

Why Hungarian Meat Processors Fail? Evidence from Price Transmission Analysis

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Abstract

My aim is to analyze the structure of the markets where Hungarian meat processors are operating. The relevance of the research is given by the fact that between 2011 and 2013 many high-capacity meat processors went bankrupt in Hungary. This could be caused by an unfavorable market situation. I carry out vertical price transmission analysis to identify the degree of competition on meat processors input as well as output markets, separately. My results suggest that both input and output market can be characterized as a competitive market where real prices did not change considerably in the revised time period (2004–2012). In addition, 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. On the basis of these results, I argue that the reason for the failure of the Hungarian meat processors is the continuously decreasing demand.

JEL codes: Q11, C22, L11

Keywords: price transmission, competition, Granger causality, Hungarian meat supply chain

1 Introduction

The purpose of this paper is to analyze the market situation of the Hungarian meat processors. Considering the fact that many high-capacity meat processors went bankrupt in the recent years, meat processing is a critical area of the Hungarian economy. According to János Ruck, former general manager of Gyulai Húskombinát Plc. (one of the companies that went bankrupt in 2012), there is no profitable meat processor in Hungary at the time being (Rácz, 2012).

This picture is partially modulated by the fact that more than half of the Hungarian meat processors' and producers' operating profit was positive in 2011. Figure 1 shows the aggregate operating profit of the industry from 2001 to 2011. For benchmark, I plotted the aggregate operating profit of other food processing industries. Compared to other sectors, meat processors market performance is not really good but not hopeless either. However, the close to zero average operating profit per firm ratio is not sustainable in the long run.

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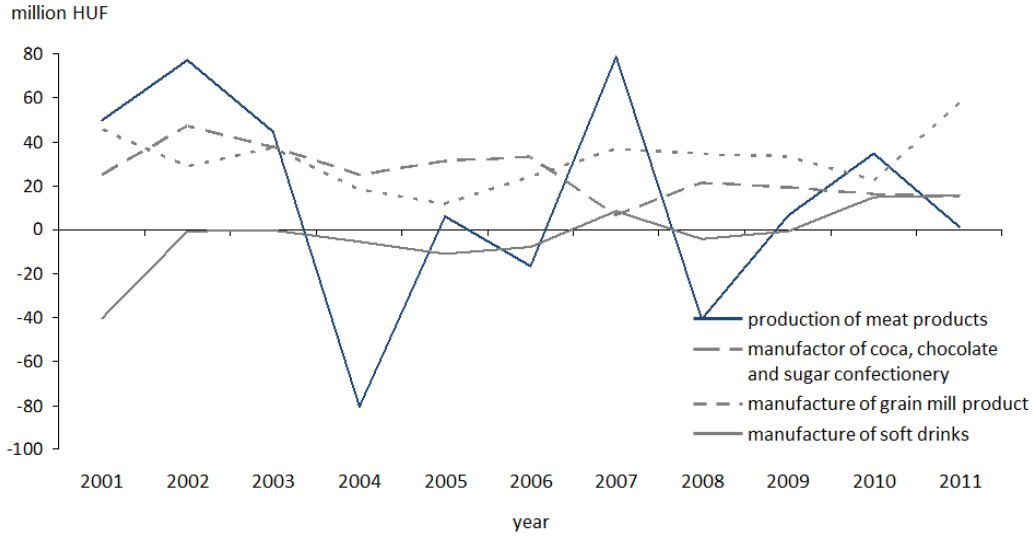


Figure 1: Operating profit per company in some industries

Source: National Tax and Customs Administration of Hungary

The above mentioned evidences naturally indicate the question 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 influences the performance of a company as well. If input and/or output market players' behavior exhibit some sort of market power, meat processors may not operate profitable because of this. Market structure analysis will answer the question whether unfavorable market situation existed or not.

The result has policy implications as central and local government tried to bail-out meat processors. If the market structure is unfavorable, then policy invention (e.g. institutional reforms) may help basically efficient companies to become profitable in the long run. On the contrary, the bail-out of inefficient companies with softening budget constraints is pointless and harmful as losses will reproduce themselves.

