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RESEARCH ARTICLE

DETERMINANTS OF PORK DEMAND FUNCTION BY VARIANCE INFLATION AND STEPWISE METHOD IN SOUTH KOREA.

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Abstract

As trade barriers are collapsed by result of trade liberalization, competition of global pork market has been accelerated by each country. Since pork is the most consuming meat in South Korea, analysis of determinants to pork consumption is a good indicator in decision making of pork producers, distributors and consumers. In addition, it is useful for 6th industrialization combing production, processing and sales of pig. The predictive power on determinants for consumption of domestic pork (CDP) was confirmed by variance inflation factor and stepwise selection methods. We selected seven and four variables, respectively, depending on the both methods for examination of CDP determinants. Production and beginning stocks of domestic pork had the greatest influence on CDP and a positive relation with each other ($P < 0.01$). However, CDP had a negative relationship between consumer price of Hanwoo beef and chicken meat. As this result is a different pattern from general economic theory, it is considered that the situation is owing to characteristic of meat consumption concentrated in summer at South Korea.

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Introduction:-

As pork is one of the most widely consuming meats in the world, production and consumption of livestock products are already reached at high levels, and the products are slowly growing or stagnating in developed countries (Thornton, 2010). According to FAO statistics at 2014, the most important sharing countries in pork production worldwide include China (48.05%), USA (6.86%), Brazil (3.84%) and Germany (2.87%). As South Korea (1.02%) is the 17th country in pork production worldwide (FAOSTAT, 2016), pork consumption has been steadily increased with per capita income growth in South Korea (MAFRA, 2016). Since production of pig increases depending on consumption of pork, the industry has an attracted attention as the most important item in agricultural production value. However, since production of pig requires biological parallax from insemination to marketing, pork shows inelasticity of supply that is not responding instantly to price change (Kim, 2003). Especially, seasonal fluctuations are observed in production and consumption of pork due to distinctly four seasons in South Korea (Kim, 2016a). Similarly, seasonality in price and demand and/or supply exists inherently in most agricultural commodity markets (Tomek and Peterson, 2001).

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Determinants for demand and supply of pork have been estimated by interview and time series data in previous studies (Gay and Laurian, 2001; Davis and Lin, 2005; Lam *et al.*, 2013). Pork demand is determined by income of households, safety of pork, careers, ethnicity of consumer, place buying pork, living area, age and gender (Gay and Laurian, 2001; Davis and Lin, 2005; Lam *et al.*, 2013). However, formation of livestock price is socially-biased by gender, wealth and residence reflecting differential access and powers within local markets in dryland Africa (Turner and Williams, 2002). Livestock production will be increasingly affected by carbon constraints and environmental and animal welfare legislation, and livestock demand in the future will be heavily moderated depending on socio-economic factors such as human health concerns and changing socio-cultural values (Thornton, 2010). In addition, pork supply amount is importantly regulated by feeding heads, beginning stocks and production of pork, whereas pork demand is controlled by population size, household income level, and consumer price of Hanwoo beef along with consumption of pork in South Korea (Kim, 2016a). Therefore, price and quantity of pork traded in market are determined by correlation between various factors affecting supply and demand (Kim, 2016a).

In this study, we evaluated determinants of consumption for domestic pork (CDP) by multiple regression model, and discussed characteristics of domestic pork market. To achieve these goals, we analyzed factors to significantly affect behavior of CDP using variance inflation factor (VIF) and stepwise selection method (STEPWISE).

