



Why Hungarian Meat Processors Failed? Evidence using Price Transmission Analysis

Journal:	<i>Agribusiness: an International Journal</i>
Manuscript ID:	AGR-14-0161
Wiley - Manuscript type:	Research Article
Keywords:	food systems, agribusiness, food manufacturing

SCHOLARONE™
Manuscripts

Review

Why Hungarian Meat Processors Failed? Evidence using Price Transmission Analysis

Abstract

Between 2011 and 2013 many high-capacity Hungarian meat processors went bankrupt that was possibly caused by an unfavorable market situation. In this paper we carry out vertical price transmission analysis to identify the degree of competition in meat processors input as well as output markets, separately. The results suggest that both input and output markets can be characterized as a competitive market where real prices did not change considerably in the reviewed time period from 2004 to 2012. Granger causality tests indicate that price shocks starting at pig breeders run through the supply chain and also influence consumer prices, however, there is no significant feedback effect. One plausible reason for the failure could be the continuous fall in demand. [EconLit Classifications: Q11, C22, L11].

1 Introduction

Many high-capacity meat processors went bankrupt in recent years, which is an important industry for the Hungarian economy. János Ruck, former general manager of Gyulai Húskombinát Plc.¹ made a remark that “there is no profitably operating meat processor in Hungary at the time being, all the companies from the largest to the smallest are loss-making” (Rácz, 2012). This picture is distorted by the fact that more than half of the Hungarian meat processors’ and producers’ operating profit was positive in 2011.² Compared to other sectors, meat processors’ market performance is not dismal

¹ Gyulai Húskombinát Plc. is one of top 10 meat processing companies in Hungary. It went bankrupt in 2012.

² Figure 1 shows the average operating profit of the industry from 2001 to 2011. For comparison purposes, average operating profit of other food processing industries are also plotted.

either. However, close to zero average operating profit per firm ratio may not be sustainable in the long-run.

The above mentioned evidences naturally pose the question that what is the reason behind the poor performance of the Hungarian meat processors. The profitability of a company mainly depends on the decisions made by managers and corporate leaders. However, market structure can influence the performance of a company as well. Meat processors may not operate profitably if either the input or the output players' behavior exhibit some sort of market power. Further analysis of the market structure will determine whether the situation was favorable for the processors or not.

The result has policy implications given that general and local governments tried to retain jobs by giving financial support to most of the companies. This calls for an immediate analysis of the meat supply chain to understand whether it was unfavorable market situation or other factors which caused the same. If market structure is unfavorable, then policy intervention (e.g. institutional reforms) may help the efficient companies to become profitable in the long-run. On the contrary, the bail-out of inefficient companies will soften their budget constraints and it is very likely that losses will reproduce themselves.

Previous studies found mixed results analyzing the Hungarian meat industry before the country joined the European Union (Bakucs & Fertő, 2005; Varga, Tunyoginé Nechay & Mizik, 2007; Bakucs & Fertő, 2009). In addition, every study analyzed at least two stages of the supply chain (e.g. slaughtering and processing or processing and whole selling) together. Therefore, in a case of asymmetric price transmission, one cannot separate whether input or output market player's behavior exhibit market power on meat processors. The objective of this paper is to analyze the market situation of the meat processors, with focusing on input and output markets, separately.

The structure of this paper is as follows. Section 2 gives a short introduction of the Hungarian meat industry. Section 3 presents the theoretical framework of the analysis. Section 4 focuses on previous studies. Sections 5 and 6 describe the methodology and the dataset used, respectively. Section 7 is

made up of the results of the analysis. Concluding comments and possible explanations are presented in Section 8.

2 The Hungarian meat industry

The meat processing industry lies in the middle of the meat supply chain, which begins at the farms and finishes at the consumers (“from farm to fork”, as the title of Eurostat (2011) states). This paper focuses on the meat processing industry: inputs are produced by slaughterhouses and outputs are bought by whole sellers and/or retail chains.

Table 1 demonstrates concentration and profitability statistics of the Hungarian meat supply chain in 2008. The statistics show that processing is the most concentrated at the vertical level, still, it generated the highest losses. The processing sector is highly concentrated in almost every European country (Ecorys, 2010). A Hungarian specialty is the relatively small foreign ownership compared to other EU countries (Bakucs & Fertő, 2005).

On the other hand, Czibik and Makó (2008) state that more than half of the meat and dairy processors had raised their wholesale prices by more than the inflation rate in 2006. No other food processing sector was so successful with regard to price increases, which can at least partially be caused by the high concentration ratio.

According to a Nielsen (2011a) survey, 81% of the Hungarian consumers prefer Hungarian meat products, which is the highest ratio considering food products. In addition, private labelled goods have a market share of only 25%, which is moderate compared to other product categories (Nielsen, 2011b). The rest of the market is occupied by branded products providing more profit to their manufacturers. These latter facts draw a better picture of the industry and its market perspectives.

3 Theoretical framework

Price transmission analysis examines the flow of price shocks through the supply chain or through spatially separated markets. As prices of various stages of the supply chain can vary, vertical price transmission analysis is based on the following ideas (Rapsomanakis, Hallam & Conforti, 2003; Vavra & Goodwin, 2005):

- co-movements and integration of prices;
- speed and symmetry of the price adjustment process after a cost, tax, etc. shock.

Conforti (2004) identifies six groups of factors that can affect price transmission. Three of these factors, market power, returns to scale (sometimes increasing return to scale) and product differentiation have the most important effect on vertical price transmission. All of the three factors are relevant for the Hungarian meat processing industry. High concentration ratio of manufacturers (Table 1) may indicate market power in their negotiations. Relatively large plants can also indicate increasing returns to scale. Product differentiation also seems to be present, indicated by the relatively high level of branded products (Nielsen, 2011b) along with a wide range of quality of the products sold in the market.

In a competitive market price shocks run through the supply chain fast and symmetrically (Meyer & von Cramon-Taubadel, 2004). But the above mentioned imperfections can cause asymmetric and/or long-run price adjustments (i.e. the speed of the adjustment process is slow). If players' behavior at different vertical levels exhibit some sort of market power, price adjustment process can be asymmetric. According to Meyer and von Cramon-Taubadel (2004), both positive and negative asymmetric price transmission (APT) can evolve in an oligopolistic market. It mainly depends on the expectations of the firms (e.g. what they think what their competitors will do after an input price shock) and on whether firms' aim is to maintain their mark-up or their market share.

