THESES OF THE DOCTORAL (PhD) DISSERTATION

TIBOR BAREITH

KAPOSVÁR UNIVERSITY

FACULTY OF ECONOMIC SCIENCE

2020

KAPOSVÁR UNIVERSITY

FACULTY OF ECONOMIC SCIENCE

INSTITUTE OF FINANCE AND ACCOUNTING

Head of Doctoral School:

PROF. DR. IMRE FERTŐ

Doctor of the Hungarian Academy of Science

Supervisor:

PROF. DR. JÓZSEF VARGA

Professor

Co-Supervisor:

DR. GYÖRGY KÖVÉR

associate professor

DYNAMICS OF THE COMPETITION IN THE HUNGARIAN PORK AND POULTRY INDUSTRY

Written by:

TIBOR BAREITH

KAPOSVÁR

2020

DOI: 10.17166/KE2020.007

Research objectives

The level of market competition can be characterized by profit persistence. We can examine market competition from several aspects, accordingly, the relationship of stakeholders to market competition is different. From the owner's (and investors') point of view, market competition is undesirable in the short term, the maximum profit available is higher in a market without competitors or with few competitors. From a consumer perspective, competition is good, on the one hand, prices fall in a competitive environment, and on the other hand, there is a constant pressure on companies to innovate due to competition. In this situation, corporate profits are lower and consumer surpluses are higher. Third, it is the role of the regulatory side to act in the best interests of consumers and to prevent the processes which enable companies to acquire excessive monopoly power.

The results of the dissertation can be exciting for potential investors and the regulatory authorities. Investors are looking for industries where they can achieve the highest returns (and abnormal returns) with the lowest possible risk-taking. The regulatory side would like to encourage these efforts, to create equal opportunities in different markets. The dissertation contains important information for both sides, however, the “market” looks for the possibility of a potential extra profit, the regulatory side focuses on eliminating it.

According to theoretical economics, competition reduces abnormal profits, in the case of perfect competition there is no possibility to gain extra profit. Abnormal profits are conceivable in the short run, but in the long run, prices adjust to market norms due to competition. Profit persistence measures the rate of this correction, how quickly profit reaches equilibrium. In contrast, in reality, this is rarely seen in practice.

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

The Hungarian food processing sector has been declared a strategic sector of the national economy by the Hungarian government. Poultry and pork account for more than ninety percent of the Hungarian population's meat consumption. For this reason, it is important that its source be provided by controlled and preferably domestic producers. Domestic "conditions" allow for both quantitative and qualitative meat processing, but this also requires quality raw material from the input side. If we want to cover this consumption from domestic sources, it is essential to have a more accurate picture of the profitability and competitive situation of the pig and poultry sector. Technologically, these two sectors can be developed the most. Due to modern animal husbandry technology, the human workforce can be reduced, so investing in these sectors can be an attractive option for investors.

I would like to get a comprehensive picture of profit persistence and the corporate and industry factors that affect the profitability of companies, through a systematic review of the literature in line with international standards. I will give priority to relevant scientific studies in agriculture and the sectors closest to it.

The most important goal of the dissertation is to examine the competitiveness and profitability of the Hungarian pig and poultry sector through profit persistence. In addition to examining profit persistence, my aim is to incorporate the factors influencing profitability learned in the literature review into the competitive dynamics models of the pig and poultry sector and to estimate their impact on abnormal yields. To the best of my knowledge, no model of competitive dynamics has yet been developed for the Hungarian pig and poultry sector, and no one has yet processed the topic of profit persistence using a systematic literature review method.

The pig and poultry sectors have undergone significant transformations over the last two decades. A long-term industry strategy can only be developed if there are operators in the market who can operate profitably, but a healthy competitive environment is also ensured. For this reason, it is important to examine the profitability of the sectors, the factors affecting profitability, and the competitiveness itself. A profit persistence study carried out with the right methodology and specification can answer these questions.

The results of empirical research can provide useful information for the management of companies and the operators with capital waiting to be invested. Management gets a much more comprehensive picture of the competitive environment in which it has been operating for years, as well as getting to know the relevant factors on which it has a direct or indirect impact, so that more informed economic decisions can be made. The management side is interested in the correction, wants to correct the mistakes it has made, and to strengthen the decisions that will help the company achieve higher profits. With these in mind, the investor side can decide whether it is worth entering such a competitive environment at all, and if so, its activities can be organized in the light of the results. For regulatory authorities, in particular, industry effects and the goodness of resource allocation systems contain useful information on which they may have a direct or indirect impact.

Material and method

In this chapter, I present a theoretical approach to measuring profit persistence in a static and dynamic environment. Autoregressive models (AR) are best suited for empirical testing of a dynamic approach. I review the AR models in detail, with the help of which the operation and interpretation of profit persistence can be best understood. After presenting the AR models, I turn to the dynamic panel model most commonly used today, with which I also conducted my empirical research.

Modelling profit persistence is different in static and dynamic (Schumpeterian) environments. I present the derivation of profit persistence based on the study of Cable and Mueller [2008]. In a static environment, profit is:

$$\pi_{i,t} = \pi_i + \mu_{i,t} \qquad (1)$$

The *i* denotes the given company, *t* stands for the time. Where, the constant π_i denotes constant profit, in perfect competition this term is zero. The $\mu_{i,t}$ is a random shock in profit that follows a normal distribution with zero expected value. Profit is stochastic, but essentially it is constant over the period under review.

In a dynamic environment, innovative companies achieve higher profits, which goes down over time. This year's profit also depends on last year's profit, but is approaching a long-term equilibrium profit. Suppose every company has a constant profit rate, let it be zero now. Write down the profit as the deviation from the constant profit rate ($\mu_{i,t}$) and take into account that the profit for the given year (u_i) also depends on the profit for the previous period

$$\mu_{i,t} = \lambda_i(\mu_{i,t-1}) + \varepsilon_{i,t} \qquad (2)$$

The random error term $\varepsilon_{i,t}$ has zero expected value.The $\varepsilon_{i,t}$ is a random error term with zero expected value.

