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THE HISTORY OF RESEARCH ON THE "PIG CYCLE"

Abstract

The subject of the author's considerations is the "pig cycle" phenomenon, which had been first formulated by Samuel Benner in 1895. Since then, the mechanism of the pig cycle has been investigated and discussed by many foreign and Polish scientists. The key fields of American studies on the pig cycle such as: reasons for cyclic development of pig production, cobweb theorem, duration of the cycle and its particular phases, are presented in the article. The results of researches conducted during the last several years are also discussed.

An important part of the article is devoted to the Polish pig cycle in both pre- and post-World War II periods. In the post-war period the researchers who examined the pig cycle problem had to face a difficult question whether cyclic fluctuations of hog production could take place in centrally planned economy.

The article also points out a very practical aspect of the study, related to stabilization of the pig market. Different approaches to agricultural policies in some countries and periods are also presented.

According to the Encyclopaedia of Agribusiness [23], the term "pig cycle" is understood as a "type of fluctuations in pig stocks and production, classified as the so called special cycles, i.e. having their own mechanism". In short, the mechanism is the following: decrease in profitability, i.e. pigs-to-fodder price ratio, causes farmers to lose interest in breeding pigs. As a consequence, the stocks of sows are reduced. In time, it results in decreased stocks of piglets and then fatteners. Thus, the prices increase and the pigs-to-fodder price ratio broadens at the same time. It raises farmers' interest in breeding pigs, manifesting itself in the beginning in the growing demand for piglets and the increase in their prices etc.

This seemingly simple mechanism has been a subject of researchers' inquiry for over 100 years. The first one to note the repeating from time to time low and high prices of pigs and to use the name pig cycle was S. Benner[1]. In 1895 he published a study "Prophecies of Future Ups and Downs in Prices", containing also a prognosis of future pig supply and prices. However, the studies concerning this phenomenon started only twenty years later on a larger scale. At that time, the relations between pigs supply and their prices as well as between pig prices and corn prices[2] were determined by means of the correlation coefficients. The most important work of the pre-war period was "The Cobweb Theorem" by M. Ezekiel[3] published in 1938, where the so called "cobweb theorem" was formulated, generally considered as a theoretical explanation of the phenomenon[4].

In the 1930s, the research on the pig cycle was initiated also in Europe, mainly in Germany[5] and Great Britain [8], but also in Poland. In this case, the study by S. Schmidt and S. Mandecki should be mentioned above all [34]. The authors showed cyclical fluctuations of supply and prices of pigs and fodder on the basis of monthly data from the years 1925-1933 and the 12-month moving average. They indicated the opposed direction of fluctuations, i.e. a negative correlation between pig supply and prices as well as between pig prices and fodder prices. They found that the direct cause of fluctuations in pig supply is the relation of pig prices to rye prices, adding however that the force which starts the cycle is the activity of a producer aiming at achieving the income at a level as high as possible. This is why according to authors "the final source of cyclical economic changes lies in subjective economic attitude of a producer and in his mentality rather than in objective production conditions".

After the II World War, when it seemed that, in principle, all key issues related to the pig cycle, i.e. its existence, reasons for its occurrence and functioning mechanism had been explained long time before, the controversy arose over this phenomenon anew. It resulted from the fact that economic conditions are never at a standstill, and the new reality requires constant verification of opinions. From our point of view, the most interesting literature on the subject was written in this period in the United States and in Poland. In the first case it mainly results from a long-time tradition of the research and interesting achievements on this field. In the second case – from the fact that the research on the pig cycle for a long time had to overcome the barriers of the system which, by its nature, denied the existence of any economic cycles typical to capitalism. It

[1] This fact is mentioned *inter alia*, by S. Schmidt and S. Mandecki [34].

[2] The first one to apply methods of statistical analysis was A. Wallace, then Sarle, Wright, Warren, Pearson and Bean [34].

[3] M. Ezekiel: The Cobweb Theorem. Quart. Jour. Econ. 1938 (quoted by Dean G.W., Heady E.O.: Changes in Supply Response and Elasticity for Hogs. Journal of Farm Economics, vol. 40, nr 4. 1958).

[4] Description of the model is contained *inter alia*, in the work of W. Tomek, K. Robinson [43].

