*Full Length Research Paper*

# Simultaneous Estimation Function Model To Identify Factors That Influence of Beef Demand and Supply

## Dwi AuliaPuspitaningrum[1]; Masyhuri[2] ; Slamet Hartono[2]; Jamhari [2]

[1]Departmentof Agribusiness. Faculty of Agriculture, University of Pembangunan Nasional (UPN)"Veteran" Yogyakarta Indonesia
[2]Faculty of Agriculture Gadjah Mada University Yogyakarta,Indonesia
*Corresponding author: e-mail :auliayk@yahoo.com / dwi.aulia.p@mail.ugm.ac.id
Telephone : 081228055877 (WA) ; 081392781717

The Income per capita in each district in Daerah Istimewa Yogyakarta (DIY) Indonesia always increase year to year. The Human population in that area also high rise too. This condition makes the demand of food also increase, both the staple food and secondary food. The Supply of beef in this area have not been balance with the demand of beef. This study purpose to analyze the condition of beef supply-demand in DIY, and to identify factors that influence the demand and supply of beef. We incorporated one of econometric model called Simultaneous Estimation Function Model to approach the goal of this research by using secondary time series data from 1995 through 2016 from Indonesia Statistical Bureau and Data Centre of Directorate General for Livestock Services of Indonesia. Many parameters observed are production and consumtion of beef. Many parameters are running in this model especially Two Stage Least Square (2SLS) methode. The result of this study indicated that all of parameter that include in this model were determined simultanouesly by demand and supply Linkage. This condition indicated that in the future time there will be increasing of demand of beef in DIY. It must be fullfill with the availaibility of beef in this province. Generally Province of DIY able to provide the wise policy to anticipate non balance condition between beef demand and supply.

Keywords: Beef, Demand, Supply, Simultanoeous Model.

## INTRODUCTION

Recently, in Daerah Istimewa Yogyakarta (DIY) Indonesia the human population rises so that it makes changeof the food demand. This is not only for staple food but also for the secondary food, including beef, chicken and other meats. The increasing income per capita also could influence to change of the demand of meat. If the demand of beef change, the supply is expected be available to cover this condition. Production of beef as one of the parameters of supply must will be able to fulfil the demand of beef as long as the equilibrium condition goes well. In case of beef in DIY, only have small number of grassland to serve the feed
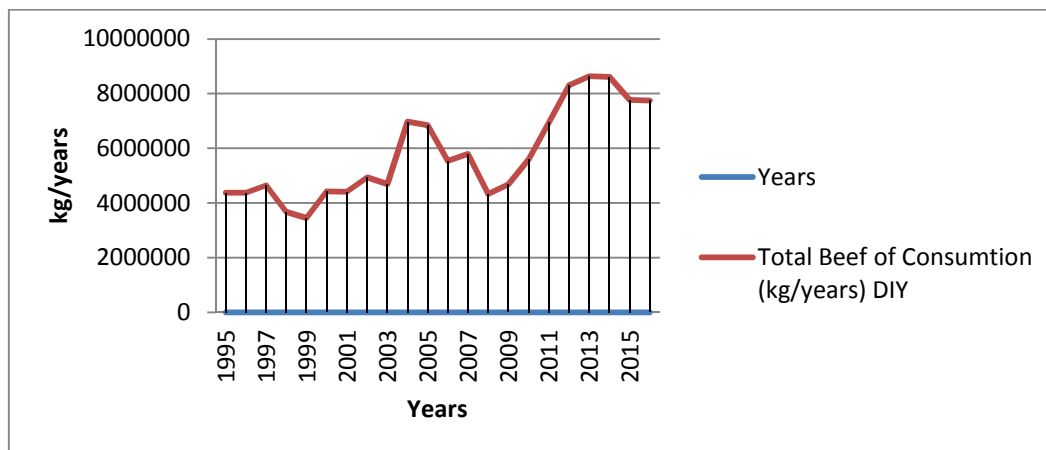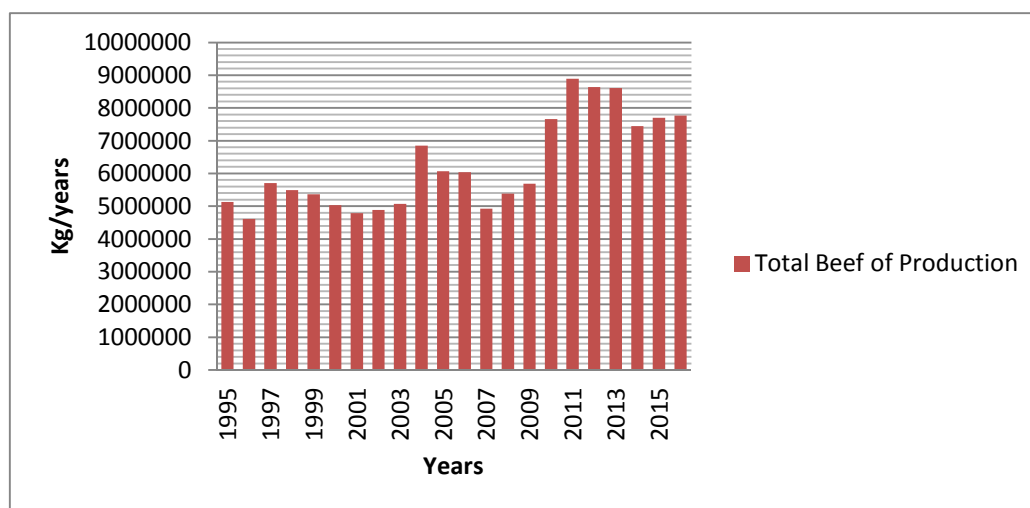
**Figure 1.** DIY Beef Consumption 1995-2016