Suppose that model (1) is true for all periods, then $\mu_{i,t-1}$ can be rewritten in the following form:

$$\mu_{i,t-1} = \pi_{i,t-1} - \pi_i \qquad (3)$$

In this step (and in Equation (1)), we define the abnormal profit, which is the difference between the profit for the given period and a constant profit level.

Insert model (3) into (2):

$$\mu_{i,t} = \lambda_i(\pi_{i,t-1} - \pi_i) + \varepsilon_{i,t} \qquad (4)$$

Then (4) into (1):

$$\pi_{i,t} = \pi_i + \lambda_i(\pi_{i,t-1} - \pi_i) + \varepsilon_{i,t} \qquad (5)$$

Rearranged:

$$\pi_{i,t} = (1 - \lambda_i)\pi_i + \lambda_i\pi_{i,t-1} + \varepsilon_{i,t} \qquad (6)$$

Model (6) is essentially an autoregressive process (AR (1)) that can be estimated easily. The coefficient λ_i is the profit persistence, which must be between zero and one. The closer it is to one, the longer the extra profit (abnormal profit) stays on, i.e. the weaker the competition is. If the value of lambda is 0, then (6) = (1), i.e. if the profit persistence is zero, then the static theory is the same as the dynamic.

As it is defined by Cable and Mueller [2008], profit persistence is a component of profit. This component determines the extent to which profit deviates from normal levels. Also, the value of profit persistence shows how quickly abnormal profit returns to equilibrium (see Figure 1 earlier).

After the theoretical side of the methodological measurement of profit persistence, let us review the practical implementation. In examining profit persistence, the generally accepted profitability indicator is return on assets

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

(ROA). In some cases, we may encounter studies where profit is measured by return on equity (ROE), e.g., Stephan and Tsapin [2008] or Zeren and Öztürk [2015]. In the dissertation I worked with the ROA indicator, the corporate (non-banking) activity justifies the use of the ROA indicator. A further argument in favour of the ROA indicator is that this provides the best comparability with similar researches.

During the abnormal profit test, I analyze the extent to which each firm's ROA for a given year differs from its average annual profitability level. Thanks to normalization, we can filter out the effects of macroeconomic cycles and interpret profit as a deviation from market norms (Maruyama and Odagiri [2002]; Gschwandtner [2012]).

$$\pi'_{i,t} = ROA_{i,t} - \overline{ROA_t} \tag{7}$$

$$\pi'_{i,t} = \frac{ROA_{i,t} - \overline{ROA_t}}{\overline{ROA_t}} \tag{8}$$

$\pi'_{i,t}$ denotes abnormal yield. There is no substantive difference between the abnormal profit measurement method (7) and (8). Among others, Gschwandtner [2005] and McMillan et al. [2011] used method (8), Hirsch et al. [2014] and Resende [2006] conducted their research according to method (7). In the study, I measure abnormal profit according to (8). Normal profit ($\overline{ROA_t}$) is calculated separately for each year.

Initially, autoregressive processes were used to measure profit persistence, most often the AR(1) model. In number of lag 1 model, the profit rate at time t is explained by the profit rate one year earlier (t-1). Equation (9) shows this model.

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

$$\pi'_{i,t} = \alpha_i + \lambda_i \pi'_{i,t-1} + \varepsilon_{i,t} \qquad (9)$$

The error term $\varepsilon_{i,t}$ is white noise with zero expected value and constant variance.

The parameter $\hat{\lambda}_i$ gives the short-term persistence and stickiness of profit (Hirsch and Gschwandtner [2013]). By stickiness we mean the long-term presence of abnormal profit, its re-emergence from year to year in the case of a given plant. The process AR (1) is stationary if $-1 < \hat{\lambda}_i < 1$. The_$\hat{\lambda}_i$ measures the fit of short-term profit to the competitiveness norm. If the closer the parameter $\hat{\lambda}_i$ is to one, the higher the profit persistence is. In the case of high profit persistence, the company's profit slowly approaches the market's normal profit, so the market is characterized by weak competition. With low lambda, the market approaches perfect competition.

When estimating profit persistence, we do not necessarily have to be stuck to the AR (1) process, we can also estimate higher order AR processes. For example, AR (3):

$$\pi'_{i,t} = \alpha_i + \lambda_{1,i}\pi'_{i,t-1} + \lambda_{2,i}\pi'_{i,t-2} + \lambda_{3,i}\pi'_{i,t-3} + \varepsilon_{i,t} \qquad (10)$$

In this case, we assume that the abnormal profit for period t is affected not only by period t-1 but also by t-2 and t-3. According to international research, in the largest proportion of cases only the parameter $\lambda_{1,i}$ is significant, i.e. the profit of period t is not affected by the period 2-3 years earlier. Maruyama and Odagiri [2002] and Gschwandtner [2012], among others, came to this conclusion.

I present the determination of long-term profit persistence in the case of the AR (1) process. Long-term profit persistence is the expected value of the autoregressive process:

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

$$\hat{p}_i = \frac{\hat{\alpha}_i}{1 - \hat{\lambda}_i} \tag{11}$$

If $\hat{p}_i$ does not deviate significantly from zero, then the examined plants are characterized by perfect competition. $\hat{p}_i$ is also called the profit rate planned for the long-run. If all firms achieve normal profits, then p_i is equal for all firms and there is no significant difference (Gschwandtner [2005]). It is important to note that profit persistence estimated with AR models can be considered an appropriate choice if our time series has been available for at least the past 20 years. In the case of a short time series, methodological problems arise and the value of long-term profit persistence will not be reliable (Cable and Mueller [2008]). The longer the time series is, the less likely it is that an innovation shock will change the dynamics of the time series. The examination of profit persistence is no exception compared to other empirical works, the more data, the better and more accurate the estimation will be.

