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AGRICULTURAL TRADE AND MARKETING

AGRÁRKERESKEDELEM, MARKETING

ON THE SUPPLY FUNCTION OF THE HUNGARIAN PORK MARKET

NYÁRS, LEVENTE – VIZVÁRI, BÉLA

Abstract

The Hungarian pork market has been in a decreasing position in the last years. The main reasons for that is the increasing international competition, the Hungarian support system has been replaced by CMO of pigmeat and the decrease of pig meat consumption as a result of customer behaviour. There was no exact estimation of the Hungarian supply function. In a earlier paper we have published for regression equations for it. In the first part of present paper we show that these equations forecasted in a appropriate way the pessimistic scenario. The second part of paper discusses revisited, new regression equations.

Keywords: international competition, change of consumers' behaviour, price elasticities, forcasting

Introduction

Traditionally pork has one of the largest shares in the meat market in Hungary. Although per capita consumption is the half of EU15 average. The share of poultry is still increasing and its consumption has exceeded the consumption of pork. The consumption of any other type of meat is low.

The Hungarian pork market experienced several structural changes in the last two decades. Among them the last one is that Hungary joined to the European Union in May 1, 2004. In each year several interventions took place on the market before joining to the EU, which is not possible according to the CAP regulations.

The supply function provides us with very important information on the market. It determines the quantity which will appear on the market in the future. It also shows that the producers' surplus, which determines the potential of the sector even in the case of hard conditions. The organizations of producers complain on the low market price. They either do not give the cost or give only one value although there is a large variance among the producers. (However the prices were high in 2006.)

In a previous study the supply function has been estimated by regression analysis [Nyárs, Vizvári 2005]. The time series has been finished exactly at the moment of the joining to EU. It is important to find out if the new structure changed the supply significantly. The present study analyses the supply function according to the new data until the end of 2006.

Overview of literature

Any theory of economics determining a supply function is based on some hypotheses like (i) the existence and presence of price elasticities, (ii) the behaviour of the producers is known, e.g. it can be described by adaptive price expectations [Nerlove 1958].

The price elasticities of supply were observed for the major Bulgarian agricultural commodities (in the crop sector) and estimated the elasticities of total supply and of marketed quantities [Mishev *et al*. 1998]. The authors drew conclusions that the own price elasticity of

products supplied to the market is higher than those in the developed countries. That high own price elasticity of supply is represented by the strong shortage of grain on the domestic market over the transition period. In an other study dealt with the supply function in Bulgaria, Romania and Slovenia. The author discovered that the agricultural market could be explored econometrically only in the case of Slovenia [Hallam 1998].

The agricultural production and price trends were examined in Slovenia over the period between 1961 and 1995 [Erjavec *et al*. 1998]. The authors calculated the price elasticities for six main agricultural products. These products were ranked into three groups. High supply elasticities were indicated forthcoming the value 1.0 for beef and maize. These farm products are not regulated by State, but depended on market trends. Both of these products were supposed to be weakly influenced by the fixed factors of production. The second group was with low supply elasticities below 0.50 and lower (pig and potatoes). In the examined period pork production was under market conditions, however the government highly intervened in the market. The third group of farm products was characterized by wheat and milk. Elasticity coefficients were close to zero, with high degrees of State regulation in wheat and milk market organisations.

The changes in the price of the product substitutes had no significant impact on production [Mishev *et al*. 1998]. They detected a strong correlation between the purchased quantity of a product and the prices of the other products analysed. An other study highlighted the agricultural supply in transition economies [Hallam 1998]. The author found it ironic that while the economic transitions make the knowledge of agricultural supply response to prices important, the entailed structural breaks in fundamental economic behaviour make modelling problematic. The author used standard dynamic econometric models (Kalman filter).

He declares that due to the far-reaching implications of transition and the relatively short and often unstable post-transition period consistent post-transition series will not commonly provide adequate degrees of freedom for conventional econometric supply analyses. He also examined that farm-level panel data sets pretended to supply analysis based on the profit function, are not available.

