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# Two-stage pork consumption model in the US

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TWO-STAGE PORK CONSUMPTION MODEL IN THE US

by

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Bachelor of Science, Nanjing Xiaozhuang University  
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A Research paper  
Submitted in Partial Fulfillment of the Requirements for the  
Master of Science Degree.

Department of Agribusiness Economics  
in the Graduate School  
Southern Illinois University Carbondale  
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RESEARCH PAPER APPROVAL

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By

Wenwei Wang

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for the Degree of

Master of Science

in the field of Agribusiness Economics

Approved by:

Dr. Wanki Moon, Chair

Graduate School  
Southern Illinois University Carbondale  
April 10th 2015

## AN ABSTRACT OF THE RESEARCH PAPER OF

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TITLE: TWO-STAGE PORK CONSUMPTION MODEL IN THE US

MAJOR PROFESSOR: Dr. Wanki Moon

In the 21st century, the pork industry has become an important component of the American economy. Creating more benefits and generating more job opportunities. To have a better understanding of the industry can help the companies and government participate in the market better, so that the consumers can have products with better quality.

By aiming at five specific pork products, we try to figure out what element can affect consumers' purchase behavior directly. How do they select the pork product that meet their preferences. And how can the answer to these question can benefit the producers.

By a survey consisted by a number of specific questions, and two regression models ,we try to analysis consumers' purchase behavior based on the numbers we collected by the survey. And present the affection of all the explanatory variables we selected. The result of the analysis can provide an important information to the producers: which pork product is the best seller in the pork market, which attribute of the pork in the most important one that should be paid more attention in the producing process for different parts of pork products. Also, we've made some suggestions based on the advantages and disadvantages in our paper for further study.

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## CHAPTER 1

### Introduction

America is a big pork industry country in the world. The number of live pig amount of livestock on hand and the output of pork production is the second in the world. But during 90's in the 20th century, the amount of output of pork production has decreased in a couple years in a row. After 21st century, the number of live pig amount of livestock on hand has increased, and created 0.8million job opportunities. So that we can see that, the pork industry is a very important part in American economy.

FAO (Food and agriculture Organization) says that: The accelerate development of the increase in income, population growth and the process of the urbanization are the advantageous dynamic of the meat consumption demand increasing, especially in developing countries. It is expected that in the year 2050, the output of meat will increase from 22.8 millions of tons nowadays to 46.3 million tons in the future. In the next 40 years the output of meat will be doubled, an annual increase of about 6 millions tons. The amount of pork production will increase significantly.

A very rapidly consolidation has occurred in the beef and pork industry. Since 1980, the number of hogs' slaughter plants has decreased from 500 to 1800 in a large scale. The decreasing number causes the increasing of firm size; the fewer and larger business has changed the industry structural. The change happened in pork industry may have a significant affection to the pork producers and grocery store managers. How consumers will response to this change, how will they perceive and value the difference will be a major problem the big companies want to focus on. A new way of pork industry development is needed in the current economy circumstance; we want to help the pork



company to make a more efficient and beneficial way to increase the pork demand in the food market.

A survey has been used to collect the data of the pork market to study the WTP (Willingness to pay) for pork production (Dwight R. Sanders, Wanki Moon, and Todd Kuethe 2007). We will focus on five different parts of pork production: Roasts, Chops, Steak, Ribs and Loins. And those parts are associated with four major attributes: Juiciness, Tenderness, Marbling and leanness (Ajzen, I., and M. Fishbein 1980).

We will find out which attribute is more important when consumers purchasing pork products and which part of pork is consumer's favorite. More specifically considering a specific part of pork, like steaks or ribs, what are the different attributes may the consumers consider, which attribute will make consumers willing to pay more. Since it will focus on more detail parts of the market demand, it will give the pork company more information about the pork market, to help them organize their process of pork produce. Using the same amount of input to be more efficient and beneficial.