Hirsch and Gschwandtner [2013] found that due to the previously presented limitations of AR model estimation, the dynamic panel model with the Arellano-Bond Generalized Method of Moments (GMM) estimation is the most suitable for investigating profit persistence. According to Hirsch (2018), GMM is the proper technique for estimating profit persistence, OLS estimation biases upwards. The estimation can be applied well if there is a large number of observed companies (small T, large N type sample) for a short period of time.

$$\pi'_{i,t} = \sum_j \alpha_j (X_{j,i,t}) + \lambda \pi'_{i,t-1} + \varepsilon_{i,t} \tag{12}$$

Where $\varepsilon_{i,t} = \eta_i + \nu_{i,t}$. The Arellano-Bond GMM estimate is based on the first differences in the equation, which eliminates time-invariant firm specific (η_i) effects (Hirsch and Gschwandtner [2013]; Kozlenko [2015]).

Firm and industry-specific variables (X_j) that may explain the persistence of corporate profits may be included in the model. The GMM estimate is considered consistent if there is no second order autocorrelation in the error terms (the first order cannot be due to the delayed explanatory variable) and the instruments are adequate. Second-order autocorrelation is easy to test, and instruments can be tested by Hansen and Sargan test. The lagged depended variable is endogenous; everything else is exogenous variables in the model (Hirsch and Gschwandtner [2013]). The Hansen test is robust to heteroscedasticity. Which test results are reported varies from study to study. Only the Hansen test was reported by Goddard et al. [2011]; Gschwandtner and Hirsch [2018]; Stephan and Tsapin [2008]; Puziak [2017]; Hirsch and Hartmann [2014], an exclusively Sargan test was reported by Goddard et al. [2005]; Alarcón and Sánchez [2013]; Kozlenko [2015], the results of both tests were presented by Hirsch and Gschwandtner [2013]. In their work, Amidu and Harvey [2016] presented mainly the Hansen test for estimating the dynamic panel, but sometimes only the result of the Sargan test was reported.

During the literature review, it happened only a few times that a different dynamic panel estimation procedure appeared in addition to the AMM model. In order to test the robustness of the results, I also performed a profit persistence estimation using the Blundell-Bond [1998] method. The Arellano-Bond GMM estimation procedure gives more reliable results than the panel OLS estimates, but does not perform perfectly. The Arellano-Bond GMM performs very poorly if the auto-regressive parameter (λ) is too large or the ratio of the variance of the panel effect and the variance of the individual error terms is too large (Blundell and Bond [1998]), the Blundell-Bond model was developed to remedy this.

The Blundell-Bond estimate assumes that there is no autocorrelation among the individual error terms, and that proper operation requires that the panel effect be independent of the first difference in the first observation of the dependent variable. Just like the Arellano-Bond estimate, Blundell-Bond works well when we have a lot of observations, but the time parameter is finite.

For profit persistence estimates, the Arellano-Bond method can be considered to be the standard, in my opinion the reason for this is that the Blundell-Bond estimate gives a more reliable estimate when the autoregressive parameter is high, but profitable persistence is typically low in agriculture and food industry. For this reason, I consider the results of the Arellano-Bond estimate to be the guideline, and I use the Blundell-Bond estimate to check the robustness of the results.

The upper and lower few percentages of the distribution of variables were handled with trimming due to the outliers. The database certainly contains human error, it takes several steps to populate the database with data, and problems may arise during queries. For this reason, a "cut off" of few percents of the data is justified. The treatment was performed for all variables.

During the research I used data from the National Agricultural Research and Innovation Centre (NAIK) Research Institute of Agricultural Economics (AKI) test Farm Accountancy Data Network (FADN). Every country in the European Union has the FADN system, which collects data about more than 80,000 farms. The EU-wide database represents a population of approximately 6.4 million (Keszthelyi [2017]). The database is representative of region, size and activity. Due to the form of data provision the data of individual and corporate farms becomes comparable. The Hungarian test farm system covers 2% of the population; the monitored plants provide more than 5000 data a year

PDF-XChange Editor
Click to BUY NOW!
www.tracker-software.com

Results

Specification for dynamic panel models

In this chapter, I primarily rely on the Hungarian literature to determine the factors that are expected to affect the (abnormal) profitability of enterprises significantly.

One of the main drivers of the structural transformation of the pig sector over the last 20 years is economies of scale. Accordingly, according to preliminary expectations, farm size had a positive effect on the profitability of pig farms. Empirical research by Csörnyei [2015] proved that farm size has the strongest influence on the efficiency and development and innovation potential of Hungarian pig farms. In my own work, I use two variables to express the farm size: the number of pigs kept by the farm (number of individuals) and the balance sheet total. The former is used to express the natural size of the holding, while the latter tends to express the size of the holding. The poultry sector model also includes variables for both farm sizes. Szőllősi and Nábrádi [2008] found that one of the problems identified in the study of poultry sector problems was lower than optimal size, Szőllősi and Molnár (2018) found similar consistency in relation to profitability and size. Sipiczki et al. (2019) found that the average farm size was the lowest in the pig and poultry sector. Accordingly, farm size was expected to have a positive impact on the profitability of poultry farms. In my study, I use two variables to express the size of the farm: the number of poultry kept by the farm (number of animals) and the balance sheet total. The former serves to express the natural size of the farm, while the latter serves to express the size of the farm. The relationship between profit persistence and company size (balance sheet total) is unclear. In the case of large size, the principle of economies of scale may work, although several studies have been written about less efficient large companies. Company size plays a significant role in the food industry (Hirsch and

Gschwandtner [2013]; Hirsch and Hartmann [2014]). I expect a positive relationship between size and (abnormal) profitability in the Hungarian agricultural environment. In the model, indicators for both sizes are included as equal explanatory variables, so that their effect can be examined under each other's control.

The mechanization of pig farms is also an important influencing factor. Popp et al. [2015] point out that technology is a cardinal issue in the Hungarian pig sector. To overcome the gap with advanced European competitors, the use of modern housing technology is required. Thanks to technological investments, natural efficiency indicators and thus profitability are significantly improved. One of the biggest problems of the poultry sector is the lack of technological development and iinnovation (and Nábrádi Szőllősi [2008]; Szőllősi [2014]; Szőllősi and Szűcs [2014]; Jankovics [2017]). In domestic literature, technology is a recurring problem. Similar sentences can be found: "our professional knowledge is stagnant at the leel of 1995-2000; our management knowledge is at the level of 15-20 years before" (Nábrádi and Szőllősi [2008] cited by Bárány [2007]). According to the literature, the poultry sector is facing a major technology gap and there has been no significant progress at the sector level in the last 20 years. As a result, the poultry sector model includes two variables expressing the mechanization of the holdings.

