a time trend variable. In the farm-level supply equation, the amount of farm-level potato output supplied to the market (in tons) is a function of the average seasonal deflated potato grower price for all potatoes (in dollars per cwt), the per acre expenditures (in dollars per acre), last year's potato farm-level price (in dollars per cwt), the spring season dummy variable, the summer season dummy variable, and the fall season dummy variable.

In the fresh retail price equation, the average seasonal deflated retail price for fresh potatoes (in dollars per cwt) is a function of the average seasonal deflated potato grower price for all potatoes (in dollars per cwt), the amount of fresh government potato purchases (in tons), the population as of January 1 of the market year, the personal consumption expenditure index, the fall season dummy variable, the spring season dummy variable, and the summer season dummy variable. In the processed grower price equation, the average seasonal grower price for processed potatoes (in dollars per cwt) is a function of QGP, the amount of potatoes utilized for

processing (in tons), the time trend variable, the spring season dummy variable, and the fall season dummy variable. QGP is never defined by Nicks (2004), although through context, I assume QGP stands for government purchases of processed potato. In the demand for storage equation, Nicks (2004) does not clearly define the dependent variable. From context the dependent variable would appear to be the future season's amount of potato inventory at the beginning of period $t+1$ (in tons). The future season's amount of potato inventory at the beginning of period $t+1$ (in tons) is a function of the average seasonal deflated potato grower price for all potatoes (in dollars per cwt), the amount of farm potato output supplied to the market (in tons), the interest rate, the winter season dummy variable, the spring season dummy variable, and the time trend variable. Nicks (2004) provides hypotheses on how the variables affect the dependent variables.

For the farm-level inverse demand function of fresh potatoes, Nicks (2004) finds an R-squared of 0.73 and an adjusted R-squared of 0.69. The variables that are found to be statistically significant are potato farm quantity supplied, time trend variable and fresh potato retail price. The government purchases are found to be statistically insignificant and have a negative sign on the coefficient, which is opposite of what is predicted. For the farm-level supply of fresh potatoes, Nicks (2004) finds an R-squared of 0.99 and an adjusted R-squared of 0.99. Having a .99 R-squared could imply multicollinearity problems. As an aside, it is impossible to have the R-squared and adjusted R-squared that are the same. Nicks' (2004) reported of the R-squared and adjusted R-squared could be a rounding error or a typo. The variables that are statistically significant are per acre expenditures, spring season, summer season, and fall season dummy variables.

For the retail-level price for fresh potatoes, Nicks (2004) finds an R-squared of 0.72 and an adjusted R-squared of 0.67. The variables that are found to be statistically significant are farm price, personal consumption expenditures, the previous season's retail price and the fall season dummy variable. Government purchases are found to have a negative coefficient and are statistically insignificant. This result also is opposite of what is hypothesized.

For the processed potato farm-level price, Nicks (2004) finds an R-squared of 0.53 and an adjusted R-squared of 0.48. The variables that are found to be statistically significant are the time trend dummy variable and the spring season dummy variable. The government purchases of processed potatoes are found to have a negative coefficient but are statistically insignificant. For the demand for stocks, Nicks (2004) finds an R-squared of 0.97 and an adjusted R-squared of 0.97. The variables that are statistically significant are quantity of farm potatoes supplied, the average seasonal potato grower price, the winter season dummy variable, the spring season dummy variable, and the time trend variable (Nicks 2004).

When reviewing Nicks' (2004) results some obvious variables are missing from the model. For example, for the farm-level inverse demand of both potatoes and tomatoes, the price of substitutes is omitted with no explanation. For farm-level supply of both tomatoes and potatoes, input costs are omitted as well with no explanation.

Nicks' (2004) thesis has an additional limitation as well. Though Nick's (2004) two commodities are largely produced in the United States, the amount of commodity procurements of tomatoes and potatoes that the government purchases is about 1% of the total production of the two commodities. There are many commodities purchased under the CPP that have 15% of their total production purchased. Perhaps the reason Nicks (2004) found no statistical significance for the government purchases variable is because her commodities are not purchased

in a high enough percentage of the total crop. Nicks (2004) also does not consider the possibility that the government purchases could be endogenous. The largest quantity of purchases tends to happen when the price is low. The government purchases being endogenous could cause a negative sign on the government purchases coefficient.

Another study was done by the National Food and Agricultural Policy Project (2001), who analyzed the farm-level price effects of the CPP of fresh fruits and vegetable. The paper is short and does not state the model or variables used in the estimation. It does state that the quantity supplied of the crop is assumed fixed once the government purchase happens. The study found small increases in farm-level price from the CPP purchases of fresh fruits and vegetables. The study states that occasionally the amount of money spent on the purchases is more than the amount of money gained by the farmers. How often the purchase cost is larger than the money gained by the farmers is not stated in the study (Arizona State University 2001).

Chapter 3 - Theoretical and Empirical Models

Using the background information discussed in Chapter 2, a theoretical model of the effects of commodity procurements on the farm-level price is constructed. A study by Larry G. Traub is also used to help construct the theoretical model. Once the theoretical model is constructed, a mathematical and empirical model is applied.

3.1 Graphical Illustration of the Theoretical Model

The economic theory behind Bonus Buys and Entitlement Buys on their commodity markets are different. The theory behind both is explained well by Larry G. Traub in *Influences on U.S. Direct Food Purchase Program (1984)*. Traub's (1984) objective is to identify the variables that influenced the AMS's decision to purchase commodities. Although, Traub's (1984) intent was not to estimate a model showing the effects of the CPP on prices, he defined the theoretical expectations of the CPP in his work, which apply to how the CPP may impact price and production and help to inform the analysis being undertaken in this thesis.

In *Influences on U.S. Direct Food Purchase Program*, Traub (1984) examines the economic and political events that lead to a Section 32 procurement. Traub (1984) explains that \$7.3 billion is spent on the program annually and hence understanding how and why this money is spent is important. His research benefits the individuals, who are regular participants in the Section 32 procurements. Traub's (1984) research helps those individuals to be able to better predict the Section 32 purchases.

Traub's (1984) work is unique in that, to my knowledge, no other work has been done to examine this problem. In Traub's (1984) work, he outlines a basic legislative history, an explanation of the receipts, the disbursement of funds across feeding programs, the commodity procurement process, the importance to school's commercial market purchases, the importance

to expenditure and production, and the economics of Section 32 purchases. With this information, Traub (1984) builds his theoretical model as to what he believes would influence the total expenditure of one commodity by the U.S. Direct Food Purchase Program.

Traub's (1984) explanation of the economics of Section 32 relates directly to this thesis work. Traub (1984) describes how the commodity purchases expand the demand for different commodities, which is intended to alleviate some of the downward price pressures of a surplus. The application of Traub's (1984) work to this thesis is further described in the theoretical model.

The data used by Traub (1984) includes the direct purchase program in total expenditure by commodity on an annual basis from 1968-1981, farm and parity prices and production, quantity statistics of every commodity disseminated by the National School Lunch Program, and statistics on population of school aged children. With this data, Traub's (1984) empirical model used regression analysis.

The equation Traub (1984) used for the linear regression is:

$$E_{i,j} = a + b_1C_{j,k} + b_2D_{i,j} + b_3F_{i,j} + b_4G_j + b_5H_{i,j} + b_6I_{i,j} + b_7J_{i,j} + b_8K_{i,j} + e_i \quad (1)$$

where E is the dependent variable representing expenditure for purchases in the direct purchase program funded from Section 32 in thousands of dollars deflated by the gross national product implicit price deflator; i denotes the agricultural commodity; j denotes the fiscal year; k is the crop year; a is the intercept; b_i represents the parameters; C is the farm price deflated by its own parity price; D is the lagged farm price deflated by its own parity price; F is the lagged expenditure for the direct purchase program funded from Section 32 in thousands of dollars deflated by the GNP implicit price deflator; G is the larger of either the budgeted amount for the direct purchase and diversion programs or the actual outlay for the direct purchase program in

thousands of dollars, deflator; H is the quantity distributed to schools participating in the National School Lunch Program funded from Section 6 in thousands of pounds on a farm-weight basis; I is a binary variable in which 1 represents years when own farm price is equal to or greater than its own parity price and zero for years when its own farm price is less than its own parity price; J is the population of school age children (6-18 years), in thousands of persons; K is the farm price deflated by its own parity price of commodities that compete for the same program funds; and e is the error term (Traub 1984).

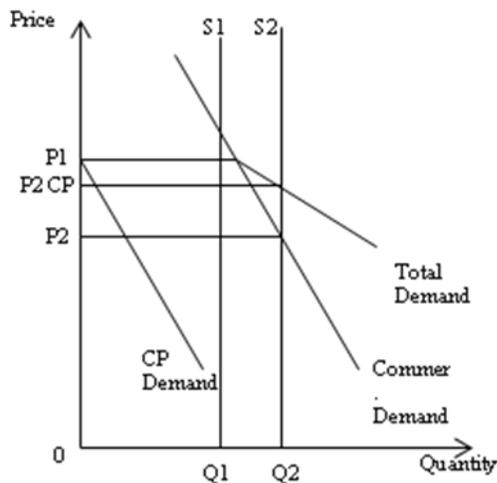
Since Traub (1984) estimates the above equation for 21 different commodities independently, the results vary by commodities. Cumulatively Traub's (1984) results show that the variables with the largest effect on the size and type of commodity procurement are farm price, previous year's program support, and the size of the budget. The variable for the population of school aged children was not significant. These results imply that drops in the commodity prices are the most notable reason for a purchase, which creates signals for the vendors that a drop in price could lead to a purchase. The limitation of Traub's (1984) analysis is that the program has changed since 1984. The ability to buy based on the price being lower than parity prices no longer exists. Nevertheless, his theoretical explanation of the CPP of how bonus buys and entitlement buys theoretically should affect prices is applicable. Also Traub's (1984) work identifies the variables affecting the commodity procurement demand curve. The identification of the variables affecting the demand curve for commodity procurement is important for the justification of this thesis's models and their empirical estimations.

3.1.1 Bonus Buys

The theory behind the Bonus Buy's function in the commodity markets is outlined well by Traub (1984). Traub (1984) explains how the commodity purchases expand the demand for

the different commodities, which is intended to alleviate some of the downward price pressures of a surplus. Figure 1 illustrates how the Bonus Buys purchases are meant to alleviate the downward price pressures at either the processor or farm-level. Traub (1984) does not state which level but his work is applicable to both the processor-level and farm-level. Traub (1984) assumes supply to be perfectly inelastic. Total demand is the horizontal sum of commercial demand and procurement demand. When the quantity supplied occurs between zero and S1, the price received will only be determined by the commercial demand curve. Once the quantity supplied moves beyond S1, for example to S2, the quantity demand will be affected by both the private and procurement demand. Figure 1 shows that at Q1, the price is only affected by the commercial demand. Also Figure 1 shows that when Q2 is the quantity produced, the price received without the procurement demand is P2 and with the procurement demand, the price is P2CP. This shows that the increase in demand by the government should theoretically increase price.

Figure 1 – Hypothesized Effects of 32C Purchases on Demand



(Based on Traub 1984, p. 16)

Once the conditions are met for the commodity to be considered in “extreme surplus” by the government analyst and the purchase occurs, total demand then consists of both private and procurement demand with a positive effect on price. Traub (1984) explains that if the purchases

occur because of rare events that cause market distortions, the producers will most likely not include these events in their long-run production decisions because these events are rare. On the other hand, if the purchases occur on a regular basis, then the producers most likely will consider the procurement demand as a part of their long run demand curve causing a supply shift.

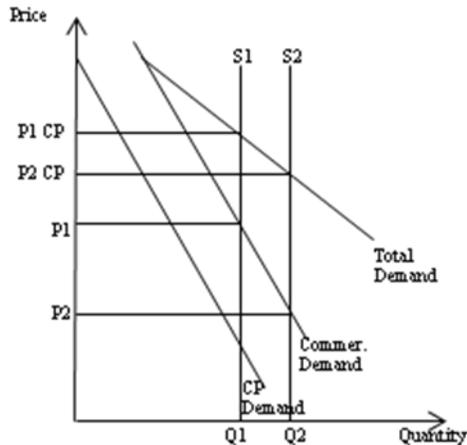
3.1.2 Entitlement Buys

The economic theory that Traub (1984) explains can be modified to describe the effects of Entitlement Buys on demand. Only 32R Entitlement Buys are meant to support prices by expanding the demand for the commodities. The FNS funds are not required support prices. Although since the FNS funds increase demand the same as 32R funds, the FNS funds probably have similar effects on price as the 32R funds.

Figure 2 illustrates how the Entitlement Buys are intended to increase demand. Assuming perfectly inelastic supply, the total demand is the sum of commercial demand and procurement demand. When the FNS feeding programs require food, the added procurement demand will cause an outward shift of the total demand. The quantity supplied and price will be determined by the commercial demand only when there is no procurement demand for a commodity. Figure 2 shows that when Q_1 is the quantity supplied, the price received without the procurement demand is P_1 . With the procurement demand, the price is P_1CP . This shows that the increase in demand by the government should theoretically increase price. Entitlement Buys occur on a regular basis and Traub (1984) concludes that the producers most likely would consider the procurement demand as a part of their long run demand curve causing a supply shift outward once more suppliers enter the market or current suppliers increase their production. This supply shift is shown in Figure 2 by the shift from S_1 to S_2 . The quantity supplied is Q_2 .

The price received without procurement demand would be P_2 and the price received with procurement demand would be P_2CP .

Figure 2 - Hypothesized Effects of FNS funds on Demand



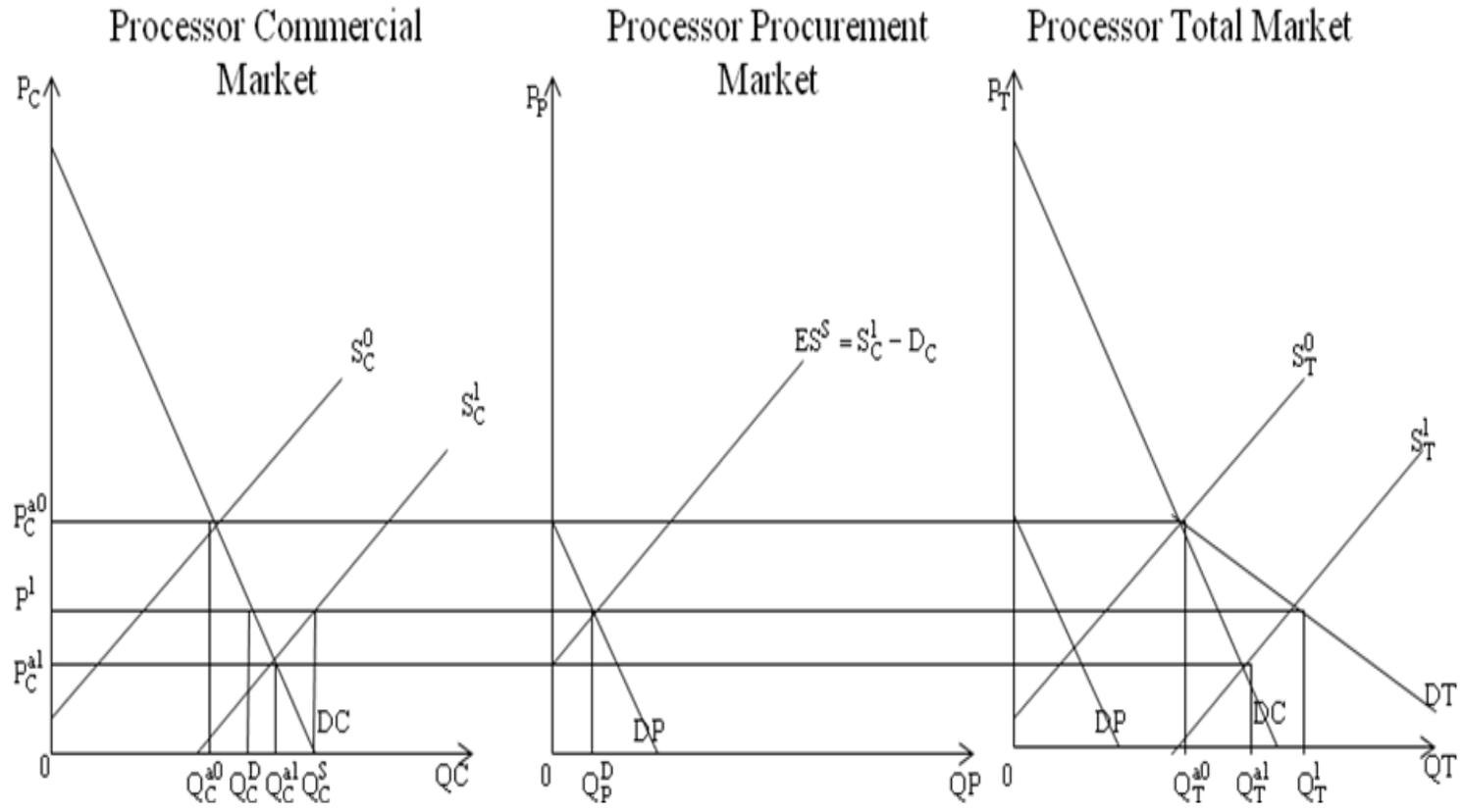
(Based on Traub's (1984) work and Entitlement Buy background)

With entitlement buys and bonus buys there are different price thresholds at which the government enters the market. The price threshold at which the government enters the market for Entitlement Buys is higher than that of Bonus Buys. The demand for Entitlement Buys and Bonus Buys can be combined into one government demand.

