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PARTIAL EQUILIBRIUM ANALYSIS AND FORECAST OF CHINESE RABBIT MEAT MARKET

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ABSTRACT

A partial equilibrium model is built to analyze the supply, demand, trade and price linkages of Chinese rabbit meat market, applying data from 1991-2013. Model implies inertia in the sectors of production and consumption, and per capita disposable income level has the significantly positive impact on rabbit meat consumption. Based on this, out-of-sample forecast shows that the market will remain on an upward trend, while slowing slightly on the long term. By 2025, stocks quantities and output of rabbit meat will increase to 237 million head and 1037 thousand tons respectively. Per capita rabbit meat consumption will reach to 0.736 kg, as the proportion of import and export drop to below 1%.

Key words: Rabbit meat market, Partial equilibrium model, Forecast

INTRODUCTION

Chinese rabbit industry has undergone fast growth during the past decades. As the main products, rabbit meat is higher in protein, minerals, digestibility, and lower in fat, cholesterol, calories, which make it popular for some consumers in china (Chinese Rabbit Research System, 2014). Because of these healthy attributes and the growing demand, more and more rabbit meat was produced. In 2014, the rabbit meat output of China reached to 829 thousand tons, and about 13 thousand tons exported to different countries in the world.

Previous papers often singly study the characteristics of rabbit meat consumption (Wang et al, 2013; Beal et al., 2004; Kallas et al., 2012) , of rabbit raising behavior (Mailu et al., 2014; Song Yhe, 2014, or the trade development (Gu, 2012). However, sectors of production, consumption and trade are not isolated but influenced and restrained by each other. And price volatility in these years impacted on farmers, middlemen and consumers in China. Under these circumstances, we have to reconsider the Chinese rabbit meat market in a whole system.

Therefore, the objectives of this article are to study the internal relationship between different sectors of Chinese rabbit meat, and forecast the market trend. Firstly, we developed a partial equilibrium model for Chinese rabbit meat market to determine how factors influencing the supply, demand, trade and prices. Then, we made predictions for exogenous variables, and go back into the model to forecast the market changes on medium and long term.

MATERIALS AND METHODS

Based on partial equilibrium theory (Marshall, 1920), Chinese rabbit meat market consists of four sectors: production, consumption, import and export, from which we deduce the supply-side equations, demand-side equation, trade-side equations and price linkages, and the market-clearing condition.

Supply side

According to the theory of producer behavior, raising rabbit mainly depends on the raising habit, resource constraint and expected return. Letting SQ_t represent the rabbit stock quantities, considering the actual case of China, the stock function is given by:

$$(1) \ln SQ_t = \alpha_1 + \beta_{11} \ln SQ_{t-1} + \beta_{12} CRRS_t + \beta_{13} \ln RPV_{t-1}$$

where SQ_{t-1} is the stock quantities in the previous period which made the basis for the current period, and RPV_{t-1} is the rabbit production value in the previous period which shows the expected revenue. A dummy variable for policy is introduced in as the China Rabbit Research System ($CRRS_t$), which launched by the Ministry of

Agriculture in 2009 to focus on technology and farmer training, played an important role in the whole industry. In general, the farm chooses an optimal output based on its own situation and market performance. Letting MR_t represent the output for meat of rabbit, the output function is given by:

$$(2) \ln MR_t = \alpha_2 + \beta_{21} \ln SQ_{t-1} + \beta_{22} \ln CW_t + \beta_{13} \ln RP_t$$

where the stock quantities in the previous period (SQ_{t-1}) affect the slaughtered quantities in the current period, and CW_t is the carcass weight of rabbit which represent the indicator for “yield”. RP_t is the domestic rabbit meat price.

Demand side

Demand for rabbit meat consists of two parts in China: direct edible using and processing. We only consider the first part as the rabbit meat for processing is converted to edible using at last. Basing on the theory of consumer behavior, letting PMC_t represent the per capita rabbit meat consumption in current period, then the consumption function is given by:

$$(3) \ln PMC_t = \alpha_3 + \beta_{31} \ln PDI_t + \beta_{32} \ln RP_t + \beta_{33} \ln CP_t + \ln PMC_{t-1}$$

where PDI_t is per capita disposable income, and CP_t is the domestic chicken price which is considered as the substitute goods for rabbit meat in China, and PMC_{t-1} is the per capita rabbit meat consumption in previous period which indicates the consumption habit.