In 2012 and 2013, many meat processors went or may go bankrupt in Hungary. General and local governments have tried to save workplaces and have given financial support to most of these companies. Therefore the analysis of the meat supply chain is a relevant research area at the time being. This can answer the question whether unfavorable market situation or something else is the reason behind the poor market and financial performance of these firms.

Other studies analyzing the Hungarian meat industry (e.g. Bakucs and Fertő, 2005; Varga et al., 2007) had been conducted before Hungary joined the European Union (EU). Results are also partially controversial. In addition, every study analyzed at least two stages of the supply chain (e.g. slaughtering and processing or processing and wholesaling) together. Therefore we cannot separate whether the input or the output market player's behavior exhibit market power on meat processors. My aim is to analyze the market situation of the meat processors, therefore I examine their input and output markets separately.

The structure of this paper continues with a short introduction of the Hungarian meat industry. In section 3, I present the theoretical framework of the analysis. In section 4, I focus on previous studies. In section 5 and 6, I describe the methodology and the dataset used, respectively. In section 7, I present 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 (field to fork). In this paper I focus on the meat processing industry: inputs are produced by slaughterhouses and outputs are bought by wholesalers and/or retail chains.

Table 1 demonstrates concentration and profitability statistics of the Hungarian meat supply chain in 2008. The statistics indicate that processing is the most concentrated vertical level, still, it showed 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 and Fertő, 2005).

Table 1: Concentration and profitability statistics of the Hungarian meat supply chain (in 2008)

Designation	Number of firms	CR3* (%)	CR5* (%)	HHI*	Profit** (million HUF)
Processing and preserving of meat	358	21.08	31.29	279	−6.839
Production of meat products	43	74.49	82.53	2601	−40.653
Retail sale in non-specialized stores	4881	49.9	57.62	1182	0.381

Note: * based on net sales revenue; ** operating profit per firm

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

On the other hand, Czibik and Makó (2008) states 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 regarding 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 label products 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 for their manufacturers. These latter facts draw a better picture of the industry and its' market perspectives.

3 Theoretical framework

The aim of a price transmission analysis is to examine the transmission of price shocks through the supply chain or through spatially separated markets. As the prices of various stages of the supply chain can be related in a wide range of variety vertical price transmission analysis is based on the following ideas (Rapsomanakis et al., 2003; Vavra and Goodwin, 2005):

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

In this paper I conduct a vertical price transmission analysis. Conforti (2004) collects 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 may indicate market power in their negotiations if slaughterhouse and wholesale level is less concentrated.

Relatively large plants can also indicate increasing returns to scale. Product differentiation also seems to be presented, indicated by the relatively high level of branded products on the market and the wide range of quality of the products sold.

In a competitive market price shocks run through the supply chain fast and symmetrically. 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 explanations, many other motives can lead to APT (for further details, see Meyer and von Cramon-Taubadel, 2004).

4 Literature review

In the recent years many studies dealt with price transmission in pork markets. A 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 in 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 in 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) find 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.

Bojnec and Peter (2005) demonstrate that Slovenian pork market is a competitive market operating with higher mark-ups than developed market economies do. Fertő and Bakucs (2005) use similar tools regarding the Hungarian pork market. Their results show that Hungarian pork market is competitive, moreover, price transmission is symmetric. However, Bakucs et al. (2006) find short-run asymmetries in the Hungarian pork market. Varga et al. (2007) prove that retailers have significant market power in case of many but not every product made from pork.

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).

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 break point 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.

Gervais (2011) analyzes price transmission in a nonlinear framework. Using US pork meat prices, he finds strong evidence 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.

Bakucs et al. (2013) conduct a meta-analysis to determine the causes of asymmetric price transmission. Based on 69 price transmission analyses from several European countries and agricultural markets they find that price transmission is more asymmetric if among others farm structure is more fragmented and bargaining power of farmers and retailers is more imbalanced. Broadly speaking, the possibility of asymmetric price transmission is higher when some players in the supply chain possess market power.