3.1.3 Implications from Traub's Work

Traub's (1984) model for the total market consists of a commercial market component and a procurement market component. By considering these markets separately it becomes easier to see the relationship between the two markets.

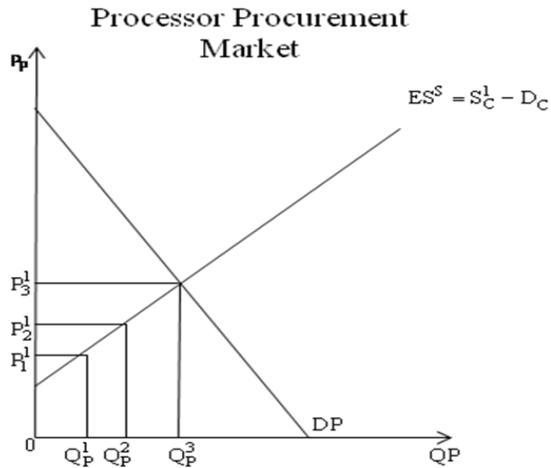
Figure 3 - Hypothesized Procurement Effects on the Processors' Commercial and Total Markets



In Figure 3, the initial equilibrium is price and quantity is at P_c^{a0} and Q_c^{a0} , which is the autarky price and quantity. Autarky is defined as the self-sufficient price and quantity, which is unaffected by the Federal CPP. At the autarky price and quantity total market of the processor is not affected by the processor procurement market because at this price the government does not enter the market. When the farm-level supply shifts out, the farm price falls. The farm price decrease has two effects. First the processors begin to supply more because the input price is lower. Second the government begins to consider purchasing because of the lower prices. In Figure 3, the processor's supply in the commercial market is shifting out because of the lowering input costs from S_c^0 to S_c^1 . Once the commercial market's supply curve has shifted out, the autarky price on the commercial market is lowered to P_c^{a1} and the autarky quantity is increased to Q_c^{a1} . Now that the processor market price has dipped below the reservation price for government procurement, the procurement market's demand curve (DP) is added to the commercial market's curve (DC) to create an increased total demand curve (DT). The added demand causes the new autarky price, P_c^{a1} , and quantity, Q_c^{a1} , to not be the price and quantity observed on the market. The price and quantity are dictated by the combined commercial and procurement market demand curves. The total quantity supplied to the processor market is Q_T^1 and the price received for that quantity is P^1 . The quantity demanded in the processor commercial market is Q_c^D . Since there is not enough demand in the commercial market for quantity supplied when the price is at P^1 , there is an excess supply curve. The quantity demanded by the processor procurement is where the excess supply curve ES^1 equals DP. The quantity demanded by the processor procurement is Q_P^D . The quantities demanded by both markets equal the quantity supplied to the commercial market (Q_c^S), which also equal the quantity supplied in the total market, (Q_T^1).

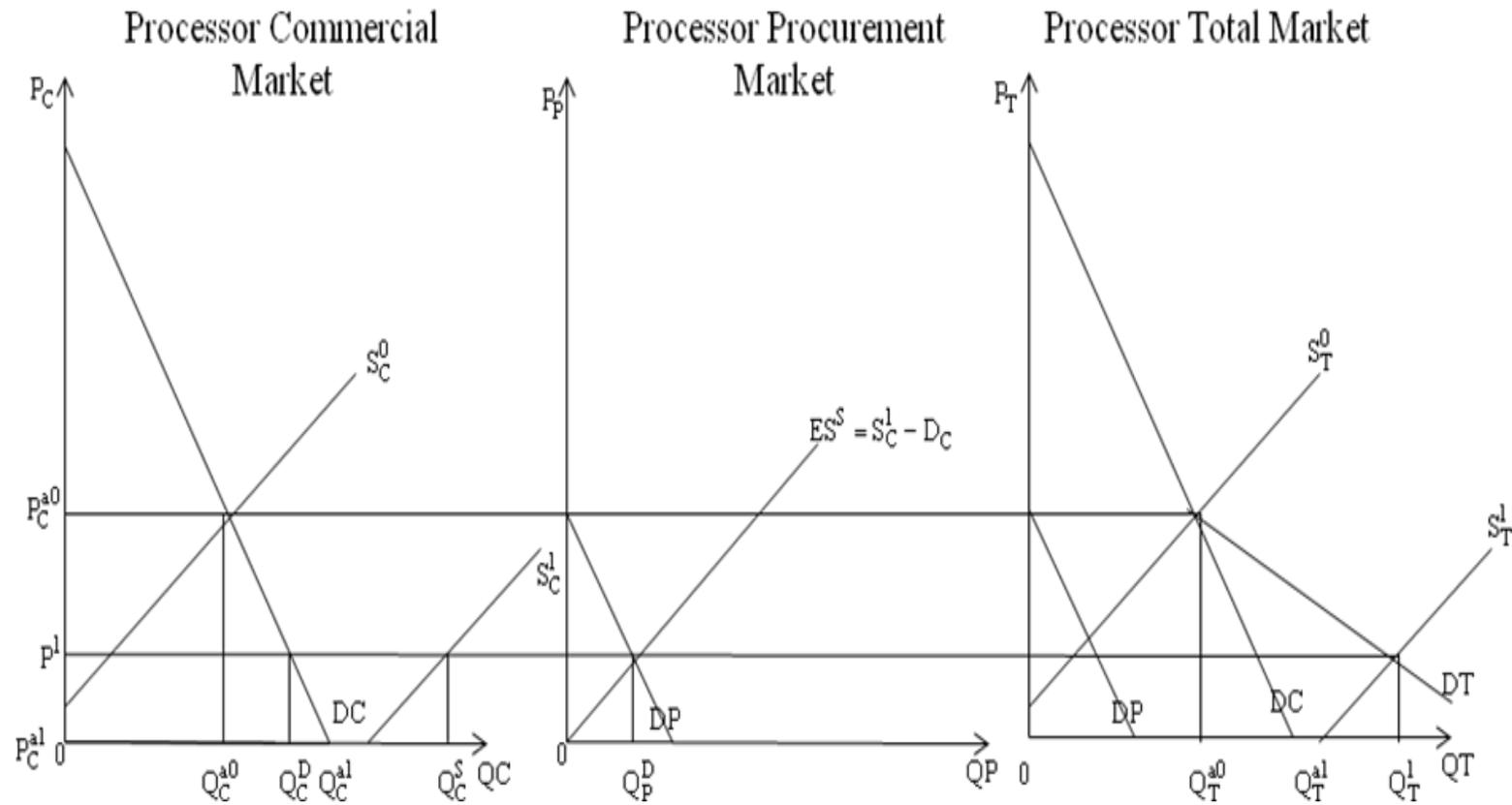
A more detailed version of the processors' procurement market graph provides an illustration of how the bidding system functions. Figure 4 is an enlarged processor procurement graph. In Figure 4, Firm 1 bids their marginal costs at P_1^1 , and supplies the quantity that correlates with P_1^1 from the Firm 1's individual supply and demand curves, which is Q_P^1 . Since Firm 1 cannot supply the whole quantity demanded by USDA, Firm 2 supplies the amount of $Q_P^2 - Q_P^1$ at P_2^1 . Firm 3 supplies the remainder of the quantity demanded by the USDA of $Q_P^3 - Q_P^2$ at P_3^1 , which is also the market price, P^1 .

Figure 4 - Detailed Version of the Processors' Procurement Market



Also a special case of the effects of the procurement market demand provides an example of how large and important a role the processor procurement market can have on the farm market. In Figure 5, the supply in the processor commercial market has shifted out beyond the processor's commercial market demand due to a large increase in supply at the farm-level.

Figure 5 - Procurement Effects from a Supply Shift beyond Processors' Commercial Market Demand



The new autarky price, P_c^{a1} , is at zero and the autarky quantity is at Q_c^{a1} . Once the procurement demand is added to the commercial market demand the price rises to P^1 . The quantity demanded by the commercial market is Q_c^D and the quantity demanded by the procurement market is Q_P^D , which equals the total quantity supplied in the commercial market, Q_c^S or Q_T^1 . The increase in the processor's total demand allows for excess supply at the farm-level to be absorbed, when it would not have been otherwise. The excess supply at the farm-level is absorbed because of the increase in demand at the farm-level. The relationship between the increase in demand at the processor-level and the increase in the demand at the farm-level is made clear through an explanation of vertically related markets.

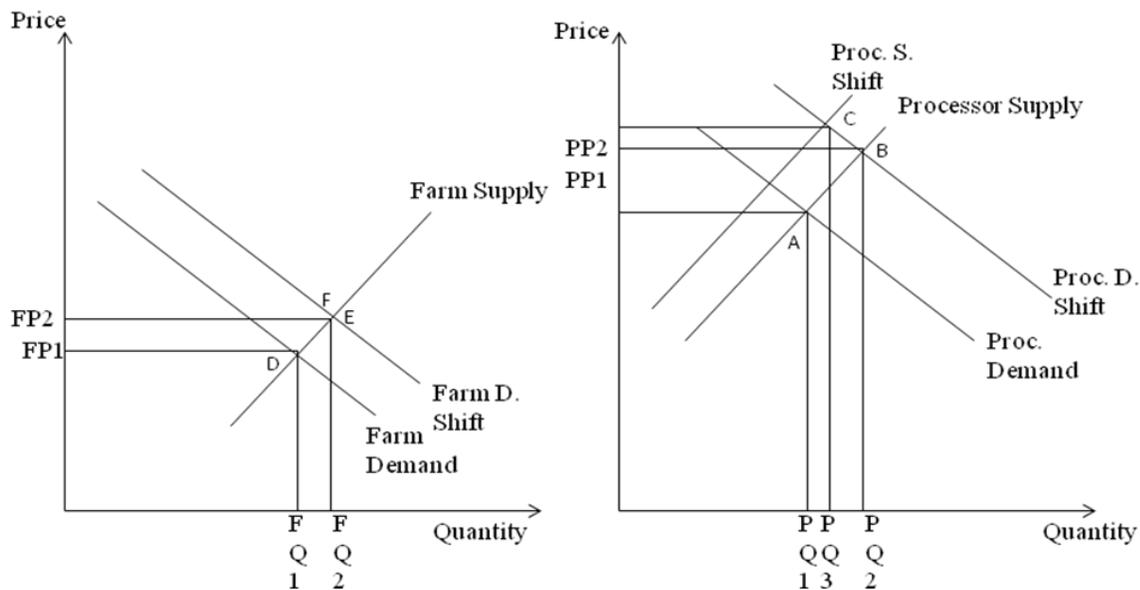
3.1.4 Vertically Related Markets

Since fruits and vegetables are perishable, most of the fruit and vegetable commodity procurements are of value-added fruit and vegetable products to provide a longer shelf life. Value-added fruits and vegetables include canned, frozen, dried, juiced, dehydrated, and pureed fruits and vegetables. Since the procurements happen at the processor-level, qualitatively Traub's (1984) work implies a shift out in the processor demand when the procurement demand is included. This leads to the question of what will happen to the farm-level price of a raw commodity when there is an increase in commodity procurements of the processed commodity.

The theory of vertically related markets needs to be applied (Wohlgenant 1989; Wohlgenant 2001). The markets for the value-added fruit and vegetables and the raw fruits and vegetables are connected through the raw fruits and vegetables being an input into the valued-added fruits and vegetables. The quantity demand for commodity procurements according to theory should increase the demand for the valued-added fruits and vegetables causing the processor demand curve to shift out. The increase in processor demand will increase the demand

for valued-added inputs, one of which is raw fruit and vegetables. This causes the farm demand to shift out, which in turn causes the farm price to increase. The increase in farm prices causes an increase in the price which the processor must pay for the input. This increase in turn causes a shift in the processor supply curve. This process continues until the effects of the procurement purchases stabilize. These stages are illustrated in Figure 6, where the demand curves depicted are the total demand for each market level.

Figure 6 - Procurement Demand Shift Effects



The effects of the procurement demand shifts at the processor-level partial and final reduced forms can be seen in Figure 6. The shift out in the processor-level demand is caused by the added demand from commodity procurements. The processor-level demand shift causes an increase in processor-level price from PP1 to PP2 and an increase in processor-level quantity from PQ1 to PQ2. The processor-level equilibrium shifts from A to B. At the farm-level, the demand curve shifts out because of the increase in the processor-level price. The processor-level partial reduced form holds the farm-level price constant and the farm-level quantity increases from FQ1 to FQ2. The farm-level equilibrium shifts from D to E. The final reduced form

effects for the processor-level occur when the farm-level price is allowed to vary; and an increase in price for raw fruit and vegetables is seen in Figure 6 from equilibrium E to F. The farm-level price increase causes an inward shift of the processor-level supply curve. This causes another increase in processor-level price from PP2 to PP3 and a decrease in processor-level quantity from PP2 to PP3. The processor-level equilibrium moves from B to C.

The effects of the procurement demand shifts at the farm-level partial and final reduced forms can be seen in Figure 6. The farm-level partial reduced form does not hold the farm-level price constant. The farm-level demand curve shifts out because of the increase in the processor-level price. The farm-level price increases from FP1 to FP2; and the quantity increases from FQ1 to FQ3. The farm-level equilibrium shifts from D to F. In the farm-level partial reduced form, the quantity demanded of commodity procurements does not have a direct effect on the farm-level demand shift because these effects work through the processor-level price. The farm-level final reduced form appears in Figure 6 graphically the same as the farm-level partial reduced form, except now the quantity demanded of commodity procurements does have a direct effect on the farm-level demand shift. The small shift inward of the processor-level supply and the small increase in the processor-level price causes a small shift in the farm-level demand. This process continues until both market-levels reach a stable equilibrium. Once the markets reach a stable equilibrium, the final reduced forms are revealed. Showing this process graphically is difficult so it is assumed that equilibrium C and F are the final equilibriums.

From Figure 6, the partial and final reduced form effects of the quantity demand of commodity procurements on farm-level and processor-level price and quantity can be seen. In the partial reduced form, the quantity demanded of commodity procurements has no direct effects on the farm-level and increases processor-level quantity and price. In the final reduced

form, the effects of quantity demanded of commodity procurements on the farm-level are an increase in farm prices and quantity from the autarky price and quantity. In the final reduced form, the effects of the quantity demanded of commodity procurements on the processor-level are a larger increase of processor price than in the partial effects and a smaller increase in quantity than in the partial effects.

