Business Cycle in Agriculture in Poland

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Abstract

The main objective of the study was to characterize the business cycle and its particular phases in Polish agriculture and compare with the features of the cycle occurring in theory. The research for the years 2001-2015 which was based on annual real changes in final output allowed to identify three full cycles in Polish agriculture: 1) 2001-2006; 2) 2007-2010; 3) 2011-2015. The analysis of fluctuations showed that all cycles lasted from 4 to 6 years. Growth phases took from 2 to 4 years, and all downward ones lasted 2 years. The amplitudes of these phases were similar. There were both turning points and turning zones in the cycles. The analysis of accumulated dynamics of production, income, prices and investments in particular phases of the business cycle in Polish agriculture shows that in each growth phase all categories have increased. In almost all cycles, the dynamics of these categories in the growth phase was greater than the changes during the downturn. According to the theory of the classical cycle, the value of production as well as agricultural prices changed the most. They had negative dynamics in almost every downward phase. On the other hand, the dynamics of agricultural incomes was positive in all downward phases. Therefore, changes in this category in most cases had the features of the modern cycle. Changes in investments in the downward phases were diversified. The analysis of dynamics indicates that agricultural income and investments in Poland was also affected by the Common Agricultural Policy.

Key Words

business cycle; agriculture; final output; income; prices; investments

1 Introduction

Cyclical fluctuations are one of the characteristics of the modern economy. They also apply to its specific sectors, including agriculture. Despite the fact that the developed states purses the stabilization policy based on many instruments, changes of the main categories may have a surprising and significant impact on the functioning of business entities, including agricultural holdings. Knowledge about the causes, mechanisms and consequences of changes in the economic situation in agriculture is important both for the entities as well as agricultural policy makers. It allows farms to take into account cyclical fluctuations in their operation strategies. It also allows to search for the instruments that limit the risk. For the agricultural policy it enables better selection of tools and the period of their application. It also contributes to a better understanding of existing restrictions.

Research on the cyclicality of agriculture, in comparison to the analysis of other sectors, is quantitatively significantly smaller. In developed countries, this is due to the small share of agriculture in the creation of domestic production and more complex processes taking place in this sector. Ball et al. (2014) analyzed the relationship between the business cycle and the convergence of levels of agricultural efficiency in the US. Da-Rocha and Restuccia (2006) assessed the impact of share of agriculture in the economy on cyclical fluctuations in particular countries. They also compared fluctuations in production and employment in agriculture and in the entire economy. However, the analysis of how globalization affects the synchronization of cycles, also in agriculture, is included in the work of Kose et al. (2003). In Poland, Jędruchniewicz (2018), Seremak-Bulge (2017) and Walczyk and Szajner (2016) focused on determining and describing the phases of the recovery and downturn in agriculture. Czyżewski and Majchrzak (2017) assessed changes in the total productivity of production factors in these phases. On the other hand, the works of Maśniak (2015) and Grzelak (2013a) concern the relations between the agricultural situation and the entire economy.

The study is of empirical character. Its main purpose is to characterize the business cycle and its particular phases in Polish agriculture and compare with the features of the classic and modern business cycle. The characteristic will be carried out through the dynamics of the main categories in agriculture, i.e. production, income, prices and investments. The research tries to expand the existing in literature knowledge in the field of referring identified cycles to the theoreti-

cal description as well as assessment of cumulative changes in selected categories in particular stages of the cycle.

2 Classic and Modern Business Cycle

In general, the business cycle can be defined as relatively regularly recurring changes in economic activity. Therefore, they do not display a simple regular character. Due to the irregularity of changes in product size, modern economics has generally given up attempts to interpret fluctuations as a combination of deterministic cycles of different lengths (ROMER, 2011). However, cycles are characterized by a fixed scheme of changes.

In literature, classic and modern economic cycles can be distinguished (STOCK and WATSON, 1999). The differences between them are pointed out. On the other hand, ROMER believes that the economic fluctuations in the period before the Great Depression and after World War II did not differ significantly. The reason for the differences are serious errors in the estimates of the main macroeconomic statistical series (ROMER, 2011).

The definition of the classic cycle was formulated by BURNS and MITCHELL (1946: 3): "*Business cycles are a type of fluctuation found in the aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle*". Such a cycle consists of four clearly separated phases. They were called differently by economists. In the classic cycle, the basis for phase separation and analysis is the general direction of changes in business operations. Therefore, the production volume is used in absolute terms. In total, during the recovery and expansion phases, production and other categories increase while during recession and depression all categories fall. The turning points in the discussed cycle are generally sharp and clear. The amplitudes and lengths of the growth and downward phases are similar. The phase lengths amount to 4-6 years. The classic cycle is generally characterized by symmetry (see BARCZYK and KOWALCZYK, 1993).

An analysis of production cyclicality based on absolute quantities, as it is in the classic cycle, is im-

possible when real production is still increasing on an annual basis in the long run. This was the case in the German economy after the Second World War and is currently in Poland. MINTZ (1972: 41) proposed a new cycle name and definition based on production growth rates: "*Growth cycles are fluctuations in aggregate economic activity. A growth cycle consists of a period of relatively high growth rates occurring at about the same time in many economic activities, followed by a period of similarly widespread low growth rates which merges into the high-growth phase of the next cycle*".