**Figure 2.** The Production of Beef in Daerah Istiewa Yogyakarta 1995-2016

of animal especially cow. This condition maybe influence of the supply, shown on the production of beef. Many factors are able to influence both the demand and also the supply of beef.

In supply side of beef as shown on the consumption of beef, many factors able to influence, for example the beef production, price of beef, IB availability, grass feed availability, the amount of cow population, the import of cow and also the export of cow to this area. In other hand in the demand side, many factors maybe influence for example human population, income per capita, price of beef, price of other meat like chicken, price of cat fish, and price of soybean. If the supply not able to full fill the demand, the condition will not balance and will be any gap, both excess demand or excess supply of beef.

Base on the demand of beef, figure 1 showed about the beef comsumption condition in DIY.,Except the beef of consume of household, in DIY there are hight the

improving of the beef agroindustrial with the many variation of the derived product of beef, especially demand of food arena, restaurant, hotel, guest house, public service make the demand will increase too. Yogyakarta is the main destination of touristm in Indonesia. Domestic tourism and also the foreign every year fulfill the space arena of Yogyakarta. This condition make the consume of beef higher than its years before. In other hand, Figure 2 showed that the supply of beef in DIY. The supply is meausrement by production data base 1n 1995 through 2016. In 1995 the production in Yogyakarata city is 5,134,133 kg, increase by 6,069,136 kg in 2005 and rises at 7,695,767 kg in 2015 and increaase by 7,765,213 kg in 2016 . This condition showed that the share of the production of beef in Sleman district 21.21%; Bantul district 8.41%, Kulonprogo district 34,25%, Gunungkidul 16.61% and Yogyakarta city only 21.77 % to Province of DIY on
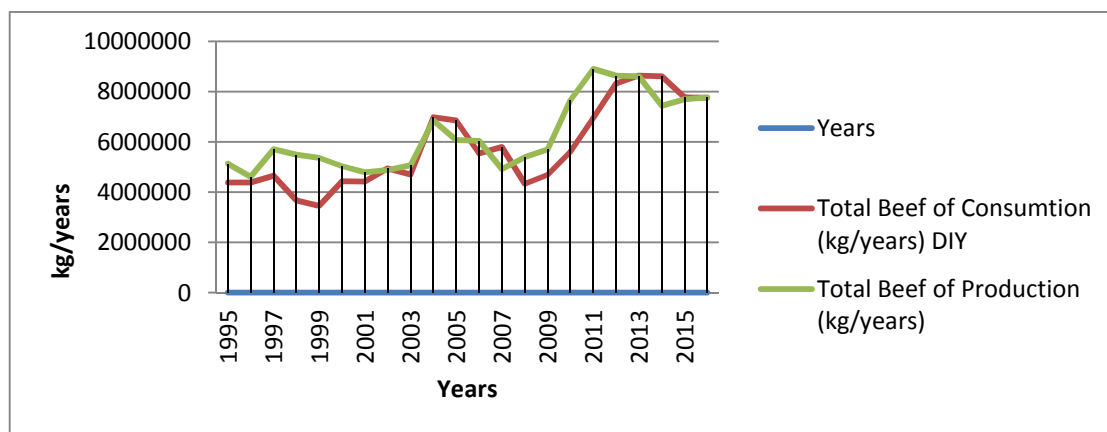
**Figure 3.** Beef Production and Consumption in DIY 1995 -2016