[5] The research on the pig cycle was commenced in Europe by A. Hanau, in the publication: Die Prognose der Schweinepreise [34] and H.E. Buchholz in: Zyklische Preis- und Mengenschwankungen auf Agrarmaerketen [in:] Buchholz H.E., Schmitt G., Woelken E.: Landwirtschaft and Markt.

is worth mentioning that in the modern European literature on economics and agriculture, the research on the pig cycle occupies a modest position, which is by no means related to the weight of the issue. Therefore, the United States is not only a pioneer, but also an unquestionable leader in this research.

Research on the pig cycle in the United States

In the very extensive post-war American economic literature on the pig cycle, there are few areas deserving particular attention. They are as follows: the causes of the pig cycle and their internal or external origin; the cobweb theorem, duration of the cycle and its individual phases; usefulness of the pig cycle mechanism as an instrument of making forecasts, and finally the question which has been arising more often in recent years – whether such an old phenomenon as the pig cycle can occur under the present conditions, characterised by high production concentration and specialisation, popularity of agricultural production contracts, vertical and horizontal integration of the sector etc.?

There are two divergent theories on the origins of the pig cycle. The supporters of the first theory search for the sources of the cycle in external factors, i.e. having no direct association with its mechanism, while the supporters of the second theory – in the nature of the cycle. The former ones claim that pig cycles are caused e.g. by fluctuations in supply of fodder and its prices [36] or by bad policy of a government and the impact of such events on the pig production as wars or elections, which distort the normal system of price relations and cause price fluctuations [9]. The latter ones believe that only internal factors have the impact on the occurrence of the pig cycle. H.F. Breimyer [4] in the discussion on endogenous and exogenous causes of animal cycles stated that the cycle used to begin only as a result of fulfilling the particular conditions of production, such as the length of time necessary for a gilt to reach the breeding age when it was ready to reproduce and the length of the investment period. According to H.F. Breimyer, the direct cause of fluctuations in supply and prices of pigs was the volatility of pigs-to-corn price ratio. He also stated that in the current conditions this relation had even bigger impact on the production than ever, because its volatility was more and more often the result of changes in pig prices and more and more seldom the result of changes in corn prices.

Another approach is presented by authors who believe that both, internal and external factors have their influence on cyclical changes in supply and prices of pigs. For example, A. R. Reddy [32] claims that fluctuations in production and prices of pigs result from the essence of the cycle, but an external factor is needed to start the cycle mechanism. This factor may be for example, the bad weather, which affects the decrease in crop and causes the increase in fodder prices. L.D. Stearns and T.A. Petry [39] claim, that the internal factor responsible for the pig cycle is the time of biological reproduction, whereas the external factors are changes in fodder production, supply of meat on competitive markets as well as economic, social and political factors affecting the demand for pork.

The cobweb theorem is probably the most discussed problem. The period of particular intensification of criticism of this model was the sixties, but essentially the period has lasted so far. The cobweb concept has always raised doubts as to whether a simple cobweb model may faithfully reflect a complex and constantly changing reality. It was believed that more sophisticated econometric models were needed to describe it. As a consequence, many proposals for cobweb model modifications appeared. A. Harlow [14] for example presented a sector model based on four equations of supply, i.e. for the number of pregnant sows, the size of pig farms on the basis of individual farrows, live weight of a pig and supply of pork stock. M. Hayenga and D. Hacklander [15] worked out a model with five equations, two of them pertained to pigs and another two to cattle. Those were equations of average monthly prices of pigs and cattle, pig and cattle slaughters and pig stock. Each of these equations explained five endogenic variables. A. Larson [21] defined the pig cycle as the harmonic motion. In his model the cycles in pig production were strictly connected to the cycles of pig stocks. He applied models explaining the pace of production changes in the description of this phenomenon. M. Jelavich [18] on the other hand developed a model of delayed demand for the estimation of harmonic motion. Another approach was presented by H. Talpaz [45]. He developed a multi-frequency cobweb model. The model he created was a combination of three models, i.e. the cobweb model, the harmonic motion model and the delayed demand model. I.P. Chavas and M. Holt [6] presented a method of non-linear dynamics, used for the analysis of the development of pigs-to-fodder price ratio. They discovered that the pig cycle is chaotic and because of that it cannot be perfectly anticipated. Non-linear dynamic models were presented also by M. Ruth, L.M. Cloutier, Ph. Garcia [33] as well as M.T. Holt and L.A. Craig [17]. On the other hand, J.S. Shonkwiler and T.H. Spreen [37] as well as D.A. Bessler and J.L. Kling [3] apply dynamic autoregressive models to analyse the hog cycle, where among explanatory variables there are also delayed explained variables only.