3.2 Mathematical Model

This graphical explanation can be used to shape the mathematical and empirical approaches to constructing the estimation model.

3.2.1 Farm-Level Quantity Supplied and Demanded

The quantity supplied of raw fruit and vegetables (Q_{FS}) is assumed to be perfectly inelastic. This assumption is made for multiple reasons. First, the farm-level supply is assumed perfectly inelastic by Traub and Wohlgenant. Second, the farm-level quantity supplied adjusts slowly to changes in the market, since the peach trees require five years to mature and yield a full crop. Third, the industries perceive that commodity procurements do not affect the farm-level quantity supplied. The farm-level supply is denoted as,

$$Q_{FS} = f(\underset{+}{P_{FO}}, \underset{-}{P^{FS}}, \underset{-}{\mathbf{W}_F}, \underset{?}{\mathbf{Z}_{FS}}) \quad (2)$$

The subscripts on each independent variable indicate whether there is an expected negative or positive relationship between the independent variable and dependent variable. For example the positive symbol under farm own price indicates that when farm own price increases the quantity supplied is expected to decrease.

The quantity demanded for raw fruits and vegetables (Q_{FD}) is a function of farm-level price (P_{FO}), processor-level price (P_{PO}), a vector of processor-level input costs (\mathbf{W}_P), and a vector of other factors affecting processor-level supply (\mathbf{Z}_{PS}). The farm demand function is denoted as:

$$Q_{FD} = f(P_{FO}, P_{PO}, \mathbf{W}_P, \mathbf{Z}_{PS}) \quad (3)$$

- + - ?

3.2.2 Processor-level Quantity Supplied and Demanded

The quantity supplied of value added fruit and vegetables (Q_{PS}), is a function of farm-level price (P_{FO}), processor-level price (P_{PO}), a vector of processor-level input costs (\mathbf{W}_P), and a vector of other factors affecting processor-level supply (\mathbf{Z}_{PS}). The processor supply function is denoted as,

$$Q_{PS} = f(P_{FO}, P_{PO}, \mathbf{W}_P, \mathbf{Z}_{PS}) \quad (4)$$

- + - ?

Equation (4) has the same independent variables as equation (3) but a different dependent variable. This is because the raw commodity is an input to the processed commodity. The demand for the raw commodity depends on the amount demanded by the processor. The amount the processor decides to supply is based on the variables listed for processor supply, which follows that the variables listed for processor supply also determines farm-level demand.

The quantity demanded for value added fruits and vegetables (Q_{PD}), is a function of processor-level price (P_{PO}), a vector of price of substitutes (\mathbf{P}_{PS}), income (Y), and a vector of other factors affecting the processor-level quantity demanded (\mathbf{Z}_{PD}). The processor demand function is denoted as,

$$Q_{PD} = f(P_{PO}, \mathbf{P}_{PS}, Y, \mathbf{Z}_{PS}) \quad (5)$$

- + + ?

3.2.3 Commodity Procurement Quantity Demanded

The processor's total demand is a function of the processor demand and the procurement demand as discussed earlier. The quantity demanded of commodity procurements is a functions of the variables found to be significant in Traub's (1984) work. The quantity demanded of

commodity procurements (CP_{QD}) is a function of the current year's farm-level price (P_{FO}), the previous year's program support ($TC_{CP(t-1)}$), and the size of the current year's budget (TC_{CP}).

The processor procurement demand function is denoted as,

$$CP_{QD} = f(P_{FO}, TC_{CP}, TC_{CP(t-1)}) \quad (6)$$

These variables shown by Traub to be significant are also shown to be significant determinants by the commodity procurement selling process. As previously stated, the FNS surveys show the demand for a particular type and amount of food, and the demand translates in budgeted amount to spend on each commodity. The detailed CPP structure also explains that the farm-level price is a significant variable in deciding if there is to be a purchase using the CPP funds.

3.2.4 Farm-level and Processor-level Market Clearing Conditions

The following equations are the entire structural model and marketing clearing conditions for the farm-level and processor-level assuming perfect competition.

$$Q_{FS} = f(P_{FO}, P^{FS}, W_F, Z_{FS}) \quad (2)$$

$$Q_{FD} = f(P_{FO}, P_{PO}, W_P, Z_{PS}) \quad (3)$$

$$Q_{PS} = f(P_{FO}, P_{PO}, W_P, Z_{PS}) \quad (4)$$

$$Q_{PD} = f(P_{PO}, P_{PS}, Y, Z_{PS}) \quad (5)$$

$$CP_{QD} = f(P_{FO}, TC_{CP}, TC_{CP(t-1)}) \quad (6)$$

$$Q_{FS} = Q_{FD} \quad (7)$$

$$Q_{PD} + CP_{QD} = Q_{PS} \quad (8)$$

where equation (7) is the farm-level market clearing condition; and equation (8) is the processor-level market clearing condition. The partial reduced form equation for the farm-level price is obtained by setting equal equations (2) and (3) as shown in equation (7), and solving for the

farm-level price (P_{FO}). The partial reduced form equation for the processor-level price is obtained by setting the sum of equations (5) and (6) equal to equation (4) as shown in equation (8) and solving for the processor-level price (P_{PO}). When equation (5) and equation (6) are summed together, CP_{QD} is not substituted for the variables of which it is a function because the hypotheses of this thesis are pertaining to the quantity demanded of commodity procurements.

The final reduced form equation for the processor-level price is created by substituting in the partial reduced form equation for the farm-level price into the partial reduced form equation for the processor-level price and solving for the processor-level price (P_{PO}). The final reduced form equation for the farm-level price is created by substituting the final reduced form equation for the processor-level price into the partial reduced form equation for the farm-level price and solving for the farm-level price (P_{FO}).

3.3 Empirical Model

3.3.1 CPP's Effects on Price

The theoretical model defined assumes that the quantity supplied on the farm-level is constant or perfectly inelastic. The perfectly inelastic supply assumption simplifies the model and conserves degrees of freedom. The farm-level supply will be assumed perfectly inelastic following Wohlgenant (1989) and Traub (1984) precedence.

The theoretical model can be used to build an empirical model. The empirical supply and demand equations representing equations (2) and (3) for the raw fruits and vegetables in linear form are:

$$Q_{FS} \text{ (assumed perfectly inelastic)} \tag{9}$$

$$Q_{FD} = \beta_0 + \beta_1 P_{FO} + \beta_2 P_{PO} + \beta_3 \mathbf{W}_P + \beta_4 \mathbf{Z}_{PS} + e_{FD} \tag{10}$$

where, β_i are the farm-level demand parameters; Q_{FS} is the perfectly inelastic farm-level quantity supplied; and e_{FD} is farm-level demand error. The signs expected on the parameters $\beta_1 \leq 0$, $\beta_2 \geq 0$, $\beta_3 \leq 0$; and β_4 has an unknown sign.

The empirical supply and demand representing equations (4) and (5) for the value-added fruits and vegetables in linear form are:

$$Q_{PS} = \lambda_0 + \lambda_1 P_{FO} + \lambda_2 P_{PO} + \lambda_3 \mathbf{W}_P + \lambda_4 \mathbf{Z}_{PS} + e_{PS} \quad (11)$$

$$Q_{PD} = \gamma_0 + \gamma_1 P_{PO} + \gamma_2 \mathbf{P}_{PS} + \gamma_3 Y + \gamma_4 \mathbf{Z}_{PD} + e_{PD} \quad (12)$$

where, γ_i are the processor demand parameters; λ_i are the processor supply parameters; e_{PD} is processor demand error; and e_{PS} is processor supply error. The signs expected on the parameters are $\lambda_1 \leq 0$, $\lambda_2 \geq 0$, $\lambda_3 \leq 0$, $\gamma_1 \leq 0$, $\gamma_2 \geq 0$, $\gamma_3 \geq 0$; and λ_0 , λ_4 , γ_0 , and γ_4 have unknown signs.

The empirical demand representing equation (6) for commodity procurements of value-added fruits and vegetables in linear form is:

$$CP_{QD} = \delta_0 + \delta_1 P_{FO} + \delta_2 TC_{CP} + \delta_3 TC_{CP(t-1)} + e_{CPD} \quad (13)$$

where, δ_i are the processor procurement demand parameters; e_{CPD} is processor procurement demand error. The signs expected on the parameters are such that $\delta_1 \leq 0$, $\delta_2 \geq 0$, $\delta_3 \geq 0$; and δ_0 has an unknown sign.

3.3.1.1 Partial Reduced Forms

The farm-level partial reduced form price equation is derived by setting equations (9) and (10) equal and solving.

$$P_{FO} = \frac{1}{(\beta_1)} Q_{FS} - \frac{\beta_0}{(\beta_1)} - \frac{\beta_2}{(\beta_1)} P_{PO} - \frac{\beta_3}{(\beta_1)} \mathbf{W}_P - \frac{\beta_4}{(\beta_1)} \mathbf{Z}_{PS} - \frac{1}{(\beta_1)} e_{FD}$$

Or

$$P_{FO} = \sigma_0 + \sigma_1 Q_{FS} + \sigma_2 P_{PO} + \sigma_3 \mathbf{W}_P + \sigma_4 \mathbf{Z}_{PS} + v \quad (14)$$

where, σ_i are the farm-level partial reduced form equation parameters, which are a combination of the previously described parameters; and v is the error term from the farm-level demand curve divided by the farm-level demand parameter on the farm-level price. It is important to note that the quantity demanded of commodity procurements has no direct effect in the farm-level partial reduced form price equation. Since there are no direct effects from the quantity demanded of commodity procurements on the farm-level price, the farm-level partial reduced form price equation is not used to test any hypotheses.

The processor-level partial reduced form price equation is derived by adding equations (12) and the left-hand side of (13) and setting them equal to equation (11) and solving for price.

$$\begin{aligned} P_{PO} = & \frac{\lambda_0}{(\gamma_1 - \lambda_2)} - \frac{\gamma_0}{(\gamma_1 - \lambda_2)} + \frac{\lambda_1}{(\gamma_1 - \lambda_2)} P_{FO} + \frac{\lambda_3}{(\gamma_1 - \lambda_2)} \mathbf{W}_P - \frac{\gamma_2}{(\gamma_1 - \lambda_2)} \mathbf{P}_{PS} \\ & - \frac{\gamma_3}{(\gamma_1 - \lambda_2)} Y - \frac{1}{(\gamma_1 - \lambda_2)} CP_{QD} + \frac{\lambda_4}{(\gamma_1 - \lambda_2)} \mathbf{Z}_{PS} - \frac{\gamma_4}{(\gamma_1 - \lambda_2)} \mathbf{Z}_{PD} \\ & + \frac{1}{(\gamma_1 - \lambda_2)} e_{PS} - \frac{1}{(\gamma_1 - \lambda_2)} e_{PD} \end{aligned}$$

Or

$$P_{PO} = \kappa_0 + \kappa_1 P_{FO} + \kappa_2 \mathbf{W}_P + \kappa_3 \mathbf{P}_{PS} + \kappa_4 Y + \kappa_5 CP_{QD} + \kappa_6 \mathbf{Z}_{PD} + \kappa_7 \mathbf{Z}_{PS} + \varepsilon \quad (15)$$

where, κ_i are the processor-level partial reduced form price equation parameters, which is a combination of the previously described parameters; and ε is the combined error term from the processor-level supply curve and the demand curve divided by the difference in the processor-level demand and supply parameters on the processor-level price. Of particular interest is the sign on the parameter of CP_{QD} , or $\mu_5 = \frac{\kappa_5}{1 - \kappa_1 \sigma_2}$. Since γ_1 is less than zero, and

λ_2 is greater zero based on theory, κ_5 is hypothesized to be greater than zero.

As shown graphically, the partial effects of the quantity demanded of commodity procurements have no direct effect on the farm-level. Estimating the farm-level partial reduced form price equation, equation (14), provides no extra information on how the quantity demanded of commodity procurements effects farm-level prices since the quantity demanded of commodity procurement is not an explanatory variable in equation (14). The processor-level partial reduced form price equation, equation (15), is worth estimating to know the effects of the quantity demanded of commodity procurements on the processor-level price and quantity, while the farm-level price and quantity are held constant. The estimation of equation (15) can be used to test the hypothesis that the quantity demanded of commodity procurements has a positive effect on the processor-level price when the farm-level response is held constant. In mathematical form the hypothesis is:

$$H_0: \kappa_5 = 0; H_1: \kappa_5 > 0.. \quad (16)$$

3.3.1.2 Final Reduced Forms

Using both the partial reduced form equations, equations (14) and (15), the processor-level final reduced form price equation can be created. The processor-level final reduced form price equation is derived by substituting (14) into (15) and solving.

$$\begin{aligned} P_{PO} = & \left(\frac{\kappa_0}{1 - \kappa_1 \sigma_2} \right) + \left(\frac{\kappa_1 \sigma_0}{1 - \kappa_1 \sigma_2} \right) + \left(\frac{\kappa_1 \sigma_1}{1 - \kappa_1 \sigma_2} \right) Q_{FS} + \left(\frac{\kappa_1 \sigma_3}{1 - \kappa_1 \sigma_2} \right) \left(\frac{\kappa_2}{1 - \kappa_1 \sigma_2} \right) \mathbf{W}_P \\ & + \left(\frac{\kappa_3}{1 - \kappa_1 \sigma_2} \right) \mathbf{P}_{PS} + \left(\frac{\kappa_4}{1 - \kappa_1 \sigma_2} \right) Y + \left(\frac{\kappa_5}{1 - \kappa_1 \sigma_2} \right) CP_{QD} \\ & + \left(\frac{\kappa_6}{1 - \kappa_1 \sigma_2} \right) \left(\frac{\kappa_1 \sigma_4}{1 - \kappa_1 \sigma_2} \right) \mathbf{Z}_{PS} + \left(\frac{\kappa_7}{1 - \kappa_1 \sigma_2} \right) \mathbf{Z}_{PD} \\ & + \left(\frac{1}{1 - \kappa_1 \sigma_2} \right) v + \left(\frac{1}{1 - \kappa_1 \sigma_2} \right) \varepsilon \end{aligned}$$

Or

$$P_{PO} = \mu_0 + \mu_1 Q_{FS} + \mu_2 \mathbf{W}_P + \mu_3 \mathbf{P}_{PS} + \mu_4 Y + \mu_5 CP_{QD} + \mu_6 \mathbf{Z}_{PS} + \mu_7 \mathbf{Z}_{PD} + \zeta \quad (17)$$

where, μ_i are the processor-level final reduced form price equation parameter, which are a combination of the previously described parameters; and ζ is the combined error term from the processor-level partial reduced form price equation error and the farm-level partial reduced form price equation error divided by the difference in the parameters on the processor-level price. Of particular interest is the sign on the parameter of CP_{QD} , or

$$\mu_5 = \frac{\kappa_5}{1 - \kappa_1 \sigma_2}. \text{ The variable } \kappa_5 \text{ is greater than zero. Since } \kappa_1 \text{ is less than zero and } \sigma_2 \text{ is less}$$

than zero, κ_1 multiplied by σ_2 is greater than zero. The sign of the denominator, $1 - \kappa_1 \sigma_2$, depends on the size of $\kappa_1 \sigma_2$. If $\kappa_1 \sigma_2$ is less than one, μ_5 is positive. If $\kappa_1 \sigma_2$ is greater than one, μ_5 is negative. As Wohlgenant (1989) shows the denominator of $1 - \kappa_1 \sigma_2$ is expected to be positive in all normal cases, which implies that expected sign on CP_{QD} is positive.

The estimation of equation (17) can be used to test the hypothesis that the quantity demanded of commodity procurements has a positive effect on processor-level prices while allowing for the simultaneous changes in the farm-level price. In mathematical form, the hypothesis is:

$$H_0: \mu_5 = 0; H_1: \mu_5 > 0. \tag{18}$$

The estimation of equations (15) and (17) will determine if there is a larger increase in the processor-level price in the final-reduced form than in the partial reduced form as expected. Also it will determine if there is a smaller increase in the quantity in the final-reduced form than in the partial reduced form as expected.