However, the inference of a varying parameter model via an updating procedure such as the Kalman filter is appropriate only under the assumption that the parameters are changing continuously throughout the sample period while maintaining long-run equilibrium (cointegrating) relationships between the variables [Charemza 1993]. He states that the transition process in the CEEC's is of a different nature and is best explained by a kind of continuous structural change with constant long-run relationships operating for the pre- and post-transition periods.

Analysing the transition economies, researchers have to face the problem of the length of the time series. recommended that Long enough time series' must have at least 15 annual observations or 24 quarterly [Blangiewicz *et al*. 1993]. In the present study the date for third years of 1996-2006 have been used, i.e. the length of time series is 32.

In 1992, a study were published about the welfare effects of accession to the EC on the Spanish hog market. The analysis examined the effects of the accession in 1986 to the EC on the Spanish hog market within an econometric supply and demand framework. According to the authors entry to the EC resulted in increased imports, a sharp decline in prices, increased Spanish consumption and reduced levels of Spanish hog production. Pig producers lost an

estimated 1.6 billion ECUs and evidence indicates that government support to hog producers represented about 1% of losses (Albiac and Garcia 1992).

In Hungary, the apparent stagnation in total pig numbers conceals the changes in pig production structure. According the authors the eventual termination of the intervention buying of cereals would give some impetus to pig farming. They expected that if that condition was met, the number of pigs would rise over 4.5 million by 2010. Optimally, if the cancellation of the intervention in the market of cereals was accompanied by improving efficiency (methodically that would include cutting back general operating costs by 10 percent, improving the utilisation of feed by 10 percent and rationalizing labour input), by 2010 the number of pigs would exceed 5.2 million, with the number of sows increasing at an even more dynamic rate, reaching 380 thousand (the level of the second half of 2002). This, however, would require the acceleration of the inevitable structural reform and the availability of the funds required by the modernisation projects. The model findings suggest that, even considering the best scenario, pig farming can reduce the increasing pressure on the Hungarian market in cereals arising due to the surplus quantities produced, only to a rather moderate extent (Udovecz *et al*. 2006).

According to there is no reliable investigation of producers' behaviour in the Hungarian meat market. There are indications that adaptive price expectation is present in Hungarian markets in general. On the other hand the parameter of this expectation behaviour is not unique and at the same time indications show the presence of other types of expectations, e.g. the extrapolative one, too [Lakner *et al*. 2000].

Materials and Methods

One reasonable assumption is that there is an underlying dynamics on the market. If the important inputs of the production are expensive then the farmer can expect only low or even negative profit. Therefore the production will decrease. In the opposite case, i.e. the unputs are cheap the farmer expects high profit and the production increases. Thus the input prices at the beginning of the production are important. The duration of the production is approximately 6 months. Thus the hypothesis is that the input prices lagged by the time periods have the greatest influence on the current value of the production.

If a producer suffers losses for a long time, then the production has no sense from the economic point of view thus it will be finished. The market is a dynamic system as the producer estimates the future profit from the present state of the market on decides on the future production. This means that the state of the market is determined by previous states. In Hungary the animals are slaughtered in the age of 8 months. Thus, the size of the current pig population is determined by the input and output prices 8 months earlier. This assumption is also important from a technical point of view as there are available data on the pig population according to the methodology of EU in every fourth month (third of a year).

After the political turnover of 1990 a great structural change was experienced in Hungarian agriculture. In this research the time periods from the 1st third of 1996 to the 4th third of 2006 has been investigated. In this period the pig population was approximately the half of the former peak. Between 2002 and 2006, the pig population decreased from 5 000 000 to 4 000 000.

In Hungary the main feed of pigs is maize. Thus the following four factors and their nonlinear functions were considered as independent variables in the regression analysis, which determine the pork production. These factors are: (i) the 8 months earlier corn price, (ii) the 8 months earlier market price, (iii) the 8 months earlier piglet price, and (iv) the current chicken price.