On the other hand, in a competitive environment the theory of menu costs can also explain APT. If changing prices or quantities cause some adjustment costs that the companies have to pay, prices

will respond slower. Apart from these two main explanations, other motives can also lead to APT, but their analysis is not wide-spread at all (for further details, see Meyer & von Cramon-Taubadel, 2004). Bakucs, Fałkowski and Fertő (2014) conduct a meta-analysis to determine the causes of asymmetric price transmission. Based on 101 price transmission analyses from several countries and agricultural markets they find that price transmission is more asymmetric if among others farm structure is more fragmented, bargaining power of farmers and retailers is more imbalanced and the regulation of retailers are more restricted (i.e. the competition among retailers is not very intense). Broadly speaking, the possibility of asymmetric price transmission is higher when some players in the supply chain possess market power.

4 Literature review

In recent years many studies discussed the price transmission mechanism in pork markets. The wide range of results indicate that national markets can be very different. Furthermore, price transmission is a dynamic process, therefore it could change over time.

Conforti (2004) finds poor vertical price transmission in the pork market of sixteen developing countries. In the majority of the countries there were no significant price transmission at all. Von Cramon-Taubadel (1998) tests asymmetric price transmission in Germany using error correction models. His results show significant positive asymmetries between producer and wholesale prices. Abdulai (2002) analyzes price transmission with threshold cointegration models in the Swiss pork market. His results also show positive asymmetries in the supply chain. If producer prices increase, consumer prices will increase more rapidly than *vice versa*. Ecorys (2010) examines pork market price transmission in four EU member states (Germany, United Kingdom, Netherlands and Poland). They evaluate farm-wholesale and wholesale-retail price spreads and model the changes of the spreads. Interestingly, they find decreasing price spreads in Germany which is the contrary to the result of von Cramon-Taubadel (1998). Furthermore, Ecorys (2010) finds positive APT in the Netherlands and in

Poland. Price movements are complex in the United Kingdom, consumer prices are not related to farm-gate and/or wholesale prices.

Miller and Hayenga (2001) distinguish between high- and low-frequency price cycles in the US pork market and analyze price transmission separately. Their results indicate that farm–wholesale price adjustments are asymmetric both in high- and low-frequency cycles but wholesale–retail price responses are symmetric in high-frequency cycles (and in the full sample as well). Gervais (2011) analyzes price transmission in a nonlinear framework. Using US pork meat prices, he finds strong evidences that price movements are nonlinear. Although, asymmetric price transmission in the sense that the speed of the adjustment process differs after an input price increase from a decrease, is not fully supported by the data. Adachi and Liu (2009) analyze the Japanese pork market in the time period of 1967–2002. They identify four breaks in the farm-retail price relationship using an endogenous breakpoint search method. All of the regimes can be characterized by positive asymmetric price transmission, however, the linkage between farm-gate and consumer prices weakens from regime to regime.

Bojnec and Peter (2005) demonstrate that Slovenian pork market is a competitive market operating with higher mark-ups than developed market economies do. Bakucs and Fertő (2005) use similar tools with regard to the Hungarian pork market. Their results show that Hungarian pork market is competitive, moreover, price transmission is symmetric. However, Bakucs, Fertő, Hockmann and Perekhonuk (2006) find short-run asymmetries in the Hungarian pork market and Varga, Tunyoginé Nechay and Mizik (2007) prove that retailers have significant market power in case of many but not every product made from pork. Bakucs and Fertő (2009) analyze the Hungarian pork market between 1992 and 2005. They find that a structural break occurred in the price movement in April 1996 and margins began to squeeze after that. Marketing margins indicate that the market structure is not competitive, however, price transmission is found to be symmetric in the long run, and the direction of the Granger causality is from producer to retail prices.

5 Methodology

There are several types of econometric models to analyze the price transmission mechanism. Hassouneh, von Cramon-Taubadel, Serra and Gil (2012) and Frey and Manera (2007) give a methodological framework. The first step is to determine whether time series are stationary or not. The suitable methodology depends on the results of the unit root tests. If the series contain stochastic trends (i.e. they are not stationary), we should test for cointegration and build error correction models.

5.1 Testing for unit root

Augmented Dickey–Fuller (ADF) test was used to examine whether time series are stationary or they contain a stochastic trend. The test is based on a k th-order autoregressive (AR) process which can be written in the following form (Enders, 2004):

$$\Delta y_t = \alpha_0 + \alpha_1 t + \gamma y_{t-1} + \sum_{j=2}^k \beta_j \Delta y_{t-j+1} + u_t.$$

The constant and the trend are optional. If the series contains at least one unit root, the $\gamma = 0$ restriction will hold. Econometric time series literature mentions several problems connected to the ADF test (e.g. how to determine k , or the test is may not be appropriate for a moving average process), but the most important problem can be caused by structural breaks. With a structural break in the data series, unit root tests often give misleading results. Therefore Zivot and Andrews (1992) test was carried out, which is a unit root test against the alternative hypothesis of stationary with a break where the breakpoint is estimated endogenously from the data.

The Zivot and Andrews (1992) test has three different types. In this paper the following general version was adopted, where there is an endogenous change in the level of the series.

$$y_t = \alpha_0 + \alpha_1 t + \alpha_2 D_t(\lambda) + \gamma y_{t-1} + \sum_{j=1}^k \beta_j \Delta y_{t-j} + u_t,$$

where $D_t(\lambda) = 1$, if $t > T\lambda$, 0 otherwise. λ shows the breakpoint in the time series. The procedure chooses λ such that the rejection of the null hypothesis $H_0: \gamma = 1$ (i.e. series contains unit root) is most likely. The critical values of the test are given by Zivot and Andrews (1992).

5.2 Autoregressive models to analyze stationary data series

Autoregressive models can be applied for stationary data series (Hassounah, von Cramon-Taubadel, Serra & Gil, 2012). First, following Miller and Hayenga (2001) causal structure of the prices is examined using the Granger causality test. However, Granger causality test assumes that the present value of a time series can be influenced only by changes which have occurred in the past which is not a sufficient condition for causality.