By analysis the relationship between the four attributes and the five different parts of the pork production, we will run five different multiple regression models use the same kind of variables (income, age, home size, health index and the four attributes: juiciness, tenderness, marbling and leanness) to see the different affection of the four attributes to the five parts of the pork production.

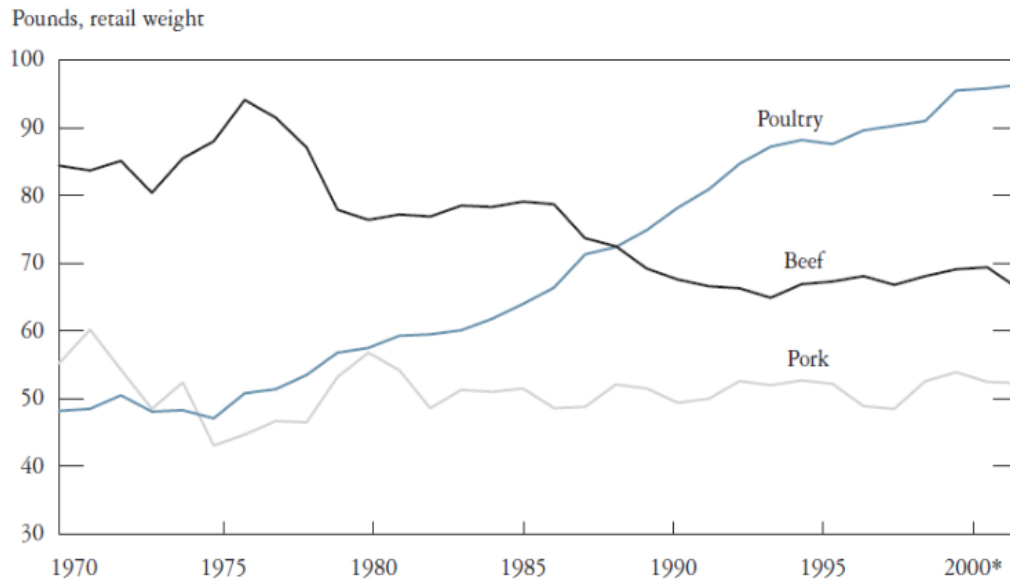
By achieving the goal we made, we are able to help the companies to gather more information about the pork market, to know much more better about the pork demand, to know what kind of attributes should be more focused on to increase the demand as they can have a higher profit.

In the next section, we will use the data we already collected by the survey to analysis the relationship. And will interpret what all the numbers mean to the companies, and will conclude a discussion of the result and ramifications to help the companies already in the market to make a change or the potential entrants into the market make a decision.

## CHAPTER 2

### Literature review

The US meat industry has changed in the past half century. Recent years the pork processing industry has been identified as "moderately concentrated". The Justice Department measure the Herfindahl-Hirschmann Index (HHI) of the pork industry, if the HHI is below 1000, then classified as unconcentrated. In 1998, the HHI was 1036 for pork processing, classified as moderately concentrated. How can the producers, retailer consumers and all the participants in the pork market affected by the industry change become a very important issue. During the last two decades, the total per capita consumption of pork edged up about 20 pounds per year, while the beef consumption fell, the pork consumption stayed steady(Figure 1)( Alan Barkema, Mark Drabenstott, and Nancy Novack 2001).

**Figure1. Per capita meat consumption****PER CAPITA MEAT CONSUMPTION**

\*Projected

Source: USDA

By the development of pork industry, consumers began to have expectation about the pork quality associate with all kind of health-related attributes also hedonistic dimensions, in terms of nutritional value, wholesomeness, freshness, leanness, juiciness, taste and tenderness. A research has been done to analysis the relations between consumers' perceptions and pork product quality by present a conceptual framework. It proves that the importance of considering consumers' quality perception and preference about pork product when developing and producing new products(L. Bredahl,a\* K. G. GrunerPt& C. Fertinb 1998).

But Steenkamp and Trijp(1996) has a little difference with this result. Because of the different methodologies, Steenkamp and Trijp measured consumers' expected and

quality perception and preference by global measures, so that they have a better explanation about the consumers' quality perception and preference.