Results

The Estimates of the Old Equations

In the previous study for regression equations have been established [Nyárs and Vizvári 2005]:

Equation (1)

(1) $\prod_t = 189\,192 - 2842.96\, m_{t-2} + 269.82\, p_{t-2} - 9.83\, l_{t-2}$

(R^2=0.5247)

Equation (2)

(2) $\prod_t = 179\,561 - 4\,723.68\, m_{t-2} + 93.26\, p_{t-2} - 6.23\, l_{t-2} + 467.08\, c_t$

(R^2=0.5630)

Equation (3)

(3) $\prod_t = 260\,098 - 9\,164.88\,(m_{t-2})^{0.5} - 1\,092.85\, m_{t-2} + 8\,155.79\,(p_{t-2})^{0.5} - 2\,849.28\,(l_{t-2})^{0.5} + 3.86 \times 10^{-7}\,(l_{t-2})^3$

(R^2=0.5884)

Equation (4)

(4) $\prod_t = 257\,860 - 1110.59\, m_{t-2} - 15\,281.32\,(m_{t-2})^{0.5} - 2.485 \times 10^{-7}\,(l_{t-2})^3 - 2\,310.02\,(l_{t-2})^{0.5} + 6\,021.6\,(p_{t-2})^{0.5} + 207.1\, c_{t-2}$

(R^2 = 0.5936),

where the following notation is used:

t	the index of time unit (time is measured in thirds of a year)
Π_t	the pork production in time period t
m_t	the price of maize in time period t
p_t	the market price of pig in time period t
l_t	the price of piglet in time period t
c_t	the price of chicken in time period t

These regression equations estimated the production of a third year in 2006 as table 1 presents:

Table 1. Estimated potential of the Hungarian pork sector in 2006 according to the different regression equations.

Equation	Estimated Production, tons
(1)	155 452
(2)	151 215
(3)	149 471
(4)	124 550

Source: Authors' own calculation, based on HCSO database

The average was 151 067 tons, i.e. three out of the four equations estimated the current potential well. Another way to characterize the robustness of the regression equation is to

calculate the correlation of the trajectory after the beginning of 2004 and the estimated time series. Table 2 presents the correlation between the real trajectory and the estimated time series.

Table 2. Correlation of the real trajectory and the time series estimated by the regression equations

Equation	Correlation on the new segment of the trajectory
(1)	0.6243
(2)	0.3279
(3)	-0.6842
(4)	0.6590

Source: Authors' own calculation

Results Based on New Regression Equations

Using the same independent variables, the coefficients of the regression equation change. Here are the new equations:

Equation (5)

(5) $\prod_t = 205\,590.7 + 1\,297.013\,m_{t-2} - 289.045\,p_{t-2} - 3.5719\,l_{t-2}$

(R^2=0. 5581)

Equation (6)

(6) $\prod_t = 179\,468 + 990.4\,m_{t-2} - 277.4\,p_{t-2} - 4.40\,l_{t-2} + 201.2\,c_t$

(R^2=0. 5730)

Equation (7)

(7) $\prod_t = 219\,596 + 52\,812.1(m_{t-2})^{0.5} - 6\,250.7\,m_{t-2} - 6\,719.93(p_{t-2})^{0.5} - 1\,220.9(l_{t-2})^{0.5} + 2.0669\times10^{-8}\,(l_{t-2})^{0.5}$

(R^2=0.5854)

Equation (8)

(8) $\prod_t = 110\,738 - 147\,341\,m_{t-2} + 1\,138\,101(m_{t-2})^{0.5} + 2.888\times10^{-8}\,(l_{t-2})^3 - 1\,587.86(l_{t-2})^{0.5} - 5\,775(p_{t-2})^{0.5} + 104.8\,c_{t-2}$

(R^2 = 0.6138).

Some new regression equations have been determined as well:

Equation (9)

(9) $\prod_t = 241\,372.9 - 60.762\,m_{t-2} + 3\,253.939(m_{t-2})^{0.5} + 2.68\times10^{-8}\,(l_{t-2})^3 - 1\,683.43(l_{t-2})^{0.5} - 253.534\,p_{t-2} + 390.88\,c_t$

(R^2 = 0.6273)

Equation (10)

(10) $\prod_t = 318\,634.5 + 1.532\,(m_{t-2})^3 + 13.59\,l_{t-2} - 3\,174.18\,(l_{t-2})^{0.5} - 135.612\,p_{t-2} + 10\,903.03\,l_{t-2}$

(R^2 = 0.5947)

Results Based on Price Elasticities

Price elasticities are often thought a good tool to forecast or estimate supplier's answer to changes on market. Therefore any result obtained in a different way must be compared the ones produced by elasticities.