The next step is to study the effect of a price change. The applied model is similar to the one that was used by Miller and Hayenga (2001).

$$\Delta y_t = \alpha + \Phi_0^+ \Delta x_t^+ + \Phi_0^- \Delta x_t^- + \dots + \Phi_k^+ \Delta x_{t-k}^+ + \Phi_k^- \Delta x_{t-k}^- + u_t, \quad (1)$$

where + and – signs indicate the direction of price change. x_t and y_t are chosen so, that x_t Granger causes y_t . There are two main differences between the model of Miller and Hayenga (2001) and the present paper. First, in this paper we examine price pairs separately, therefore we do not use vectors in the equation. Second, simultaneous explanatory variable (x_t) is also built in the model. Therefore we can examine whether price changes run through the supply chain in less than one month or not. To find the appropriate number of lags a wide model is applied and backward elimination is used to find the best fitting one.

Price transmission is symmetric in the short-run if the response parameters for positive and negative price changes are equal for every lag. The hypothesis $H_0: \Phi_j^+ = \Phi_j^- \forall j$ was tested using Wald F -test. Long-run symmetry exists if the null hypothesis $H_0: \sum_{j=0}^k \Phi_j^+ = \sum_{j=0}^k \Phi_j^-$ holds using Wald F -test again. Latter restriction allows short-run asymmetries.

5.3 Analysis of data series that are integrated in different orders

Econometric analysis of time series that are integrated in different orders is not easy to handle. Vavra and Goodwin (2005) analyze cointegration of stationary and non-stationary data series to examine price transmission. In our opinion, this methodology has certain drawbacks.

If one time series is stationary and another one is not stationary, this means that the difference between these two series changes stochastically over time. In case of time series of input and output prices, it means that the mark-up of the given company/industry changes over time. It is therefore important to analyze what causes the changes in mark-up. Ecorys (2010) use a methodology that can deal with such problems. A slightly modified version of their model is as follows.

$$\begin{aligned} \Delta(y_t - x_t) = & \beta_1 \frac{I(\Delta y_t \geq 0 \wedge \Delta x_t \geq 0) \cdot T}{\sum_{j=1}^T I(\Delta y_j \geq 0 \wedge \Delta x_j \geq 0)} + \beta_2 \frac{I(\Delta y_t < 0 \wedge \Delta x_t < 0) \cdot T}{\sum_{j=1}^T I(\Delta y_j < 0 \wedge \Delta x_j < 0)} \\ & + \beta_3 \frac{I(\Delta y_t < 0 \wedge \Delta x_t \geq 0) \cdot T}{\sum_{j=1}^T I(\Delta y_j < 0 \wedge \Delta x_j \geq 0)} + \beta_4 \frac{I(\Delta y_t \geq 0 \wedge \Delta x_t < 0) \cdot T}{\sum_{j=1}^T I(\Delta y_j \geq 0 \wedge \Delta x_j < 0)} + \mathbf{A}\Delta\mathbf{z}_t + u_t, \end{aligned} \quad (2)$$

where y_t is the price of output, x_t is the price of input, $I(\cdot)$ is equal to 1, if the assumptions in brackets hold, and 0 otherwise; and $\mathbf{z}_t$ contains several control variables.

The right-hand side of equation (2) shows the changes in mark-up. For the left-hand, four possible situations are identified: input and output prices fall, rise or one falls and the other rises. Every situation is weighted by the reciprocal value of its frequency. Therefore the estimated parameters $(\beta_1, \beta_2, \beta_3, \beta_4)$ are weighted averages of mark-up changes that occurred in a given situation. The sum of these parameters shows whether mark-up changed over the time period in question or not.

Price transmission is symmetric in the long-run, if the sum of the parameters are zero, formally, if $H_0: \sum_{i=1}^4 \beta_i = 0$ holds. It means that the price spread did not change over time, therefore all the input price changes went through the supply chain completely. Short-run asymmetries can be evaluated by testing $H_0: \beta_1 + \beta_2 = 0$. If the absolute value of the change of mark-up is the same

after an input price increase and decrease, then the price transmission is symmetric in the short-run as well. All the hypotheses are tested using Wald F -test.

5.4 Granger causality test for non-stationary data series

For non-stationary data series changes in the Granger causality test are required. Sanjuán and Gil (2001) suggest Dolado–Lütkepohl causality test. This is very similar to the Granger causality test, the only difference is that the optimal number of lags have to be enlarged by the number of unit roots.

Economic time series are often integrated of order one. Therefore the only change to be made in Granger causality test is that the number of lags should be $(k + 1)$ instead of k .

6 Data

The data used in this analysis is based on 108 monthly observations (from January 2004 to December 2012) of Hungarian live pig for slaughter and pork in halves prices as well as wholesale and consumer prices of two products made from pork. Figure 2 shows the meat supply chain. In every trade contract prices are marked on the arrows.

We examine the input and output markets of the processors. Their most important input is pork (in halves). Processors buy pork from independent slaughterhouses or produce it themselves. The price of pork mainly depends on the price of live pig for slaughter. Market power exertion between slaughterhouses and processors is estimated in this market using price transmission from live pig for slaughter to pork in halves. To apply this analysis we use slaughterhouse entry prices of live pig for slaughter and prices of pork in halves obtained from the Market Price Information System of the Research Institute of Agricultural Economics (AKI PÁIR, https://pair.aki.gov.hu/web_public/general/home.do?lang=en).

Processors produce several types of meat products from pork. While the produced good was well-defined in the previous stage of the supply chain (slaughterhouses make pork in halves), it is not true for this segment. Some studies analyzed weighted prices of pork cuts (e.g. von Cramon-Taubadel,

1998; Abdulai, 2002; Vavra & Goodwin, 2005; Gervais, 2011), others (e.g. Bojnec & Peter, 2005; Bakucs & Fertő, 2005) defined indices that contain processed as well as non-processed goods (e.g. smoked bacon, dry sausage, pork meat with bones). Because of the fact that processors mainly manufacture hams, sausages and cutlets, we analyze the price movements of two meat products, separately.