Materials And Methods:-

Data Collection:-

To predict factors determining pork consumption, we employed various secondary data reported from Korean Statistical Information Service (KOSIS), National Agricultural Cooperative Federation (NACF) and Korea Meat Trade Association (KMTA). All the data were monthly collected from 2003 to 2015 (156 months), and the employed price data presented the real prices based on consumer price index (CPI) 2010 (2010=100). The nominal prices of pork and related goods were variously presented in each year instead of fact leveled out real value. Therefore, real price was applied for prices of pork and the derived goods in this study. However, dependent variable (CDP) is measured in quantity, which is not affected by inflation (Lam *et al.*, 2013). Consumption of domestic pork (CDP), beginning stocks of domestic pork (BSDP), production of domestic pork (PDP), import of pork (IP) and average wholesale price of domestic pork (WPDP) maintained characteristics of supply function for pork. Otherwise, population with age15 and above (PA15), ending stocks of domestic pork (ESDP), export of pork (EP), average consumer price of domestic pork (CPDP), average consumer price of Hanwoo beef (CPH) and average consumer price of chicken (CPC) had characteristics of demand function for pork. PA15 was presented as a scale of consumer. In addition, since Hanwoo beef and chicken meat have been generally recognized as a substitute for pork, CPH and CPC were selected as independent variables. Since global free trade has been expanded in recent global market, and demand and supply of domestic pork have been changed depending on their factors in market of South Korea, IP and EP were selected as variables (Table 1).

Data Analysis:-

Mathematical models to analyze factors affecting CDP were applied by multiple linear regression analysis. CDP estimated by demand function was described as below:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p + \varepsilon_i$$

Where

$\beta_0, \beta_1, \dots, \beta_p$ are coefficients for predictor variables X_1, X_2, \dots, X_p , respectively.

ε_i presents an error term, which the expected value is 0 and variance has σ^2 .

$H_0 : \beta_j = 0$ Vs $H_1 : \beta_j \neq 0, j = 0, 1, 2, \dots, p$. If null hypothesis (H_0) is rejected at significant level α , the alternative hypothesis (H_1) is adopted. At least one or more among independent variable (X_1, X_2, \dots, X_p) indicate contributes to regression model. Verification of model uses analysis of variance (ANOVA). At that time, statistic for test of null hypothesis is $F_0 = \frac{SSR/p}{SSE/(n-p-1)} = \frac{MSR}{MSE}$. In here, SSR is sum of the squares of

residuals in the model, SSE is error sum of the squares, the mean square for error (MSR) is the mean squared residuals, and MSE indicates the mean-squared error in the estimator (SAS, 009).

If the null hypothesis is rejected at significant level α , at least one or more independent variable affects significantly dependent variables. In addition, the significant verification of the partial coefficient (β_j) is done by t-test. If the null

hypothesis ($H_0 : \beta_j = 0$) is rejected at significant level α , it is determined that the independent variable X_j affects significantly dependent variable Y .

Although factors to affect CDP are determined by mutually direct or indirect effect, survey of total contents is not only difficult in terms of time and cost, but becomes difficult of model estimation to occur multicollinearity problems among independent variables (Kim, 2016b). Therefore, it is necessary to be appropriate selection of independent variable to have high explanatory power for CDP.

Multicollinearity indicates when a regressor (independent variable) X_i is nearly a linear combination of other regressors X_k in the model, where X_1, X_2, \dots, X_p are in the relationship of $\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_p X_p \cong 0$. At this time, at least two of $\beta_1, \beta_2, \dots, \beta_p$ are not 0. If there are multiple collinearities, the variance of the estimated value of some regression coefficients becomes excessively large and the estimated value of the regression coefficient becomes very unstable. In such a case, although the coefficient value of determination R^2 is generally displayed large, most regression coefficients do not appear to be significant. Therefore, it is necessary to find out which variables are nearly collinear with other variables.

In this study, we employed variance inflation factor (*VIF*) to confirm existence of multi-collinearity. *VIF* measures inflation in variances of the parameter estimations due to collinearities that exist among the regression (independent) variables. There are no formal criteria for decision whether a *VIF* is large enough to affect the predicted values (SAS, 2009). The *VIF* for the estimated j^{th} predictor is described as $VIF_j = 1/(1 - R_j^2)$. If the independent variable X_j has no correlation with the remaining independent variables, then R^2 is 0, *VIF_j* become 1. In other words, *VIF_j* represents the inflation rate of variance for the regression coefficient according to the degree which the independent variable X_j is explained by the remaining independent variables. Therefore, although it is likely that collinearity do not exist when *VIF_j* is closer to 1, if *VIF_j* of regression coefficient is large, it is evaluated that there is multi-collinearity.