A discussion about the duration of the cycle and its individual stages as well as practical usefulness of the pig cycle mechanism arose in connection with the research on the cobweb theorem. A. Harlow [14], M. Jelavich [15] and H. Talpaz [42] tried to prove, by means of various statistical instruments, that the pig cycle referred both to the supply and to pig prices lasts for four years. J.S. Shonkwiler and T.H. Spreen, who conducted the spectral analysis of the two periods, i.e. 1946-1962 and 1964-1980, stated that the length of pig cycles was changeable. The four-year cycles were observed most frequently, but the shorter ones – three-year long and the longer ones – even the 7-year cycles – also occurred. R. Plain and J.E. Williams [29] by using weekly data from 1970-1979 for a harmonic analysis, proved that the average length of a pig cycle was even shorter than three years, i.e. it was 2.75 years. G.A. Futrell, D.G. Mueller, G Grimes [12] based their research on a long, over 30-year period of 1950-1986. They conducted an analysis of cyclical fluctuations in production of pigs and their prices. In their opinion, the duration of cycles ranged from three to seven years in the case of pig production. The length of the cycle was usually determined by the duration of an

expansion phase, because the length of a liquidation phase was rather constant and equalled two years. The situation stems form the fact that the expansion phase is determined not only by the profitability level but also by biological aspects of production growth, whereas the fall in the production is determined only by economic factors. The authors also noted that the hog price cycles were shorter than the cycles in hog production. Their length was from one to five years, where the expansion phase lasted usually two years and the liquidation phase one year. L.D. Stearns and T.A. Petry [39] stated that in 1930-1994 the length of the pig cycle oscillated between two and six years. J. Bancroft[6] claims that the length of the cycle is determined by a number of factors, such as corn prices (and therefore fodder prices), pork substitute prices (e.g. poultry meat), the share of the producer price in the retail price of pork, demand for pork and export of pork, production efficiency, production technology, consumers' preferences, impact of unexpected events (such as political decisions), demographic factors (such as the age of pig breeders), competitiveness of pork on the global market.

Most researchers who study the pig cycle are in agreement that the modifications of the cycle result from structural, technological, genetic and other changes in the pig sector. Some of them, like J.E. Dieckhoff [10], claim that the cycles are getting longer. According to J.E. Dieckhoff, the average duration of the pig cycle was five years in the eighties and in the nineties, whereas only three years in the seventies. It results mainly from the genetic progress which allows for longer maintenance of a sow than previously. J.S. Shonkwiler and T.H. Spreen [37] claim, that specialisation in pig production may cause an expansion phase to lengthen, even though it is currently shorter than before. Others however, prove that the cycles are becoming shorter. R.P. Stilman [40] proves, that structural changes in the pigs sector will result in a slow disappearance of the pig cycle. D.J. Hayes and A. Schmitz [16], J. Lawrence [22], J.E. Albrecht [1] put a question whether the pig cycle still exists? Although everyone answers in the affirmative, they cannot hide the surprise at its existence. Hayes and Schmitz regard the pig cycle as a peculiarity which should be eliminated by farmers themselves, who know the price prognoses after all. They add however, that the costs related to obtaining and analysing this information are high and that is why cycles still persist. If this information gets cheaper it can eliminate the cycles.

However B. Buhr [5], D. Kenyon and W. Purcell [19], as well as L.D. Stearns and T.A. Petry [39] and others strongly contradict the opinions on disappearance of the pig cycle. They claim that structural changes in the pig sector have their impact only on the decrease in fluctuations of pig production. However, as the fluctuations in live pig prices are still strong, there is no doubt that the pig cycle persists and it is still taken advantage of in practice. Also G. Grimes [13] expresses his opinion on the subject, that industrialisation of the pig sector and coordination between producers and packaging companies lead to the situation where classic parameters, such as the ratio pigs-to-corn prices are no longer so useful for forecasting supply and prices of pigs as they were before.