The final reduced farm-level price function is derived by substituting (17) into (14) and solving.

$$P_{FO} = \sigma_0 + \sigma_2 \mu_0 + (\sigma_2 \mu_1 + \sigma_1) Q_{FS} + (\sigma_2 \mu_2 + \sigma_3) W_P + \sigma_2 \mu_3 P_{PS} + \sigma_2 \mu_4 Y + \sigma_2 \mu_5 CP_{QD}$$

$$+ (\sigma_2\mu_2 + \sigma_4)Z_{PS} + \sigma_6\mu_7Z_{PD} + v + \sigma_2$$

Or

$$P_{FO} = \pi_0 + \pi_1Q_{FS} + \pi_2W_P + \pi_3P_{PS} + \pi_4Y + \pi_5CP_{QD} + \pi_6Z_{PD} + \pi_7Z_{PS} + \omega \quad (19)$$

where, π_i are the farm-level final reduced form parameters, which are a combination of the previously described parameters; and ω is $v + \sigma_2$. Of particular interest is the sign on the parameter of CP_{QD} , or $\pi_5 = \sigma_2\mu_5$. The signs on μ_5 and σ_2 are greater than zero; and when multiplied together π_5 is greater than zero.

The farm-level final reduced form price equation, equation (19), would show that the effects of the quantity demanded of commodity procurements increases the farm-level price. The estimation of equation (19) can be used to test the hypothesis that the quantity demanded of commodity procurements has a positive effect on farm-level prices. In mathematical form the hypothesis is:

$$H_0: \pi_5 = 0; H_1: \pi_5 > 0 \quad (20).$$

Testing equation (20) answers the main question posed by this thesis. The processor-level final reduced form price equation, equation (17), would be useful to determine the total effects of the quantity demanded of commodity procurements on processor level price and quantity. Unlike the partial reduced form price equations, both final reduced form price equations, (17) and (19), show the total effects of the quantity demanded of commodity procurements on the farm-level and processor-level prices.

3.3.2 CPP's Effects on Variances

The CPP could also be supporting the processor-level canned peach price and farm-level canning peach price by stabilizing the prices. To stabilize the processor-level and farm-level prices, the CPP would need to be decreasing the variance of the prices. To test if the quantity

demand of commodity procurements decreases the variance of the farm-level price and the processor-level price, a Breusch-Pagan test for heteroskedasticity, focusing on the coefficient on quantity demanded of commodity procurement can be used.

Using the squared predicted error, $\hat{\varepsilon}^2$, from the processor-level partial reduced form price equation, equations (15), and the explanatory variables from the processor-level partial reduced form price equation, equations (15), the Breusch-Pagan test for the processor-level partial reduced form price equation can be derived. The Breusch-Pagan test for the processor-level partial reduced form price equation is:

$$\hat{\varepsilon}^2 = \rho_0 + \rho_1 P_{FO} + \rho_2 W_P + \rho_3 P_{PS} + \rho_4 Y + \rho_5 CP_{QD} + \rho_6 Z_{PD} + \rho_7 Z_{PS} + \tau. \quad (21)$$

The Breusch-Pagan test can be used to test the hypothesis that the quantity demanded of commodity procurements has a statistically significant decreasing effect on the variance of the processor-level price before the adjustment in input price is controlled. In mathematical form the hypothesis is:

$$H_0: \rho_5 = 0; H_1: \rho_5 < 0. \quad (22)$$

Using the squared predicted error, $\hat{\zeta}^2$, from the processor-level final reduced form price equation, equations (17), and the explanatory variables from the processor-level final reduced form price equation, equations (17), the Breusch-Pagan test for the processor-level final reduced form price equation is:

$$\hat{\zeta}^2 = \varphi_0 + \varphi_1 Q_{FS} + \varphi_2 W_P + \varphi_3 P_{PS} + \varphi_4 Y + \varphi_5 CP_{QD} + \varphi_6 Z_{PD} + \varphi_7 Z_{PS} + \eta. \quad (23)$$

The Breusch-Pagan test can be used to test the hypothesis that the quantity demanded of commodity procurements has a statistically significant decreasing effect on the variance of the processor-level price once the adjustment in input price is taken into account. In mathematical form the hypothesis is:

$$H_0: \varphi_5 = 0; H_1: \varphi_5 < 0. \quad (24)$$

Using the squared predicted error, $\hat{\omega}^2$, from the farm-level final reduced form price equation, equations (19), and the explanatory variables from the farm-level final reduced form price equation, equations (19), the Breusch-Pagan test for the farm-level final reduced form price equation is:

$$\hat{\omega}^2 = \theta_0 + \theta_1 Q_{FS} + \theta_2 W_P + \theta_3 P_{PS} + \theta_4 Y + \theta_5 CP_{QD} + \theta_6 Z_{PD} + \theta_7 Z_{PS} + \xi. \quad (25)$$

The Breusch-Pagan test can be used to test the hypothesis that the quantity demanded of commodity procurements has a statistically significant decreasing effect on the variance of the farm-level price once the adjustment in input price is taken into account. In mathematical form the hypothesis is:

$$H_0: \theta_5 = 0; H_1: \theta_5 < 0. \quad (26)$$

The discussion in Chapter 4 pertains to the data that represents the variables discussed in the theoretical model.

Chapter 4 –Data

Before there can be a discussion of the data used to estimate the model, the conceptual issues associated with data limitations and a possible endogenous variable need to be discussed. This discussion reveals that due to data limitations the number of variables in each equation has to be limited. The variables for each equation are selected using theoretical arguments and an equal number of variables from all the structural components of the market. Also this discussion reveals that instrumental variables need to be identified for a suspected endogenous variable. Once the variables and the identifying instruments are determined, the data representing these variables are discussed.

4.1 Conceptual Issues Affecting Data Selection

The first conceptual issue is a consequence of the data limitations. The data limitations are that the commodity procurement data only dates back to FY1979 on a yearly basis. The longest available span of data is from 1980-2007 with an annual frequency. Consequently, there are only 28 observations, which is a very limited amount. For this reason, a clear understanding of the degrees of freedom associated with the model that is to be estimated is required.

From the empirical model in Chapter 3, there are three equations that are to be estimated: the processor-level partial reduced form price equation, the processor-level final reduced form price equation, and the farm-level final reduced form price equation. The processor-level partial reduced form price equation and the farm-level final reduced form price equation can be used to create a system of equations. The equations are considered as a system because the farm-level price (P_{FO}) is endogenous and there is reason to believe the error terms between the equations are correlated. The processor-final reduced form could be included or excluded from the system. There is no efficiency gain by including the processor-final reduced form equation in the system,

since the processor-level final reduced form has the same explanatory variables as the farm-level final reduced form equation (Huang 1970).

The system of equations is:

$$P_{PO} = \kappa_0 + \kappa_1 P_{FO} + \kappa_2 \mathbf{W}_P + \kappa_3 \mathbf{P}_{PS} + \kappa_4 Y + \kappa_5 CP_{QD} + \kappa_6 \mathbf{Z}_{PD} + \kappa_7 \mathbf{Z}_{PS} + \varepsilon \quad (27)$$

$$P_{FO} = \pi_0 + \pi_1 Q_{FS} + \pi_2 \mathbf{W}_P + \pi_3 \mathbf{P}_{PS} + \pi_4 Y + \pi_5 CP_{QD} + \pi_6 \mathbf{Z}_{PD} + \pi_7 \mathbf{Z}_{PS} + \omega \quad (28)$$

where, equation (27) is the processor-level partial reduced form price equation and equation (28) is the farm-level final reduced form price equation.

The processor-level final reduced form equation is:

$$P_{PO} = \mu_0 + \mu_1 Q_{FS} + \mu_2 \mathbf{W}_P + \mu_3 \mathbf{P}_{PS} + \mu_4 Y + \mu_5 CP_{QD} + \mu_6 \mathbf{Z}_{PD} + \mu_7 \mathbf{Z}_{PS} + \zeta \quad (29)$$

The number of degrees of freedom (df) available for a single linear equation is determined by the number of observations (n) minus the explanatory variables (k) minus one (df=n-k-1). In a system of equations the number of observations increases. The number of system observations is equal to the number of equations in the system multiplied by the number of observations on a variable (Theil, 1971). Given that there are two equations (28 and 29) and 28 observations, there are 56 available system observations (56=2 x 28) associated with this data. For equation (29) there are 28 observations. For reliable inferences, there needs to be at least 4 observations per parameter estimated (Bentler and Chou 2005). For the system, there are 56 system observations; and 56 divided by 4 is 14, which implies that there can be no more than 14 parameters estimated in the system of equations. For equation (29), there are 28 observations; and 28 divided by 4 is 7, which implies that there can be no more than 7 parameters estimated for equation (29). In a linear model, the number of parameters is the number of explanatory variables plus the constants. If the number of parameters allowed for the system of equations, which is 14, is divided evenly among the two linear equations, there is an allowance of seven (7=14/2) parameters per equation.

For equation (29), the number of parameters allowed is also seven, six explanatory variables per equation maximum are allowed (7 parameters = 6 explanatory variables + 1 constant). Also, considering that there are exactly four observations for each parameter, it would be advantageous to limit the number of explanatory variables per equation further to less than six for more efficient estimates. However, it is important to recognize that omitting an important variable can lead to omitted variable bias.

When limiting the number of explanatory variables per equation to six it is important to realize that certain variables must be included as explanatory variables in equations (27), (28), and (29) for specific reasons. Equation (27) must include the farm-level price (P_{FO}) since it is endogenous. All equations must include quantity demanded of commodity procurements (CP_{QD}) since it is the variable of interest for this thesis. Furthermore, equations (28) and (29) must include the farm-level quantity supplied (Q_{FS}) because it represents the entire farm-level structural supply component of the market. The requirement that P_{FO} , Q_{FS} , and CP_{QD} be included accounts for two explanatory variables in each equation and this leaves four more explanatory variables per equation to be determined. The explanatory variables that are available to be chosen can come from the vector of processor-level input costs (W_P), the vector of the price of substitutes for canned peaches (P_{PS}), income (Y), the vector of the other factors affecting the processor-level supply (Z_{PS}) and the vector of the other factors affecting the processor-level demand (Z_{PD}).

To resolve the first conceptual issue, two steps are used to determine at most four additional explanatory variables for each equation. The first step is to determine which four variables are most important theoretically. The second step is to have approximately the same number of determinants from the structural farm-level supply, farm-level demand, processor-

level supply, processor-level commercial demand, and processor-level procurement demand equations. The second method reduces the possibility of omitting an important sector of the market. By already including Q_{FS} and CP_{QD} the structural farm-level supply and the processor-level procurement demand equations are already represented and are not discussed again. The vector of the other factors affecting the processor-level supply (Z_{PS}) and the vector of the other factors affecting the processor-level demand (Z_{PD}) are not included in any of the equations because both are difficult to define and do not have the theoretical significance as the other remaining variables.

The vector of the processor-level input costs (W_P) is a determinant from both farm-level demand and processor-level supply structural components. Under the assumption of profit maximization, the determinants for the farm-level demand and the processor-level supply are processor supply and input demand factors and are identical by Hotelling's Lemma. Consequently, these two structural equations have the same determinants. Since the processor-level input costs (W_P) are a vector of costs and represent the farm-level demand and processor-level supply, the two largest processor-level input costs (W_P) are included as two explanatory variables. According to a U.S. International Trade Commission report (2007), the largest input cost for canned fruit is the price of the raw product, which is represented by the farm-level price (P_{FO}) and is already included. The second largest cost is the cost of the metal cans; and the third largest cost is the cost of labor. A variable representing the price of cans (W_{PM}) and a variable representing the price of labor (W_{PL}) is included in the equations.

From the processor-level commercial demand determinants, the price of substitutes (P_{PS}) and income (Y) are the other two variables that are included. For the price of a substitute, fresh peaches are a significant substitute to canned peaches due to the current trend in consumer

preferences for fresh fruit instead of canned fruit. A variable representing the fresh peach price (P_{PS}) is included. Income (Y) is included in the equations because of its theoretical significance and to add another variable that represents the effect from the structural component of the processor-level commercial demand.

Based on the above discussion, the system of equations that is to be estimated is:

$$P_{PO} = \kappa_0 + \kappa_1 P_{FO} + \kappa_{21} W_{PL} + \kappa_{22} W_{PM} + \kappa_3 P_{PS} + \kappa_4 Y + \kappa_5 CP_{QD} + \varepsilon \quad (30)$$

$$P_{FO} = \pi_0 + \pi_1 Q_{FS} + \pi_{21} W_{PL} + \pi_{22} W_{PM} + \pi_3 P_{PS} + \pi_4 Y + \pi_5 CP_{QD} + \omega \quad (31)$$

Also the processor-level final reduced form equation that is to be estimated is:

$$P_{PO} = \mu_0 + \mu_1 Q_{FS} + \mu_{21} W_{PL} + \mu_{22} W_{PM} + \mu_3 P_{PS} + \mu_4 Y + \mu_5 CP_{QD} + \zeta \quad (32)$$

With this variable selection the number of parameters per equation is seven, which is the maximum limit defined previously.

The second conceptual issue to consider is that some of the variables in the system may be endogenous. The farm-level price (P_{FO}) and processor-level price (P_{PO}) are known to be endogenous. The farm-level price appears as an explanatory variable in equation (30), but is defined by equation (32). Also as discussed previously, the quantity demanded of commodity procurements (CP_{QD}) is suspected of being endogenous. Identifying instruments for the quantity demanded of commodity procurements (CP_{QD}) must be determined to test if CP_{QD} is endogenous. Good instruments must be correlated with the suspected endogenous variable (CP_{QD}), but uncorrelated with the error terms (ε , ζ , and ω). Traub's (1984) work identifies the farm-level price (P_{FO}), the size of the current year's budget (TC_{CP}), and the previous year's budget ($TC_{CP(t-1)}$) as variables that significantly affect the amount of commodity procurements. Consequently, these variables are correlated with the quantity demanded of commodity procurements (CP_{QD}). Since the identifying instruments must not be correlated with the error

terms (ε , ζ , and ω), and the farm-level price (P_{FO}) is already known to be endogenous, the farm-level price (P_{FO}) cannot be used as an identifying instrument. However, the previous year's farm-level price ($P_{FO(t-1)}$) can be used as an identifying instrument for the farm-level price (P_{FO}). The size of the current year's budget (TC_{CP}) should be exogenous in this system, since the size of the budget is independently determined by the Federal government. If CP_{QD} is found to be endogenous, it will be treated as such and the equation for the CP_{QD} will be added to the system and the system is estimated by Three Stage Least Squares (3SLS).

4. 2 Data Selection

Data are needed for each of the variables defined in the system of equations and the variables defined as identifying instrumental variables for CP_{QD} . This data discussion is arranged according to the structural components of the market. The data that represent each identifying instrument are discussed after the data for the system of equations are discussed. In addition, all of the variables in dollars are deflated using a Consumer Price Index (CPI). All variables that are indexes have been transformed to a 1982 base year and have been deflated using the CPI. The CPI is the U.S. city average CPI from the Bureau of Labor Statistics (BLS) (BLS 2009). The more general CPI is used because the CPI is used to adjust not only food prices, but also machinery, energy, the total costs of canned peaches commodity procurements, and labor costs. The CPI is an annual CPI from 1980-2007 with a base year of 1982.

Table 1 provides details on the data's time span, frequency, units, and source. Table 1 is organized by the structural components of the market. The first structural component is the farm-level output supply function. The farm-level quantity supplied is represented by the utilization canned quantity (Q_{FS}) of peaches from the Economic Research Service's (ERS) Fruits and Vegetables Yearbook Spreadsheets (ERS 2007). These data are selected because they are

the amount of peaches delivered by the farmers to canners. Since the canned peaches are mainly clingstone peaches, and are not sold in any quantity in the fresh market, the amount delivered to canners is the equilibrium amount supplied by the farmers.

