THE DETERMINANTS OF AQUATIC PRODUCTS RETAIL PRICE FLUCTUATIONS IN CHINA 1978-2000

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ABSTRACT

An empirical model of aquatic product price fluctuations in China has been built using a time series of urban residential and rural panel data, and estimated through cointegration and an error correction model. In the long-run cointegration equation based on urban consumption behaviour, movements in income, average consumption and farmer prices were found to have a significant impact on aquatic product retail price. In the long-run cointegration equation based on rural consumption behaviour, movements in transitory income, average consumption, rural population and farmer price were significant. The estimate of the dynamic equation reveals a rich autoregressive structure in aquatic product retail prices. In the short-run error-correction equation, movements in income, and average consumption were not found to have a significant impact on aquatic product retail prices based rural and urban consumption behaviour and movements in rural population based on rural consumption behaviour. So the result shows that the consumption of aquatic products had been the logjam. The elasticities of error-correction suggest that adjustment toward the long-run relationship is slow.

Keywords: aquatic products; retail price; cointegration, error correction model (ECM), consumption behaviour, China

INTRODUCTION

In China, the fishery sector has been one of the fastest growing within China's agricultural and food economy over the past two decades, enjoying an average annual growth rate of about 10%. The growth in the fishery sector has also been accompanied by significant structural change. The share of output in total production from aquaculture has increased substantially from 25% in 1970 to 60% in 2000.

On the demand side, per capita consumption of fish was only 1.2 kg in rural and 3.7 kg in urban areas in 1980, but had reached 5.8 kg and 18 kg respectively by 2000 [1]. Although there has been a slow increase in incomes over the period 1997-2002, the annual growth rate in consumption slowed from 9.3% to 3.9%. At the same time, the aggregate retail price of aquatic products fell from 863.8 in 1997 to 724.645 in 2002 (Figure 1) due to the expansion in supplies of aquatic products exceeded the growth in domestic demand

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and limited export growth opportunities of aquaculture products because of the food quality and safety issues *inter alia* [2,3, 4]. Hence it is important to analyze and understand the determinants of aquatic products retail price fluctuations in order to expand the domestic demand.

Figure1. Aquatic product retail price trends in China

This paper is organized as follows. Section 2 specifies empirical inverse demand models of aquatic product prices in rural and urban areas. Section 3 estimates via cointegration and an error correction mechanism specification (ECM) separate models based on rural and urban consumption in China. Section 4 discusses the results and draws some conclusions.

THEORETICAL MODEL AND DATA

According to Zhang [4], the inverse demand function for aquatic products can be specified as follows:-

$$PR = g(AC, P_o, In, POP) \quad \text{Eq. (1)}$$

where *PR* is retail price, P_o is the vector of prices of related products, *In* is income, *POP* is population and *AC* is average per capita consumption.

Although there are a range of functional forms and specifications which can be adopted, a single equation model with logarithmic transformation is employed due to shortage of statistical data. Earlier studies of aquatic product prices [5,2] have suggested that products such as meat and eggs have exerted little influence on the consumption of aquatic products in China. Hence we omit substitute prices from the estimated equation, which additionally conserves degrees of freedom in estimation. The specification of the equation of retail price formation is given in Equation (2) below.

$$\ln PR = a_0 + \eta_{AC} \ln AC + \eta_{In} \ln In + \eta_{POP} \ln POP \quad \text{Eq. (2)}$$

However, Equation 2 only considers the static determinants of consumption, but does not take into account the fact that there may be dynamics and short run price transmission processes at work within the market from producer price through wholesale to retail. Hence the final model specification is given in Equation 3.

$$\ln PR = d_0 + \eta_{PF} \ln PF + \eta_{AC} \ln AC + \eta_{In} \ln In + \eta_{POP} \ln POP + \mu \quad \text{Eq. (3)}$$

where η_i is respectively the elasticity relating to each variable, PF is producer price.

The present state of official statistics in China does not produce an aggregate index of national residents' income. There are two indexes, one for rural household net income, and the other for urban household disposable income. Studies of income and consumption relationships in China [6,7,8, 9] suggest that the consumption behaviour of rural residents can be explained by the permanent income hypothesis of Friedman, and the consumption behaviour of urban resident is best explained by the Keynesian absolute income hypothesis. Let the permanent and transitory components of rural household income be written as follows:-

$$\begin{cases} PRIn_t = (In_t + In_{t-1} + In_{t-2})/3 \\ CRIn_t = In_t - PRIn_t \end{cases} \qquad \text{Eq. (4)}$$

where *PRIn* is permanent income, *CRIn* is transitory income and *RIn* and *Tin* denote the indices of rural and urban incomes respectively.