5 Methodology

There are several econometric models to analyze price transmission. Hassouneh et al. (2012) and Frey and Manera (2007) give a methodological framework for price transmission analysis. The first step is to determine whether time series are stationary or not. The suitable methodology highly depends on the results of the unit root tests. If the series contain stochastic trend (i.e. they are not stationary), we should test cointegration and build error correction models. Otherwise the analysis is less complicated as we can use level data to determine the connection among prices.

5.1 Testing for unit root

I use augmented Dickey–Fuller (ADF) test 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 , a moving average process can be problematic), 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 I carry out the Zivot and Andrews (1992) test. It is a unit root test against the alternative hypothesis of stationarity with a break where the breakpoint is estimated endogenously from the data.

The Zivot and Andrews (1992) test has three different types, I adopt the following version where there is an endogenous change in the level of the series. This is the most general type according to the authors.

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

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

5.2 Vector autoregressive models to analyze stationary data series

According to Hassouneh et al. (2012), vector autoregressive (VAR) models can be applied for stationary data series. First, as Miller and Hayenga (2001) do, I also examine the causal structure of the prices using Granger causality test.

The idea of the Granger causality test is that the future cannot cause the present or the past. Therefore the present value of a time series can be influenced only by changes occurring in the past. Formally, the model is the following according to Maddala (2001):

$$y_t = \sum_{j=1}^k \alpha_j y_{t-j} + \sum_{j=1}^k \beta_j x_{t-j} + u_t, \quad (1)$$

where if $H_0 : \beta_j = 0 \quad \forall j$ can be rejected, then data series x_t Granger causes y_t . I use Akaike information criteria to find the appropriate number of lags (i.e. k).

However, Granger causality only means that something happened earlier than something else which is not a sufficient condition for causality. On the other hand, in the opinion of the Cowles Foundation, in a simultaneous system of equations causality cannot be examined without a priori assumptions (Maddala, 2001).

In my research, Granger causality means that a price series is followed (or not followed) by an other one. These results can be starting-points to determine the direction of price shocks. The next step is to study the effect of a price change. I use a VAR model, similar to Miller and Hayenga (2001).

$$\Delta y_t = \alpha + \Phi_0^+ \Delta x_t^+ + \Phi_0^- \Delta x_t^- + \dots + \Phi_k^+ \Delta x_{t-k}^+ + \Phi_k^- \Delta x_{t-k}^- + u_t, \quad (2)$$

where $+$ and $-$ signs indicate the direction of the price change. In addition, I choose x_t and y_t so, that x_t Granger causes y_t . There are two main differences between the model of Miller and Hayenga (2001) and mine. First, I examine price pairs separately, therefore I do not use vectors in the equation. Second, I also build in simultaneous explanatory variables (x_t) because I use monthly data against Miller and Hayenga (2001) who used weekly ones. I think that one month is long enough for price changes to run through the supply chain.

To find the appropriate number of lags I begin with a wide model and use backward elimination 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 lags. Formally, I test the hypothesis $H_0 : \Phi_j^+ = \Phi_j^- \quad \forall j$ 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 Granger causality test for non-stationary data series

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

Economic time series are often integrated of order one. Therefore the only change I have to make in equation (1) is that the number of lags should be $(k + 1)$ instead of k .