Pressed ham is a rather expensive pork product,³ therefore their market may be different from the market of a cheaper product (one reason for that is the presence of manufacturer brands). ‘Italian’ cutlet belongs to the cheap category, some stores only sell private labelled ones. This can cause higher competition among meat processors (e.g. because of the absence of brand loyalty and product differentiation).

AKI PÁIR database contains wholesale prices of pressed ham and ‘Italian’ cutlet only until 2005. For the remaining time period monthly producer price indices by 4-digit NACE Rev. 2 classification was used (data was published by the Hungarian Central Statistical Office). Consumer prices of pressed ham and ‘Italian’ cutlet were also used. The source of these datasets is also the Hungarian Central Statistical Office.

To avoid modelling inflation, all the series were deflated using monthly core inflation indices published by the Hungarian Central Statistical Office and the Central Bank of Hungary. We have chosen core inflation rate because we want to analyze relatively small changes in real prices. Deflating by core inflation leaves this small real price changes invariable. Varga, Tunyoginé Nechay and Mizik (2007) use core inflation because of the same reason.

Figure 3 shows the prices of the three stages of the meat supply chain (farms, slaughterhouses, processors) using comparable (real) prices.

³ The price of 1 kg pressed ham was HUF 795 in January 2004, as long as the price of 1 kg ‘Italian’ cutlet was HUF 485 at the same time (USD 1 was equal to HUF 210 in January 2004).

7 Results and discussion

Reviewed literature suggests that asymmetric price transmission and market power are connected to each other. However, most of the studies where APT was found analyzed farm-gate and wholesale or consumer prices. Therefore one cannot distinguish whether farmers, slaughterhouses, meat processors or retailers have market power in the supply chain. We analyze trade contracts separately, in order to identify exactly which players possess market power and which players do not. In the following subsections the results of price transmission analyses carried out in the meat processors input and output markets are presented, respectively.

7.1 Price transmission in the input market

Meat processors input market is defined as the market where they buy pork in halves from slaughterhouses. Some processors have an own slaughterhouse therefore these two phases (slaughtering and processing) may not separate. However, that is a reasonable assumption that a slaughterhouse belonging to the same group as the processor realizes pork at the all-time market price. If a company group uses special accounting prices in intra-firm trade, this will only mean that profits and losses are accounted somewhere else. But this phenomenon has no effect on this analysis.

Table 2 presents the results of the ADF stationary tests. The null hypothesis (i.e. data series are non-stationary) can be rejected as the p -values are extremely low. These strongly indicate that both prices of live pig for slaughter and pork in halves are stationary (or integrated of order zero). Zivot and Andrews (1992) unit root test come to the same conclusion that neither of the series contain unit root.

Surprisingly, previous analyses (e.g. Bakucs & Fertő, 2009) carried out using Hungarian data came to the conclusion that price series are non-stationary. On the other hand, both of the series are in real terms, therefore stationary means that real prices did not change considerably in the reviewed time period.

1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33
34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60

As prices are stationary, testing for cointegration is not needed. In the next step of the analysis, Granger causality test was carried out to determine the causal structure of the prices. Table 3 indicates that the price of live pig for slaughter Granger causes the price of pork in halves. Taking into consideration the limitations of the Granger causality test, we can state that price changes in live pig for slaughter forego the price changes in pork in halves.

Considering the results of the Granger causality test, equation (1) was estimated. First, we built in four lags in the equation and then reduced to more parsimonious models using backward elimination and five percent level of significance. Table 4 shows the final results. There are some important criteria connected to the relevance of the model. The fitted model explains more than 80% of the variability of the dependent variable ($R^2 = 0.8281$). There is no significant residual autocorrelation in the model (p -value of the Breusch–Godfrey F -test is 0.7922), furthermore, residuals are also homoscedastic (p -value of the White χ^2 -test is 0.4028).

Symmetry of the price transmission was tested using Wald F -statistic. In this case short- and long-run symmetry is the same, because there is no lag in the regression. The p -value is 0.1527 which indicates that price transmission is symmetric in the input market. If the price of live pig for slaughter changes (increases or decreases), the price of pork in halves will change immediately (in the same month) and symmetrically. Therefore input market can be characterized as a competitive market.

7.2 Price transmission in the output market

Meat processors produce several ready-to-eat meat products from pork. They sell these products to whole sellers and retail chains that vend the products to consumers. The aim of this subsection is to present the results of the analysis of the wholesale price changes caused by changes in the price of pork in halves. Due to the fact that product range of the meat processors contains various types of merchandises, we analyze the price movements of pressed ham and ‘Italian’ cutlet, separately.

First, the results of the price transmission analysis carried out in the pressed ham market is presented. Unfortunately, both ADF and Zivot and Andrews' (1992) stationary tests indicate that wholesale price series are integrated of order one. Table 5 shows the results.

As input prices are stationary and output prices are integrated of order one, we should analyze the causes of mark-up fluctuation, namely, to estimate equation (2). Two exogenous variables were used to control changes in other factors. One important cost element of the meat processors is the wages of their employees, therefore the change in average monthly earnings was included in the regression. Second, following Bakucs, Fałkowski and Fertő (2014), the changes in bargaining power of meat processors and retail chains were evaluated by the change in the ratio of net turnover of meat processors per net turnover of retail chains.

Table 6 shows the results (insignificant coefficients were dropped). The error term is homoscedastic and is not autocorrelated, which proves that the model is well-designed. Wald F -test indicates that the price transmission process is symmetric in the long-run (p -value is 0.4435) and in the short-run (p -value is 0.2612) as well. This induces that mark-up did not change considerably between 2004 and 2012. This can be verified by Figure 4 which shows the mark-up series. On the basis of the results, pressed ham market can be characterized as a competitive market where market players' behavior do not exhibit remarkable market power.

Second, the results of the price transmission analysis carried out in the 'Italian' cutlet market is presented. Wholesale price series of 'Italian' cutlet are also non-stationary. Therefore, as for the pressed ham market, equation (2) was again estimated, using the same two control variables. Results are presented in Table 7. Testing the symmetry of price transmission eventuates that it is symmetric both in the long-run (p -value is 0.7045) and in the short-run (with a p -value of 0.3913). Therefore, this market is also a competitive one similarly to the pressed ham market.