The reduced form of (3) and (4) is:

$$\begin{cases} \ln PR = d_0 + \eta_{PF} \ln PF + \eta_{RAC} \ln RAC + \eta_{PRIn} \ln PRIn + \eta_{CRIn} \ln CRIn \\ \quad + \eta_{RPOP} \ln RPOP + \mu \\ \quad Rural \\ \ln PR = d_0 + \eta_{PF} \ln PF + \eta_{TAC} \ln TAC + \eta_{TIn} \ln TIn + \eta_{TPOP} \ln TPOP + \mu \\ Urban \end{cases} \qquad \text{Eq. (5)}$$

As there is only an aggregate retail price index for aquatic products which is undifferentiated as between rural and urban areas, the variable *PF* also remains the same in both Equations (5).

All data are collected from *Zhongguo Tongji Nianjian* (China Statistical Yearbook) and *Zhongguo Nonye Tongji Nianjian* (China Agricultural Statistical Yearbook), published by China statistical publishing press annually. All data is calculated based on the data in 1978 as 100 and adjusted by the price deflator.

ESTIMATION AND RESULTS

Model based on rural consumption behaviour

A test for unit roots was initially conducted and is shown in Table 1. It reveals that all of the variables are I(1) at the 5% significance level, except for permanent income. According to the theory of cointegration, all variables having a causal relationship should be of the same order of integration at the same significance level. Hence we reject the hypothesis of permanent income exerting a causal influence as a determinant of aquatic product retail price fluctuations. The variable of permanent income was therefore removed from the model 5 specification and Equation 6 estimated in error correction specification.

$$\ln PR = d_0 + \eta_{PF} \ln PF + \eta_{RAC} \ln RAC + \eta_{C\_RIn} \ln CRIn + \eta_{RPOP} \ln RPOP + \mu \qquad \text{Eq. (6)}$$

Table I: The Unit Root Test via ADF (Augmented Dickey-Fuller)

Var.	**The type of test**		**Critical value**[1]	**Var.**	**The type of test**		**Critical value**
	(c,t,n)	**ADF**			**(c,t,n)**	**ADF**	
ln (*PR*)	(c,0,1)	-2.2317	-3.0400	**ln (*PR*)**	(c,t,3)	-3.3407	-3.3588[2)]
ln (*PF*)	(c,0,1)	-2.0551	-3.0400	**ln (*PF*)**	(c,t,5)	-3.5810	-3.3588[2)]
ln(*RAC*)	(c,t,0)	-3.1681	-3.6746	**ln(*RAC*)**	(c,0,0)	-5.1341	-3.0400
ln(*PRIn*)	(c,t,2)	-4.4411	-3.7199				
ln(*CRIn*)	(c,0,0)	1.4277	-3.0114	**ln(*CRIn*)**	(c,t,3)	-4.1992	-4.0815
ln(*RPOP*)	(c,t,0)	-1.5468	-3.6746	**ln(*RPOP*)**	(c,0,0)	-3.8060	-3.0400

[1]At 5% significance level.

Secondly a Johansen test to determine the number of co-integrating relations was performed (Table II)

Table II: Johansen Test for Co-integrating Vectors For Rural Consumption.

The hypothesis	The value	Likelihood ratio	critical	
			5%	1%
$r > 0$ **	0.870826	71.89313	47.21	54.46
$r > 1$ *	0.692867	35.05442	29.68	35.65
$r > 2$	0.471252	13.80586	15.41	20.04
$r > 3$	0.121683	2.335465	3.76	6.65

Table II shows that there are two co-integrating relationships amongst all of the variables. The first one is useful for us. It shows that all of variables have a long-run causal relationship. The estimated co-integrating vector is given in Equation 7

$$LnPR_t = -\underset{\substack{(0.989)\\ [-6.940]}}{2.769} + \underset{\substack{(0.091)\\ [-7.261]}}{0.664} LnPF_t + \underset{\substack{(0.015)\\ [-1.068]}}{0.02} LnC\_RIn_t + \underset{\substack{(1.022)\\ [0.8474]}}{0.866} LnRPOP_t + \underset{\substack{(0.086)\\ [1.735]}}{0.148} LnRAC \quad \text{Eq. (7)}$$

and the corresponding ECM model for short run dynamics in Equation 8.

$$\Delta LnPR_t = \underset{\substack{(0.070)\\[8.877]}}{0.618}\Delta LnPF_t + \underset{\substack{(0.011)\\[-1.595]}}{0.02}\Delta LnCRIn_t + \underset{\substack{(0.067)\\[1.779]}}{0.120}\Delta LnRAC_t + \underset{\substack{(0.198)\\[1.690]}}{0.198}\Delta LnPR_{t-1}$$

$$-\underset{\substack{(0.121)\\[-1.780]}}{0.215}LnPF_{t-1} - \underset{\substack{(0.184)\\[-2.438]}}{0.450}ECM_{t-1} \qquad \text{Eq. (8)}$$

$$R^2 = 0.9269, D.W = 2.171$$

Finally the stability was examined through the CUSUM test, as a simple (albeit weak) diagnostic test of recursive residuals.