In the lack of investment and innovation, technology is the substitute for labor, which, with a few exceptions, is less effective than its machines. To express technological development, one (two in the case of poultry) mechanization index and one in the labor utilization index were included in the model. According to preliminary expectations, mechanization has a positive effect, while the latter has a negative impact on profitability. In their study Tamirat et al. [2018] found a positive relationship between investment and profitability in Dutch pig farms, in the case of mixed animal husbandry the relationship is negative and also significant.

An old dilemma in domestic pig farming is the ideal ratio of own and purchased feed. According to the research carried out by Kőműves and Horváthné Petrás [2017] among producers in Somogy county, the development of feed prices is a significant factor of uncertainty for pig farmers. In this uncertain environment, the stable existence of a self-produced feed base can be a significant competitive advantage. At the same time, the procurement of high-quality feed mixtures, in addition to own feed production, provides high added value in pig farms (Popp et al, [2018]). Jankovics [2017] states that cereal prices and broiler feed prices move closely together, but the real problem is that rising cereal prices increase costs more than that of chickens for slaughter. The biggest problem in the profitability of table egg producers besides size is the volatility of feed prices (Szőllősi and Molnár [2018]). According to Szőllősi's [2008] calculations, 60% of the costs of broiler chicken fattening is determined by the purchased feed. On this basis, profitability is very sensitive to changes in prices. The unfavorable development (opening) of the price scissors of industrial-agricultural products has a significant impact on the profitability of agricultural farms (Borszéki [2003]). Varga et al. [2017] found that price scissors have shown a favorable image in agriculture over the past 10 years, but the picture is improved by crop production and the situation for livestock farmers remains unfavorable. Taking all this into account, we can assume that the proportion of purchased feed within the total feed cost has a negative impact on profitability.

To realize positive returns, you need to take the risk, and risk is included in the definition of a business. According to profit persistence research, I approach the concept of risk from an accounting point of view, accordingly short-term and long-term risk depending on the time horizon of indebtedness.

High risk is expected to result in high expected returns (see CAPM model). Bowman [1980] found a negative correlation between risk and profit, which is supported by the practice of smoothing profits. Profit persistence research in the food industry has found a positive and negative relationship between risk and profitability. In most cases, long-term risk is positive or insignificant, and short-term risk has a negative impact on food companies. In his study, Borszéki [2008] determined the cost of capital for the pig and poultry sectors, based on calculations, the optimal leverage ratio for each of the two sectors is 35%, ie approximately two thirds of the liabilities side is equity and the remaining debt. This is far below the real capital structure, one of the main reasons of which is the lack of own resources needed for foreign sources (Borszéki [2003]). The lack of technological development is rooted in the same place. If we re-study the work of Tamirat et al. [2018], we can see that short-term risk does not affect profitability, long-term risk has a negative impact on Dutch pig farms. This discrepancy / diversity characterizes well the relationship between risk and profitability, and consequently, we have no clear expectation of the relationship between any of the risk indicators.

The European Union and the prevailing domestic government policy have a special focus on agriculture. The level of subsidies in agriculture is outstanding compared to other industries (Sipiczki and Rajczi [2018]; Varga and Sipiczki [2017a]), and it is worth highlighting the favourable financing arrangements that are not effectively used by the farms. Subsidies received under the Common Agricultural Policy (CAP) also had a significant impact on the profitability of agricultural economies and the structure of production (Varga and Sipiczki [2017b]; Rajczi and Wickert, [2018]). These factors mean a reduction in operational risks, so we use the subsidy ratio of total output as a control variable. Interestingly, except in one case, empirical studies in international literature do not include any form of support. The only exception

PDF-XChange Editor
Click to BUY NOW!
www.tracker-software.com

is Tamirat et al. (2018), where the proportion of subsidies is not explanatory in Dutch agriculture as a whole; the same is true for field crop production and pig holdings (!). There was a positive relationship in dairy farms and a negative (!) relationship in mixed livestock holdings between aid intensity and profitability. In my opinion, it is difficult to deny the subsidy dependence of the Hungarian agricultural economy although it is important to consider that the subsidy rate is much lower for livestock farmers than for crop producers. Moreover, according to Sipiczki et al. [2019], poultry and pig holdings are the most profitable sector within agriculture, but, if subsidies are taken into account, they become the least profitable. Several studies confirm that the profitability of poultry holdings has deteriorated with the reduction of subsidies (Szőllősi and Nábrádi [2008]; Szőllősi [2014]). With these in mind, I expect the relationship to be positive or neutral.

In case of changing the form of the enterprise, I assume that the profitability of non-business enterprises (typically primary producers, sole proprietors) is higher. The reason for this is that the primary farmers' tax rules provide significant benefits and exemptions for families operating the farm. The poultry sector is definitely characterized by a very small, sub-optimal (Szőllősi & Nábrádi [2008]) farm size, which gives tax advantages. As a result, I expect the variable to have a negative sign (I mark companies with 1).

Markov chain analysis

Profit persistence research is most often based on some econometric estimate (AR1, OLS, GMM), in contrast, the Markov chain approaches the measurement from a different perspective. Markov chains can be used to examine the likelihood of a company being transferred to a more profitable or even less profitable group. It is much more up to the researcher to evaluate the results, it is more difficult to compare because there is no specific value on which to comment. Another important difference is that in econometric estimates, profit is measured by a continuous variable (usually ROA), the Markov chain "works" with discrete values. Profit (ROA) and abnormal profit (aROA) were classified according to the size of the sample into three groups with equal elements in the pig sector and into five groups with equal elements in the poultry sector, all of them are arranged in order of increasing profitability. I marked these groups from 1 to (3) 5, 1 being the group of least profitable companies, and (3) 5 being the group of companies having the highest profitability. I did the same for abnormal profits. The output of Markov chains is the transition probability matrix, as its name implies, the matrix contains probabilities, showing the probability that a company belonging to a given group has changed a group (either upwards or downwards). In terms of profit persistence, it is the diagonal of the matrix which is important, the closer the values are to 1, the higher the profit persistence is, the profit rate does not - or only slightly - change from year to year therefore everyone is "stuck" in their own group. Profit is "sticky".