The second and third structural components are the processor-level output supply and input demand function. As previously stated, the functions have identical determinants. The farm-level price is represented by the price that farmers receive for peaches delivered to canners in dollars per ton (P_{FO}) from the ERS's Fruits and Vegetables Yearbook Spreadsheets (ERS 2007). The processor-level price is represented by the price of canned cling peaches 24/303 choice heavy syrup (HS) per case (P_{PO}) from the Food Institute's Price Trend of Canned Fruits Reports (Food Institute 1981-2008). The price of processor-level labor is represented by the hourly earnings of production workers of manufacturing nondurable goods in dollars per hour (W_{PL}) from the BLS (BLS 2009). The price of material inputs is represented by the metal cans and can components price index (W_{PM}) from the BLS (BLS 2009).

The fourth structural component is the processor-level output demand function. The processor-level price (P_{PO}) has already been described by the processor demand for peaches for canning. The price of a substitute for canned peaches is the fresh peach price received by growers in dollars per pound (P_{PS}) from the ERS Fruit and Vegetable Spreadsheets (ERS 2007). Income is represented by the United States GDP per capita in dollars per person (Y) from the ERS's International Macroeconomic Data (ERS 2008). The GDP per capita also implicitly controls for changes in population. The quantity demanded of commodity procurements is represented by the total farm weight of canned peach commodity procurements data in pounds (CP_{QD}) from the AMS (Fruit and Vegetable Quality Division 1979-1990; AMS 2008).

Table 2 provides details such as the data's time span, frequency, units, and source about the data selected for the identifying instruments for quantity demanded of commodity procurements (CP_{QD}). The previous year's farm-level price is represented by the lagged price received by growers ($P_{FO(t-1)}$). The current year's budget and the previous year's budget are represented by the total cost of canned peach commodity procurements data in dollars (TC_{CP}) and the lagged total cost of canned peach commodity procurements data in dollars ($TC_{CP(t-1)}$) from the AMS Commodity Procurement Files (Fruit and Vegetable Quality Division 1979-1990; AMS 2008).

4.3 Data Description

The descriptive statistics for the data in Tables 1 are listed in Table 2. In Table 2, each variable has 28 observations. The discussion of the descriptive statistics focuses on the main variables of interest in this thesis: the farm-level price (P_{FO}), the processor-level price (P_{PO}), and the quantity demanded of commodity procurements (CP_{QD}). Figures 7 and 8 show some of the general trends in the data from the most important variables to this thesis.

Figure 7 - The Real Farm-level Canning Peach Price and Real Processor-level Canned Peach Price Trends

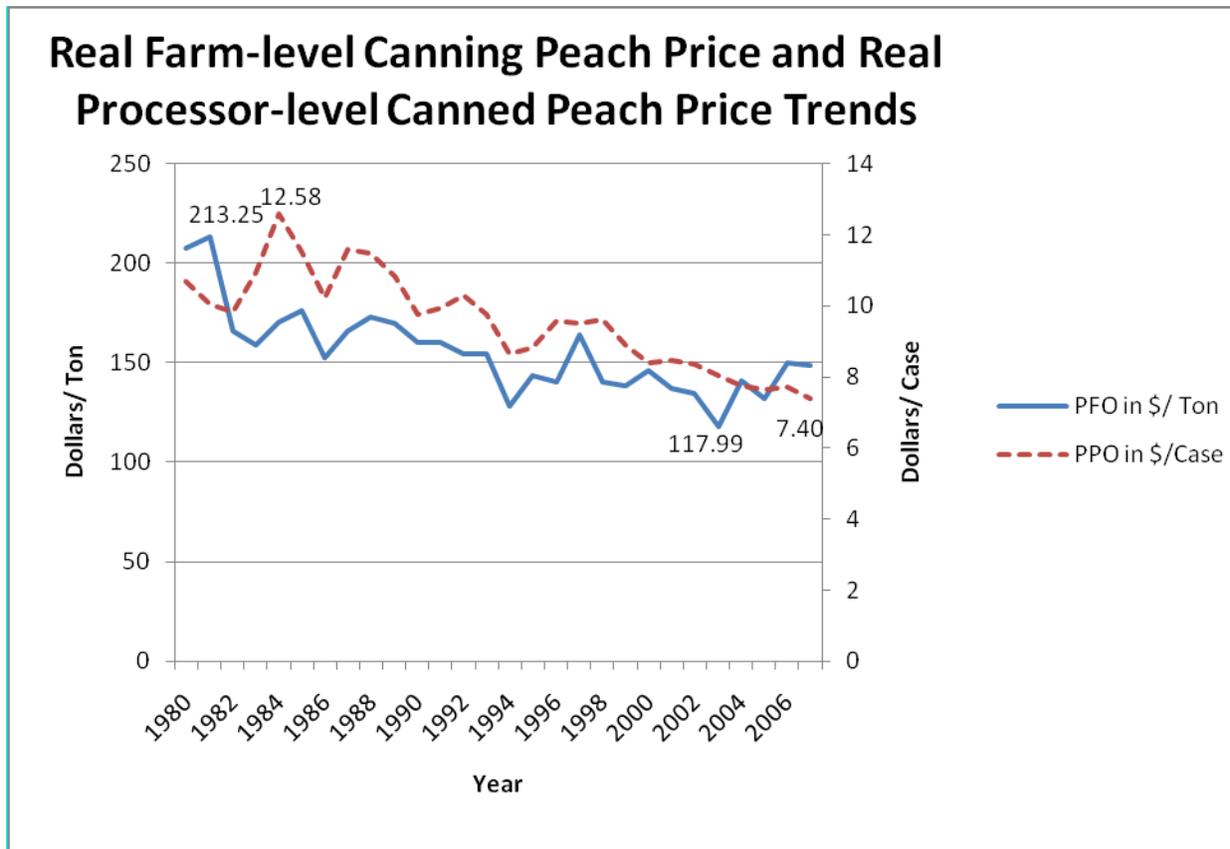


Figure 7 shows that from 1980- 2007 the real farm-level price of peaches for canning and real processor-level canned peach price have slowly declined overall. There are peaks in the farm-level price in 1982, 1985, 1988, and 1997. The large depressions in the farm-level price are in 1983, 1986, 1994, and 2003. The minimum farm-level price from 1980-2007 is 117.99 dollars per ton in 2003 and the maximum farm-level price is 213.25 dollars per ton in 1981. From 1980-2007, the average relative farm-level canning peach price is 155.17 dollars per ton with a standard deviation of 21.37 dollars. The peaks in the processor-level price are in 1984, 1987, 1992, and 1996. The depressions in the processor-level price are in 1982, 1986, 1990, and 1994. Following 1998, the processor-level price does not have a peak, but declines consistently. The

minimum –processor-level price from 1980-2007 is 7.40 dollars per case in 2007 and the maximum processor-level price is 12.58 dollars per case in 1984. From 1980-2007, the average relative processor-level canned peach price is 9.58 dollars per case with a standard deviation of 1.36 dollars.

The gradually declining price trends seen in the processor-level price and the farm-level price are very similar. The peaks and depressions in the farm-level price seem to follow a year after the peaks and depressions in the processor-level price. This observation is not exact but is relatively accurate. The similar trends between the farm-level price and the processor-level price are expected according to the theory of vertically related markets.

Figure 8 - The Quantity Demanded of Commodity Procurements of Canned Peaches

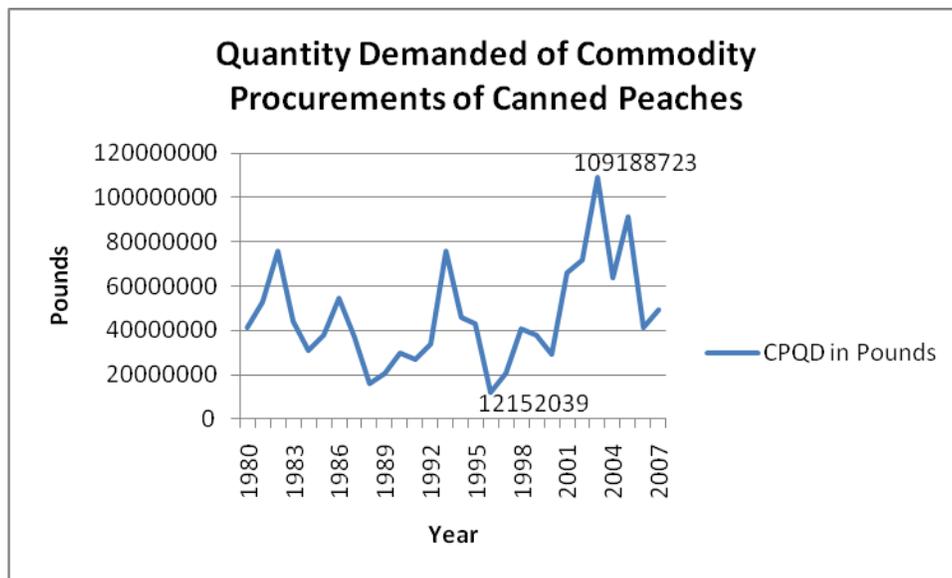


Figure 8 shows that from 1980- 2007 the quantity demanded of commodity procurements has a cyclical pattern. There are peaks in the quantity demanded of commodity procurements in 1982, 1986, 1993, and 2003. The valleys of the quantity demanded of commodity procurements are in 1984, 1988, 1996, and 2006. The minimum quantity demanded of commodity procurements from 1980-2007 is 12,152,039 pounds in 1996 and the maximum quantity

demand of commodity procurements is 109,188,723 pounds in 2003. On average from 1980-2007, the AMS procures 4.75 percent of the American canned peaches available on the market. It is noteworthy that the highest quantity demanded of commodity procurements occurred the same year that the farm-level price had its lowest price level. From 1980-2007, the average relative quantity demanded of commodity procurement of canned peaches is 46,367,020 pounds with a standard deviation of 22,962,979 pounds.

Table 3 is the correlation matrix of all of the data discussed. The numbers generated in the correlation matrix indicate the magnitude of the correlation between the variables and the linear direction of that correlation. Although correlation does not imply causation, it is important to highlight the correlations between the dependant and independent variables do provide an illustration of how the variables are related, not holding the other variables constant. The correlation matrix indicates there are no independent variables highly ($|.8|$ or higher) correlated with the farm-level price (P_{FO}). There is a high correlation between the processor-level price (P_{PO}), and the price of metal cans (W_{PM}) and income (Y). Also since the quantity demanded of commodity procurements (CP_{QD}) is the variable of interest, the correlation between CP_{QD} and P_{FO} is -0.38; and the correlation between CP_{QD} and P_{PO} is -0.44. The negative correlations between CP_{QD} 's and the dependant variables' data reflect the direction of the linear correlation. Since the linear direction is negative, there is more reason to question if CP_{QD} is endogenous because the theory showed that an increase in CP_{QD} should cause an increase in the dependent variables. The variables selected from the available data are used in the regressions to obtain the parameter estimates. The empirical implementation, results, and limitations of the model are discussed in Chapter 5.

Chapter 5 - The Empirical Implementation and Results

In this chapter, the empirical implementation of the model and the results of the estimation are discussed.

5.1 Empirical Implementation

Using the variables and the corresponding logged data previously described, the system of equations to be estimated is:

$$\ln P_{PO} = \kappa_0 + \kappa_1 \ln P_{FO} + \kappa_2 \ln W_{PL} + \kappa_3 \ln W_{PM} + \kappa_4 \ln P_{PS} + \kappa_5 \ln Y + \kappa_6 \ln CP_{QD} + \varepsilon \quad (33)$$

$$\ln P_{FO} = \pi_0 + \pi_1 \ln Q_{FS} + \pi_2 \ln W_{PL} + \pi_3 \ln W_{PM} + \pi_4 \ln P_{PS} + \pi_5 \ln Y + \pi_6 \ln CP_{QD} + \omega \quad (34)$$

Equations (33) and (34) create a triangular system because P_{FO} enters the equation for P_{PO} but not vice versa. This causes a non-diagonal disturbance covariance matrix (Lahiri and Schmit 1978). To estimate a triangular system with a non-diagonal disturbance covariance matrix, seemingly unrelated regressions can be used (Zellner 1966; Hausman 1975; AMS 2008). Furthermore, Hausman (1975) shows that the use of seemingly unrelated regressions (SUR) implies that generalized least squares (GLS) can be used. Lahiri and Schmidt (1978) show that if the predicted covariance matrix of the error term is based on a consistent estimate of the actual covariance matrix of the error term, the estimates are still consistent when using GLS. As, Lahiri and Schmidt (1978) suggest, an iterated GLS procedure, also known as iterated SUR (ITSUR), generates a consistent covariance matrix. Iterated GLS is used to estimate this system of equations. When GLS is applied, the original model is adjusted by the contemporaneous covariances between the error terms (Heij, de Boer et al. 2004). When GLS is iterated, GLS is performed repeatedly until the estimates converge to the maximum likelihood estimates, which minimizes the sum of squares (Lahiri and Schmit 1978).

Also, using the variables and the corresponding logged data previously described, the processor-level final reduced form equation to be estimated is:

$$\ln P_{PO} = \mu_0 + \mu_1 \ln Q_{FS} + \mu_{21} \ln W_{PL} + \mu_{22} \ln W_{PM} + \mu_3 \ln P_{PS} + \mu_4 Y + \mu_5 \ln CP_{QD} + \zeta \quad (35)$$

Equation (29) is a single linear equation that is estimated using Ordinary Least Squares (OLS).

All parameter estimates that are insignificant are tested for joint significance using an F-test at 10% significance level. A 10% significance level is used because the number of observations per parameter is low. If the F-test shows that the variables are jointly insignificant, the variables will be dropped from the system of equations for efficiency. The ITSUR model and the OLS model will be reestimated if variables are dropped. Then, equations (33), (34), and (35) are tested for correct functional form independently using a Regression Equation Specification Error Test (RESET) to be certain there is not an omitted variable problem. The Breusch-Pagan test is employed to test for increasing or decreasing variance impact of the variable, $\ln CP_{QD}$. If the logged quantity demanded of commodity procurements ($\ln CP_{QD}$) variable can significantly decrease the variance of the price models, it is an indication that the quantity demanded of commodity procurements are stabilizing the processor-level and/or farm-level prices. The Breusch-Pagan test also is used to test equation (33), (34), and (35) for heteroskedasticity within the equations. The ITSUR is not tested for heteroskedasticity across equations, since the estimation techniques of ITSUR adjusts for heteroskedasticity across equations.

Once equations (33), (34), and (35) are tested for jointly significance of individually insignificant variables, correct functional form, and homoskedasticity, the Hausman test is used to test if the quantity demanded of commodity procurements (CP_{QD}) in equations (33), (34), and (35) is endogenous. The null hypothesis that the quantity demanded of commodity procurements (CP_{QD}) is exogenous is evaluated at a 10% significance level. The identifying instrumental

variables are the previous year's farm-level price ($P_{FO(t-1)}$), the size of the current year's budget (TC_{CP}), and the previous year's budget ($TC_{CP(t-1)}$). Because the quantity demand of commodity procurements (CP_{QD}) is strongly believed to be endogenous and the power of the Hausman test decreases as the sample size decreases (Meepagala 1992), the equation for CP_{QD} is added to the system and the system estimated by three stage least squares (3SLS)

The 3SLS system is:

$$\ln P_{PO} = \kappa_0 + \kappa_1 \ln P_{FO} + \kappa_{21} W_{PL} + \kappa_{22} W_{PM} + \kappa_3 P_{PS} + \kappa_4 Y + \kappa_5 \ln CP_{QD} + \varepsilon \quad (36)$$

$$\ln P_{FO} = \pi_0 + \pi_1 \ln Q_{FS} + \pi_{21} W_{PL} + \pi_{22} W_{PM} + \pi_3 P_{PS} + \pi_4 Y + \pi_5 \ln CP_{QD} + \omega \quad (37)$$

$$\ln P_{PO} = \mu_0 + \mu_1 \ln Q_{FS} + \mu_{21} W_{PL} + \mu_{22} W_{PM} + \mu_3 P_{PS} + \mu_4 Y + \mu_5 \ln CP_{QD} + \zeta \quad (38)$$

$$\ln CP_{QD} = \delta_0 + \delta_1 \ln P_{FO} + \delta_2 TC_{CP} + \delta_3 TC_{CP(t-1)} + e_{CPD} \quad (39)$$

F-tests for jointly significance among subgroups of variables, RESET tests for the correct functional forms of the individual equations, and Breusch-Pagan tests for heteroskedasticity in the individual equations are employed to test the 3SLS model as previously done with the ITSUR and OLS models. The 3SLS model is adjusted accordingly based on the results of the tests. The Breusch-Pagan test also is employed to test the 3SLS model for increasing or decreasing variance impact of the variable, $\ln CP_{QD}$.