**Table 1.** The Population of Cow in Each District of DIY Indonesia 1995-2016

| Year | Yogyakarta City District | Bantul District | Kulonprogo District | GunungKidul District | Sleman District | Province of DIY |
|---|---|---|---|---|---|---|
| 1995 | 265 | 35925 | 37692 | 98950 | 22683 | 195515 |
| 1996 | 268 | 36700 | 37704 | 99304 | 22687 | 196663 |
| 1997 | 269 | 36923 | 37814 | 99610 | 22812 | 197428 |
| 1998 | 270 | 36864 | 37702 | 101617 | 24689 | 201142 |
| 1999 | 266 | 37434 | 37998 | 99287 | 27153 | 202138 |
| 2000 | 205 | 38778 | 38304 | 102162 | 27265 | 206714 |
| 2001 | 206 | 41346 | 39066 | 102348 | 28923 | 211889 |
| 2002 | 262 | 42309 | 39208 | 106273 | 31318 | 219370 |
| 2003 | 262 | 42867 | 40256 | 106804 | 34058 | 224247 |
| 2004 | 219 | 47876 | 41451 | 108395 | 38785 | 236726 |
| 2005 | 181 | 48157 | 44478 | 109187 | 45007 | 247010 |
| 2006 | 133 | 48399 | 45318 | 111502 | 45983 | 251335 |
| 2007 | 146 | 49655 | 46544 | 114139 | 47352 | 257836 |
| 2008 | 146 | 51452 | 51404 | 115421 | 51504 | 269927 |
| 2009 | 179 | 52513 | 53961 | 121469 | 54921 | 283043 |
| 2010 | 186 | 55585 | 60814 | 126455 | 47909 | 290949 |
| 2011 | 345 | 79595 | 72536 | 181188 | 51706 | 385370 |
| 2012 | 312 | 84423 | 56491 | 162240 | 54921 | 358387 |
| 2013 | 297 | 50552 | 45595 | 138134 | 38216 | 272794 |
| 2014 | 231 | 52564 | 49370 | 147195 | 52651 | 302011 |
| 2015 | 250 | 54640 | 49715 | 148586 | 53500 | 306691 |
| 2016 | 222 | 56821 | 51859 | 136633 | 49866 | 295401 |

Source : Indonesia Statistical Centre. DIY Chapter.

2015-2016.

Many factors that influence the beef supply, for example population of cow, the slaughtered cow ,the amount of cow both the cow enterng DIY or exiting from DIY, Price of beef, the availability of semen for artificial insemination, The availability of grassland. The main reason from this condition and one of the rasional caused problem maybe the wide of grassland that decrease year of year , according the high growth rate of land conversion from agricultural land to other many purpose destination especially to get higher of the bussiness economic activities.

Figure 1 and 2 showed that base on data from 1995-2016, the demand and suply of beef and not going

similarly. Figure 3 showed the Growth rate of demand is 3.2 %/year and growth rate suplly is 2.08. It looks that there is not an equilibrium condition. Based on the background of the research, this study aims to analyze the factors that are abble to influence of demand of beef and also the supply of beef in DIY,