In addition, a method to select an optimal independent variable in the model is the stepwise variable selection method (STEPWISE). STEPWISE is obtained as new variable is selected by additionally important variables via one by one for selecting a combination of the best described variable (Kim, 2003).

To select the models that contain optimal variables with significant explanatory power, we employed STEPWISE in this study. Model selection criteria are needed to select optimal variables in the model. The most commonly used criteria are coefficient of determination (R^2), an adjusted coefficient of determination (adj R^2) and Mallows' total mean-squared error (C_p). The R^2 statistic measures proportion of the total variation explained by the linear model. In models with intercept, it is defined as the ratio $R^2 = 1 - SSR/SST$, where SSE is the residual (error) sum of squares and SST is the total sum of squares corrected for the mean. R^2 is a value between 0 and 1, and closer independent variable to 1 excellently explains dependent variable. The adjusted R^2 statistic is an alternative to R^2 that is adjusted for the number of parameters in the model. The adjusted R^2 statistic is calculated as $\text{adj } R^2 = 1 - [(n - i)(1 - R^2)] / (n - p)$, where n is the number of observations used in fitting the model, and i is an indicator variable to become 1 if the model includes an intercept (SAS, 2009). However, these statistics tend to be increased depending on addition of new variables.

In comparison, the C_p statistic is proposed by Mallows (1973) as a criterion for selecting a model. It is a measure of totally squared error defined as $C_p = SSE_p/s^2 - (N - 2p)$, where s^2 is MSE for the full model, and SSE_p is the sum-of-square errors for a model with p parameters including the intercept. If C_p is plotted against p , Mallows recommends the model where C_p first approaches p . When the right model is chosen, the parameter estimates are unbiased, and this is reflected in C_p near p (SAS, 2009). C_p statistic is used as a stopping rule for various forms of stepwise regression. Under a model no suffering from appreciable lack of fit (bias), C_p has expectation nearly equal to p which is the sum of intercept and independent numbers (Mallows, 1973). With these criteria, Durbin-Watson statistic (DW) test shows that the autocorrelation is zero when regression is performed on time series data. The value of DW is close to 2 if the errors are uncorrelated (SAS, 2009). Data were analyzed by PROC REG/CORR Procedure in SAS 9.2 (SAS, 2009).

Results and Discussion:-

Coefficient Of Variation And Amplification:-

Coefficient of variation (CV) is a standardized measurement of dispersion for a probability distribution or frequency distribution. It is often expressed as a percentage, and is defined as ratio of standard deviation to mean (SAS, 2009). When the value of CV maintains higher, the more relative difference causes. It is profusely utilized in economic models. Likewise, amplitude coefficient is magnitude of difference between the highest and lowest values of the variable over a period.

As shown at Table 2, CDP was decreased from 2003 to 2006, but increased after 2006. However, it was greatly decreased in 2011 due to aftereffects of foot-and-mouth disease (FMD) caused nationwide from the end of 2010 to march 2011, but CDP was increased by the most amount at 2013 among the examined years, and then it has been maintained by a constant consumption level. Coefficient of amplification for these pork consumption was displayed by larger values in 2006, 2010, 2011 and 2012 when compared with a standard of 32.7% on the whole average. In particular, it represented a seriously month difference to 88% in 2011. These results were also confirmed by coefficient of variation. The coefficients of variation were maintained within 10% overall, but they were highly presented as 17.5 and 11.4% in 2011 and 2012, respectively. It indicates a very high consumption fluctuation in the years. Therefore, it is evaluated that annual average of CDP is influenced by external factors such as disease.

Furthermore, factors to increase the fluctuation range of consumption were also found by seasonal factors. Since pig production was presented by biological disparity from delivery to marketing time, producer showed inelasticity of supply that was not responded instantly to changes of market price. Although consumption continued throughout the year, in particular demand presented seasonal fluctuation to drastically increase during the periods of holiday season and summer compared to other seasons (Kim, 2003). As a result, the monthly price of pork in South Korea usually based on cycle of a year showed clearly seasonal fluctuation that is rising in summer and falling in winter (see Table 3).