The Markov chain analysis was based on the study of Stephan and Tsapin [2008], through which I formally present the method. Denote the rate of profit by y_s^t, the Markov chain working with discrete values requires the following relationship:

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

$$P\{y_s^{t+1} = j | y_s^t = i\} = p_{ij} \quad (13)$$

It can be read from formula (13) that the profit rate in t+1 depends only on the state at time t. The transition between each group can be described as follows:

$$F_y^{t+1} = P * F_y^t \quad (14)$$

F_y denotes the distribution of corporate profitability in t and t +1. These equations can be used to estimate the transition probability matrix. The estimated probabilities will be unbiased if two conditions are met: 1) the data generating process (companies 'profit rate) is constant over time, so its variance is constant; 2) the number of observations is sufficiently large. Tables 1 and 2 show the estimated transition probability matrices for the pig and poultry sector.

Table 1.: Transition Probability Matrices (pork)

ROA	(1)	(2)	(3)	Pi
(1)	**0.627**	0.255	0.118	0.333
(2)	0.250	**0.526**	0.224	0.333
(3)	0.136	0.231	**0.633**	0.333
Pj	0.335	0.333	0.331	1.000

aROA	(1)	(2)	(3)	Pi
(1)	**0.611**	0.235	0.154	0.333
(2)	0.241	**0.532**	0.228	0.333
(3)	0.146	0.253	**0.601**	0.333
Pj	0.327	0.342	0.331	1.000

Source: own editing based on STATA output

The first half of Table 1 shows the probabilities of the ROA indicator, and the second half shows the results for the abnormal ROA. For both indicators, values above 0.5 are found in the diagonal. Values above 0.5 indicate strong profit persistence (Amidu and Harvey [2016]). In the case of the pig sector, it is likely that there is profit persistence. It can be observed that the probabilities are the highest in groups (1) and (3), so the persistence of profit is high in poor and well-performing companies. Anyone who performs poorly has a hard time breaking out of this "state", who performs well has a good chance of remaining in the more profitable group. Something similar can be said of abnormal profits (aROA): who perform below the market average, they find it difficult to change that. Based on the Markov chain analysis, it is not possible to make a clear "judgment" about the competitive nature of the market, however, there are indications that the market is not perfect.

Table 2 shows the transition probabilities for the poultry sector. While the ROA and aROA matrices are very similar for the pig sector, the aROA probabilities are lower in the poultry sector in most cases. So high ROA values do not automatically mean that abnormal profits are also high. The industry average profitability and the profitability of individual plants are more likely to move together. The values in the diagonal are lower than in the pig sector, competition is expected to be closer to perfect competition than in the pig sector.

Based on Markov chain analyzes, the poultry sector is characterized by greater competition, so the profit persistence estimated by the dynamic panel is expected to be lower in the poultry sector than in the pig sector. The dynamic panel estimation will give a more accurate picture because 1) the conditions of the model are less strict (time invariance) than in the case of the Markov chain and 2) it is possible to control for different effects to get the most accurate value for the profit persistence coefficient. The Markov chain is appropriate as a starting point, and based on the results obtained, I have some expectations about the dynamics of competition in the two sectors.

Table 2.: Transition Probability Matrices (poultry)

ROA	(1)	(2)	(3)	(4)	(5)	P_i
(1)	**0.413**	0.215	0.162	0.093	0.117	0.200
(2)	0.226	**0.341**	0.204	0.137	0.093	0.200
(3)	0.137	0.224	**0.282**	0.232	0.125	0.200
(4)	0.103	0.120	0.265	**0.322**	0.190	0.200
(5)	0.070	0.104	0.104	0.235	**0.487**	0.200
P_j	0.191	0.200	0.204	0.204	0.201	1.000

aROA	(1)	(2)	(3)	(4)	(5)	P_i
(1)	**0.332**	0.199	0.170	0.129	0.170	0.200
(2)	0.155	**0.400**	0.241	0.141	0.064	0.200
(3)	0.118	0.192	**0.314**	0.269	0.106	0.200
(4)	0.104	0.121	0.264	**0.281**	0.229	0.200
(5)	0.180	0.160	0.121	0.199	**0.340**	0.200
P_j	0.179	0.214	0.225	0.205	0.179	1.000

Source: own editing based on STATA output

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

Model of competition dynamics in the pig sector

Table 3 shows the estimation results of the dynamic panel models of the pig sector. There is no second-order autocorrelation based on the tests, the Arellano-Bond estimate is adequate based on the Sargan and Hansen test. In the following, I present the results of the Arellano-Bond estimate, the Blundell-Bond estimate is used to check the robustness of the results, where the two models show a difference, I also indicate in the text.

Abnormal profit persistence is significant at five percent, however, the value of the coefficient is close to zero. According to the model, the abnormal profit disappears in one year, the stickiness is not typical. According to the literature, profit persistence is lower in the food economy than in the manufacturing industry, however, persistence around zero is rare. In their work, Hirsch and Gschwandtner [2013] measured abnormal profit persistence between 0.1 and 0.3 in their research covering five European countries, and observed a profit persistence above 0.3 in the economy-wide research. The profit persistence measured in the Dutch pig sector is 0.071, which is significant at 1%, very close to the estimate based on Hungarian data (see Table 12).