**METHOD AND MODEL ANALYSIS OF BEEF IN DIY**

We incorporated the simultaneous estimation function model to close the objective of the research. Simultaneous model is the part of econometric model especially in regression analysis model. A Simultaneous
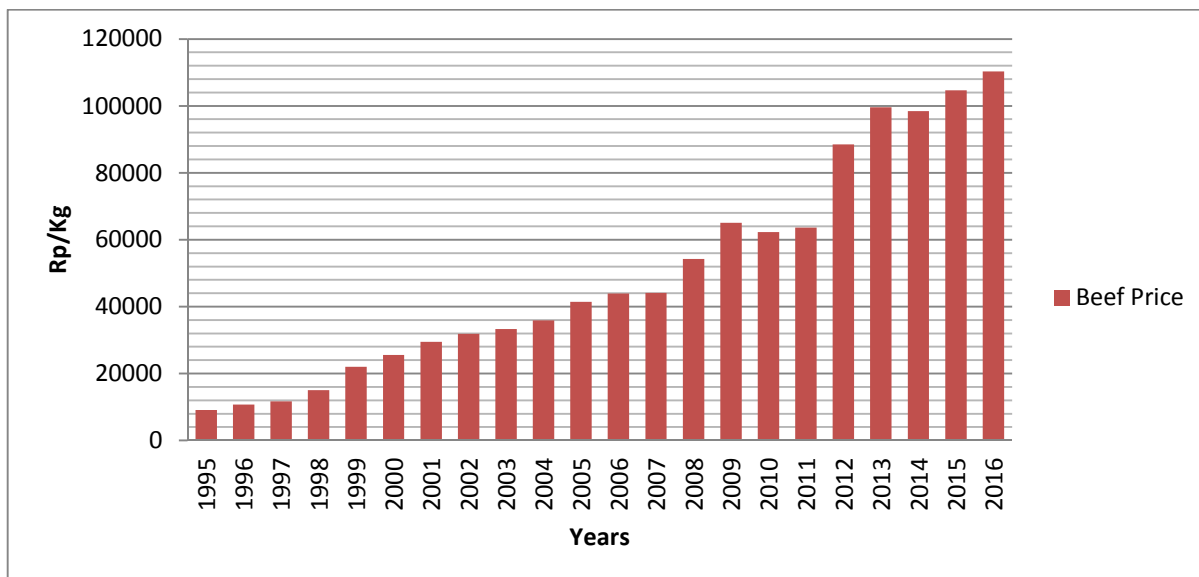
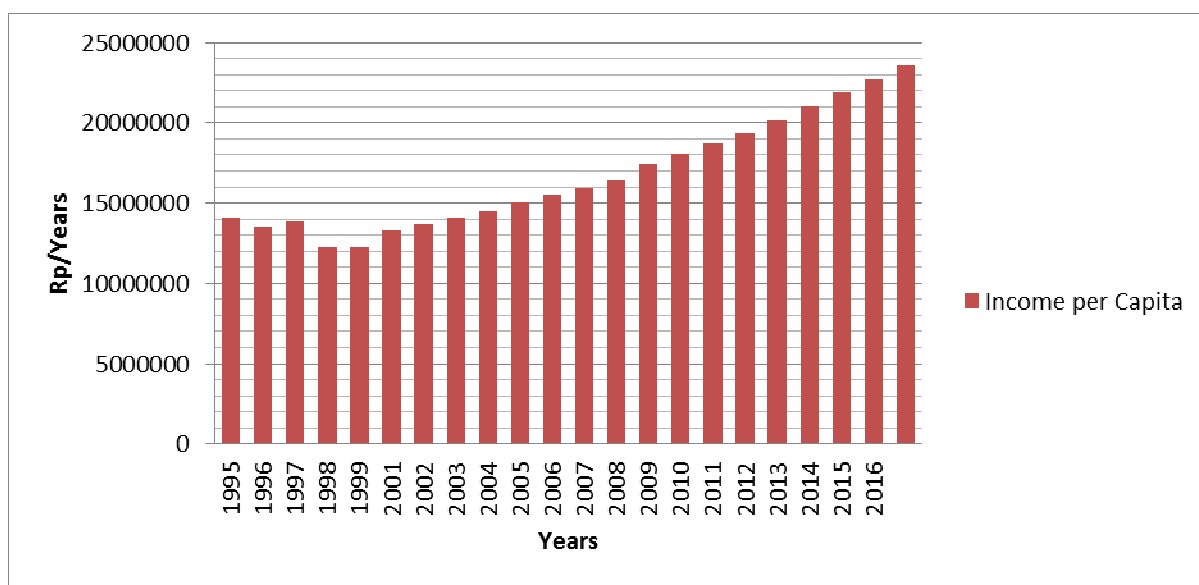**Figure 4.** The Beef Price in DIY 1995-2016