Trade side

In general, rabbit meat of imports (MI_t) depends on the domestic rabbit meat price (RP_t) and rabbit meat of import price (MIP_t), and the domestic per capita rabbit meat consumption (PMC_t). Similarly, rabbit meat of exports (ME_t) depends on the domestic rabbit meat price (RP_t) and rabbit meat of export price (MEP_t), and a dummy variable for trade environment as China’s accession to WTO (WTO_t). Thus, the trade function is given by:

$$(4) \ln MI_t = \alpha_4 + \beta_{41} \ln RP_t + \beta_{42} \ln MIP_t + \beta_{43} \ln PMC_t$$

$$(5) \ln ME_t = \alpha_5 + \beta_{51} \ln RP_t + \beta_{52} \ln MEP_t + \beta_{53} WTO_t$$

Price linkages

Price of import and export in current period are mainly influenced by the previous period, and related to the domestic rabbit meat price since China played an important role in the world rabbit meat industry. Also, exchange rate should be introduced in. Thus the price linkages are given by:

$$(6) \ln MIP_t = \alpha_6 + \beta_{61} \ln MIP_{t-1} + \beta_{62} \ln RP_t + \beta_{63} \ln ER_t$$

$$(7) \ln MEP_t = \alpha_7 + \beta_{71} \ln MEP_{t-1} + \beta_{72} \ln RP_t + \beta_{73} \ln ER_t$$

Market-clearing condition

Finally, the rabbit meat market comes into equilibrium when output (MR_t) plus imports (MI_t) equals domestic total consumption ($POP_t \times PMC_t$) plus exports (ME_t), thus:

$$(8) MR_t + MI_t = POP_t \times PMC_t + ME_t$$

ARIMA model (Enders, 2008) and historical extrapolation method is used to make prediction for the exogenous variables. Finally, we forecast the endogenous variables by the estimated coefficients.

Data used in this paper is mainly from FAO database, China statistical yearbook and Ministry of Agriculture of China. Time span is selected from 1991 to 2013 for completeness. In order to eliminate the influence of inflation, all the variables of price and value are deflated by CPI (1991=100).

RESULTS AND DISCUSSION

Estimation Results

As most equations’ R square is high and most estimated coefficients are consistent with economic theory and reality in China, we can judge that the model fitting well (Table2).

From the supply equations, rabbit stock quantities in previous year have positive impact on the quantities in current year (significant at the 1% level), which implies farmers’ raising habit and continuity when making decision. Development of CRRS since 2009 increased rabbit stock quantities significantly. On the other hand, larger rabbit stock quantities in previous year led to significantly increased output of rabbit meat (significant at the 1% level).

As the demand equation shows, an increase in per capita disposable income or a decrease in rabbit price significantly increase per capita rabbit meat consumption. The income elasticity and own-price elasticity are 0.547 (significant at the 1% level) and -0.161 (significant at the 5% level) respectively, which confirm the

consumer theory. Moreover, per capita rabbit meat consumption in previous year is significantly positive for the consumption in current year, which due to steady preference for rabbit meat especially for consumers in Sichuan and Chongqing province.

Table 2: Estimation results for the partial equilibrium model

Dependent Variable	Independent Variable	Coefficient	Std. Err.	R ²	Dependent Variable	Independent Variable	Coefficient	Std. Err.	R ²
lnSQ_t	lnSQ_{t-1}	0.751***	0.156	0.7753	lnMI_t	lnRP_t	-4.750*	2.741	0.364
	CRRS_t	0.055*	0.031			lnMIP_t	-1.325**	0.641	
	lnRPV_{t-1}	0.016	0.076			lnPMC_t	-1.33	1.309	
	Cons ₋	1.275	0.907			Cons ₋	1.347	3.606	
MR_t	lnSQ_{t-1}	3.108**	0.521	0.7821	lnME_t	lnRP_t	-0.394	0.361	0.7909
	lnCW_t	0.914	0.993			lnMEP_t	0.554**	0.223	
	lnRP_t	0.039	0.329			WTO_t	-1.026***	0.137	
	Cons ₋	-12.833***	3.073			Cons ₋	0.195	0.88	
lnPMC_t	lnPDI_t	0.547***	0.102	0.9766	lnMIP_t	lnMIP_{t-1}	0.132	0.185	0.1364
	lnRP_t	-0.161**	0.066			lnRP_t	-0.943	0.936	
	lnCP_t	0.023	0.101			lnER_t	1.557	1.28	
	PMC_{t-1}	0.276***	0.104			Cons ₋	0.414	2.275	
	Cons ₋	-5.141***	0.913						
					lnMEP_t	lnMEP_{t-1}	0.616***	0.203	0.3516
					lnRP_t	-0.204	0.251		
					lnER_t	0.127	0.42		
					Cons ₋	0.864	1.087		

Note: *, **, and *** indicates significances at 10%, 5%, and 1%, respectively.