To summarize the results of this subsection, price movements are symmetric for both higher quality products and cheaper (in the majority of the cases private labelled) ones. These facts indicate that neither meat processors nor whole sellers or retailer chains exhibit remarkable market power.

7.3 Causality structure of price series

In subsection 7.1 Granger causality test was conducted to analyze the causality structure of the input market. In this subsection we carry out Granger and Dolado–Lütkepohl causality tests to identify the causal structure of the whole supply chain.

Based on Table 8 it is unambiguous that input (i.e. pork is halves) price change Granger causes the wholesale price change of pressed ham. However, it is not so unequivocal for ‘Italian’ cutlet. However, we can conclude that wholesale price changes do not affect input price changes. There is no feedback effect from the upstream to the downstream market.

The same is also true for the next stage of the supply chain (Table 9). Wholesale prices influence consumer prices and there is no sign indicating any feedback effect. The results are in line with the findings of Bakucs and Fertő (2009). Furthermore, this means that a demand shift does not cause any wholesale price change for ready-to-eat meat products. Therefore quantity has to adjust to reach the new market equilibrium.

8 Conclusion: Why Hungarian meat processors failed?

The aim of this research is to analyze the price movements of the Hungarian meat supply chain, mainly focusing on the meat processors. Therefore we examined price transmission in the input as well as in the output market of the meat processors. In addition, we identified the causality structure of the whole supply chain using Granger and Dolado–Lütkepohl causality tests.

There is no evidence of asymmetric price transmission, neither in the short- nor in the long-run. Bakucs and Fertő (2005) came to the same conclusion with regard to the Hungarian meat market between 1996 and 2002. However, price transmission is found to be asymmetric in majority of the

developed countries (e.g. Germany, Switzerland, Japan) based on prior studies (von Cramon-Taubadel, 1998; Abdulai, 2002; Adachi & Liu, 2009). We improve upon previous studies by analyzing the stages of the meat supply chain (slaughterhouses, processors, whole sellers) separately. Therefore the results can exactly show which players' behavior exhibit some sort of market power, if any.

Results indicate that meat processors' input market (i.e. the market where they buy pork in halves from slaughterhouses) is a competitive market. Even more, the real price of input (pork in halves) remained unchanged in the reviewed time period.

The real price difference between ready-to-eat meat products (pressed ham or 'Italian' cutlet) and pork in halves has not been biased considerably in this time period either. This indicates symmetric price transmission in the product (i.e. output) market as well.

In the light of the results we can state that the market position of the Hungarian meat processors did not change significantly between 2004 and 2012. Hungary joined the European Union on May 1, 2004 and it caused the elimination of customs duty for food products. Results indicate that the new European competitors, that entered the Hungarian market with imported products, have not basically biased the price movements. The market entrance of new competitors did not cause a price war.

However, the question of why Hungarian meat processors failed, still remains unanswered. What is the cause behind the fact that many Hungarian meat processors have gone bankrupt in the last couple of years? On the basis of the price transmission analysis, there is a possible explanation.

In this paper only prices were examined. Although revenues have two main components, prices and quantities. As it was mentioned in the previous subsection, Granger causality tests indicate that demand shocks do not affect wholesale prices. Therefore, if demand decreases, it will cause a quantity reduction to reach the new market equilibrium.

Figure 5 shows the per capita meat consumption in Hungary. Hungarian Central Statistical Office (2013) published long-run data as well. These indicate that there is a permanent demand decrease. In 1990, per capita meat consumption was 38.8 kg in Hungary, it was 28 kg in 2000, and 24.5 kg in 2012. This is in line with gross output value of the manufacturers,⁴ which is also decreasing from 2007 onwards (even in nominal value).

Due to these courses meat processors excess capacity have increased. If production decreases, only variable cost elements can be saved, fixed cost remains the same. As a result of these, average cost of production has to increase, and profitability has to decrease. Depending on the original profitability level of the firm, profit may turn into losses.

This explanation is supported by the fact that the biggest meat processors have become bankrupt. This is a reasonable assumption that these manufacturers had highest fixed costs as well as they were the most affected by the continuous reduction in demand (for a smaller firm it is easier to find a market niche to maintain sales volume).

The results of the current research suggest that it could be reasonable to base policy decisions (i.e. whether to bail-out meat processors or not) on market demand forecasts. If domestic and/or export demand will increase, then it may be appropriate to bail-out the given meat processing firms.⁵ Otherwise, this will only spin out the consolidation of the industry.

References

Abdulai, A. (2002). Using threshold cointegration to estimate asymmetric price transmission in the Swiss pork market. *Applied Economics*, 34(6), 679–687.

⁴ Published by the Hungarian Central Statistical Office.
⁵ It is still important to analyze whether the production of the given firm was efficient or not. A possible method is described in Reiff, Sugár and Surányi (2002).

- Adachi, K., & Liu, D.J. (2009). Estimating Long-Run Price Relationship with Structural Change of Unknown Timing: An Application to the Japanese Pork Market. *American Journal of Agricultural Economics*, 91(5), 1440–1447.
- Bakucs, L.Z., & Fertő, I. (2005). Marketing Margins and Price Transmission on the Hungarian Pork Meat Market. *Agribusiness*, 21(2), 273–286.
- Bakucs, L.Z., & Fertő, I. (2009). Marketing and Pricing Dynamics in the Presence of Structural Breaks: The Hungarian Pork Market. *Journal of International Food & Agribusiness Marketing*, 21(2–3), 116–133.
- Bakucs, L.Z., Fertő, I., Hockmann, H., & Perekhoznuk, O. (2006). Farm to retail price transmission on the pork market: A German-Hungarian comparison. In Curtiss, J., Balmann, A., Dautzenberg, K., & Happe, K. (eds.), *Agriculture in the Face of Changing Markets, Institutions and Policies. Challenges and Strategies* (pp. 414–429). Halle: IAMO Leibniz Institute of Agricultural Development in Central and Eastern Europe.
- Bakucs, Z., Fałkowski, J., & Fertő, I. (2014). Does Market Structure Influence Price Transmission in the Agro-food Sector? A Meta-analysis Perspective. *Journal of Agricultural Economics*, 65(1), 1–25.
- Bojnec, Š., & Peter, G. (2005). Vertical market integration and competition: the meat sector in Slovenia. *Agricultural and Food Science*, 14(3), 236–249.
- Conforti, P. (2004). Price transmission in selected agricultural markets. Rome: Commodities and Trade Division, Food and Agriculture Organization of the United Nations.
- Czibik, Á., & Makó, Á. (2008). Nagyméretű kiskereskedelmi üzletláncok és beszállítóik kapcsolatának oksági elemzése. (Causal analysis of the relationship of big retail chains and their suppliers.) Budapest: Hungarian Chamber of Commerce and Industry, Research Institute of Economics and Enterprises.