The hypotheses stating that the quantity demanded of commodity procurements (CP_{QD}) has a positive effect on the processor-level partial reduced form price, the processor-level final reduced form price, and the farm-level final reduced form price are tested with a single tailed T-test. The hypotheses are:

$$H_0: \kappa_5 = 0; H_1: \kappa_5 > 0 \quad \setminus \quad (40)$$

$$H_0: \mu_5 = 0; H_1: \mu_5 > 0 \quad (41)$$

$$H_0: \pi_5 = 0; H_1: \pi_5 > 0 \quad (42)$$

The hypotheses stating that the quantity demanded of commodity procurements decreases the variance of the farm-level price and the processor-level price are tested with a single tailed T-test on the squared residuals via the Breusch-Pagan regressions (see equations 21, 23, and 25).

The hypotheses are

$$H_0: \rho_5 = 0; H_1: \rho_5 < 0. \quad (43)$$

$$H_0: \varphi_5 = 0; H_1: \varphi_5 < 0. \quad (44)$$

$$H_0: \theta_5 = 0; H_1: \theta_5 < 0. \quad (45)$$

The coefficients ρ_5 , φ_5 , and θ_5 are the coefficients on the quantity demanded of commodity procurements in the Breusch-Pagan regressions for the processor-level partial reduced form, the processor final-reduced form, and the farm-level final reduced form equations, respectively.

5.2 Results

The results from the ITSUR and OLS models are discussed first as well as the results from their diagnostic tests. Then, the results from the 3SLS model and its diagnostic tests are discussed.

5.2.1 ITSUR and OLS Results

The results of the ITSUR are presented in Table 4. None of the variables are jointly insignificant; therefore none of the variables are excluded from the model. The RESET tests show that each individual equation in the ITSUR model is specified correctly. The Hausman test indicates that there is not enough evidence with a 0.34 p-value to show that the quantity demanded of commodity procurements (CP_{QD}) is endogenous. The chi-squared statistics of equations (33) and (34) indicate that the explanatory variables in both equations of the final ITSUR are jointly significant with p-values of 0.00. Since the ITSUR technique converges to a

maximum likelihood estimate, the R-squared is a pseudo R-squared, which is an indicator of the goodness of fit of the model. In equation (33), the R-squared is 0.87. In equation (34), the R-squared is 0.76.

The first column of the ITSUR results in Table 4 corresponds to equation (33), the processor-level partial reduced form price equation ($\ln P_{PO}$). The t-tests and p-values reveal that the coefficients on the logged price of processor-level labor ($\ln W_{PL}$), the logged fresh peach price ($\ln P_{PS}$), the logged income ($\ln Y$), and the logged quantity demanded of commodity procurements ($\ln CP_{QD}$) are significantly different from zero. Of the coefficients that are statistically significant in the processor-level partial reduced form price equation ($\ln P_{PO}$) only the logged processor-level labor ($\ln W_{PL}$) coefficient has the same sign as hypothesized in Chapter 3. The hypothesized signs in Chapter 3 are based on economic theory, where canned peaches are assumed a normal good. A 1% increase in the processor-level labor (W_{PL}) increases the processor-level price (P_{PO}) by 1.60% ceteris paribus. This is a large increase in the processor-level price (P_{PO}) given an increase in the processor-level labor (W_{PL}). A 1% increase in the fresh peach price (P_{PS}) decreases the processor-level price (P_{PO}) by 0.17% ceteris paribus. This result is opposite to what we expected. The reason for this result could be because of the strong change in preferences away from canned peaches to fresh peaches. Another reason for the negative relationship between canned peaches and fresh peaches could be that they are complements. A 1% increase in the income (Y) decreases the processor-level price (P_{PO}) by 0.56% ceteris paribus. This is a sign that canned peaches are an inferior good. Given that the current demand for canned peaches is decreasing, it would not be surprising if canned peaches are an inferior good. A 1% increase in the quantity demanded of commodity procurements (CP_{QD}) decreases the process-level price (P_{PO}) by 0.16% ceteris paribus. There is no sign of

increasing or decreasing variance associated with $\ln CP_{QD}$. This is not consistent with the hypothesis that the commodity procurement has a positive impact on the price of peaches. The coefficient on the quantity demanded of commodity procurements is shown to have a statistically significant negative effect on the processor-level partial reduced form price in the ITSUR model. There are many possible reasons that there would be negative effects from the quantity demanded of commodity procurements (CP_{QD}) on the processor-level price (P_{PO}). The first reason that the quantity demanded of commodity procurements (CP_{QD}) could be showing a negative effect on the processor-level price (P_{PO}) is that the identifying instrumental variables we used in this thesis could endogenous themselves. Alternative measurements of amount of quantity demanded of commodity procurement may need to be identified. The second reason is that perhaps the quantity demanded of commodity procurements does not increase the price but stabilizes the processor-level price, which can be tested in the Breusch-Pagan test. The third reason that the quantity demanded of commodity procurements could have negative effects on processor-level prices is the USDA procurement process of accepting the lowest bid. This could have a downward pressure on prices. Since the lowest bidders are going to be the processors with the lowest marginal costs, the USDA is only providing an advantage to lowest cost processors. Since the lowest cost processors benefit, while the higher cost processors do not, the commodity procurement process could be driving higher cost producers from the market.

The second column under ITSUR results in Table 4 corresponds to equation (34), the farm-level final reduced form price equation ($\ln P_{FO}$), of the ITSUR model. The t-tests and p-values indicate that the logged price of metal cans ($\ln W_{PM}$), the logged farm-level quantity supplied ($\ln Q_{FS}$), and the logged fresh peach price ($\ln P_{PS}$) coefficients are individually significantly different from zero. All of the coefficients that are significant and have the same

sign as predicted by economic theory except the farm-level quantity supplied (Q_{FS}). A 1% increase in the farm-level quantity supplied (Q_{FS}) increases the farm-level price (P_{FO}) by 0.29% ceteris paribus. This is a fairly large increase in farm-level price given an increase in the farm-level quantity supplied. The reason that the sign on the farm-level quantity supplied is inconsistent with economic theory could be a result of the contractual process used by the associations and processors to set the farm-level price. Since the farm-level price is set before harvest and most bids are not awarded until just before or during harvest, the farm-level price is set before the market has time to account for the added demand by the CPP. A 1% increase in the price of metal cans (W_{PM}) increases the farm-level price (P_{FO}) by 0.67 % ceteris paribus. A 1% increase in the fresh peach price (P_{PS}) increases the process-level price (P_{FO}) by 0.20% ceteris paribus. The expected sign on the fresh peach price is observed in the farm-level final reduced price equation as a substitute in production. In contrast to the hypothesis that logged quantity demanded of commodity procurements have a positive effect on the farm-level price, the coefficient on the quantity demanded of commodity procurements is shown to have a statistically insignificant effect on the farm-level final reduced form price in the ITSUR model. The main reason that the quantity demanded of commodity procurements could be insignificant to the farm-level price is because the farm-level price is contracted ahead of harvest. Since many of the invitations for bids are just before or during harvest, the farm-level price has been contracted already and does not adjust to the change according to changes in the processor-level demand.

The results of the OLS estimation are presented in Table 4. The OLS column corresponds to equation (35), the processor-level final reduced form price equation ($\ln P_{PO}$), of the OLS model. In the initial OLS model estimation, the farm-level quantity supplied, the price

of cans, and the price of fresh peaches are jointly insignificant. The farm-level quantity supplied is not excluded from the OLS model because it represents the whole farm-level structural supply component. The price of cans and the fresh peach price are excluded from the model, since other components from the same structural equations are remaining in the equation. Once the price of cans and the fresh peach price are dropped from the OLS equation, the OLS model is shown to be specified correctly by the RESET test. The Hausman test indicates that there is not enough evidence with a 0.45 p-value to prove that the logged quantity demanded of commodity procurements ($\ln CP_{QD}$) is endogenous. The F-test of all the explanatory variables used in the final OLS indicates the explanatory variables are jointly significant with a p-value of 0.00. The R-squared of equation (35) is 0.86, which means that 86% of the variation in the logged processor-level price ($\ln P_{PO}$) can be explained by the variation in independent variables.

For the processor-level final reduced form price equation ($\ln P_{PO}$) the t-tests and p-values reveal that the coefficients on the logged price of processor-level labor ($\ln W_{PL}$), the logged income ($\ln Y$), and the logged quantity demanded of commodity procurements ($\ln CP_{QD}$) coefficients and the constant are significantly different from zero. Of the coefficients that are statistically significant only the processor-level labor ($\ln W_{PL}$) coefficient has the same sign as predicted by economic theory, when in the economic theory presented in Chapter 3 canned peaches are assumed to be a normal good. The difference between the processor-level partial and final reduced forms is that in the partial reduced form the logged fresh peach price is statistically significant. Of the statistically significant variables in both the processor-level partial and final reduced forms, all the coefficients have the same sign and fairly similar magnitude. A 1% increase in the price of processor-level labor (W_{PL}) increases the processor-level price (P_{PO}) by 1.49% ceteris paribus. A 1% increase in the income (Y) decreases the

processor-level price (P_{PO}) by 0.76% ceteris paribus. A 1% increase in the quantity demanded of commodity procurements (CP_{QD}) decreases the process-level price (P_{PO}) by 0.12% ceteris paribus. The possible reasons the signs are different from economic theory have already been discussed with the results from the processor-level partial reduced form price equation ($\ln P_{PO}$). The coefficient on the quantity demanded of commodity procurements is shown to have a statistically significant negative effect on the processor-level final reduced form price in the OLS model, which again is in contrast to the hypothesized positive effect.

The results of the Breusch-Pagan tests are presented in Table 5 for the ITSUR and OLS models. The first column under the partial reduced forms corresponds to the Breusch-Pagan test for the processor-level partial reduced form price equation ($\ln P_{PO}$). The coefficient on $\ln CP_{QD}$ in the processor-level partial reduced form's squared residuals ($\text{Residuals } \ln P_{PO}$)² equation is not significantly different from zero, which shows a constant variance. There is no sign of increasing or decreasing variance associated with $\ln CP_{QD}$. The second and third columns under the final reduced forms correspond to the Breusch-Pagan test results for the farm-level final reduced form price equation ($\ln P_{FO}$), and the processor-level final reduced form price equation ($\ln P_{PO}$). Also the coefficient on $\ln CP_{QD}$ in the farm-level final reduced form's squared residuals equation ($\text{Residuals } \ln P_{FO}$)² and processor-level final reduced form's squared residuals ($\text{Residuals } \ln P_{PO}$)² equation are not significantly different from zero, which shows a constant variance. These results can be used to test the hypotheses that the quantity demanded of commodity procurements causes a decrease in the variance of the processor-level price and farm-level price once the farm-level price has had time to adjust to the increase in demand. Since there are no signs of increasing or decreasing variance, this is statistical evidence that the CPP is not stabilizing the farm-level or processor-level prices. If the CPP were stabilizing prices on

either the farm-level or processor-level, there would be statistical evidence of decreasing variance in prices. All three Breusch-Pagan tests' results also show that all of the coefficients on all the explanatory variables tested are individually and statistically insignificant and jointly insignificant. Since all are jointly insignificant, there is no significant evidence of heteroskedasticity in the individual equations.

5.2.2 Three Stage Least Squares Results

The results of the 3SLS model are presented in Table 6. In the initial 3SLS regression, the logged fresh peach price ($\ln P_{PS}$), the logged income ($\ln Y$), and the logged previous year's program support ($\ln TC_{CP(t-1)}$) are jointly insignificant. In the initial 3SLS, the logged fresh peach price ($\ln P_{PS}$) and the logged income are marginally significant in the processor-level partial reduced form price equation ($\ln P_{PO}$), and the processor-level final reduced form price equation ($\ln P_{FO}$). When only one of the two variables is removed, the other variable becomes insignificant. Consequently, the logged fresh peach price ($\ln P_{PS}$), and the logged income are not removed from the model since these two variables represent all of the structural consumer demand components. The logged previous year's program support ($\ln TC_{CP(t-1)}$) is not removed so that the order condition is satisfied. The chi-squared statistics of the processor-level partial reduced form price equation ($\ln P_{PO}$), the farm-level final reduced form price equation ($\ln P_{FO}$), the processor-level final reduced form price equation ($\ln P_{PO}$), and the quantity demanded of commodity procurements equations ($\ln CP_{QD}$), indicate that the explanatory variables in all equations of the 3SLS model are jointly significant with p-values of 0.00.

The processor-level partial reduced form price equation ($\ln P_{PO}$) results reveal that the coefficients on the logged farm-level price ($\ln P_{FO}$), the logged price of processor-level labor ($\ln W_{PL}$), the price of substitutes ($\ln P_{PS}$), the logged income ($\ln Y$), and the logged quantity

demand of commodity procurements ($\ln CP_{QD}$) coefficients are all significantly different from zero. Of the coefficients that are statistically significant, the price of substitutes ($\ln P_{PS}$), the logged income ($\ln Y$), the logged quantity demanded of commodity procurements ($\ln CP_{QD}$) coefficient have a different sign than predicted by economic theory, when canned peaches are assumed to be a normal good (as done in Chapter 3).

A 1% increase in the farm-level price (P_{FO}) increases the processor-level price (P_{PO}) by 0.23% ceteris paribus. A 1% increase in the price of processor-level labor (W_{PL}) increases the processor-level price (P_{PO}) by 1.72% ceteris paribus. A 1% increase in the price of substitutes (P_{PS}) decreases the processor-level price (P_{PO}) by 0.14% ceteris paribus. A 1% increase in income ($\ln Y$) decreases the processor-level price (P_{PO}) by 0.42% ceteris paribus. A 1% increase in the quantity demanded of commodity procurements (CP_{QD}) decreases the process-level price (P_{PO}) by 0.09% ceteris paribus. The possible reasons why the specific signs do not correspond with economic theory have already been discussed. Since the 3SLS technique converges to a maximum likelihood estimate, the R-squared is a pseudo R-squared, which is an indicator of the goodness of fit of the model. The R-squared of the processor-level partial reduced form price equation ($\ln P_{PO}$) in the 3SLS model is 0.86.

The farm-level final reduced form price equation ($\ln P_{FO}$) results in the 3SLS model indicate that the coefficients on the logged price of metal cans ($\ln W_{PM}$), the logged price of processor-level labor ($\ln W_{PL}$), and the logged farm-level quantity supplied ($\ln Q_{FS}$) coefficients are individually significantly different from zero. Of the coefficients that are statistically significant in equation (31), the logged farm-level quantity supplied ($\ln Q_{FS}$) and the logged price of processor-level labor ($\ln W_{PL}$) coefficients have a different sign than predicted by economic theory. A 1% increase in the farm-level quantity supplied (Q_{FS}) increases the farm-level price

(P_{FO}) by 0.22% ceteris paribus. A 1% increase in the price of metal cans (W_{PM}) increases the farm -level price (P_{FO}) by 0.50 % ceteris paribus. A 1% increase in the price of processor-level labor (W_{PL}) decreases the farm-level price (P_{FO}) by 1.24% ceteris paribus. The reason why an increase in price of one input follows economic theory and the other does not is hard to determine. One reason the processor-level labor could be decreasing the farm-level price could be a result from the data being imprecise to the canning industry. The data that is used for the processor-level labor is the hourly earnings of production workers of manufacturing nondurable goods in dollars per hour. The reasons that the other signs on the coefficients that are statistically significant and do not correspond with economic theory have already been discussed. The pseudo R-squared for the farm-level final reduced form price equation ($\ln P_{FO}$) results in the 3SLS model is 0.75.