The logarithm of the annual average number of pigs and the logarithm of the balance sheet total are used to measure economies of scale. As expected, the average number of pigs has a positive effect on the abnormal yield. The structural transformation of recent years is also supported by the fact that large-scale pig farmers have been able to survive. Our results confirming the positive effect of farm size measured by the number of pigs are in line with the findings of Duffy [2009], Hsu [2015], and Csörnyei [2015]. In the period under review, profits above the industry average were typically achieved by farms with larger stocks. Thus, large-scale pig farming proved to be the "profitable side" of the dual farm structure emphasized by Bartha [2009]. The results are also in good agreement with the findings of Fertő and Csonka [2016] and Csonka and Fertő [2017] regarding spatial concentration.

PDF-XChange Editor
Click to BUY NOW!
www.tracker-software.com

Table 3.: Results of dynamic panel estimation (pork)

Arellano-Bond	Coefficient	Corrected Std. error	p-value
abnormal ROA.L1	0.064	0.030	0.038**
ln total assets	-0.759	0.351	0.033**
subsidy ratio	9.182	4.238	0.033**
ln labor	-1.350	0.600	0.027**
purchased feed	-0.041	0.022	0.066*
ln number of pig	1.640	0.661	0.015**
long risk	2.013	5.573	0.719
short risk	0.888	1.470	0.548
mechanization	-0.149	3.759	0.968
	Tests		
AR(2)	$z = -1.37$		0.172
Sargan	$Chi^2 (38) = 14.05$		1.000
Hansen	$Chi^2 (38) = 39.94$		0.384

Blundell-Bond	Coefficient	WC-Robust Std. error	p-value
abnormal ROA.L1	0.047	0.027	0.076**
ln total assets	-1.606	0.607	0.008***
subsidy ratio	10.178	5.929	0.086**
ln labor	-2.710	1.217	0.026**
purchased feed	-0.023	0.033	0.481
ln number of pig	2.888	1.026	0.005***
long risk	18.422	19.700	0.350
short risk	1.012	1.514	0.504
mechanization	5.535	7.372	0.453
	Test		
AR(2)	$z = -7.04$		0.482

Source: own editing based on STATA output

***, **, *significant on 1, 5, 10%

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

In contrast, an increase in the balance sheet total reduces an abnormal return. This suggests that the natural measure (average number of pigs) is a more significant indicator of farm size. One reason for this is that the balance sheet total is affected by a number of other factors, such as unmatched customer or supplier inventory, temporarily higher inventories, and so on. The Funding for Growth Scheme (FGS) launched in 2013 and the favourable credit schemes available to agriculture almost continuously Széchényi (e.g. agricultural working capital loan program, agricultural capital investment loans, Card, etc.) may have a further distorting effect. According to MNB [2020] statistics, most subsidized loans were drawn down in agriculture after the commercial sector. On the other hand, several dissertations have been written on the inefficiencies of large companies, which have shown that the principle of economies of scale increases efficiency only to a certain point.

Mechanization is shown by the ratio of own machines used in animal husbandry to total assets, and labour was measured by the logarithm of the average statistical number of full-time employees. The mechanization variable - at least with the inclusion of the labour variable - is not significant, it has no effect on the abnormal return. Labour, as expected, reduces abnormal returns. If the company wants to perform above the average profit of the given year, it has to reduce the labour, which also means that technological development, investments and, ultimately, cash capital are needed. This also explains the crowding out of the small business class. I would add to the previous findings on the technological development of the sector (Nyárs [2009], Udovecz – Nyárs [2009], Popp et al. [2015]) that technological (primarily mechanization-increasing) investments do not improve the profitability of pig farming on their own, but only if the livelihood-inducing effect is realized.

The intensity factor of purchased feed is the quotient of the purchased pig feed and the average number of pigs. As expected, the relationship between

PDF-XChange Editor
Click to BUY NOW!
www.tracker-software.com

abnormal returns and purchased feed is negative. This supports the statement of Kőműves and Horváthné Petrási [2017] that the price development of purchased feeds poses an income risk for farmers. This risk materialized between 2005 and 2016, so the high value-added effect emphasized by Popp et al. [2018] did not materialize in the increase in income. To properly interpret the result for purchased feeds, it is also worth mentioning the effect of feed price fluctuations. The volatility of producer feed prices was significant during the period considered, but a decrease can be observed after 2012, however, prices were still higher than in the initial period of the investigation. Wholesale and retail prices were much higher than this: traders react immediately when producer prices rise, but they are less flexible when prices fall. Price volatility brings uncertainty to the ordinary course of business, thus reducing the profit prospects of pig farms (especially smaller farms). Based on the Blundell-Bond model, the intensity factor of the purchased feed is not significant.

Short-term risk is the quotient of short-term liabilities and current assets, long-term risk is the quotient of long-term liabilities and balance sheet total. None of the risk indicators became significant. A negative or neutral relationship was most commonly found in the international literature (e.g., Gschwandtner [2005], Andersen et al. [2007]). Table 8 contains descriptive statistics of the variables, according to which the long-term liability is zero for half of the surveyed farms, i.e. they are financed almost entirely from their own resources. In the case of short-term risk, current assets cover short-term liabilities, we cannot talk about classic financial / financing risks. The reason for this is to be found in the support system. More than eight percent of total output comes from grants that are independent of the activity. Based on our dynamic panel estimate, the subsidy rate has a positive effect on the abnormal return, i.e. it has a market distorting effect. If the business can draw down these subsidies more efficiently, it can expect a higher return. This is also supported by the study of Rajczi and Wickert [2015], according to which the support system influences the activity and profitability of farms.

Model of competitive dynamics in the poultry sector

The pig sector is followed by the poultry sector; the results of the dynamic panel estimation are shown in Table 4. As in the pig sector, the models passed all the tests “successfully”, so the identification was successful. Similar to the pig sector, I rely on the results of the Arellano-Bond estimation to present the results, where the Blundell-Bond estimation procedure shows a different result, I indicate in the text.

The profit persistence value is 0.108, but not significant, in fact zero. On the one hand, surprisingly rare is the study in which profit persistence is zero (eg Kozlenko [2015] for some food sectors). On the other hand, on the basis of Hungarian literature, it has been emphasized on several occasions that the poultry farms are small, which is one of the barriers to profitability (Szőllősi and Nábrádi [2008]; Sipiczki et al. [2019]).