In general if factor y is dependent on factors $x_1,\ldots,x_n$ and has elasticities $e_1,\ldots,e_n$ then y is forecasted by the following equation:

$$y = c\times x_1^{e1}\times\ldots\times x_n^{en}, \qquad (***)$$

where c is an appropriate constant.

Two types of price elasticity of pigmeat was considered: own and maize price elasticities. Both of them were calculated with lags from zero to nine. The formula (***). i.e. the appropriate constant c, was determined with n=2 and the two lags were equal. Some elasticities had too high absolute value so the calculation could not be carried on (Table 3).

Table 3. Pork and maize price elasticities in Hungary (January 2004- July 2007)

Lag	Own Price Elasticity	Maize Price Elasticity
0	0,71304	2,84704
1	1,82281	3,82239
2	0,30397	-9,51559
3	4,97572	-19,58339
4	-5,24797	5,81445
5	-1,41650	-12,39944
6	0,73950	12,14533
7	3,41476	7,93589
8	1,11579	-2,90313
9	4,53845	-18,87919

Source: Authors' own calculation, based on HCSO and AKI database

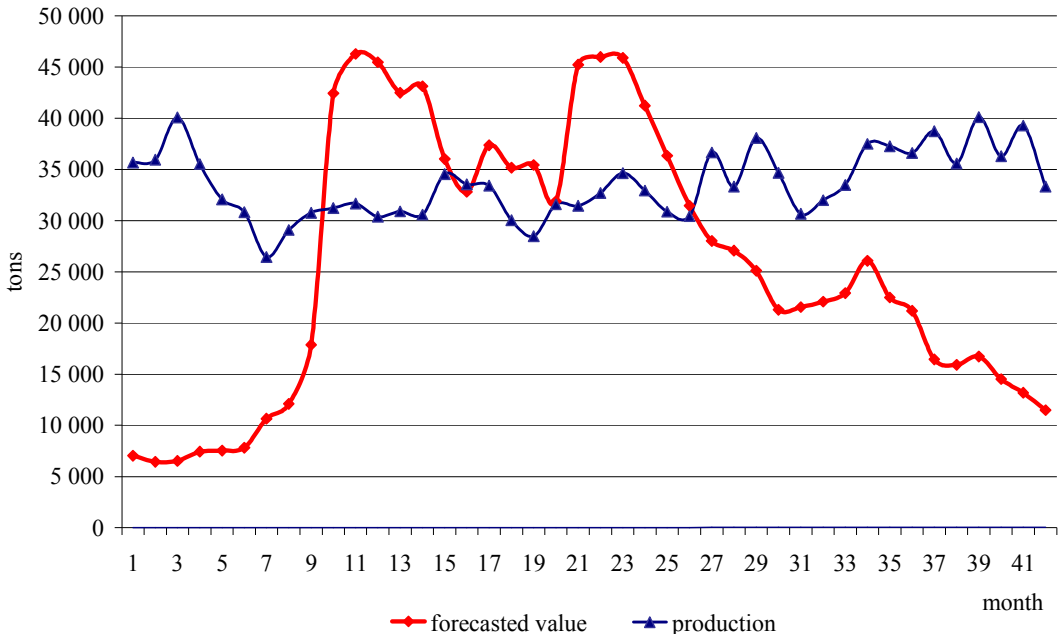

Figure 1. Pork production and forecasted production with lag0

Source: Authors' own calculation, based on HCSO and AKI database

In determining elasticities the data of 40 months were taken into consideration. The results below for months 41 and 42 below show the real forecasting power of the method. The pairs with lag 0 and 8 behave significantly much better than the other ones (Figure 1, figure 2). Their constants are 7109836 and 1086594, respectively.