**Figure 5.** The Income Per Capita in DIY 1995-2016

Equation Model (SEM) is a model in the form of a set of linear simultaneous equations. The system is jointly determined by the equations in the system; In other words, the system exhibits some type of simultaneity or "back and forth" causation between the X and Y variables. As the name makes clear, the heart of this class of models lies in a data generation process that depends on more than one equation interacting together to produce the observed data. Unlike the single-equation model in which a dependent ($y$) variable is a function of independent ($x$) variables, other $y$ variables are among the independent variables in each SEM equation. The $y$ variables in the system are jointly (or simultaneously)

determined by the equations in the system (Greene,2003)

Compare the usual single equation. Notice that the first equation in the system has a conventional $x$ variable, but it also has a dependent variable ($y_2$) on the right-hand side. Likewise, the second equation has a dependent variable ($y_1$) as a right-hand side variable. In a simultaneous equations system, variables that appear only on the right-hand side of the equals sign are called exogenous variables. (Koutsoyiannis,1977)

They are truly independent variables because they remain fixed. Variables that appear on the right-hand side and also have their own equations are referred to as

Table 2. The Result of The Simultaneous Model of beef demand and  beef Supply in DIY,Indonesia

| Variabel | Notice | Parameter Hypothesis | Probability | Note |
|---|---|---|---|---|
| C | Constanta | 1.86714 | 0.0815 | $R^2$ = 0.798 |
| $X_{HP}$ | Human Population | 1.573289 | 0.1374 | Adjusted $R^2$ = 0.721 |
| $X_{CI}$ | Income per capita | 0.077366 | 0.0031*** | DW = 2.07 |
| $X_{PB}$ | Price of Beef | -0.012536 | 0.0024*** | F Statistic = 43,127 |
| $X_{PC}$ | Price of Chicken meat | -0.40067 | 0.4786 | **=α10% |
| $X_{PLL}$ | Price of "lele" catfish | -0.35189 | 0.1264 | *** = α 5% |
| $X_{PSY}$ | Price of Soybean | -0.095736 | 0.2529 | |
| $X_{BF}$ | Beef Production | 3.201171 | 0.0070*** | |
| $X_{CP}$ | Cow population | 1.413051 | 0.0178** | |
| $X_{IB}$ | The available of IB | -1.43229 | 0.0024*** | |
| $X_{SC}$ | The slaughtered cow | 4.579357 | 0.0004*** | |
| $X_{CI}$ | Cow import | 1.248874 | 0.0123** | |
| $X_{CE}$ | Cow export | -0.882122 | 0.6372 | |
| $X_{GL}$ | Grassland | 0.5463 | 0.3732 | |

Source : Analysis Survey and Secondary Data ,2017

endogenous variables. Unlike exogenous variables, endogenous variables change value as the simultaneous system of equations grinds out equilibrium solutions. They are endogenous variables because their values are determined within the system of equations.   The equitation of the model is divided into three steps. As follow :

1.	Formulated Demand of Beef in  DIY ( Base on Consumption Data)

Demand : QD

QD	= f( $X_{HP}$ ,$X_{IC}$ ,$X_{PB}$ , $X_{PC}$ ................................ $Q_{t-1}$)

QD	= $\alpha_0$+ $\alpha_{HP1}X_{HP}$ + $\alpha_{IC}X_{IC}$ + $\alpha_{PB}$ $X_{PB}$ + $\alpha_{PC}$ $X_{PC}$ + $\alpha_{PLL}$ $X_5$ + $\alpha_{PSY}$ $X_{PSY}$+$\alpha_{BP}$ $X_{7BP}$ + e

lnQD = $\alpha_0$ +$\alpha_{HP}$ ln $X_H$ + $\alpha_{IC}$ln$X_{IC}$+ $\alpha_{PB}$ ln $X_{PB}$+ $\alpha_{PC}$ ln $X_{PC}$ $\alpha_{PLL}$ ln $X_{5PLL}$ + $\alpha_{PSY}$ln $X_{PSY}$ +$\alpha_{BF}$ ln $X_{BF}$ + e

Note of Variable are :