- Ecorys. (2010). Study on the Competitiveness of the European Meat Processing Industry. Luxembourg: Publications Office of the European Union.
- Enders, W. (2004). *Applied Econometric Time Series*. 2nd ed. Hoboken: Wiley.
- Eurostat. (2011). *Food: from farm to fork statistics*. Luxembourg: Publications Office of the European Union.
- Frey, G., & Manera, M. (2007). Econometric Models of Asymmetric Price Transmission. *Journal of Economic Surveys*, 21(2), 349–415.
- Gervais, J.P. (2011). Disentangling nonlinearities in the long- and short-run price relationship: an application to the US hog/pork supply chain. *Applied Economics*, 43(10–12), 1497–1510.
- Hassouneh, I., von Cramon-Taubadel, S., Serra, T., & Gil, J.M. (2012). *Recent Developments in the Econometric Analysis of Price Transmission*. Exeter: TRANSFOP Transparency of Food Pricing.
- Hungarian Central Statistical Office. (2013). Az élelmiszer-fogyasztás alakulása, 2011. (Formation of food consumption, 2011.) *Statisztikai Tükör*, VII(42), 1–5.
- Meyer, J., & von Cramon-Taubadel, S. (2004). Asymmetric Price Transmission: A Survey. *Journal of Agricultural Economics*, 55(3), 581–611.
- Miller, D.J., & Hayenga, M.L. (2001). Price Cycles and Asymmetric Price Transmission in the U.S. Pork Market. *American Journal of Agricultural Economics*, 83(3), 551–562.
- Nielsen. (2011a). Tízből hat fogyasztó tartja fontosnak... (Six consumers from ten prefer...) hu.nielsen.com/site/20111109.shtml, November 9, 2011.
- Nielsen. (2011b). Élelmiszernél nőtt a kereskedelmi márkák piaci részesedése... (Market share of private label products increased...) hu.nielsen.com/site/20110307.shtml, March 7, 2011.
- Rapsomanakis, G., Hallam, D., & Conforti, P. (2003). Market integration and price transmission in selected food and cash crop markets of developing countries: review and applications. In *Food and*

Agriculture Organization., Commodity market review 2003–2004 (pp. 51–75). Rome: Commodities and Trade Division, Food and Agriculture Organization of the United Nations.

Rácz, T. (2012). A Gyulai Húskombinát végnapjai. Megbélyegző segítség. (The last days of Gyulai Húskombinát Plc. A condemned help.) HVG, XXXIV(49), 74–76.

Reiff, Á., Sugár, A., & Surányi, É. (2002). Productive efficiency in the Hungarian industry. Hungarian Statistical Review, 80(7), 45–74.

Sanjuán, A.I., & Gil, J.M. (2001). Price transmission analysis: a flexible methodological approach applied to European pork and lamb markets. Applied Economics, 33(1), 123–131.

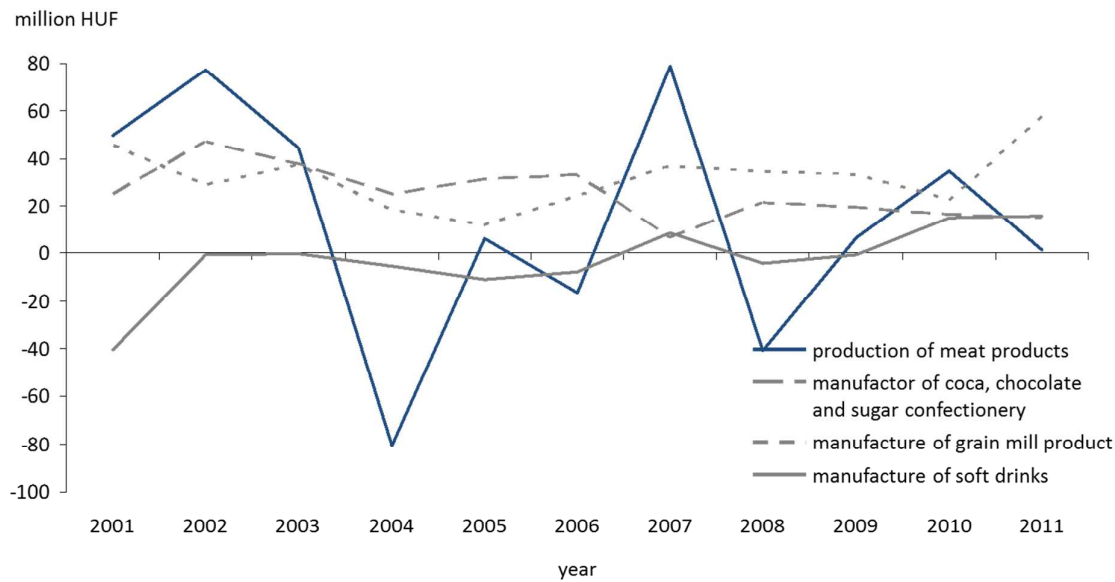
Varga, T., Tunyoginé Nechay, V., & Mizik, T. (ed. 2007). A mezőgazdasági árképzés elméleti alapjai és hazai gyakorlata. (Price Calculation in Agriculture: Theoretical Foundations and Current Practice in Hungary.) Budapest: Research Institute of Agricultural Economics.

Vavra, P., & Goodwin, B.K. (2005). Analysis of Price Transmission Along the Food Chain. Paris: OECD Publishing.

von Cramon-Taubadel, S. (1998). Estimating asymmetric price transmission with error correction representation: An application to the German pork market. European Review of Agricultural Economics, 25(1), 1–18.