[6] Bancroft J.: The Big Hog Cycle – What goes down, must go up? OMAF 2003.

Finally, it has to be stressed that the literature on the pig cycle in the United States is so extensive that it is almost impossible to conduct its full review. Therefore, it was necessary to take into account the selected publications only, mainly more available ones.

Research on the pig cycle in Poland

In the post-war Poland the researchers who investigated the pig cycle above all had to face the problem: whether the cyclic fluctuations in pig production could occur in the socialist planned economy and how to reconcile their potential existence with theoretic foundation of the economy?

According to the Small Economy Encyclopaedia[7], the pig cycle is a phenomenon characteristic of the capitalistic economy, although it can occur on certain conditions under the centrally planned economy. M. Pohorille [30] stated that „until individual farms predominate in agriculture, there will still be the danger of impulsive fluctuations in agricultural production. Pig cycles, being a specific form of these fluctuations, have not been therefore eliminated once and for all as a result of the hitherto transformation of the Polish economy. They can occur anew in certain conditions – in case of weakening of the regulation role of a socialist country in the agricultural products market". At the same time however, the author added that "the impact of the centrally planned economy on the individual agriculture (through contracting, sale of fodder, regulation of piglet prices etc. (...), as well as constant and fast growth of demand for food, create conditions which allow for the elimination of cycles in the breeding of livestock". In view of the above, the collapse of animal production in the end of the fifties was mainly explained by bad administrative decisions [35].

In the sixties Z. Kozłowski [20] proposed a thesis, that fluctuations in pig production occurring in the first 20-year period of People's Republic of Poland had all characteristics of the pig cycle. As he stated, the thesis was not then approved by the agricultural economists' circles. The critics [28] argued that breakdowns in pig production resulted from poor harvests of basic cereals, caused mainly by non-economic factors. Similar thesis to this of Z. Kozłowski was presented by H. Chojnacka [7]. She attempted to prove that regular fluctuations could be observed in the development of pig production, "similar to fluctuations characteristic of the pig cycle". J. Małkowski [24] however, expressed an opinion, that "the essence of cyclic fluctuations is not the fluctuation itself, but its regularity (...). In the post-war fluctuations (...) such regularity cannot be precisely determined". Therefore, in his opinion, the fluctuations were not cyclic. As J. Małkowski [25] stated, the lack of this regularity was manifested itself inter alia, by different duration of both, the expansion phase and the liquidation phase in pig production. The length of the expansion phase ranged from 25-36 months to even 4-5 years, whereas the liquidation phase – from 11--15 months to about 20 months. According to J. Małkowski, the duration of the

[7] Small Encyclopaedia of Economy, Warsaw 1962. Entry "Pig cycles".

liquidation phase in pig production depended on the quick reaction of agricultural policy to this drop. "The quicker the reaction the smaller the drop, and the shorter its duration".

The second important aspect of research on pig cycle concerned the reasons for its occurrence. Z. Kozłowski [20] regarded "pulsation of the fodder basis" as the most important one, i.e. periodical disturbances in the balance between pig production and fodder resources. A. Woś [44] was of a similar opinion; he found the causes of fluctuations in pig production in the sixties in "periodical drops of yields and crops of fodder cereals and potatoes, which together with unstable fodder balance led to the disproportions and the decrease of pig stocks". H. Chojnacka [7] claimed however, that causes of the pig cycle might be different according to economic and social conditions. In the conditions of a classic pig cycle, the original cause of cyclical fluctuations was the imbalance between live pig production and effective demand for it. In socialist conditions however, the cause was the imbalance between the demand for fodder and the actual possibility to satisfy it. The increase in fodder prices is therefore the first market signal of decrease in pig fattening profitability.

J. Małkowski [24, 25] proved groundlessness of the opinion that the sole reason of fluctuation in pig production is fluctuation in fodder production. He claimed that production of cereals and potatoes is not a decisive factor determining the level of pig production. It determines only the possibilities, which are taken advantage of according to the production profitability. In turn, the profitability rate indicates the sensitivity of breeding to fluctuation in fodder production. The lower profitability rate, the higher the sensitivity. Therefore, when the absolute and relative profitability of live pig production is at the high level, the growth in this production is possible even in the conditions of the smaller level of fodder crops. On the other hand, if the profitability is at the low level, then even the slightest decrease in cereals or potatoes crops can cause the drop in pig production. J. Małkowski claimed that the direct cause of fluctuations in pig production is highly variable profitability of this production.