Estimates By Variance Inflation Factor:-

We estimated regression models using all the collected variables to affect domestic pork consumption (Table 4). For this model, we performed multi-collinearity test by VIF. The model was significant ($P < 0.01$), and adj R^2 was very high as 0.974. However, according to the results from t-test of each regression coefficient, estimates of the seven variables were not significant except for PDP, BSDP and ESDP. Therefore, it is predicted that regression model is very unstable for estimate of the regression coefficient due to the existence of collinearity between independent variables.

These results were also confirmed by VIF for the estimated predictor (Table 4). VIF of PA15, ESDP, BSDP, CPH and CPDP showed fairly large values of 12.43, 6.89, 6.27, 5.95 and 4.65, respectively. For example, VIF for the predictor PA15 indicated that variance of the estimated coefficient was inflated by a factor of 12.43, because PA15 was highly correlated with at least one of the other predictors in the model. Therefore, the existence of collinearity between independent variables was predicted in the model. Based on this result, factors to maintain high correlation with other independent variables were investigated by simple correlation analysis (Table 5).

According to the result of Person correlation analysis, PA15 showed high correlations with CPH, CPC, IP, EP and ESDP as -0.882, 0.700, 0.562, -0.515 and 0.509, respectively ($P < 0.01$). WPDP showed high correlations with CPDP and IP as 0.764 and 0.557, whereas ESDP presented high correlations with BSDP and PA15 by 0.896 and 0.509, respectively ($P < 0.01$). Accordingly, in order to reduce collinearity among variables, we selected variable directly related to research purpose among mutually correlated variables. In other words, we selected variables directly related to CDP, but eliminated indirectly related variables. As a result, PDP, BSDP, IP, EP, CPDP, CPH and CPC were selected as factors determining CDP, but excepted PA15, WPDP and ESDP (Table 6). In response to reduction of the selected variables, the adj R^2 value decreased from 97.4% to only 81.8%. However, despite decrease in the number of independent variables, the number of statistically significant parameter estimates increased from 3 to 4 ($P < 0.01$). This was expressed by the following regression model.

$$\text{(Model 1)} \quad CDP = 12636^* + 0.777PDP^{**} + 0.241BSDP^{**} - 0.095IP^* + 0.374EP + 0.251CPDP - 0.098CPH^* - 1.241CPC^{**}$$

Here, * $P < 0.05$, ** $P < 0.04$.

Variance explained by the regression was 80.9% of total variance, and the corresponding F value was significant as 94.69 ($P < 0.01$). That is, 80.9% in variation of the dependent variable (CDP) was described by 7 independent variables to be selected. Although explanatory power of the model was somewhat decreased owing to the lower $\text{adj } R^2$, there was a high possibility that collinearity did not exist because VIF_j was not excessively larger than 1. In addition, since DW value was close to 2 as 1.955, the error terms were evaluated to be uncorrelated (Table 6).

As PDP had the greatest effect on CDP, when PDP increased, CDP also increased. CPDP showed a positive relationship with CDP ($P < 0.01$). However, this result was contrary to a general economic theory to decrease consumption when the price of goods increases, but it was not significant. Therefore, it is evaluated that an increase in CDP by such a situation leads to an increase in CPDP. When IP increased, CDP decreased owing to substitute of domestic pork ($P < 0.05$), and as EP increased, CDP increased, but it was not significant.

The increase of competition in global pork markets is a result of free trade agreements (FTA) among countries, and at present, pork import and export in each country are part of international trade rather than simply domestic pork supply and demand (Oh and See, 2012). However, since import and export of pork have been analyzed to be weakly impacted on the domestic pork market, the result may be explained by influence of export interruptions due to FMD occurred in South Korea, and the import embargo due to bovine spongiform encephalopathy (BSE) occurred in other countries (Oh and Whitley, 2011; Kim, 2016a).