Zivot, E., & Andrews, D.W.K. (1992). Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis. Journal of Business & Economic Statistics, 10(3), 25–44.

Figure 1. Operating profit per company in some industries



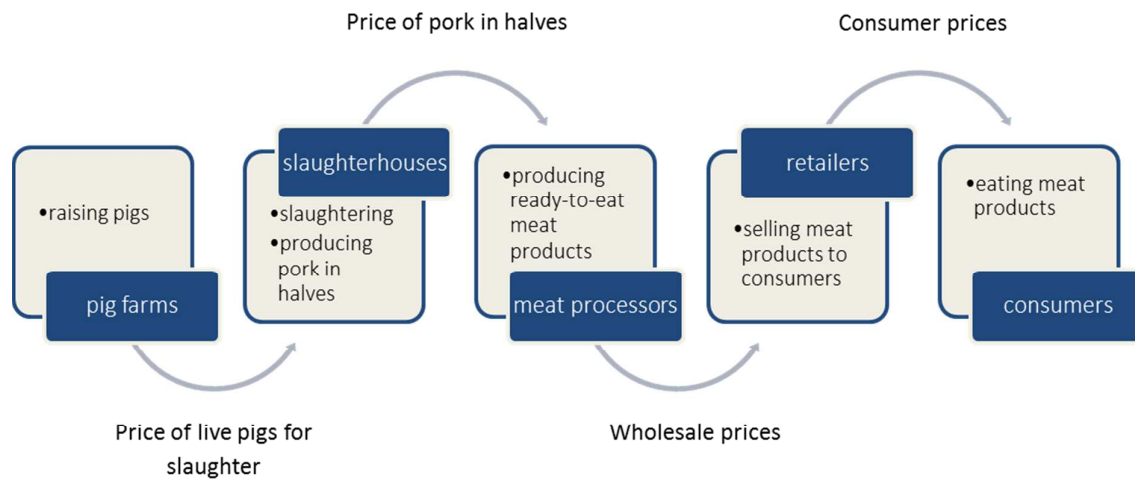
Source: National Tax and Customs Administration of Hungary

Table 1. Concentration and profitability statistics about the Hungarian meat supply chain (in 2008)

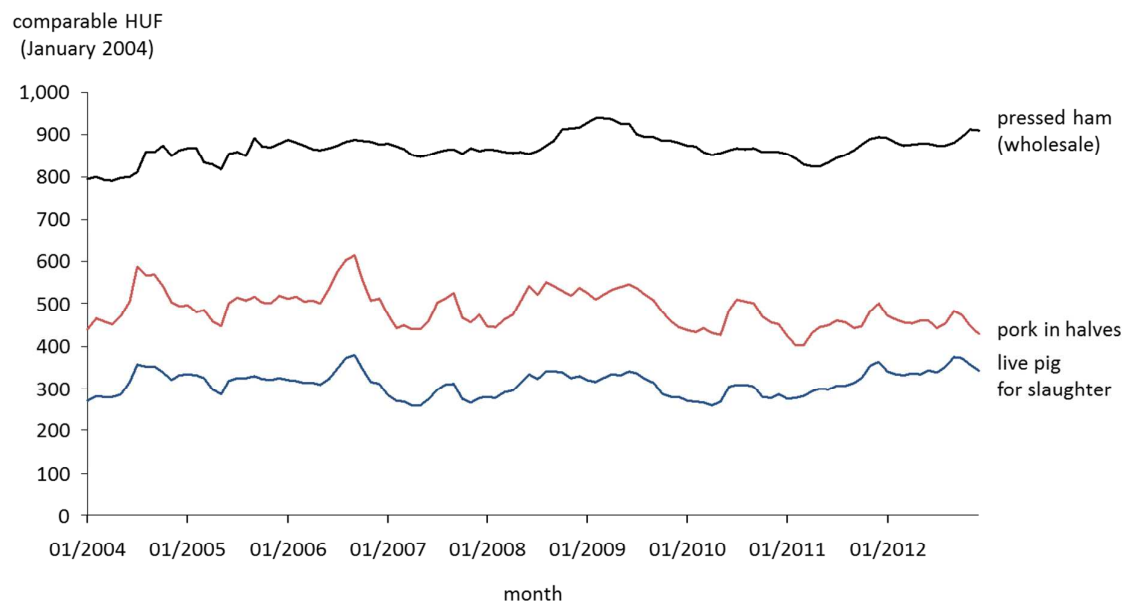
Designation	Number of firms	CR3* (%)	CR5* (%)	HHI**	Operating profit per firm (million HUF)
Processing and preserving of meat	358	21.08	31.29	279	-6.839
Production of meat and poultry meat products	43	74.49	82.53	2601	-40.653
Retail sale in non-specialized stores with food, beverages or tobacco predominating	4881	49.9	57.62	1182	0.381

Note: * based on net sales revenue, ** Herfindahl–Hirschmann Index: sum of squared market shares (in %) based on net sales revenue

Source: Hungarian Competition Authority – Competition statistic database and National Tax and Custom Administration of Hungary

Figure 3. The model of the meat supply chain

Source: own construction

Figure 2. Monthly prices (per kg) in the Hungarian meat supply chain

Source: based on datasets published by the Research Institute of Agricultural Economics – Market Price Information System and Hungarian Central Statistical Office

Table 2. Input market unit root test results

Variable	Test statistic value	p-value
Price of live pig for slaughter	-3.90	0.0029
Price of pork in halves	-3.76	0.0044

Source: own calculation

Table 3. Granger causality test

Null hypothesis	F-test value	p-value
Live pig for slaughter price does not Granger cause price of pork in halves	4.8394	0.0098
Price of pork in halves does not Granger cause live pig for slaughter price	2.9758	0.0555

Source: own calculation

Table 4. Regression results, dependent variable: price change of pork in halves

Variable	Coefficient	Std. error	p-value
constant	-2.5758	1.3826	0.0653
Φ_0^+	1.3321	0.1261	0.0000
Φ_0^-	1.6191	0.1136	0.0000