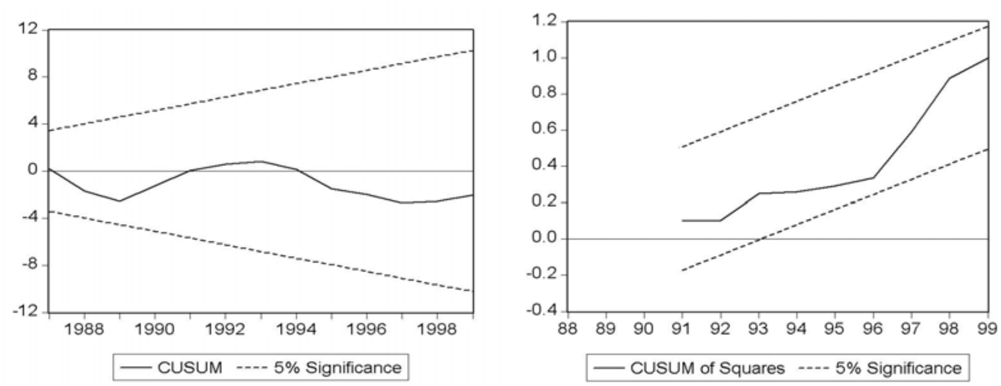

Fig 2 CUSUM test

Model based on urban consumption behaviour

Following a similar procedure to that for rural consumption, unit root tests for stationarity and order of integration were conducted using the ADF procedure (Table III).

Table III: the Unit Root Test via ADF(Augmented Dickey-Fuller)

Var.	**The type of test**		**Critical value**[1]	**Var.**	**The type of test**		**The critical value**
	(c,t,n)	**ADF**			(c,t,n)	ADF	
ln (*PR*)	(c,0,1)	-1.9669	-3.0199	△ **ln (*PR*)**	(c,t,0)	-3.3749	-3.2677[2)]
ln (*PF*)	(c,0,1)	-1.8332	-3.0114	△**ln (*PF*)**)	(c,t,3)	-4.0679	-3.7119
ln(*TAC*)	(c,t,0)	-2.8103	-3.6454	△**ln(*TAC*)**	(c,0,0)	-6.8249	-3.0199
ln(*TIn*)	(c,t,1)	-2.1986	-3.6591	△**ln(*TIn*)**	(c,0,2)	-3.4463	-3.0400
ln(*TPOP*)	(c,0,0)	-4.1534	-3.0114				

[1] At 5% level of significance

Table III shows that all of the variables are I(1) at the 5% significance level, except for the urban population which was subsequently dropped from the specification and Equation 9 estimated.

$$\ln PR = d_0 + \eta_{PF} \ln PF + \eta_{TAC} \ln TAC + \eta_{TIn} \ln TIn + \mu \qquad \text{Eq. (9)}$$

Secondly the Johansen test results for the number of co-integrating vectors are shown in Table IV.

Table IV: Johansen Test for Cointegrating Vectors: Urban Consumption

The hypothesis	**The value**	**Likelihood ratio**	**Critical Value**	
			5%	**1%**
$r > 0$ **	0.930860	92.59740	47.21	54.46
$r > 1$ **	0.706858	39.16487	29.68	35.65
$r > 2$	0.515073	14.62292	15.41	20.04
$r > 3$	0.007362	0.147793	3.76	6.65

Table IV shows that there are two co-integration relationships amongst the variables. The first is presented in Equation 10 and

$$LnPR_t = -\underset{\substack{(0.286) \\ [-2.001]}}{2.575} + \underset{\substack{(0.106) \\ [9.497]}}{1.007} LnPF_t + \underset{\substack{(0.303) \\ [2.146]}}{0.650} LnTAC_t - \underset{\substack{(0.111) \\ [-0.652]}}{0.07} LnTIn \qquad \text{Eq. (10)}$$

The estimated ECM representation of the short run dynamics is given in Equation 11.

$$\Delta LnPR_t = \underset{\substack{(0.075) \\ [6.921]}}{0.522} \Delta LnPF_t - \underset{\substack{(0.011) \\ [3.968]}}{0.377} \Delta LnPR_{t-1} - \underset{\substack{(0.129) \\ [-1.715]}}{0.221} ECM_{t-2} \qquad \text{Eq. (11)}$$

$$R^2 = 0.8228, D.W = 2.013$$

Finally the CUSUM stability test suggests model adequacy.