On the other hand, although the price of substitute goods and the consumption of their products were theoretically displayed in a positive relationship, they showed the negative relation to the prices of Hanwoo beef and chicken meat selected as a substitute goods for pork ($P < 0.05$). It is estimated to be displayed because the consumption of meat in South Korea is mainly concentrated on seasonally summer.

Estimates By Stepwise Selection Method:-

In this study, we employed STEPWISE to dissolve problem of multi-collinearity among independent variables, and to set the optimal regression model. As a result, four independent variables including PDP, BSDP, ESDP and CPH were finally selected through four steps (Table 7). In here, the variables included in the model were adjusted to select at significant level of 0.01, and the regression model was estimated as follows.

$$(\text{Model 2}) \text{ CDP} = 2051.3 + 0.965\text{PDP}^* + 0.989\text{BSDP}^* - 0.95\text{ESDP}^* - 0.057\text{CPH}^*$$

Here, * $P < 0.01$.

Variance explained by regression was 97.4% of total variance, and the corresponding F value was significant as 1,442.16 ($P < 0.01$). That is, 97.4% in variation of the dependent variable (CDP) was described by 4 independent variables to be selected. Thus, although $\text{adj } R^2$ was high and fitness of the model was excellent ($P < 0.01$), since DW value was 1.73, which was lower than that of Model 1, it was suspected that the error was correlated (Table 8).

According to results of estimates, PDP had the greatest influence on CDP in Model 1 ($P < 0.01$). Since BSDP and PDP had a positive relationship with CDP, when BSDP and PDP are increased, CDP may be increased. In other words, since BSDP and PDP indicate domestically produced pork supply, if supply is increased, consumption may be increased. However, since ESDP showed a negative correlation with CPH, when ESDP or CPH is increased, CDP may be decreased ($P < 0.01$). Since ESDP showed the remaining part to be not consumed, it was naturally to have the opposite relation to CDP. However, as shown in Model 1, CDP had negative relationship with CPH ($P < 0.01$). In South Korea, since the preference for Hanwoo beef, which is generally recognized as a substitute to pork, is very high, the rise of CPH due to insufficient supply of Hanwoo beef appeared in a phenomenon that CDP decreases with the rise in price of pork. In other words, it is estimated that the rise of CPH strengthens PDP by expanding CDP. On the other hand, since IP and EP had a weak influence on CDP, these were excluded from the model. In other words, in South Korea, it is assumed that IP and EP do not reach the level to directly affect CDP. In addition, CPC was also excluded from model, because chicken played a weak role as substitute of pork.

Table 1:-Demand function of domestic pork (n=156)

Variable	Mean \pm SE	Min.	Max.
Consumption of domestic pork (CDP, M/T)	60328 \pm 7720	32680	76570
Production of domestic pork (PDP, M/T)	61052 \pm 7585	37358	81029
Beginning stocks of domestic pork (BSDP, M/T)	27849 \pm 8325	11802	49286

Ending stocks of domestic pork (ESDP, M/T)	27806±8313	11802	49286
Imports of pork (IP, M/T) ¹⁾	18389±8983	3506	51695
Exports of pork (EP, M/T) ¹⁾	69.3±173.0	0.00	1052
Population with age15 and above (PA15, thousand)	40141±1789	37161	43216
Average wholesale price of domestic pork (WPDP, KRW/kg)	3967±818.9	2226	6903
Average consumer price of domestic pork (CPDP, FRW/kg)	16578±2441	11616	23699
Average consumer price of Hanwoo beef (CPH, KRW/kg)	30376±7832	19475	44171
Average consumer price of chickens (CPC, KRW/kg)	4749±892.8	2573	6760

Quarantine standard.