In the food market, all kinds of fresh food like vegetables and meats all have a huge interval of different product qualities. Especially among pork products, the fresh pork chops are typically exhibiting these quality differences. Consumers have different preferences to these products associated with different attributes based on their purchase experiences.

How consumers value the different attributes can certainly cause a great interest to the producers and store managers. The answer to this question may even cause a big change in the pork processing and managing behavior.

Melton et al. has extended a model to analysis consumers' preference for different products. By integrated statistical methods, it is possible to identify different consumers' preference for products that have a continuous different quality associated with different attributes.

They found out that if consumers are not satisfied with a product which doesn't meet their perception, the frequency of repeat sales will be low even if with a lower price(Bryan E. Melton, Wallace E. Huffman, and Jason F. Shogren 1996).

## CHAPTER 3

### Survey Design

The overall goal of this project is to determine if there is an economic incentive to produce some specific part of the pork or to pay more attention on some specific attributes to different part of the pork production. This is accomplished by conducting a feasibility or willingness-to-pay study. The study examines consumer's demand for premium pork and the preferences of different parts of the pork. The survey designed to collect consumer's preferences about five different pork products and to assess the value of four salient taste-related attributes associated with pork products.

This survey consisted of a series of questions starting with asking consumer's purchase history and frequency, also their preferences toward different part of pork products were asked.( Anderson, E. W., and S. M. Shugan. 1991) The survey includes questions that measure current consumption behavior for five fresh pork products: roasts, chops, steaks, ribs and loins. Additionally, they examine whether respondents are currently purchasing premium-priced pork.

We take 8 variables into consideration. Within the 1163 respondents, we ask their income status, home size, age, and the four attributes: tenderness, juiciness, leanness and marbling. Associate these 8 variables with the pork product consumption frequency. By giving a rank from 1 to 6, we ask the respondents how they feel about the importance of each attributes by asking the specific questions like: Leanness is an important consideration when I buy pork. And assign 1 as strongly disagree and 6 as strongly agree. Similarly we ask the same question about marbling, juiciness and tenderness. For the health concern aspect, we designed six questions about health concerning problems like: I

am actively trying to consume less fat in my diet. And rank the answers from 1 to 5, 1 as not care at all, and 5 as extremely well. Then we generated an explanatory variable by add the answer for the five questions up, and marked as Hindex(Health Index) to measure the health concern level in order to relate to the pork product consumption behavior and consumption frequency.

The reason we take income status into account is that, by different income level people may have different purchase behavior. And why age is important is because that it may affect consumer's experience and elders may pay more attention on the health-related attribute. Also the home size can affect the purchase frequency, which we will try to measure in the next part of the paper.

In assessing the overall feasibility of a value-added pork product, the research pursues the following specific objectives.

1. within the five different part of pork products, which one or two is consumers' favorite. Or rank the five different parts by consumer behavior.
2. By every individual part, associated with four major attributes, which one or two attributes are regarded as the most important attributes.
3. Create an empirical model to help analysis the relationship between the consumption frequency and the dependent variables which are: income, age, home size, marbling, juiciness, tenderness and leanness.
4. Formulate specific model to see different impact to the five parts of pork products by the four associated attributes.

5. Analysis the result to present the five different models to interpret the consumer preference and perceptions.



## CHAPTER 4

### Basic Data Analysis

**Table1. Survey background of the respondents**

Demographic Characteristics	Respondents
<b>Gender (%)</b>	
Female	78.4
<b>Ethnicity (%)</b>	
White	88.7
Black	9.2
Asian	0.9
Hispanic	2.1
<b>Education (%)</b>	
High school graduate (FHHa)	78.40
High school graduate (MHHb)	90.80
Bachelor's degree (FHH)	26.60
Bachelor's degree (MHH)	33.60
<b>Household size (members)</b>	2.50
<b>Household income (\$)</b>	42500.00

Not surprisingly, the basic analysis of the data indicates that in most of the families (about 77.2%) women do the grocery shopping every month. By the average age and the education level, we are safe to interpret that there is a certain portion of housewives do the grocery shopping. This part of people have a lot experiences in shopping and have specific demand for different products, so there opinions to the pork product can reflex a significant level of pork demand and preferences in the market.