6 Data

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

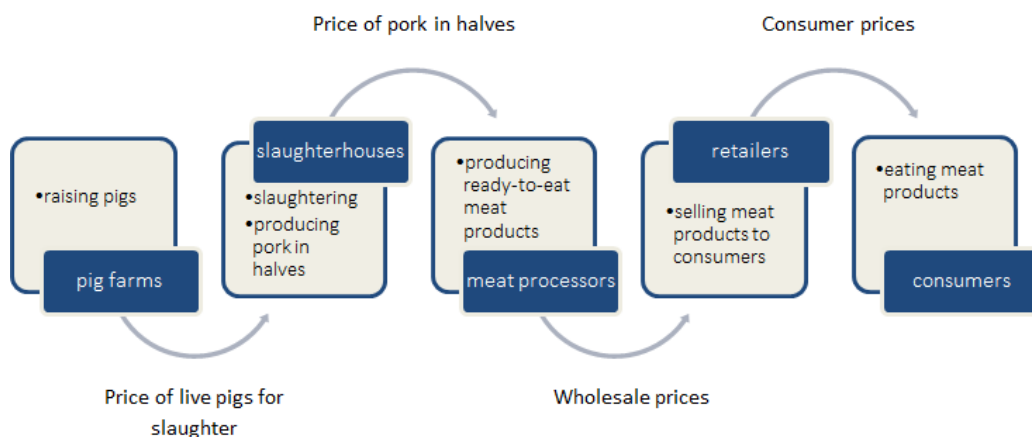


Figure 2: The model of the meat supply chain

Source: own construction

The aim of my research is to analyze the market situation of the Hungarian meat processing industry. Therefore I 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 pigs for slaughter. I estimate market power exertion between slaughterhouses and processors in this market using price transmission from live pigs for slaughter to pork in halves. To apply this analysis I use slaughterhouse entry prices of live pigs for slaughter and prices of pork in halves obtained from the Market Price Information System of the Research Institute of Agricultural Economics (AKI PÁIR).

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 analyze weighted prices of pork cuts (e.g. von Cramon-Taubadel, 1998; Abdulai, 2002; Vavra and Goodwin, 2005; Gervais, 2011), other ones (e.g. Bojnec and Peter, 2005; Bakucs and Fertő, 2005) define 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, I analyze the price movements of two meat products separately.

Pressed ham is a rather expensive pork product,¹ 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 label ones. This can cause a higher competition among meat processors (e.g. because of the absence of brand loyalty and product differentiation).

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

AKI PÁIR database contains wholesale prices of pressed ham and 'Italian' cutlet only until 2005. For the remaining time period I use the monthly producer price indices by 4-digit NACE Rev. 2 classification published by the Hungarian Central Statistical Office. Here I have to assume that the price changes were the same for every meat product. Unfortunately, better datasets are not publicly available.

I also use consumer prices of pressed ham and 'Italian' cutlet. The source of these datasets is also the Hungarian Central Statistical Office.

To avoid modelling inflation, I deflate all the series using monthly core inflation indices published by the Hungarian Central Statistical Office and the Central Bank of Hungary. I have chosen core inflation rate because the aim of my research is to analyze relatively small changes in real prices. Deflating by core inflation leaves this small real price changes invariably. Varga et al. (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.