Table 2:-Coefficient of variation and amplification for consumption of pork

Year	Consumption of domestic pork (M/T)	Standard deviation	Coefficient of variation	Amplitude coefficient
2003	64,327	6,002.5	9.3	28.7
2004	62,392	4,001.2	6.4	23.1
2005	56,388	3,654.9	6.5	24.3
2006	54,964	5,182.1	9.4	38.9
2007	56,814	4,463.1	7.9	24.9
2008	58,255	4,559.3	7.8	26.4
2009	58,605	4,009.7	6.8	26.1
2010	62,392	5,514.0	8.8	35.4
2011	46,626	8,175.7	17.5	88.1
2012	59,939	6,828.6	11.4	43.5
2013	68,935	4,433.5	6.4	22.4
2014	67,442	4,127.3	6.1	22.2
2015	67,184	4,637.1	6.9	21.5
Average	60,328	5,045.3	8.6	32.7

Table 3:-Average monthly price and consumption of domestic pork¹⁾

Months	January	February	March	April	May	June
Price (KRW/kg) ¹⁾	15,019.8	15,065.7	14,923.1	15,578.3	16,231.7	17,536.3
Consumption (M/T)	62,300.2	55,372.0	62,130.9	60,021.4	58,452.4	57,221.7
Months	July	August	September	October	November	December
Price (KRW/kg) ¹⁾	17,775.8	17,447.2	17,062.5	15,768.5	15,363.4	15,923.8
Consumption (M/T)	56,878.4	61,756.5	59,957.0	62,644.2	63,395.8	63,805.5

¹⁾ Nominal price

Table 4:-Parameter estimates and VIF for demand function of pork by the corrected data¹⁾

Variable	Estimate	SE	t Value	Pr > t	VIF
Intercept	-4395.26	7290.14	-0.60	0.5475	0.000
PDP	0.957	0.020	47.17	<.0001	2.350
BSDP	0.981	0.030	32.49	<.0001	6.273
IP ²⁾	-0.018	0.016	-1.13	0.2591	2.105
WPDP	0.318	0.221	1.44	0.1523	3.240
PA15	0.205	0.198	1.04	0.3019	12.426
ESDP	-0.951	0.032	-30.02	<.0001	6.887
EP ²⁾	-1.323	0.787	-1.68	0.0949	1.842
CPDP	-0.131	0.089	-1.48	0.1409	4.649
CPH	-0.029	0.031	-0.94	0.3512	5.950
CPC	-0.117	0.183	-0.64	0.5222	2.654

¹⁾ F Value, 577.25; P<0.0001; R², 0.976; adj R², 0.974, DW (Durbin-Watson statistic), 1.821.

VIF: variance inflation factor, PDP: production of domestic pork, BSDP: beginning stocks of domestic pork, IP: import of pork, WPDP: average wholesale price of domestic pork, PA15: population with age15 and above, ESDP:

ending stocks of domestic pork, EP: export of pork, CPDP: average consumer price of domestic pork, CPH: average consumer price of Hanwoo beef, CPC: average consumer price of chicken.

²⁾ Quarantine standard.

Table 5;-Correlation matrix for demand function of pork¹⁾

	PDP	BSDP	IP ²⁾	WPDP	PA15	ESDP	EP ²⁾	CPDP	CPH	CPC
CDP	0.866*	0.491*	-0.208*	-0.391*	0.261*	0.377*	0.061	-0.415*	-0.276*	-0.081
PDP		0.334*	-0.168	-0.481*	0.254*	0.441*	-0.004	-0.423*	-0.238*	-0.056
BSDP			0.089	-0.071	0.454*	0.896*	-0.004	-0.248*	-0.433*	0.254*
IP ²⁾				0.557*	0.562*	0.164	-0.451*	0.482*	-0.427*	0.489*
WPDP					0.372*	-0.114	-0.365*	0.764*	-0.249*	0.478*
PA15						0.509*	-0.515*	0.422*	-0.882*	0.700*
ESDP							-0.105	-0.231*	-0.459*	0.328*
EP ²⁾								-0.500*	0.361*	-0.575*
CPDP									-0.223*	0.504*
CPH										-0.590*

* $P < 0.01$.

CDP: consumption of domestic pork, PDP: production of domestic pork, BSDP: beginning stocks of domestic pork, IP: imports of pork, WPDP: average wholesale price of domestic pork, PA15: population with age 15 and above, ESDP: ending stocks of domestic pork, EP: exports of pork, CPDP: average consumer price of domestic pork, CPH: average consumer price of Hanwoo beef, CPC: average consumer price of chicken.