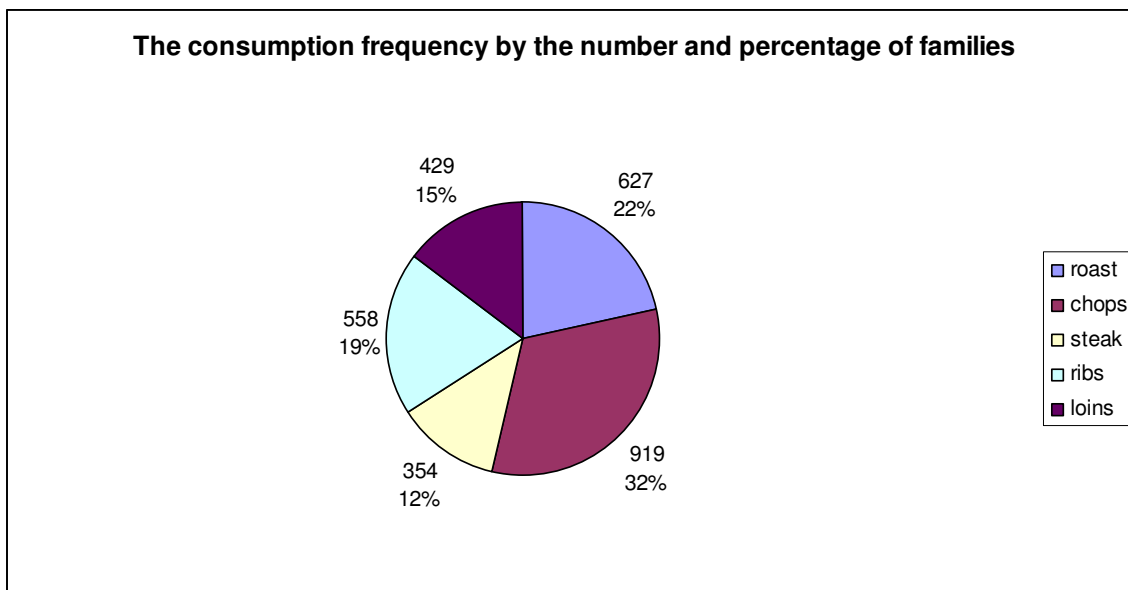
**Table2. Consumers' preferences to five different parts of the pork products.**

	The number of families buy in the last month	The number of times being bought in the last month	The number of families buy more than once in the last month
Roast	627	1032	223
Chops	919	2318	617
Steak	354	769	186
Ribs	558	990	190
Loins	429	818	163