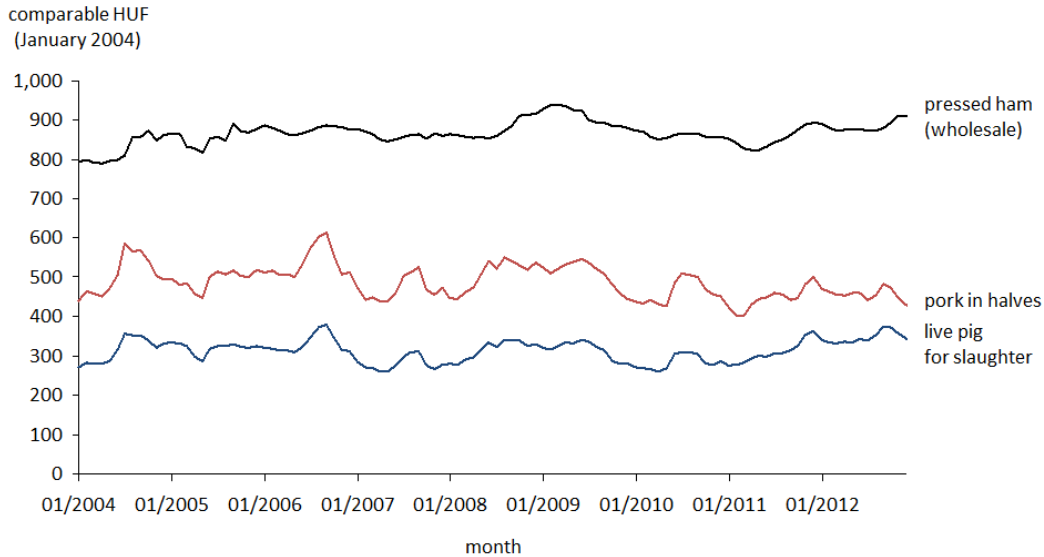


Figure 3: Monthly prices (per kg) in the Hungarian meat supply chain

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

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 we cannot distinguish whether farmers, slaughterhouses, meat processors or retailers have the market power in the supply chain. I analyze the trade contracts separately, because I want to identify exactly which players possess market power and which players do not. In the following subsections I present the results of price transmission analyses carried out on the meat processors input and output market, respectively.

7.1 Price transmission on 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 phase (slaughtering and processing) may not separate. However, that is a reasonable assumption that slaughterhouses belonging to the same group as the processor realize the pork at the all-time market price. If company groups use special accounting prices in the intra-firm trade, this will only mean that profits and losses are accounted somewhere else. But this phenomenon has no effect on the analysis.

Table 2 presents the results of the ADF stationarity 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 in order zero).

Table 2: Input market unit root test results

Variable	Test statistic value	p -value
Price of live pig for slaughter	-3.9	0.0029
Price of pork in halves	-3.76	0.0044

Source: own calculation

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

As the prices are stationary, testing for cointegration is pointless. In the next step I carry out Granger causality test 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, I can state that price change in live pig for slaughter foregoes the price change in pork in halves.

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

Considering the results of the Granger causality test, I estimate equation (2). First, I build in 4 lags in the equation and then reduce to more parsimonious models using backward elimination and 5% significance level. 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).

I test the symmetry of the price transmission 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 the responses of the price of pork in halves to positive and negative changes in the price of live pig for slaughter are not significantly different. 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.

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

Variable	Coefficient	Std. error	<i>p</i> -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

7.2 Price transmission on the output market

Meat processors produce several ready-to-eat meat products from pork. They sell these products to wholesalers and retail chains that vend the products to consumers. In this subsection my aim is to analyze the wholesale price changes caused by the changes in the price of pork in halves. Due to the fact that product assortment of the meat processors contains various types of merchandises, I analyze the price movements of pressed ham and 'Italian' cutlet, separately.

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

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

The econometric analysis of time series that are integrated in different orders is at least problematic. Therefore I calculate markup as the difference between wholesale price and input price (i.e. the price of pork in halves). Figure 4 shows the markup.

Surprisingly, markup series are stationary using ADF procedure (*p*-value is 0.0391). I carry out price transmission analysis using markup instead of wholesale price by estimating the following equation.

$$\Delta m_t = \alpha + \Theta_0^+ \Delta x_t^+ + \Theta_0^- \Delta x_t^- + \dots + \Theta_k^+ \Delta x_{t-k}^+ + \Theta_k^- \Delta x_{t-k}^- + u_t, \quad (3)$$

where Δm_t is markup change and Δx_t is input price change.