In Polish literature on the subject quite a lot of attention is dedicated to the issue of the leading price in changes of price relation of pigs-to-fodder. The opinions of researchers were rather concurrent on this subject. H. Chojnacka [7] proved that changes of this relation were determined by the fodder price. J. Małkowski expressed the similar opinion [24]. His research proved that the change of profitability level in the socialist economy was more often caused by changes in fodder prices, whereas in capitalistic economy – by changes of live pigs' prices. The following observations supported his opinion. In the economies whose potential for pig production was above the barrier of effective demand, the price of pigs was the driving force for the cyclic motion[8]. In such economies

[8] A reference to the previously mentioned Breimyer's opinion should be made, that volatility of pigs-to--corn price ratio in the United States is more and more often a result of changes in pig prices and less and less often a result of changes in corn prices.

as in Poland during the socialist period, characterised by shortages of a fodder basis, the potential for pig production was below the barrier of the effective demand for meat. Hence the price of fodder affected the change of profitability level more often. J. Małkowski confirmed his thesis by high correlation coefficients between fodder prices and their relation to pig prices as well as low correlation coefficients between pig prices and their relation to fodder prices at the same time.

Most researches, both in Poland and in the world, consider fluctuations in production and prices of pigs to be a disadvantageous phenomenon. That is why the research on the pig cycle has, apart from the theoretical aspect, equally important practical aspect, which deserves special consideration. Since the early 1930s the discussion has been continued in economic and agricultural journals in the United States as well as in the countries of Western Europe about the possibilities to stabilise the pig market. As a result of this discussion, the governments of individual countries adopted various instruments of intervention policy. At first there were only the protection instruments, i.e. customs duties and tariffs, but the next step was made very quickly, which consisted in the organisation of pig and cereal markets allowing for the complex, direct intervention of the state in prices. The intervention purchases were made at guaranteed prices as well as subsidies for export were introduced. Some of these instruments have been applied thus far. However, we observe a process of changing the instruments, i.e. the way in which the national aid is directed to agriculture. The character of state intervention is changing. The transition from direct intervention into indirect intervention is observed, which means that more and more financial transfers are allocated outside the market and the market is affected by their results only. The example of a new approach may be the Canadian Agricultural Income Stabilization Program (CAIS). Generally, it consists in the governmental payments for the producers from 1 to 4 dollars to each 1 dollar in the deposit, depending on the market situation.

In the EU member states the aid for private inventories of pork and the regulations of foreign trade are applied in the form of custom duties and limited import as well as subsidies to export. Also the intervention on the cereal market in the form of intervention purchases at guaranteed prices takes place. Supporting the pig market in the United States looks slightly different. In principle, none of the regulation instruments is applied there on the pig market, except the regulation of import and export credits as well as price forecasts. Additionally, the farmer can conclude a long-term agricultural procurement contract. On the other hand, the cereal market is supported by direct payments.

In Poland, during the whole post-war period, the attempts were also made to counteract fluctuations in pig production by various means. In the centrally planned economy the constant governmental procurement prices of live pigs were periodically set, but it did not stabilise the pig production because costs of raising pigs were volatile. Their volatility resulted in turn from the changeable

cereal production and fodder supply. In the market economy in the pre-accession period the intervention pork purchases were made at the peaks of supply and the pork intervention stocks were sold out at its troughs.

All stabilising activities, both in Poland and in other countries, mitigate the fluctuations in pig prices but do not eliminate them. Pig prices, both in Poland and in the other EU member states, as well as in the United States are highly volatile. Stabilisation activities are sometimes compared to a peculiar roller coaster (McEwan)[9], but others assessed them as an costly struggle with the market (L. Balcerowicz [2]). J.E. Dieckhoff [10] believes that the possibilities for stabilisation are determined only by technological and genetic progress, whereas Clay and Kenyon[10] claim that profit securing strategies, such as long-term contracts, may stabilise production and prices of pork.

On the other hand, the growing concentration of production in certain countries, such as the United States or Denmark, causes the agricultural policy to focus on the environmental protection to a greater extent.

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