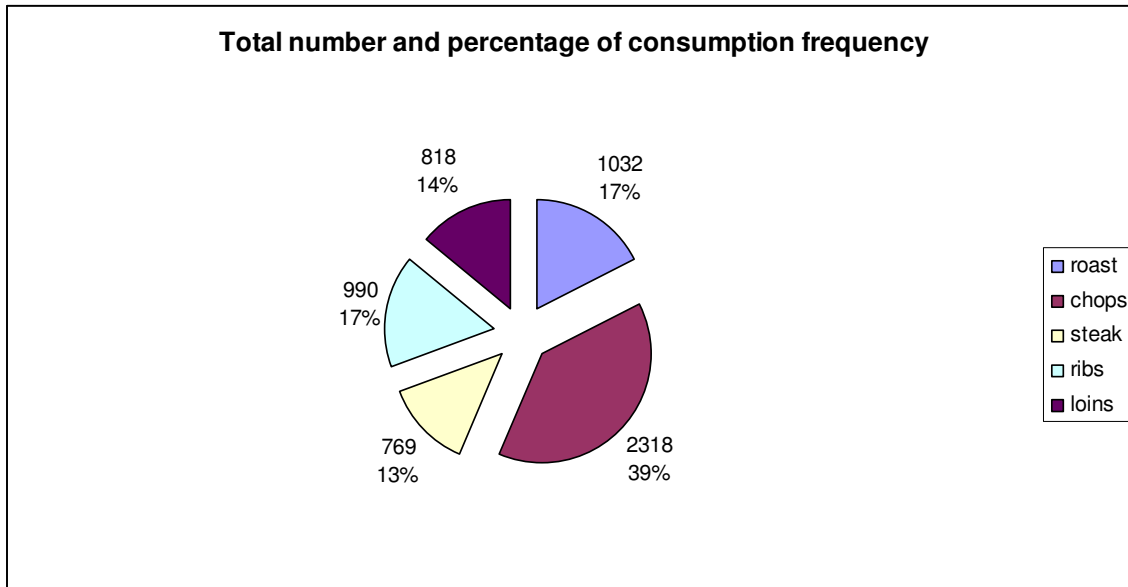
**Table3. Details of the consumption frequency for the five different pork products.**

	roast	chops	steak	ribs	loins	Total consumption
	243	105	346	274	327	
0	293	139	463	331	407	
>1	627	919	354	558	429	2887
%of consumption in total	0.22	0.32	0.12	0.19	0.15	
%of family numbers	0.54	0.79	0.30	0.48	0.37	
Total number of consumption frequency	1032	2318	769	990	818	5927
% of number of consumption frequency	0.17	0.39	0.13	0.17	0.14	
average consumption frequency	1.65	2.52	2.17	1.77	1.91	
above average frequency	223	331	90	190	163	

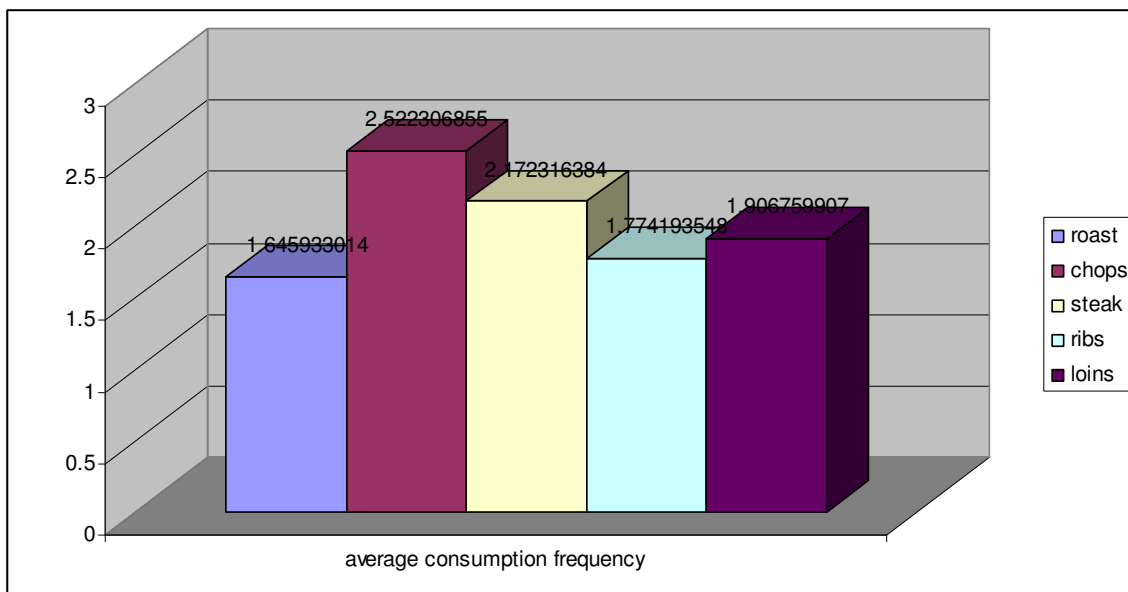
**Figure2. The consumption frequency by the number and percentage of families**