The processor-level final reduced form price equation ($\ln P_{PO}$) results in the 3SLS model show that the coefficients on the logged price of processor-level labor ($\ln W_{PL}$), the logged price of metal cans ($\ln W_{PM}$), the logged income ($\ln Y$), and the logged quantity demanded of commodity procurements ($\ln CP_{QD}$) coefficients are significantly different from zero. Of the coefficients that are statistically significant in the processor-level final reduced form price equation ($\ln P_{PO}$) results in the 3SLS model, the logged income ($\ln Y$) and the logged quantity demanded of commodity procurements ($\ln CP_{QD}$) coefficient have a different sign than predicted by economic theory, when (as done in Chapter 3) canned peaches are assumed to be a normal good. The signs on the coefficients that are statistically significant and the reasons they do not correspond with economic theory have already been discussed. A 1% increase in the price of processor-level labor (W_{PL}) increases the processor-level price (P_{PO}) by 1.44% ceteris paribus. A 1% increase in the price of metal cans (W_{PM}) increases the processor-level price (P_{PO}) by 0.33 %

ceteris paribus. A 1% increase in the income (Y) decreases the processor-level price (P_{PO}) by 0.37% ceteris paribus. A 1% increase in the quantity demanded of commodity procurements (CP_{QD}) decreases the process-level price (P_{PO}) by 0.10 % ceteris paribus. The pseudo R-squared of the processor-level final reduced form price equation ($\ln P_{PO}$) results in the 3SLS model is 0.88.

The quantity demanded of commodity procurements equation ($\ln CP_{QD}$) results reveal that the coefficients on the logged farm-level price ($\ln P_{FO}$) and the logged current year's program support ($\ln TC_{CP}$) coefficients and the constant are significantly different from zero. Of the coefficients that are statistically significant in equation (33) all the coefficients have the same sign as predicted by economic theory. A 1% increase in the farm-level price (P_{FO}) decreases the quantity demanded of commodity procurements (CP_{QD}) by 1.06% ceteris paribus. A 1% increase in the current year's program support (TC_{CP}) increases the quantity demanded of commodity procurements (CP_{QD}) by 1.07% ceteris paribus. The pseudo R-squared of the quantity demanded of commodity procurements equation is 0.86.

The results of the Breusch-Pagan test are presented in Table 7 for the 3SLS model. The Breusch-Pagan test is used to indicate if there are any signs of increasing or decreasing variance in the explanatory variables in each of the four equations in the 3SLS. The Breusch-Pagan test for the 3SLS model shows that all of the three $\ln CP_{QD}$ coefficients in the processor-level partial reduced form's squared residuals equation, the farm-level final reduced form's squared residuals equation, and the processor-level final reduced form are statistically insignificant. There are no signs of increasing or decreasing variance associated with $\ln CP_{QD}$. This result provides statistical evidence that the quantity demanded of commodity procurements is not stabilizing either the processor-level or farm-level prices. These results are the same results that are found

by the Breusch-Pagan tests of the ITSUR and OLS equations. Also, all of the coefficients on the other explanatory variables tested for 3SLS Breusch-Pagan tests are individually insignificant and jointly insignificant. This shows that the processor-level partial reduced form price equation, the farm-level final reduced form price equation, the processor-level final reduced form price equation, and the quantity demanded of commodity procurements equation have no significant evidence of heteroskedasticity in the individual equations.

Chapter 6 – Summary and Conclusions

6.1 Summary and Conclusions

This thesis analyzes the effects of the Section 32 funds and FNS funds on the farm-level price of canning peaches and processor-level price of canned peaches. The canned peach industry is selected as a sample fruit and vegetable industry on which to test the effects of the CPP on the processor-level and farm-level prices. The canned peach industry is chosen because of data availability. The effects on the processor-level price by the Section 32 funds and FNS funds are analyzed because most of the fruit and vegetable commodities procured by the CPP are processed. The reason that this analysis is needed is because the Section 32 funds are obligated by law to support the farm-level prices of the commodities purchased and their effects on the farm-level and processor-level prices are unknown. The FNS funds are included in the analysis because the FNS funds are administered using a similar process to the Section 32 funds and their effects on the farm-level and processor-level prices are also unknown. Furthermore, FNS funds are included because the quantity demanded of commodity procurements data prior to FY1991 are aggregated quantities from purchases from both the Section 32 funds and FNS funds.

The hypotheses that are tested in this thesis are stated in Chapter 1. The first hypothesis is that the quantity demanded of commodity procurements has a positive effect on the farm-level price and the processor-level price. The second hypothesis is that the quantity demanded of commodity procurements helps stabilize the farm-level price and the processor-level price.

In Chapter 2, the CPP's legislative history, funding requirements, and purchasing process are described. These sections are used to develop an understanding the factors that trigger CPP purchases. CPP purchases are based on the commodity's price, the demands of the national feeding programs, and the farm-level quantity supplied. The bidding process is an important

aspect of the CPP, where the lowest bidders are awarded the bids. Also in Chapter 2, the industries' interaction with the CPP and their perceptions of the CPP are discussed. The processors sell to the CPP through the bidding process and must create competitive bids to take part in the CPP. The farmers have very little interaction with the CPP unless the commodity being purchased is a fresh commodity such as potatoes. The industries' perspectives on the effects of the CPP on profits are considered. The industries felt that the CPP is most beneficial to profits on the processor-level and farm-level when the bids are awarded just before or during harvest.

Chapter 2 also includes the literature review. Very little literature has addressed on the CPP. There are only two pieces of literature that previously examined the effects of the CPP on the farm-level price. The two pieces of literature are written by Nicks (2004) and the National Food and Agricultural Policy Project (2001). Nicks' (2004) study is the main piece of literature that previously examined the effects of the CPP on the farm-level and processor-level prices. Nicks found that the CPP has no significant effect on the processor-level and farm-level price of potatoes or tomatoes. A study completed by the National Food and Agricultural Policy Project found that there is a small price increase on the farm-level from CPP when the commodities purchased are fresh.

Chapter 3 establishes the conceptual model through the use of economic theory, the previously discussed CPP structure and industries selling process, and extending the work of Traub (1984). A graphical model of the effects of the CPP on the farm-level and processor-level price is presented first, followed by a mathematical model that is based on the graphical model. The structural components of the market are detailed in the mathematical model. Log linear functional forms are applied to the mathematical model and the farm-level and processor-level

partial and final reduced forms price equations are derived. Based on the economic theory, three hypotheses are detailed. The first two hypotheses are that in the processor-level partial and final reduced form price equations, the quantity demanded of commodity procurements has a positive effect on the processor-level price. The third hypothesis is that in the farm-level final reduced price equation, the quantity demanded of commodity procurements has a positive effect on the farm-level price.

In Chapter 4, the conceptual issues caused by data limitations and a possible endogenous variable are discussed. The conceptual issue associated with the data limitations causes the number of parameter per equation to be limited. Given that there are 28 observations, it is determined that if the number of parameters allowed are evenly divided among each equation in the system, there can only be seven parameters estimated per equation. Since the number of parameters per equation is limited, the variables that are to be used to estimate the equations are selected from variables presented in the empirical model. The reasoning for the selection of the specific variables is provided. Since the quantity demanded of commodity procurements is possibly endogenous, identifying instrumental variables are derived from Traub's work. Also in Chapter 4, the data needed for each variable are defined and a detailed description of the farm-level price, processor-level price, and quantity demanded of commodity procurement data is provided.

Chapter 5 presents the empirical implementation and the results of the regression analysis. The logged quantity demanded of commodity procurements ($\ln CP_{QD}$) variables in the ITSUR and OLS models are tested for endogeneity and show no statistical evidence of endogeneity. The ITSUR, OLS and 3SLS models are tested for overall significance, individual significance of the variables within the models, correct functional form in the individual

equations, and homoskedasticity in the individual equations. In the regression analysis, there is no evidence supporting the hypotheses that the CPP increases the farm-level price or the processor-level price. Additionally, there is statistical evidence that the commodity procurements have a negative effect on the partial and final reduced form price equations. There is no statistical evidence that commodity procurements have an effect on the farm-level price equation. These findings correspond to Nicks (2004) findings, since she reports that each insignificant coefficient on the commodity procurement variables is negative.

The results from the Breusch-Pagan tests do not show statistical evidence that an increase the logged quantity demanded of commodity procurements decreases the variance of the farm-level or processor-level prices. This information indicates that the CPP does not stabilize or destabilize the farm-level or processor-level prices.

6.2 Limitations

There are many data limitations constraining this thesis. The data limitations are that the commodity procurement data only dates back to FY1979 on a yearly basis. Data for commodity procurements after FY1991 is available on a more frequent basis but fruit and vegetable data at the farm-level such as canning fruit prices and quantity data is not. As discussed in the data section, 28 observations are considered a small sample size. Having so few observations causes the model to be limited in the number of explanatory variables to avoid degrees of freedom problems. The data limitations also limit the sophistication of the theoretical model that can be considered to generate a feasible empirical model. To improve on the theoretical model developed in this thesis, more data would need to be available and the author would need a more advanced skill set than that of a master's student.

6.3 Future Research

In the future, there are many possible approaches that could build on the current research to provide more information about the effects of the CPP on the processor-level and farm-level price. First, if the number of observations could be increased, it would be useful to test the separate effects of entitlement buys versus bonus buys. Second, the effects of the timing of the contract awards could be tested if the number of observations is increased through using monthly or weekly data. Third, future research could include price expectations in the theoretical model if the observations could be increased. Fourth, future research should test the effects of the CPP on more commodities to better understand how the CPP affects other fruits and vegetables. Fifth, it would be useful to test if there are any effects on the fresh market farm-level price from the purchase of the processed commodity.

6.4 Dissemination of Research Findings

This research is potentially useful to the administrators of the CPP at the AMS, FNS and FSA. It will provide them with insight into how the program is currently affecting the fruit and vegetable industry, which may allow them to improve the program to better achieve their objectives of supporting farm-level prices. Also farmers, processor, and associations that participate in the CPP may be interested in how the program affects prices and production. A published government report could be created for the research results to be disseminated to the AMS, FNS, and FSA as well as to the industries that actively participate in the CPP for fruits and vegetables.

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Table 1 - Canned Peach Industry Data Selection

Farm Supply for Canning Peaches					
Variable	Span	Measurement of Variable	Units	Source	Frequency
Farm Quantity Supplied (Q_{FS})	1980-2007	Peaches: Processed Utilization Canned Quantity	Millions of LBS.	ERS F&V Yearbook Spreadsheets	Yearly
Processor Demand for Canning Peaches/ Processor Supply of Canned Peaches					
Variable	Span	Measurement of Variable	Units	Source	Frequency
Farm Price (P_{FO})	1980-2007	Price Received by Farmers for Peaches for Canning	Dollars/LBS.	ERS F&V Yearbook Spreadsheets	Yearly
Processor Price (P_{PO})	1980-2008	Price of Canned Cling Peaches for 24/303 Choice HS, 24/2 1/2 Choice HS, &6/10 Choice HS	Dollars/Case	Food Institute	Yearly
Processor Labor Costs (W_{PL})	1939-2008	Hourly Earnings of Production Workers of Manufacturing nondurable goods	Index	BLS	Yearly
Processor Material Costs (W_{PM})	1947-2008	Metal and Metal Products- Metal Cans and Can Components	Index	BLS	Yearly
Consumer Demand for Canned Peaches					
Variable	Span	Measurement of Variable	Units	Source	Frequency
Processor Price (P_{PO})		See Processor Demand for Canning Peaches/ Processor Supply of Canned Peaches			
Price of Substitutes (P_{PS})	1980-2008	Fresh Peach Price received by growers	Dollars/LBS.	ERS F&V Yearbook Spreadsheets	Yearly

Table 1 – Continued

Consumer Demand for Canned Peaches (Continued)					
Variable	Span	Measurement of Variable	Units	Source	Frequency
Income (Y)	1969-2007	GDP per Capita	Dollars	ERS International	Yearly

Quantity of Commodity Procurements (CP _{QD})	1991-2007	Commodity Procurement Data for Canned Peaches	Farm weight in LBS.	Macroeconomic AMS F&V Branch Data	Yearly
Quantity of Commodity Procurements (CP _{QD})	1979-1990	Fiscal Year Commodity Procurement Data for Canned Peaches	Farm weight in LBS.	AMS F&V Branch Data	Yearly

Quantity Demanded of Commodity Procurements Identifying Instruments					
Variable	Span	Measurement of Variable	Units	Source	Frequency
Previous Year's Farm Price (P _{FO(t-1)})	1979-2006	Price Received by Farmers for Peaches for Canning	Dollars/LBS.	NASS/ERS F&V Yearbook Spreadsheets	Yearly
Total Cost (TC _{CP})	1991-2007	Commodity Procurement Data	Dollars	AMS F&V Branch Data	Yearly
Total Cost (TC _{CP})	1979-1990	Fiscal Year Commodity Procurement Data	Dollars	AMS F&V Branch Data	Yearly
Previous Year's Total Cost (TC _{CP(t-1)})	1991-2007	Commodity Procurement Data	Dollars	AMS F&V Branch Data	Yearly
Previous Year's Total Cost (TC _{CP(t-1)})	1979-1990	Fiscal Year Commodity Procurement Data	Dollars	AMS F&V Branch Data	Yearly

Table 2 - Descriptive
Statistics

	Mean	Standard Deviation	Minimum	Maximum
Farm Price (Millions of lbs.)	155.17	21.37	117.99	213.25
Farm Quantity (Dollars/ lbs.)	2442.85	252.34	1855.3	3068.6
Processor Price (Dollars/ Case)	9.58	1.36	7.4	12.58
Price of Metal Cans (Index)	77.65	17.1	56.88	102.52
Price of Processor Labor (Index)	7.56	0.21	7.09	
Fresh Peach Price (Dollars/ lbs.)	0.17	0.02	0.12	0.22
Income (Dollars)	17469.28	2863.91	12971.59	22274.33
Quantity of Commodity Procurements (Farm weight in lbs.)	46367020	22962979	12152039	1.09E+08
Total Cost of Commodity Procurements (Farm weight in lbs.)	13591623	5490479	4467019	25719014

Note: (There 28 observations for each variable.)

Table 3 - Correlation Matrix

	Farm Price	Farm Quantity	Processor Price	Price of Metal Cans	Price of Processor Labor	Fresh Peach Price	Income	Quantity of Commodity Procurements	Total Cost of Commodity Procurements
Farm Price	1								
Farm Quantity	0.35	1							
Processor Price	0.64	0.12	1						
Price of Metal Cans	0.77	0.06	0.86	1					
Price of Processor Labor	-0.56	-0.34	-0.25	-0.36	1				
Fresh Peach Price	0.36	-0.42	0.27	0.43	-0.11	1			
Income	-0.73	-0.14	-0.84	-0.95	0.46	-0.42	1		
Quantity of Commodity Procurements	-0.38	0.03	-0.49	-0.28	0.45	-0.08	0.28	1	
Total Cost of Commodity Procurements	-0.13	0.13	-0.24	-0.00	0.14	0.03	-0.05	0.89	1

Table 4- Iterated Seemingly Unrelated Regression and Ordinary Least Squares Results

Independent Variable	ITSUR		OLS
	ln P _{PO}	ln P _{FO}	ln P _{PO}
	Coefficient		
Constant	4.5581 (0.117)	-1.6534 (0.693)	8.2896 (0.000)
ln P _{FO}	0.1943 (0.131)	-----	-----
ln W _{PM}	0.1210 (0.499)	0.6714 (0.002)	-----
ln W _{PL}	1.5982 (0.001)	-0.8923 (0.116)	1.4857 (0.008)
λ _{FS}	-----	0.2864 (0.005)	0.0571 (0.522)
ln P _{PS}	-0.1659 (0.058)	0.2019 (0.078)	-----
ln Y	-0.5616 (0.015)	0.4373 (0.151)	-0.7590 (0.000)
ln CP _{QD}	-0.1595 (0.000)	-0.0168 (0.539)	-0.1160 (0.000)
R ²	0.8716	0.7605	0.8583
X ²	193.73 (0.000)	89.30 (0.000)	
RESET			0.4975
Prob>F			0.000
Hausman		0.3366	0.4505

Note: (P-values are presented below in the Coefficients.)