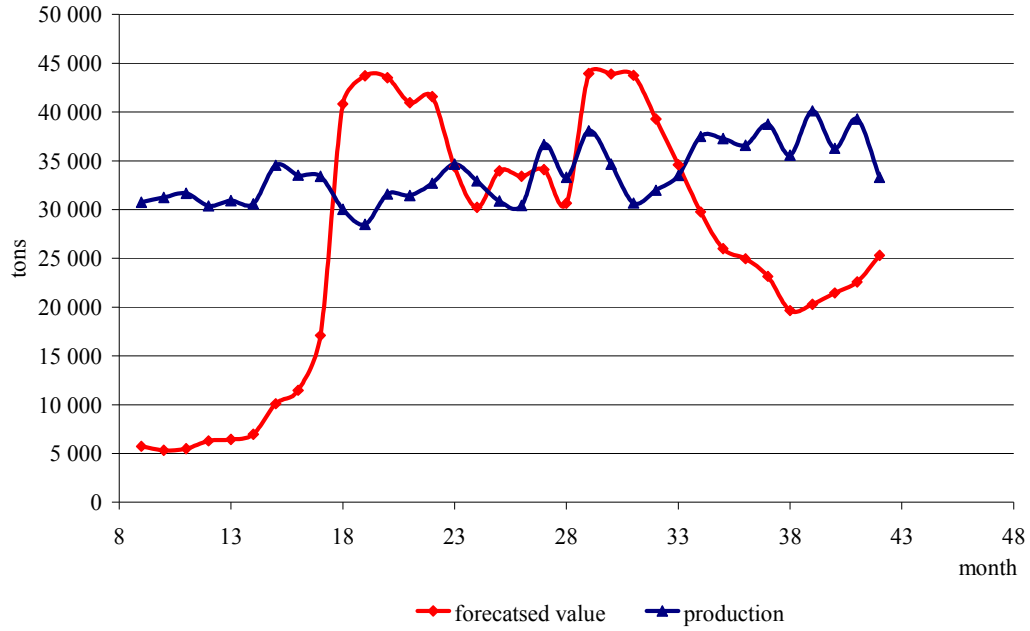

Figure 2. Pork production and forecasted production with lag8

Source: Authors' own calculation, based on HCSO and AKI Database

To show the bad quality of the results based on other lags than 0 and 8 here is the figure obtained by lag 7 (Figure 3):

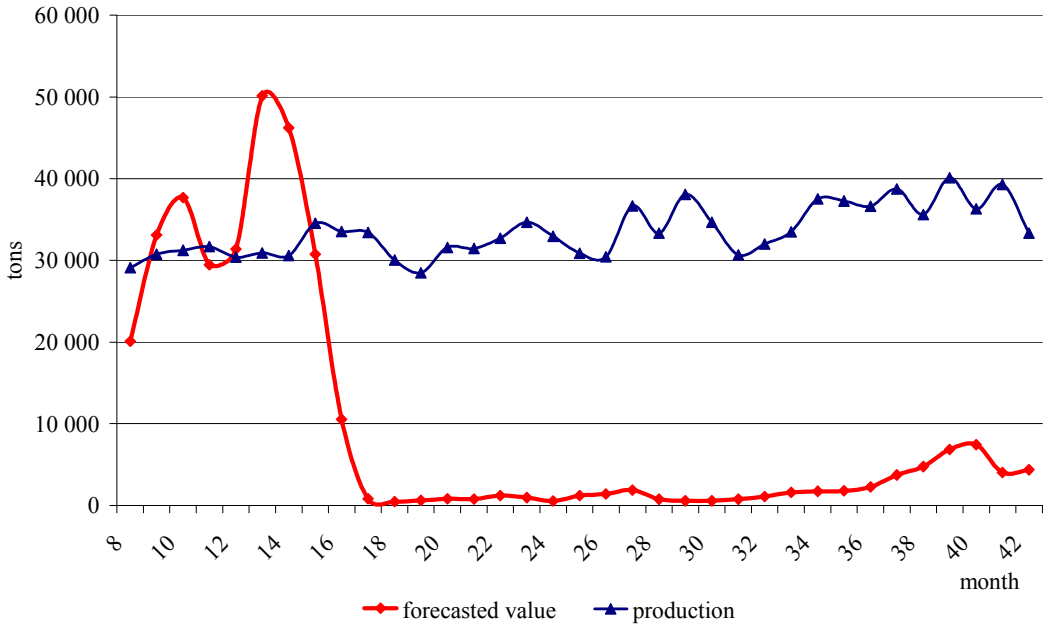

Figure 3. Pork production and forecasted production with lag7

Source: Authors' own calculation, based on HCSO and AKI database

One can obtain the following conclusion. The price elasticity method is not a suitable tool of forecasting in our particular case. As a matter fact the underlying reason is more general. The formula of type (***) is very inflexible. Most of the items do not obey a law like this. It a well-known phenomena that if price elasticity is measured based on real life data then the standard deviation is higher than the mean, which means that even the sign of the elasticity cannot determined for sure.