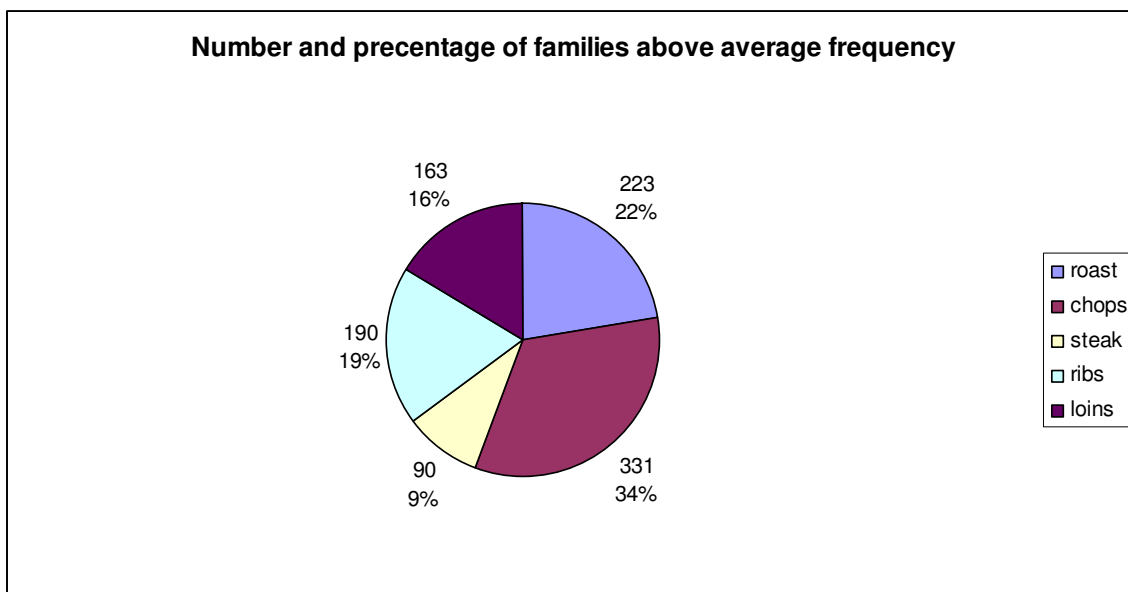
**Figure3. Total number and percentage of consumption frequency**



**Figure4. Average consumption frequency for five pork products.**



**Figure5. Numbers and percentage of families above average frequency.**



Apparently, the tables and figures above, we can tell that chops are the most popular pork products among the five parts.

With the amount of over 2000 times purchased, chops are leading the pork market demand. Roast and ribs are selling much less than chops, but roast and ribs keep at a same level of demand. Steak and loins sell the least in the pork market.

## CHAPTER 5

### Model Specification

So far, we basically solved our first problem: which of the products is the best seller in the market. Now we are going to try to identify the relationship between consumption frequency of the different products and the four different attributes.

By the survey design, we generated an independent variable which is Hindex (Health Index) and an explanatory variable, to help analysis if consumers with different level of health concern may have different purchase behavior and purchase frequency for specific pork products. And by the basic data analysis of the explanatory variables we have the result as table 4.

**Table4. The basic analysis of explanatory variables.**

Explanatory variables	Man	Std Dev	Minimum	Maximum
INCOME	19.05072	7.14386	2	33
AGE	50.09187	15.40181	20	92
HHSIZE	2.57799	1.41925	1	9
Important level of marbling	4.08517	1.4174	1	6
Important level of juiciness	4.58756	1.2338	1	6
Important level of tenderness	4.96364	1.13825	1	6
Important level of leanness	4.77703	1.22515	1	6
HINDEX	20.43445	5.27453	6	30

First, we need to analysis the purchase behavior by distinguish the respondents whether purchase a certain pork product or not. By using dummy coding, we set the purchase behavior into two categories: not buying and buying for every product. Set "not buying" as Dummy=0 and "buying" as Dummy=1 and associate the purchase behavior

with income status, age, home size, marbling, juiciness, tenderness, leanness and health index.