According to the trade equations and price linkages equations, the accession to WTO has significantly negative effect on Chinese rabbit meat exports, which suggests that the exports is decreasing after 2001 and more output is used to meet domestic demand. Higher export price of rabbit meat led to significant increased export quantities and higher import price of rabbit meat led to significant decreased import quantities. Overall, prices of import and export are relatively independent and mainly affected by its prices in previous year.

Forecast Results

Out-of-sample forecast shows stable growth in sectors of production and consumption (table 3).

Table 3: Out-of-sample forecast for main variables on medium and long term (2014-2025)

Year	Stocks (million head)	Output (thousand tons)	Per capita consumption(kg)	Import quantities(tons)	Export quantities(tons)
2014	225.78	821	0.595	8.94	9005
2015	227.55	854	0.616	9.33	8999
2016	229.02	882	0.634	8.03	8841
2017	230.23	905	0.649	7.04	8706
2018	231.26	926	0.663	6.09	8555
2019	232.16	945	0.675	5.21	8387
2020	232.98	962	0.685	4.43	8204
2021	233.74	978	0.696	3.8	8006
2022	234.46	993	0.706	3.21	7799
2023	235.17	1008	0.716	2.69	7585
2024	235.87	1022	0.726	2.25	7368
2025	236.58	1037	0.736	1.88	7148

On supply side, rabbit stock quantities will reach 232.98 million head in 2020, with a 3.19% increase over 2014 and an average annual growth rate of 0.52%. It proposes a slight decrease of average annual growth rate of 0.31% till 2025 with 236.58 million head, a 1.55% increase compared with 2020. On the other hand, output of rabbit meat will knock the amount of 962 thousand tons in 2020, which is 17.06% more than 2014 with a 2.66% average annual growth rate. However the growth during this period is relatively smooth and steady due to the market fluctuation in recent years. The rabbit meat output will break through one million tons till 2025, 1.037 million specifically, which is 7.82% more than 2020 with a lower average annual growth rate of 1.52%.

On demand side, it is believed that the rabbit meat consumption will continue to increase. The per capita rabbit meat consumption is predicted to attain 0.685 kg, representing a 0.09 kg increase with 15.24% growth compared with 2014 and a 2.39% average annual growth rate, during which the consumption potentiality gets furtherly

released. In 2025, the per capita rabbit meat consumption will then increase 0.05 kg or 7.36% compared with 2020, reaching 0.736 kg. It increases steadily with average annual growth rate of 1.43%.

On trade side, China will keep the role of net exporter. Nevertheless its import and export quantities will decline to less than 1%. The rabbit meat import will generally maintain below 10 tons. This number will become 4.43 tons in 2020 and even less than 2 tons in 2025. Similarly, the rabbit meat export will reduce from 8,204 tons (an 8.89% decrease of 2014) in 2020 to 7,148 tons (a 12.88% decrease of 2020) in 2025.

CONCLUSIONS

In above parts, we build a partial equilibrium model to study different sectors of Chinese rabbit meat market. Empirical analysis shows that the sectors of production positively influenced by lagged effect, indicating inertia of producing behavior. Meanwhile, development of China Rabbit Research System (CRRS) made a contribution to some degree. Moreover, the sector of consumption mainly affected by per capita disposable income level and rabbit meat price, and constrained by the consumption habit. Generally, the sectors of trade imposed little impact on domestic market, which implied relatively independent of Chinese rabbit meat market in the past decades.

The out-of-sample forecast suggested an obviously upward trend for supply and demand, while the growth rate may slightly slow down on the long term (2020-2025). So the rabbit stock quantities, rabbit meat output and per capita rabbit meat consumption will reach to 232.98 million, 962 thousand tons and 0.685kg respectively by 2020; and 236.58 million, 1037 thousand tons and 0.736kg respectively by 2025. Simultaneously, China will still be a net exporter in future with less than 1% for trade.

Consequently, the development of Chinese rabbit meat market should still be based on meeting the domestic demand, focusing on exploiting the potential of consumers. Media need to popularize the special healthy attributes of rabbit meat, especially in big cities. Government and organization also should pay attention to give more introduction and guidance for the farms to rational producing.

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