Source: own calculation

Table 5. Unit root test results for pressed ham

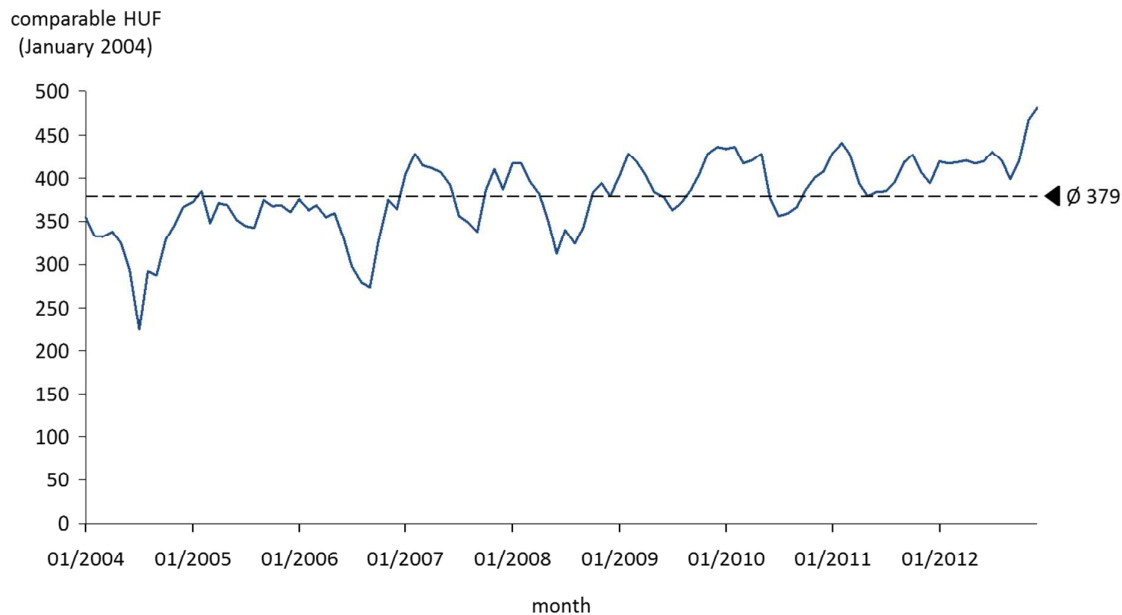
Procedure	Break point	Test statistic value	10% critical value	5% critical value	1% critical value
ADF	-	-2.37	-2.58	-2.88	-3.49
Zivot–Andrews	Oct. 2009	-4.23	-4.58	-4.93	-5.34

Source: own calculation

Table 6. Regression results, dependent variable: mark-up change of pressed ham

Variable	Coefficient	Std. error	p-value
β_1	-4.4911	0.8379	0.0000
β_2	3.1324	0.8629	0.0004
β_3	-2.6919	0.5649	0.0000
β_4	5.2111	0.7145	0.0000

Source: own calculation

Figure 4. Price difference between pork in halves and pressed ham

Source: based on datasets published by the Research Institute of Agricultural Economics – Market Price Information System and Hungarian Central Statistical Office

Table 7. Regression results, dependent variable: mark-up change of 'Italian' cutlet

Variable	Coefficient	Std. error	p-value
β_1	-4.3331	0.8018	0.0000
β_2	3.3406	0.8281	0.0001
β_3	-3.3659	0.6211	0.0000
β_4	4.9342	0.7607	0.0000

Source: own calculation

Table 8. Granger causality test

Product	Null hypothesis	F-test value	p-value
Pressed ham	Input price does not Granger cause wholesale price	4.1706	0.0182
	Wholesale price does not Granger cause input price	0.7949	0.4544
'Italian' cutlet	Input price does not Granger cause wholesale price	2.3742	0.0983
	Wholesale price does not Granger cause input price	0.2554	0.7751

Note: Input price is the price of pork in halves

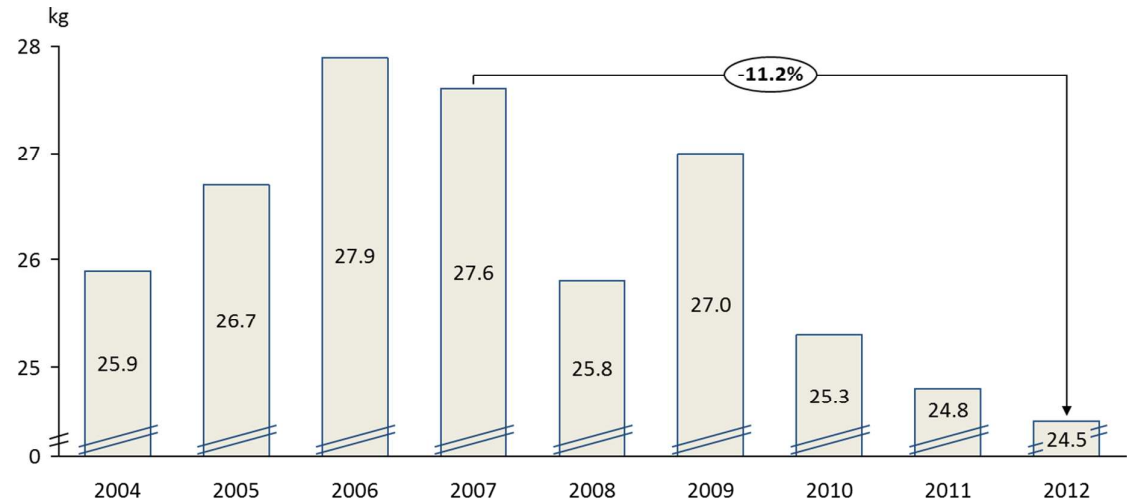
Source: own calculation

Table 9. Dolado–Lütkepohl causality test

Product	Null hypothesis	F-test value	p-value
Pressed ham	Wholesale price does not Granger cause consumer price	2.9628	0.0359
	Consumer price does not Granger cause wholesale price	0.6105	0.6098
'Italian' cutlet	Wholesale price does not Granger cause consumer price	3.1687	0.0110
	Consumer price does not Granger cause wholesale price	0.5564	0.7331

Source: own calculation

Figure 5. Per capita pork meat consumption in Hungary



Source: Hungarian Central Statistical Office