Table 4.: Results of dynamic panel estimation (poultry)

Arellano-Bond	**Coefficient**	**Corrected Std. error**	**p-value**
abnormal ROA.L1	0.108	0.109	0.325
ln total assets	-0.309	0.235	0.189
subsidy ratio	3.669	4.215	0.385
ln labor	-0.088	0.198	0.659
purchased feed	-0.022	0.064	0.737
ln number of poultry	0.478	0.277	0.087*
long risk	-0.424	0.136	0.002***
short risk	0.000	0.007	0.966
mechanization _assets	-6.475	3.190	0.044**
mechanization_number	0.574	0.323	0.077*
form of business	-0.822	0.436	0.061**
	Tests		
AR(2)	z = -0.61		0.544
Sargan	Chi2(31) = 33.68		0.339
Hansen	Chi2(31) = 35.80		0.253

Blundell-Bond	**Coefficient**	**WC-Robust Std. error**	**p-value**
abnormal ROA.L1	0.001	0.021	0,955
ln total assets	-0.580	0.303	0,055**
subsidy ratio	1.705	7.673	0,824
ln labor	0.263	0.376	0,484
purchased feed	0.002	0.095	0,986
ln number of poultry	0.856	0.325	0,008***
long risk	-0.580	0.093	0,000***
short risk	0.002	0.013	0,882
mechanization _assets	-2.729	3.785	0,471
mechanization_number	1.101	0.436	0,012**
form of business	-1.860	0.947	0,049**
	Test		
AR(2)	z = -0.89		0.375

Source: own editing based on STATA output

***, **, *significant on 1, 5, 10%

In the case of farm size, the natural indicator is significant, so by increasing the average number of poultry per year the profitability of the companies also increases, the result explains the principle of economies of scale. There are examples in the international literature where the increase in size (from an accounting point of view) reduces profitability, but in the case of the Hungarian poultry sector this "critical size" seems to be far away. The results confirm the domestic theoretical and empirical researches in the poultry sector. In the Blundell-Bond model, the size category with an accounting approach is also significant. As in the case of the pig sector, I believe that in the case of the poultry sector, the natural measure gives a more reliable picture of the size, the balance sheet total can be influenced by many factors that have little effect on the core business.

In addition to the indicator $\left(\frac{stable\ livestock\ machinery}{all\ equipment}\right)$ used in the pig sector to measure mechanization, the machinery per poultry (mechanization_number) was examined. The reason for the inclusion of the two variables was to get a more accurate picture of the depressing technological situation according to the literature. All are significant, but with a different sign. In my opinion, like the results in the pig sector, the natural approach gives a more accurate picture, so with the growth of stable machinery per bird, efficiency increases and thus profitability. According to Szőllősi and Szűcs [2014], it is the only way to improve the profitability of the poultry sector; Jankovics [2017] also comes to a similar conclusion to escape forward. The variable for labor has no explanatory power. In the case of mechanization relative to the balance sheet total, accounting adjustments (the difference between real and calculated depreciation) and other items increasing or decreasing the balance sheet "move" this indicator. Although the logarithm of the balance sheet total is not significant, studies have treated declining plant size as a fact, so this effect also influences the mechanization index affected.

A further reason for the negative impact is that investments are leveraged, as measured by long-term risk. The Blundell-Bond model confirms my conclusion about mechanization, in this model only mechanization measured by natural measures is significant. Another reason for the negative effect is that the investments are made with the involvement of foreign capital, which is measured by the long-term risk indicator.

Long-term risk has a negative impact on profitability. This is another sign of inefficiency and size problems. Improvements can be made primarily through the involvement of external capital, but with own funds, a farm is not indebted if the future expected profits yield the interest of the loan. In the current situation of the Hungarian poultry sector, this is a trap. In addition to low profitability, indebtedness in the short term is bound to worsen profitability, which owners are unlikely to undertake. Without improvements, profitability will also deteriorate, but in this case, it will be a slow process lasting several years, even decades, while in addition to indebtedness, there may be a sharp downturn and future returns are not guaranteed. In such a situation, it is difficult to choose the riskier way; especially if we consider the words of Bárányos [2007] that management knowledge is 15-20 years behind. The short-term risk is not significant according to the model. It is worth mentioning here the study of Borszéki [2008], who argues that the increase in trade payables does not mean an improvement in the market financing position, but rather the presence of the chains of debts, which is a sector problem.

Calling for grants and their rational use for development and risk reduction may be an appropriate "means". According to the model, the increase in the subsidy ratio within total output does not affect profitability. The reason for this is the low level of support compared to other agricultural sectors. The study of Sipiczki et al. [2019] is telling, according to which, without subsidies, the poultry sector is one of the most profitable agricultural sectors, taking into account the subsidies, the other sectors are improving to the extent that it becomes the least profitable. Several studies highlight the under-support of the poultry sector / egg production (Szőllősi and Nábrádi [2008]; Szőllősi and Molnár [2014]; Borszéki [2003]). For these reasons, the neutrality of the subsidies is not surprising.

Purchased feeds variable is negative but not significant. In the model specification section, several authors mention the opening of the price scissors of industrial-agricultural products. Calculations have shown that the input price increase is higher than the output price increase, which clearly has a negative impact on profitability. The poultry sector has a high proportion of purchased feeds, as it is confirmed in Popp et al. [2018], according to which 50% of the nutrient mixes produced in Hungary in 2016 was poultry feeds, half of the feed mills produce poultry feeds. From this, two conclusions can be drawn: It is likely that poultry feed production is a profitable activity and, on the other hand, poultry farms are not thinking about producing their own feed but buying.

According to preliminary expectations, business companies will achieve lower abnormal profits and individual farms will be able to claim tax benefits.