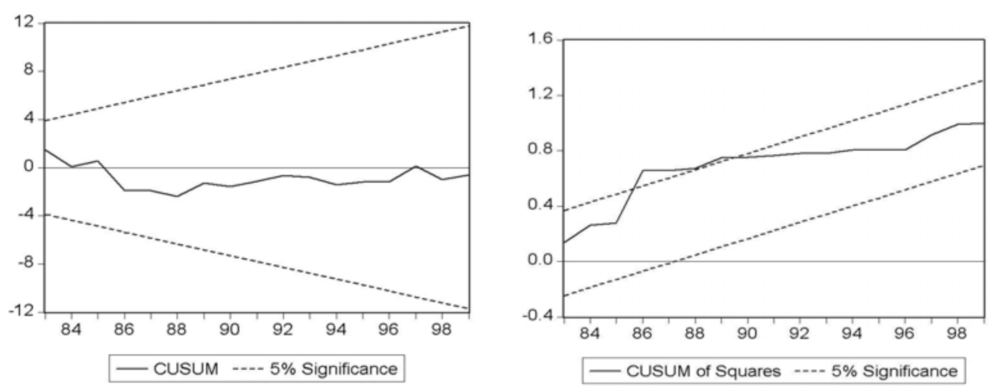

Fig 2 CUSUM test

DISCUSSION AND CONCLUSIONS

Empirical models of aquatic product price fluctuations have been specified for both urban and rural resident panel data separately in China. The estimated models show both long run cointegrating relationships between the variables and short-run dynamics through error correction mechanisms.

In the long-run cointegration equation based on urban consumption behaviour, movements in income, average consumption and farm-level prices were found to have a significant impact on aquatic product retail prices. In the long-run cointegrating equation for rural consumption behaviour, movements in transitory income, average consumption, rural population and farm price were shown to have a significant influence. The estimates of the dynamic equations reveal a rich autoregressive structure in aquatic product retail prices.

There are two reasons why permanent income is not a determinant of aquatic product retail prices in rural areas. First, there are no social security or insurance systems for medical treatment, education etc. in China rural area, and hence the rural dweller-farmer is inclined to have a high marginal propensity to save from income to provide for such expenses. Thus increases in rural incomes do not translate into equivalent increases in consumption spending. Furthermore income growth in rural areas has been relatively slow in recent years, which has further limited demand expansion for aquatic products in rural markets. Figure 3 illustrates the trend in rural household net income between 1978 and 2000. It shows that rural household net income grew slowly until 1994, but has subsequently slowed in growth again after 1997 to an annual rate of 1.7%. In fact, in mostly rural areas, especially in China's western region, the rural consumers regard aquatic product as non-staple foodstuffs.

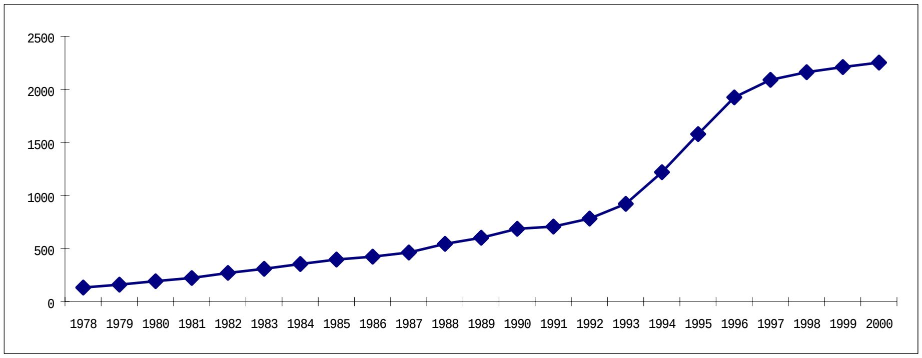

Figure 3 Rural household net income in China (1978-2000)

The likely reason why the urban population is not a determinant of aquatic product retail price fluctuations may be related more to the nature of the current statistics in China. The demography of China is based on residents' place of domicile. Therefore official statistic data fail to register and record adequately migrant workers and residents, of which there are large flows from rural to urban population centres. The urban population variable therefore may therefore under-record the actual population resident at any one time, notwithstanding the lower propensity to consume aquatic products of rural migrant workers.

In the short-run error-correction equations for both rural and urban areas, changes in income and per capita consumption were found to have no significant impact on aquatic product retail price movements. Nor did rural population change have any significant influence on short run price behaviour. The elasticity of error-correction is -0.45 and -0.221 for rural and urban areas, suggesting that adjustment toward the long-run equilibrium is slow.

In fact, the food consumption pattern of urban residents has developed in recent years to include many of the “non-staple foodstuffs types”, foods with high protein and low calorie content. At the same time, aquatic products demand in urban areas is shifting from traditional aquatic products to upmarket and higher quality ones. Segmentation is emerging in demand especially for fresh products in the high class restaurant and hotel trade, processed products for visitors and with frozen seafood more for urban residents.

Acknowledgements

This program is support by NSFC (National Nature Science Foundation of China) under Grant No. 70133001.

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