Qd	= Beef demand (kg/year)

α= intercept

$\alpha_1 - \alpha_7$= Regression Cooeficient each variable

$X_{HP}$	= Human population ( people)

$X_{IC}$	= Income per capita (Rp/capita/year)

$X_{PB}$	= Price of beef (Rp/kg)

$X_{PC}$	= Price of Chicken meat (Rp/kg)

$X_{PLL}$	= Price of "Lele" (cat fish) (Rp/kg)

$X_{PSY}$	= Price of soybean (Rp/kg)

$X_{BF}$	= Beef production ( kg/year)

e	= error

2.	Formulated supply of beef in DIY

Beef Supply : QS

QS = f ($X_{CP}$ ,$X_{PB}$ ,$X_{IB}$ , $X_{GL}$ , $X_{SC}$ ............................$Q_{t-1}$ )

Ln QS = $\beta_0$ + $\beta_{CP}$ ln $X_{CP}$ + $\beta_{PB}$ln$X_{PB}$ + $\beta_{IB}$ ln $X_{IB}$ + $\beta_{GL}$ ln $X_{GL}$+ $\beta_{SC}$ ln $X_{SC}$ + $\beta_{CI}$ln$X_{CI}$+ $\beta_{CE}$ ln $X_{CE}$+ e,

Where as	QS	=Beef supply base on data beef production (kg)

β= intersept

$\beta_{CP} - \beta_{EC}$= regression coefisient each parameters

$X_{CP}$	= Cow  population ( number)

$X_{PB}$	= Price of beef (Rp/kg)

$X_{IB}$	= The availability of IB (packet)

$X_{GL}$	= The availability of grassland (Ha)

$X_{SC}$	=. The amount of slaughtered cow

$X_{CI}$	= The amount of cow import to Yogyakarta city

$X_{CE}$	=  The amount of cow export from Yogyakarta city

e	= error

3.	The next step is run the model by Simultaneous estimation function model. If the set of equations is exactly identified then we solve the reduced form parameters and then compute the structural parameters from the reduce form and if get the over identification we use Two Stage least Square ( 2 LS). In this research the model is over identification so we use 2 LS model (Gujarati et all,2013)

4.	Showed  the result of the model will  , so we are could identify many factors that influence beef demand and also beef supply as well.

5.	Finally we reach the recommendation based on the result of the research and perform wise policy to improving of beef demand and beef supply in Province  of Daerah Istimewa Yogyakarta Indonesia.

**RESULT AND DISCUSSION**

1.	Beef	Production Growth Rate and Beef Consumption  Growth rate of  DIY

The rate of production growth of beef in DIY  rises  by

2.08 %/year. the consumption growth rate of beef in DIY in level 3.2 %/year . Base data 2015-2016, the higher share of beef consumption in each district of DIY is Sleman district by share 30.73%; and follow by Bantul district in amount 25.60%; Gunungkidul district 21.94%; Yogyakarta city district 10.87% and the least is Kulonprogo district by 10.84%.

Demand of beef in DIY Indonesia increases year of year from 1995 -2016 because of in DIY,many restaurants, food courts, hotel, motel, student resident, guest hoouses as DIY is one of the main tourist destination . in Yogyakarta city there are availability more than 200 foodcourt and more than 100 hotel , so it makes the demand of food also the demand of beef rises up year of year.

The beef demand of DIY increasing Years to Years. In 1995 the demand base data of total beef consumption is 875,116 kg/year, increase 1,052,747 kg/year (2005) rises 1,906,917kg/year (2015) and in the end of 2016 rises 1,201,630 kg/year. The get the available of beef in DIY, many kind of effort must prepare by government. The availability in supply for example the population of cow, the availability of slaughtered cow, the availability of grassland, the quantity of cow entering or importing of DIY and the cow that exit or export from DIY, production of beef is many parameters that must give attention.

**The Factors that Influence of Beef Demand and Beef Supply in DIY**

**The Background of factor that influence of Beef demand and beef supply**

Many factors influence of beef supply in DIY Indonesia. One of this is the population of cow. Base data from 1995 through 2016 showed that the population increase every year. The highest population of cow in DIY is in Gunungkidul District.