4. Conclusions and recommendations

The pig and poultry sector has undergone a significant transformation in the last two decades, what is more, a clear trend shows that most small farms are unable to compete in the EU single market. I measured market competition with abnormal profit (part above industry profit) persistence. Based on the study, it can be said that the abnormal profit persistence in the pig sector is significant, but, lower than in the food or processing industry in general. The profit persistence of the poultry sector is not significant; from a theoretical point of view it is close to perfect competition. In my previous research on total agriculture (Bareith [2019]), the value of profit persistence is lower than in pig farmers. Profit persistence coefficients (λ) developed according to the Markov chain analysis, the profit persistence of the pig sector became higher than that of the poultry sector. Although the profit level in the pig sector differs from the equilibrium profit, it is close to it. This also means that the structural adjustment of recent years, which in many respects has led to dramatic and serious social losses, has made the sector "healthier" in market terms, which is ultimately in the interests of consumers. By the end of the period under review, a more competitive and less distortive pig sector had developed in Hungary. This creates the conditions for ideas to develop the sector. In the case of the poultry sector, the many small, sub-optimal size farms justify the resulting profit persistence value.

Based on the dynamic panel model, it can be said that the average number of pigs (pcs) and the highest possible proportion of subsidies reduce competition, i.e. increase abnormal profits. According to the Arellano-Bond GMM estimate, purchased feeds reduce abnormal profits, i.e., it is more profitable to cover feed costs from own feed. The high proportion of labour also has a negative effect on the profit, the increase of the number of pigs can only increase the profitability with proper mechanization (specific labour replacement). In the case of the dynamic panel model for the poultry sector, it can also be said that increasing the number of poultry (pcs) improves profitability and reduces competition, but the rate of subsidies does not affect abnormal profits, so it does not distort competition within the sector. Technology investments that increase efficiency improve the abnormal level of profits of farms, which is also a breakthrough for the poultry sector. Labour (heads) and purchased feed have no verifiable effect on returns above market levels. Among the risks, long-term indebtedness reduces abnormal profits, if the debt is used for proper mechanization, the plants can gain a competitive advantage in the long run. Individual farms are able to achieve higher returns in relative terms.

The results of the research, compared to the antecedents of the literature (theoretical and empirical), confirm the fact that the improvement of the international competitiveness of the sector within the Hungarian dual plant structure is clearly conceivable with large-scale farms with low specific labour requirements. Consequently, policy strategies and measures aimed at maintaining and possibly increasing the domestic pig and poultry population should be planned with this in mind, focusing primarily on the development of medium and large-scale livestock farming.

Improving the competitiveness of individual and family farms can only be successful if future development programs and subsidies support jointly the achievement of at least medium-scale farm size, the reduction of the use of specific labour, horizontal and vertical integration and the provision of an own feed base in the farms concerned. Another breakout point may be the expansion of their own cutting and processing capacities, but this is not covered in the dissertation. In the case of pig farmers, the results on the rate of support show that targeted support that meets the above criteria can be a good tool for the development of viable individual and family medium-sized farms.

From the management's point of view, one of the most important findings is that increasing the proportion of purchased feeds poses a serious risk to pig farming. One of the main sectoral trends of the 21st century (in addition to concentration) is the rapid growth of the supply of compound feeds and ready-to-eat feeds, as well as the spread of animal husbandry based on purchased feed. Based on the results of the model, it is clearly in the interest of profitability and risk management in Hungarian pig farming to create our own feed base or, if this is not possible, to ensure feed supply through integrations and joint purchasing associations. In the case of the poultry sector, purchased feed has no effect on profitability, but based on empirical work by other researchers, it can be said that farms are at serious risk due to volatile input prices. For this reason, it is also recommended to reduce the dependence on purchased feed in the poultry sector.

New research results

I. I was the first to study the competitive dynamics of the pig and poultry sector in Hungarian agriculture. Based on my analysis, it can be said that the poultry sector is closer to perfect competition than the pig sector. This is also supported by Markov chain analysis and dynamic panel GMM estimates.

II. Based on the models, it can be said that the breakthrough points of the pig and poultry sector are the reduction of labour, technological development and the increase of the number of individuals.

III. I showed that the support scheme has a market-distorting effect on the pig sector. The support scheme must be aimed at technological development and the achievement of a larger plant size.

IV. I proved based on the Arellano-Bond GMM estimate that the presence of own feed in the pig sector is a competitive advantage and can provide profitability above the market average.

V. Long-term risk (indebtedness) has a negative effect on poultry farms. The reason for this is that due to the lack of subsidies, the missing capital is replaced with foreign resources, so there is no room left to raise funds and implement improvements.

PDF-XChange Editor Click to BUY NOW! www.tracker-software.com

Publications

Bareith, T., & Csonka, A. (2019). Profitperzisztencia vizsgálata a magyar sertésszektorban. Közgazdasági Szemle, 66(7-8), 847-862. DOI: http://dx.doi.org/10.18414/KSZ.2019.7-8.847

Sipiczki, Z., Bareith, T., & Varga, J. (2019). A magyarországi agrárszektor egyéni gazdaságai jövedelmezőségének alakulása 2013 és 2015 között. STATISZTIKAI SZEMLE, 97(1), 72-89. DOI: https://doi.org/10.20311%2Fstat2019.1.hu0072

Bareith, T. (2019). Profit persistence examination in the Hungarian agriculture. Global Advanced Research Journal of Agricultural Science 8 : 4 pp. 151-158. , 8 p. (2019)

Bareith, T., & Kövér, Gy. (2018): PROFIT PERSISTENCE EXAMINATION IN THE HUNGARIAN AGRICULTURE, In: Pop, Gheorghe; Csata, Andrea; Fejér-Király, Gergely; Kassay, János; Nagy, Benedek; Zsarnóczky, Martin; Pál, László (szerk.) 14th Annual International Conference on Economics and Business: CHALLENGES IN THE CARPATHIAN BASIN : Innovation and technology in the knowledge based economy, Csíkszereda, Románia : Sapientia Hungarian University of Transylvania, (pp. 69-78. , 10 p.

Varga, J., Sipiczki, Z., & Bareith, T. (2017). A magyarországi agrárolló és agrárvállalkozások jövedelmezőségének szektrorális vizsgálata 2005–2015 közti időszakban. CONTROLLER INFO, 5, 343-351.