Quarantine standard.

Table 6;-Parameter estimates and VIF for consumption of pork by correlation analysis¹⁾

Variable	Estimate	SE	t Value	Pr > t	VIF
Intercept	12636	5897.9	2.14	0.0338	0.000
PDP	0.776	0.044	17.54	<.0001	1.533
BSDP	0.241	0.041	5.91	<.0001	1.569
IP ²⁾	-0.095	0.038	-2.46	0.0149	1.622
EP ²⁾	0.374	2.099	0.18	0.8588	1.795
CPDP	0.251	0.168	1.50	0.1358	2.276
CPH	-0.098	0.049	-1.98	0.0498	2.042
CPC	-1.241	0.471	-2.64	0.0093	2.405

¹⁾ F Value, 94.69; $P < 0.0001$; R^2 , 0.818; adj R^2 , 0.809; DW, 1.955.

PDP: production of domestic pork, BSDP: beginning stocks of domestic pork, IP: imports of pork, EP: exports of pork, CPDP: average consumer price of domestic pork, CPH: average consumer price of Hanwoo beef, CPC: average consumer price of chicken.

²⁾ Quarantine standard.

Table 7;-Stepwise selection of independent variable for consumption of pork¹⁾

Step	Variable	Partial R^2	Model R^2	C_p	F-value	Pr>F
1	PDP	0.7498	0.7498	1328.50	461.53	<.0001
2	BSDP	0.0460	0.7959	1058.05	34.51	<.0001
3	ESDP	0.1760	0.9718	18.73	949.33	<.0001
4	CPH	0.0027	0.9745	4.95	15.79	0.0001

¹⁾ The other variables have not significant levels for entry into the model.

PDP: production of domestic pork, BSDP: beginning stocks of domestic pork, ESDP: ending stocks of domestic pork, CPH: average consumer price of Hanwoo beef.

Table 8;- Parameter estimates for consumption of pork in South Korea by stepwise selection¹⁾

Variable	DF	Estimate	SE	t-value	Pr > t
Intercept	1	2051.27	1064.95	1.93	0.0560

PDP	1	0.965	0.015	64.55	<.0001
BSDP	1	0.989	0.028	35.92	<.0001
ESDP	1	-0.950	0.029	-32.51	<.0001
CPH	1	-0.057	0.014	-3.97	0.0001

¹⁾ F Value, 1442.16; P<0.0001; R², 0.975; adj R², 0.974, DW, 1.73.

PDP: production of domestic pork, BSDP: beginning stocks of domestic pork, ESDP: ending stocks of domestic pork, CPH: average consumer price of Hanwoo beef.

Conclusions:-

In this study, we investigated factors influencing CDP by time series data, and selected optimal independent variables via VIF and STEPWISE. According to the results of the employed two methods, PDP and BSDP played an important role in variation of CDP. CPH as substitute for pork were analyzed to have a significantly negative influence on CDP. The negative relationship between CDP and CPH was estimated to lead the rise of CDP due to the rise in CPH. CPC had a weak influence on CDP because chicken was not able to play a role as substitute. This was estimated to the displayed results, which the demands for chicken and pork were concentrated together in summer. Although IP was accounted for a large increase in total pork consumption depending on FTA conclusion with the developed countries of livestock, it was estimated that IP has no direct influence due to irregular parallax with CDP. Therefore, it is assumed that the results of this study are useful for growth of 6th industry which is combined by production, processing and sales of pig. We suggest that entrepreneurs who produce and distribute domestic pork need to pay attention to the fact that CPC is effected by animal diseases and seasonally biased consumption characteristics together with PDP. In other words, we suggest that producers understand the ecological characteristics that pigs take about 10 months from pregnancy to selling, and conduct breeding and management to ensure so that pigs are marketed in the summer at South Korea. In addition, we suggest that distributors adjust the sale timing on the market through safe and hygienic storage management.

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