**Dummy=f(income, age, home size, marbling, juiciness, tenderness, leanness, Hindex)**

For step 2 we need to further analysis the purchase behavior of the consumers who purchase a certain pork product. By associate the consumption frequency with income, age, home size, marbling, juiciness, tenderness and leanness, we establish a regression function as:

**CFi=f(income, age, home size, marbling, juiciness, tenderness, leanness, Hindex)**

Which CFi stands for consumption frequency of chops, steaks, loins, ribs and roasts.

Income should be an important variable to take into consider because with different level of income consumers will present a huge different purchase behaviors. With lower income, consumers will have much less choice than higher income consumers, which may lead to a more careful product choice. Even some low income consumers may always choose the cheapest product regardless of the quality. So the importance of income is obvious. By taking age aspect into account is because elders may pay more attention than younger consumers who may pay more attention on the tasty and mouth feeling. The home size can directly affect the amount and frequency of the household's purchase behavior.

**Table5. Output of first step of analysis the purchase behavior.**

Variable	Roast		
	Coefficient	std	T-Value
C	-1.21	0.35	-3.50
Income	0.01	0.01	0.94
Age	0.02	0.00	5.98
Hhsize	0.10	0.04	2.82
Marbling	0.02	0.04	0.46
Juiciness	0.14	0.06	2.43
Tenderness	-0.05	0.06	-0.75
Leanness	-0.03	0.04	-0.65
HINDEX	0.00	0.01	-0.17

Variable	Chops			Steak		
	Coefficient	std	T-Value	Coefficient	std	T-Value
C	0.22	0.39	0.56	-0.45	0.35	-1.31
Income	-0.01	0.01	-0.60	-0.04	0.01	-5.45
Age	0.02	0.00	3.73	0.01	0.00	2.88
Hhsize	0.15	0.05	3.23	0.10	0.03	2.73
Marbling	-0.01	0.04	-0.17	0.09	0.04	2.42
Juiciness	0.04	0.07	0.62	0.00	0.06	-0.07
Tenderness	0.12	0.08	1.62	-0.01	0.07	-0.09
Leanness	-0.08	0.05	-1.44	-0.05	0.05	-1.18
HINDEX	-0.02	0.01	-1.62	0.01	0.01	1.27

Variable	Ribs			Loins		
	Coefficient	std	T-Value	Coefficient	std	T-Value
C	-1.25	0.34	-3.68	-1.57	0.35	-4.51
Income	0.00	0.01	-0.43	0.01	0.01	0.91
Age	0.01	0.00	3.80	0.01	0.00	4.00
Hhsize	0.09	0.04	2.53	0.03	0.03	0.72
Marbling	0.04	0.04	1.22	0.02	0.04	0.61
Juiciness	0.12	0.06	2.25	-0.02	0.06	-0.39
Tenderness	0.05	0.06	0.80	0.12	0.06	1.84
Leanness	-0.06	0.04	-1.38	0.01	0.04	0.15
HINDEX	0.00	0.01	0.49	0.01	0.01	0.87



**Table6. Output of second step to analysis the consumption frequency**

Variable	Roast		
	Coefficient	std	T-Value
C	1.39	0.50	2.80
Income	-0.02	0.01	-2.30
Age	0.00	0.00	-0.63
Hhsize	0.03	0.05	0.64
Marbling	0.09	0.05	1.80
Juiciness	-0.03	0.08	-0.32
Tenderness	0.06	0.08	0.75
Leanness	-0.02	0.06	-0.26
HINDEX	0.01	0.01	1.05