Table 5- Breusch-Pagan Tests of the ITSUR and the OLS Results

Independent Variable	Partial Reduced Forms	Final Reduced Forms	
	(Residuals In P _{PO}) ²	(Residuals In P _{FO}) ²	(Residuals In P _{PO}) ²
	Coefficient		
Constant	0.0913 (0.621)	0.4964 (0.241)	0.0301 (0.705)
ln P _{FO}	0.0071 (0.400)	-----	-----
ln W _{PM}	-0.0122 (0.289)	-0.0235 (0.287)	-----
ln W _{PL}	0.0025 (0.931)	-0.0400 (0.479)	0.0063 (0.845)
ln Q _{FS}	-----	-0.0035 (0.734)	0.0007 (0.897)
ln P _{PS}	-0.0060 (0.286)	-0.0053 (0.580)	-----
ln Y	-0.0111 (0.450)	-0.0291 (0.340)	-0.0054 (0.253)
ln CP _{QD}	0.0012 (0.384)	-0.0007 (0.804)	0.0005 (0.761)
Prob>F	0.6157	0.8786	0.8142

Note: (P-values are presented below in the Coefficients.)

Table 6- Three Stage Least Squares Results

3SLS				
	ln P _{PO}	ln P _{FO}	ln P _{PO}	ln CP _{QD}
Independent Variable	Coefficient			
Constant	2.0994 (0.453)	2.6372 (0.502)	2.6294 (0.353)	5.931 (0.017)
ln P _{FO}	0.2333 (0.047)	-----	-----	-1.0636 (.001)
ln W _{PM}	0.2126 (0.213)	0.4974 (0.016)	0.3321 (0.039)	-----
ln W _{PL}	1.7176 (0.000)	-1.2356 (0.021)	1.4362 (0.000)	-----
ln Q _{FS}	-----	0.2156 (0.025)	0.0516 (0.166)	-----
ln P _{PS}	-0.1376 (0.100)	0.1368 (0.199)	-0.1044 (0.206)	-----
ln Y	-0.4178 (0.060)	0.1963 (0.492)	-0.3671 (0.097)	-----
ln CP _{QD}	-0.0905 (0.000)	-0.0236 (0.403)	-0.0959 (0.000)	-----
ln TC _{CP}	-----	-----	-----	1.0726 (0.000)
ln TC _{CP(t-1)}	-----	-----	-----	-0.0351 (0.680)
R ²	0.8628	0.7475	0.8767	0.8625
X ²	190.34 (0.000)	91.75 (0.000)	199.87 (0.000)	180.25 (0.000)
RESET	0.3998	0.3120	0.8556	0.367

Note: (P-values are presented below in the Coefficients.)

Table 7- Breusch-Pagan Tests of the 3SLS Results

	Partial Reduced Form	Final Reduced Forms		Procurement Demand
	(Residuals In P _{PO}) ²	(Residuals In P _{PO}) ²	(Residuals In P _{PO}) ²	(Residuals In CP _{QD}) ²
Independent Variable	Coefficient			
Constant	-0.0429 (0.832)	0.5954 (0.174)	0.04478 (0.828)	-0.0646 (0.921)
ln P _{FO}	0.0094 (0.175)	-----	-----	0.0049 (0.949)
ln W _{PM}	-0.0065 (0.605)	-0.0266 (0.243)	-0.0030 (0.780)	-----
ln W _{PL}	0.0003 (0.994)	-0.0571 (0.328)	-0.0058 (0.833)	-----
ln Q _{FS}	-----	-0.0064 (0.547)	-0.0012 (0.803)	-----
ln P _{PS}	-0.0037 (0.549)	-0.0117 (0.332)	-0.0062 (0.273)	-----
ln Y	-0.0010 (0.952)	-0.0323 (0.323)	-0.0046 (0.760)	-----
ln CP _{QD}	0.0016 (0.280)	-0.0013 (0.649)	0.0014 (0.299)	-----
ln TC _{CP}	-----	-----	-----	-0.0359 (0.177)
ln TC _{CP(t-1)}	-----	-----	-----	0.0405 (0.129)
Prob>F	0.7249	0.6607	0.7733	0.3887

Note: (P-values are presented below in the Coefficients.)

Appendix A- Hypotheses and Justification of Hypotheses

Hypotheses pertaining to the Industry

Industry-Level Hypothesis 1

The industries would want commodity procurements to occur in their commodity and would want them increased if possible.

Justification of Industry-Level Hypothesis 1

Industries would view the CPP as extra demand or as a surplus removal mechanism based on the type of buy taking place. This would cause them to want more commodity procurements. In either case, increased demand drives up prices until there is an outward supply shift, which creates economic rents available to those individuals already invested in the industry, hence why extra demand would be desirable. Increased surplus removal implies a greater buffer to the variations in the markets, which is also desirable to any industry especially in agriculture.

Industry-Level Hypothesis 2

The producers, processors and associations don't fully understand the commodity procurement process. (Such as Entitlement buys and Bonus buys)

Justification of Industry-Level Hypothesis 2

Up to this point in time not much has been written on commodity procurements including its process. It is unlikely that the industry would fully understand the process.

Hypotheses pertaining to the Farmers

Farm-Level Hypothesis 1

The larger producers know more about commodity procurements than smaller producers and will take commodity procurements into account when making production decisions.

Justification of Farm-Level Hypothesis 1

Larger farmers would know more about commodity procurement because they are the ones large enough to sell fresh commodities to the government where the smaller producers do not. The smaller farmers would not be able to meet the amount necessary nor have the resources for labeling and transportation to be able to sell the large quantities to the government. Since the smaller farmers do not sell to the government directly, they probably know very little about the program and perhaps never even heard of it.

Farm-Level Hypothesis 2

The farmers who are affected by the commodity procurement program through bonus buys will not allow commodity procurements to factor into their production decisions.

Justification of Farm-Level Hypothesis 2

Farmers who receive bonus buys receive them on an infrequent basis. Since this is not a reliable demand source, they would not make production decision around it.

Farm-Level Hypothesis 3

The farmers who are affected by the commodity procurement program by entitlement buys will allow commodity procurements to factor into their production decisions.

Justification of Farm-Level Hypothesis 3

Farmers who receive entitlement buys receive them on a frequent basis. Since this is a reliable demand source, they would make production decision around it.

Farm-Level Hypothesis 4

The farmers feel that commodity procurements help increase price at the processor level and producer level.

Justification of Farm-Level Hypothesis 4

Farmers would feel that an increase in demand would increase price.

Hypotheses pertaining to the Processors

Processor-Level Hypothesis 1

The processors take into account commodity procurements for commodities purchased by entitlement buys when making their production decisions.

Justification of Processor-Level Hypothesis 1

Processors would be know that entitlement buys are frequent and would plan ahead for them and include that demand source in their production decisions.

Processor-Level Hypothesis 2

The processor will take into account commodity procurements for commodities purchased under bonus buys, once they know there is going to be a bonus buy. Then, they will be willing to process more from farmers.

Justification of Processor-Level Hypothesis 2

Processors would not buy the surplus from farmers because if there is no demand for the commodity because the processor will have the surplus and not be able to sell it. Once the government creates an invitation to buy then the processors know there is a demand and will purchase more of the raw product to fill that demand. This is all continuant upon if the invitation happens before the fresh surplus is spoiled.

Processor-Level Hypothesis 3

If the processor does not know that there is going be a bonus buy or the bonus buy happens after the end of harvest then processor production will remain the same and commodity procurements will only affect processor price.

Justification of Processor-Level Hypothesis 3

If the bonus buy happens after the surplus of the producer is spoiled then there is no chance to increase demand for the fresh product.

Processor-Level Hypothesis 4

The processors feel that commodity procurements help increase price at the processor level and producer level.

Justification of Processor-Level Hypothesis 4

Processors would feel that an increase in demand would increase price.

Hypotheses pertaining to the Associations

Association-Level Hypothesis 1

The associations feel that they can influence the occurrence of bonus buys.

Justification of Association-Level Hypothesis 1

Associations ask for the commodity procurements and supply information to the government to prove there is a surplus. Associations also have lobbying power to cause commodity procurements.

Association-Level Hypothesis 2

The associations understand the difference between entitlement buys and bonus buys.

Justification of Association-Level Hypothesis 2

The associations lobby for bonus buys which implies they understand the difference between entitlement buys and bonus buys.

Association-Level Hypothesis 3

The associations influence production through meetings and publications.

Justification of Association-Level Hypothesis 3

The associations play a role by bringing the industry together. The associations' members are jointly given information produced by the associations, which could influence their decisions.

Association-Level Hypothesis 4

The associations feel that commodity procurements help increase price at the processor level and producer level.

Justification of Association-Level Hypothesis 4

Associations ask for the commodity procurements and supply information be given to the government to prove there is a surplus, showing that they think that commodity procurements help prices.

Appendix B- Interview Questions

Associations' Questions

Association Background

- 1.) How long has the association existed?
- 2.) What is the association's influence in the industry?
- 3.) What is the goal of the association?

Association Activities

- 4.) Does the association influence the productions making decisions or price in the industry at all?
- 5.) What are the most likely causes for low prices in any given year?
- 6.) When there are low prices, what are the options that farmers and processors have to increase revenue?

Relationships

- 7.) What is the interaction between the farmers and the association?
- 8.) What is the interaction between the processors and the association?
- 9.) What is your interaction with other associations of the same commodity?
- 10.) What is your interaction with your local and federal government?

Commodity Procurements

- 11.) Have you ever participated in the commodity procurement program? If yes, how often have you participated?
- 12.) If yes, how do you feel the commodity procurement program impacted the industry?
Prices? Production?

- 13.) If yes, when does the commodity procurement program impact industry (price and production) decisions? Once the industry knows that they have a contract? Once the industry has been paid for a purchase? If no, is there a reason you have not participated?
- 14.) What sort of impact do you feel commodity procurements in your industry have on farmers? Why?
- 15.) If farmers are experiencing a surplus, how does that impact industries production decisions?
- 16.) If the processors are experiencing a surplus, how does that impact industries production decisions?
- 17.) Have you ever tried to ask for commodity procurement? What does this process entail for you?
- If yes, why did you ask?
- 18.) How often are your requests for commodity procurements resulted in obtaining a commodity procurement?
- 19.) Has the government provided you with information about commodity procurements?

Challenges

- 20.) What are most important problems at the moment or previously that the industry is facing?

Processors' Questions

Processor Background

- 1.) How large is your company? (Number of employees, farm weight processed)
- 2.) What types of commodities do you process?
- 3.) Where are all the branches of this company located?
- 4.) What is your influence in the industry?

Processor Activities

- 5.) What form is the product in when you receive it, what processing and other value-added activities do you undertake, and in form(s) do you sell the product?
- 6.) Who are your clients?
- 7.) Do you sell to them under contract? What is the nature of the relationship?
- 8.) Who are your suppliers?
- 9.) Do you contract them to supply you? What is the nature of the relationship?

Follow up questions if not answered in previous question.

Do you contract the crop? What does this entail?

Who are your customers?

How else do you market your processed commodities?

- 10.) Do you have the option to store the processed commodity?
- 11.) When do you decide how much to process and what factors do you take into account?
- 12.) How do you decide a price for your commodity purchased from the farmers?
- 13.) What are the most likely causes for low prices in any given year?
- 14.) When there are low prices, how does this influence your production decisions?
- 15.) When there are low prices, what are the options you have to increase revenue?

Relationships

- 16.) What is your interaction with farmers?
- 17.) What is your interaction with other processors?
- 18.) What is your interaction with associations?
- 19.) What are the benefits from participating in an association?

Commodity Procurement Program

- 20.) Have you ever participated in the commodity procurement program? If yes, how many times have you participated?
- 21.) If yes, how do you feel the commodity procurement program impacted you?
Prices? Production?
- 22.) If yes, when does the commodity procurement program impact your (price and production) decisions? Once you know that you have a contract? Once you have been paid for a purchase? If no, is there a reason you have not participated?
- 23.) When there are commodity procurements in your commodity that are not directly or indirectly purchased (processed goods) from your farm, have you seen any effects of those commodity procurements on you?
- 24.) What sort of impact do you feel commodity procurements in your industry have on farmers? Why?
- 25.) If farmers are experiencing a surplus, how does that impact your processing decisions?
- 26.) If the processors are experiencing a surplus, how does that impact your processing decisions?
- 27.) Have you ever tried to ask for commodity procurement? What does this process entail for you? If yes, why did you ask?

28.) When bidding for commodity procurements invitations, what is taken into account for creating your bid?

Challenges

29.) What are the most important problems at the moment or previously that the industry is facing?

Farmers' Questions

Farmer Background

- 1.) Are you a part time or full time farmer?
- 2.) How many acres do you have and of what commodities do you grow?
- 3.) How long have you been farming?
- 4.) What is your influence in the industry?

Farmer Activities

- 5.) What harvesting and other value-added activities do you undertake, and in way do you sell the product? *Follow up questions if not answered in previous question.*

How do decide a price for your commodity?

Who are your customers?

Do you contract your crop? What does the contract entail? How far in advance is your contract created?

How else do you market your crops?

- 6.) How long can you store the commodity before spoilage occurs?
- 7.) When do you decide how much to plant and what factors do you take into account?
- 8.) What are the most likely causes for low prices in any given year?
- 9.) When there are low prices how does this affect your production decisions?
- 10.) When there are low prices what are the options do you have to increase revenue?

Relationships

- 11.) What is your interaction with other farmers? (i.e. organizations, marketing together etc.)
- 12.) Do you sell to any processors?

13.) What is your interaction with your processor? (i.e. contracts, meetings on sales etc.)

14.) What is your interaction with the association? (i.e. publications, meetings etc.)

15.) What are the benefits for you from the association?

Commodity Procurements

16.) Have you ever participated in the commodity procurement program? Directly? (Sold directly to USDA); Indirectly? (Sold to processor that sells to the USDA); Not sure? If yes, how many times have you participated?

17.) If yes, how do you feel the commodity procurement program impacted you? Prices? Production?

18.) If yes, when does the commodity procurement program impact your price decisions? Once you know that you have a contract? Once you have been paid for a purchase?

19.) If no, is there a reason you have not participated?

20.) When there are commodity procurements in your commodity that are not directly or indirectly purchased (processed goods) from your farm, have you seen any effects of those commodity procurements on you?

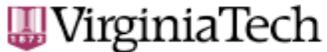
21.) If farmers are experiencing a surplus, how does that impact your production decisions?

22.) If the processors are experiencing a surplus, how does that impact your production decisions?

Challenges

23.) What are most important problems at the moment or previously that the industry is facing?

Appendix C – IRB Approval Letter for Interviews



Office of Research Compliance
Carmen T. Green, IRB Administrator
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e-mail ctgreen@vt.edu
www.irb.vt.edu
PIA00000572 (expires 1/20/2010)
IRB # is IRB00000667

DATE: May 21, 2008

MEMORANDUM

TO: Denise Mainville
Amanda Sceiford

FROM: Carmen Green 

SUBJECT: IRB Exempt Approval: "Price and Production Effects of the Commodity Procurements Program on Fruits and Vegetables", OSP #428347, IRB # 08-321

I have reviewed your request to the IRB for exemption for the above referenced project. The research falls within the exempt status. Approval is granted effective as of May 21, 2008.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in the research protocol. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.
2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File
OSP

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