On the other hand the relative good behaviour of lag 8 proves that there is an effect 8 months delay on this market. It is more or less a natural phenomena as 8 moths is the time necessary to get final product from a hog.

Estimation of the Supply Function

Prices are given in Hungarian Forint (HUF) of the year 1996. 210 HUF of 2004 equals to 100 HUF of 1996 (In 2006 1 € is approximately 260 HUF). The supply function is considered in the range of the market price [100 HUF, 160 HUF] as the real market price was varying in the same range. Three characteristic values of the piglet price are considered: 4 000 HUF, 7 000 HUF, and 11 000 HUF. 180 HUF is considered to be the maximum and 130 HUF for the lowest chicken real market price.

Each equation obtained from regression analysis automatically gives an estimation of the supply function. One obtains the estimated production from the equation if the values of the four factors are determined. The function is in the 5-dimensional space. The supply function can be plotted only if the values of some factors are fixed.

As the main part of the cost is determined by feed, it seems to be reasonable to investigate the supply function in two extreme cases. One is the situation of high maize yields resulting that the price of the maize equals to the intervention price of the EU. The other is the case of low yields implying a high maize price in the market..

The first extreme case represents the maximum potential of the Hungarian pork sector if at the same time the price of piglet is low. This situation may occur in a second consecutive year of high maize yields. In the first year there is a high demand for piglets and the price of piglets is high. The market reacts to that position by increasing the piglet production. In the second year the price of piglets goes down because the supply and demand of piglets becomes balanced.

Table 4 shows the numerical results of estimating the amount of pork produced by equations (1) to (4). The assumed prices are as follows: the real market price of pig is 160 HUF/kg, the deflated price of a piglet is 4 000 HUF, the real price of 1 kg maize is 10 HUF.

Table 4. Maximum potential of the Hungarian pork sector according to the different regression equations

Equation	Estimated Production, tons
(1)	189 200
(2)	222 000
(3)	235 900
(4)	127 660

Source: Authors' own calculation, based on HCSO database

The conclusion drawn from the numerical results is that the maximum potential of the Hungarian pork production is around 193 500 tons per one third of a year as one estimate is too pessimistic and two ones are optimistic.

Another extreme case is when the sector is in a very bad position as the costs are high and at the same time other agents of the global market are transporting cheap meat to the Hungarian market, i.e. in spite of the high costs the market price of pork is low. In this case the deflated market price is supposed to be 100 HUF. The piglet real price is 11 000 HUF. As the yield was small, the real price of maize is assumed to be 20 HUF. In this very pessimistic case the Hungarian production will collapse.

Conclusions

An uncertain situation can be observed in the Hungarian pork market in the last seven years. The main reasons for this are the increasing quantity of pork import, the decrease of pig meat consumption as the result of the permanent change of the customer's behavior, and the decreasing competitiveness of the Hungarian farms. Instead of well-defined control of the market and the absence of modernization, the lack of co-ordination ad hoc measurements have taken place before the EU accession. The farmers had to face uncertain situations and were unable to make appropriate decisions. The market price changed significantly several times within this period, which has made possible the mathematical analysis of the supply function.

Several linear and non-linear regression equations have been developed for the supply function. All of them can lead to the same conclusions. In the case of good market position, i.e. when the input prices are low and pork market prices are high, the Hungarian pork sector can produce approximately 579 thousand metric tons of pigs for slaughter (in live weight). In the opposite case, when the input prices are high and pork market prices are low the production collapses. The future of the Hungarian pork sector depends on the speed of developing the producer segment in the market, which is able to make profits under disadvantageous circumstances.

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