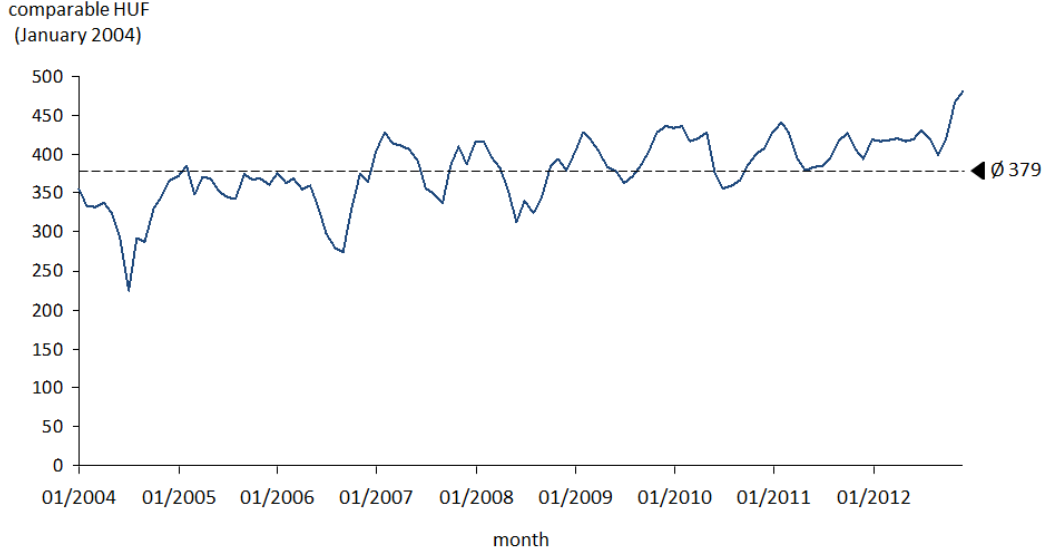


Figure 4: Price difference between pork in halves and pressed ham

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

The connection between equation (2) and equation (3) is the following:

$$\begin{aligned}
 \Theta_0^+ &= \Phi_0^+ - 1 \\
 \Theta_0^- &= \Phi_0^- - 1 \\
 \Theta_i^+ &= \Phi_i^+ \quad i = 1, 2, \dots, k \\
 \Theta_i^- &= \Phi_i^- \quad i = 1, 2, \dots, k
 \end{aligned}$$

Therefore testing short or long run symmetry does not need any changes regarding the null and alternative hypotheses.

Table 6 presents the results of the estimation. I use backward elimination to eliminate the insignificant lags from the model. Despite of the fact that Θ_1^- is insignificant, I leave it in the model because it is necessary to test short run symmetry. Testing the symmetry of the price transmission indicates that both in short and long run price changes are symmetric.² On the basis of my results, pressed ham market can be characterized as a competitive market where market players' behavior do not exhibit remarkable market power.

²The p -value is 0.1642 for short run symmetry and 0.0646 for long run symmetry.

Table 6: Regression results, dependent variable: change of markup for pressed ham

Variable	Coefficient	Std. error	<i>p</i> -value
constant	-2.1811	2.0403	0.2876
Θ_0^+	-0.8226	0.0832	0.0000
Θ_0^-	-0.9624	0.0944	0.0000
Θ_1^+	0.2059	0.0817	0.0132
Θ_1^-	-0.0269	0.0955	0.7787

Source: own calculation

Second, I present the results of the price transmission analysis carried out on the 'Italian' cutlet market. Wholesale price series of 'Italian' cutlet are also non-stationary. Therefore, as previously, I calculate markup as the price difference between 'Italian' cutlet (wholesale price) and pork in halves. ADF test strongly indicates that markup series are stationary (*p*-value is 0.0095). This fact allows me to use the same estimation method as previously. Table 7 shows the results.

Table 7: Regression results, dependent variable: change of markup for 'Italian' cutlet

Variable	Coefficient	Std. error	<i>p</i> -value
constant	0.1007	1.0916	0.9267
Θ_0^+	-0.924	0.0526	0.0000
Θ_0^-	-0.9671	0.0614	0.0000

Source: own calculation

Because of the fact that all the lags has been eliminated from the regression (using backward elimination again), there is no difference between testing short and long run symmetry. Wald *F*-test provides strong evidence that price movements are symmetric (*p*-value is 0.6551). 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 label) ones. These facts indicate that neither meat processors nor wholesalers or retailer chains exhibit market power.

7.3 Causality structure of the price series

In subsection 7.1 I conducted Granger causality test to analyze the causality structure of the input market. In this subsection I 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 in pressed ham. However, it is not so unequivocal for 'Italian' cutlet. However, I can conclude that wholesale price changes do not affect input price changes. There is no feedback effect from the upstream to the downstream market.