During 20 year,the population of cow have been increasing. In 1995 the population of cow in number 195,515 and rise in 2005 by 247,010 and in 2015 by 306,691. Animal breeding in DIY is one of progressive sector, because of that DIY Government region have been many kind policy to get balancing the demand and the supply of beef. Many program improving to promote of the availability of cow and also the availability of beef . The goal is getting food security.

The price of cow is one of the reason why farmer arrange the cattle. in rural area, the cow is one of the preferred cattle that can be fulfill the return of household in emergency time, for example the time when children entering higher school education level or the time when the household get in marriage party and the other important activities.

In DIY area the price of cow that ablle to slaughtered is IDR 18 Million until reach IDR 40 million. It depend the

condition of cow, but the average is the cows are 2 - 3 years old and the weight is 300-400 kg/cow. The market of cow in DIY all of is the traditional market that open in one time every 5 day and located in the change place depend of the "time" that open.

The condition of beef market,both the traditional market and the modern market shell the many quality of beef. Table 4 showed about the price of beef during 21 year. It look the beef price increase year to year. Recenty the price of beef always higher level . The average price of beef in traditional market is IDR 150,000 (first quality) until IDR 80,000 (least quantuty). In Modern market like Hypermart, Carrefour, Supermarket, the beef price more higher than traditional market.

Another factor that influence of beef demand is Income per capita. During 1995-2016, DIY income per capita increase too. In DIY Income per capita in 1995 is IDR 14,129,322/year/capita rises by IDR 15,489,131/year/capita and more increaseby IDR 22,688,352 /year/capita and in 2016 is IDR 23,566,246./year/capita.

The impact of increasing of income per capita in DIY make the people buy the beef more in quantity and also more in the quality. The peak season the people buy the beef is in the holiday time like religion holiday : Id'Fitri; I'd Adha, Cristmast day and the New year day. The other day that peak sesoan of the beef shelling in DIY market is the time after I'd adha day called the Giant Month, the time when many people get marriage party and circumsition party for little boy. The beef demand of this time always higher than onother month. It the time when community of DIY people always happy and celebrate many parties.

**The Simultaneous Estimation Function Model of Beef Supply and Beef Demand**

The case of beef demand, many parameters used in the model as endogenous variable and also the exogenoeus varibel. Endogenous variable of beef demand is beef consumption . The exogenous variables are Human population (people); Income per capita ( IDR Rp/capita/year); Price of beef (IDR /kg/years); Price of Chicken meat ( IDR/kg); Price of "*Lele*" cat fish ( IDR/kg); Price of soybean (IDR/kg) and Beef production (kg/year)

Demand of beef is simulated by all of beef consumption in province of DIY . Table 1 showed the factor that able to influence of beef demand. We use simultaneous model of 2SLS methode . We also had done test of model to get the model as Best Least Unbias Estimation (BLUE).

Many parameters also used in the model of beff supply in DIY. The endogenous variable is the production of beef. The exogenous variables are Cow population ( amount of cow);Price of beef (ID/kg);the availability of artificial insemination familiar called "IB "(packet); the

availability of grassland (Ha); the amount of slaughtered cow, the amount of cow import or entered to DIY and the amount of cow exit or export from DIY to other area. The supply influence was calculated by simultaneous model of 2SLS methode . We also had done test of model to get the model as Best Least Unbias Estimation (BLUE).

Table 2, showed in DIY by the factors that influence of beef demand are price of beef and income per capita (Confident ratio 95%). in the side of supply that influence of beef supply are beef production, the availability of IB, The slaughtered cow (confident ratio= 95%) and cow population and cow import from other district or other province or other countries (confident ratio =90%)

## CONCLUSION

Base of the secondary data from 1995 through 2016, The result of this study conclude that in DIY Indonesia, the growth rate of beef demand is 3.2 %/year and the growth rate of beef supply 2.08 %/year. Econometric model especially simultaneous model and the Two Stage least Square ( 2 LS) showed that the factors that influence beef demand in DIY are price of beef and income per capita and The factors that influence beef supply in DIY are beef production, price of beef, the availability of IB, The slaughtered cow and cow import. The market of beef in DIY is the oligopoly market, where as the equilibrium is not growing as balance between beef demand and beef supply. Government of Province DIY is able to make any action to anticipate the increasing beef demand by wise some policy program.

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