Variable	Chops		
	Coefficient	std	T-Value
C	1.96	0.50	3.91
Income	-0.03	0.01	-3.44
Age	0.00	0.01	-0.21
Hhsize	0.10	0.05	1.83
Marbling	0.05	0.05	0.97
Juiciness	0.07	0.08	0.84
Tenderness	-0.04	0.09	-0.48
Leanness	0.05	0.07	0.79
HINDEX	0.02	0.01	1.62

Variable	Steak		
	Coefficient	std	T-Value
C	2.89	0.76	3.81
Income	-0.06	0.02	-3.74
Age	0.00	0.01	-0.17
Hhsize	0.04	0.08	0.51
Marbling	0.00	0.09	0.05
Juiciness	0.03	0.14	0.24
Tenderness	-0.09	0.15	-0.63
Leanness	-0.04	0.11	-0.34
HINDEX	0.04	0.02	1.71

Variable	Ribs		
	Coefficient	std	T-Value
C	1.40	0.74	1.90
Income	-0.03	0.01	-2.36
Age	0.00	0.01	0.51
Hhsize	0.02	0.07	0.22
Marbling	0.05	0.08	0.65
Juiciness	-0.10	0.12	-0.82
Tenderness	0.10	0.13	0.78
Leanness	-0.02	0.09	-0.17
HINDEX	0.03	0.02	1.39

Variable	Loins		
	Coefficient	std	T-Value
C	1.72	0.98	1.76
Income	-0.04	0.02	-2.28
Age	-0.01	0.01	-1.31
Hhsize	0.13	0.09	1.42
Marbling	-0.01	0.09	-0.08
Juiciness	0.09	0.14	0.62
Tenderness	-0.13	0.16	-0.80
Leanness	0.07	0.11	0.68
HINDEX	0.06	0.02	2.26

For all five products the coefficient value of income are all negative. By this result we can assume that at a certain level, when consumers' have more income, they are willing to buy more beef or seafood instead of pork, so the negative coefficient can be considered as reasonable. But the age of consumers doesn't have a significant effect on the consumption frequency.

And by the coefficient of the four major attributes, we can interpret that, for roast, marbling and tenderness are more important than juiciness and leanness. For chops, marbling, tenderness and juiciness are more important than leanness. For steak, marbling and juiciness are more important than tenderness and leanness. For ribs, marbling and

tenderness are more important than leanness and juiciness. And last for loins, leanness and juiciness are more important than tenderness and marbling. We even can rank the importance of each attributes for every individual pork products by ranking the coefficient in our result. And by the output of HIndex level, we can see that with higher health index level, consumers are willing to buy more loins than any other products.

## CHAPTER 6

### Conclusion

By the results we have above, it will help the pork companies understand the pork market and the consumers' preferences better. The attributes of different aspects can surely affect the consumption frequency of different pork products. By focus on different attributes for different products, pork companies can have a clear direction to adjust their produce process, make it more efficient and meet more consumers' perception and requirement, in order to increase selling and profits.

Based on our survey and model design, pork companies can pay more attention on the information they need when doing the market research, to gather more useful information to help with companies' decision about produce amount and price the products. Melton et al(1996) integrated statistical methods of experimental design and methods of experimental economics, so compare our result with Melton's paper, Melton is possible to differences in consumers' preferences for products that exhibit continuous variance in multiple quality attributes or characteristics. For further study in the pork or any other market, we still can do some modification based on our survey and model design. But in order to have a more accurate result to analysis the relationship and affection, since our respondents are all from Illinois, and the amount of respondents are small, so that the valuable answers to the questions are not too much, so based on the result of survey, we suggest that the further study can try to have a larger respondent amount, and try to cooperate with pork companies to have a more reliable result.

As we represented at the beginning of the paper, the pork industry in the US nowadays has become an important component of the US economy. To have a better

understanding of the pork industry can help companies be more competitive, efficient and beneficial. By keep on improving the research method in this area, gaining the knowledge of the industry structure change, the companies can fit in the current industry better, and produce products with higher products which can meet the consumers' different requirements for health, mouth feeling, taste and all kinds of preferences.

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