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

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. This means that a demand shift do not cause any price changes regarding ready-to-eat meat products. Therefore quantity has to adjust to reach the new market equilibrium.

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

8 Conclusion: Why Hungarian meat processors fail?

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

Price transmission modeling suggests no evidence about asymmetric price transmission, neither in the short nor in the long run. Bakucs et al. (2006) came to the same conclusion regarding the Hungarian meat market between 1992 and 2005.

However, price transmission is asymmetric in the majority of the developed countries (e.g. Germany, Switzerland, Japan) based on previous results (e.g. von Cramon-Taubadel, 1998; Abdulai, 2002; Adachi and Liu, 2009). A main difference between the previous analyses and mine is that I analyze the stages of the meat supply chain (slaughterhouses, processors, wholesalers) separately. Therefore the results can show which players' behavior exhibit some sort of market power, if any.

My results indicate that the 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 the input (pork in halves) remained unchanged in the reviewed time period.

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

In the light of the results I can state that the market position of the Hungarian meat processors did not change significantly between 2004 and 2012. Taking into consideration the fact that Hungary has 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 remained 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 scenario.

In this paper I examine only prices. Although revenues have two main components, prices and quantities. As I mentioned in the previous subsection, Granger causality tests indicate that demand shocks do not affect wholesale prices. Therefore, if demand decreases, it will have to 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 24.8 kg in 2011. This is in line with gross output value of the manufacturers,³ which is also decreasing from 2007 (even in nominal value).

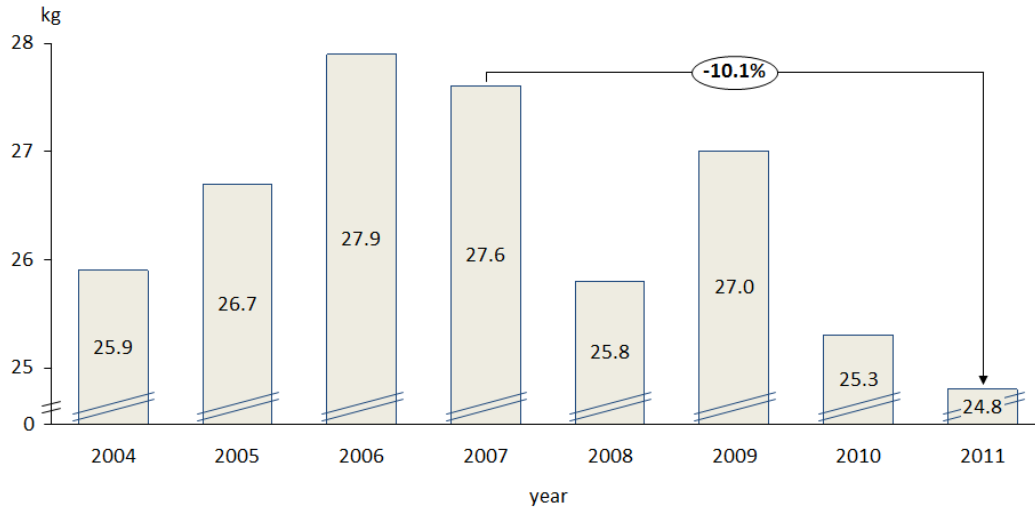


Figure 5: Per capita pork meat consumption in Hungary

Source: Hungarian Central Statistical Office

Due to these courses meat processors excess capacity have increased. The maintenance of a high-capacity plant is very costly which a fix cost element of the production is. If production decreases, only variable cost elements can be saved. As a resultant of these,

³Published by the Hungarian Central Statistical Office.

average cost of production increases, and profitability decreases. Depending on the original profitability of the firm, profit may change for negative value.

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

The results of my 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, than it may be rational to rescue these firms.⁴ Otherwise this will only spin out the consolidation of the industry.

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⁴It is still worth to analyze whether the production of the given firm was efficient or not. A possible method is described in Reiff et al. (2002).

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