The modern cycle is based on the analysis of relative changes in production volume. The criterion for separating the phases in the growth cycle is the relation of the rate of change in production to the normal or average rate. There is the domination of appointing of only two phases. Sometimes, however, these phases are divided into more detailed periods (RUTH et al., 2006). During a time of prosperity, production, prices and revenues grow faster than in a downward phase. These categories definitely do not fall even in this last phase. However, investments may fall due to their specificity and place in the production structure (see GARRISON, 2001).

In the modern cycle, turning points are often replaced by turning zones. The growth phase amplitude is greater than the one of the downward phase. The phase lengths are also different. The growth phase lasts 2-3 years, while the decline phase 1.5-2 years. The modern cycle is generally characterized by asymmetry (see BARCZYK and KOWALCZYK, 1993). The frequency of this cycle is higher than of the classic cycle, which is due to the fact that the growth cycle is shorter than the classic cycle.

3 Data and Methods

The study of cyclical fluctuations of main categories in agriculture was carried out for the period of 2001-2015. At that time, three full business cycles in Polish agriculture were distinguished. The data used in the study come from the Statistical Yearbook of Agriculture of the Central Statistical Office in Warsaw and scientific publications.

In the analysis of the presented problem, method of analysis of subject literature, verbal logic, method of comparison of economic category dynamics and statistical measures were used. The dynamics comparison method was used to assess the differences in the rate of category changes in particular phases of the

agricultural business cycle. Statistical measures were used to examine the changes and variability of the analyzed categories.

The characteristic of the business cycle in Polish agriculture mostly depends on its duration. The determination of time intervals of these cycles and their phases was made on the basis of the annual dynamics of final agricultural output (FAO) in real terms. "*Final agricultural output is the sum of the following values: market output, own consumption of agricultural products from own production increase in inventory products of plant and animal origin and the increase in farm animal stocks (livestock – the basic and working herd). Final output, as opposed to the gross output, does not include those products from own output that were utilised for production purposes, e.g. feed, sown material, manure.*" (CSO, 2017: 69). This category was adopted as the basis for the cycle extraction because it is much wider than the gross value added. The changes in final production are less dynamic, because it captures only a small part of the elements constituting intermediate consumption. Large changes in the entire intermediate consumption would have a significant impact on fluctuations in gross value added in agriculture, while changes in the value of agricultural production would be smaller and even reversed. The specificity of agriculture makes final production a category that more accurately reflects the actual cyclical fluctuations in this sector. For the analysis, the data showing annual production are used. This is a low frequency of data. However, there is no data concerning final production of agriculture in quarters. This production was used and not the opinions of farmers and other ancillary categories because it represents the actual and therefore objective value generated by agriculture.

In the study of the cycle in agriculture in Poland, two phases of the cycle were distinguished: the growth phase, which is a period of prosperity, and the downward phase, which a period of an economic downturn. Elimination of random changes was made by calculating the moving average. The weighing scheme with weights: 0.6 for the current year and 0.2 for the previous and subsequent years was used. This average smoothed out the original data. Then, from the moving average calculated in this way using the Hodrick-Prescott filter (λ=10,000), the trend was removed. This procedure allowed to isolate the cyclical component of annual changes in final production of agriculture. It was the basis for determining the length of cycles and individual phases.

In the article, the full business cycle in agriculture is set out from the beginning of the growth phase to the end of the downward phase. Therefore, turning points or turning zones were appointed (see LUBIŃSKI, 2004; BARCZYK, 2000-2001). The bottom of the cycle was determined when the dynamics of production was clearly the lowest. The bottom of the cycle was included in the downward phase. In the next year, the cycle goes into a growth phase. The top of the cycle is clearly situated at the highest point. The peak of the cycle was included in the growth phase. Further, the economic situation is entering into a downward phase. Turning zones were designated when the extreme dynamics of production in more than one year were similar. As the end of the growth phase, the last year of the upper turning zone was recognized. The same was done for the downward phase. Individual phases were determined when specific production changes lasted more than a year.

Agricultural income used in the analysis is gross disposable income. "Is obtained as a result of correcting grossprimary income by: current taxes on income, wealth, etc., net social contributions, social benefits (i.e. social security benefits and other social benefits) as well as transfers." (CSO, 2017: 55). The analysis of price dynamics concerns the prices of global production of agriculture. They present in a synthetic way changes in prices of sold agricultural products. Price gap constitutes the ratio of price index of sold agricultural products to price index of purchased goods and services. While "Investment outlays are financial or tangible outlays, the purpose of which is the creation of new fixed assets or the improvement (rebuilding, enlargement, reconstruction or modernization) of existing capital asset items as well as outlays on so-called initial investments." (CSO, 2017: 50).

4 Results and Discussion

4.1 Cyclical Fluctuations in Agricultural Output

The analysis of the original time series shows that the dynamics of final agriculture output in particular years was variable. These data also show that cyclical changes can be isolated from them (Figure 1). A longer period on the figure than the years studied allows for showing cyclical changes in a broader perspective. The highest FAO increment occurred in 2001 (8.6%) and similar in 2004 (8.0%). On the other hand, the biggest decrease was in 2005 (-4.4%). In years 2001-

Figure 1.   The annual dynamics of final agricultural output, the moving average and cyclical component (in %)
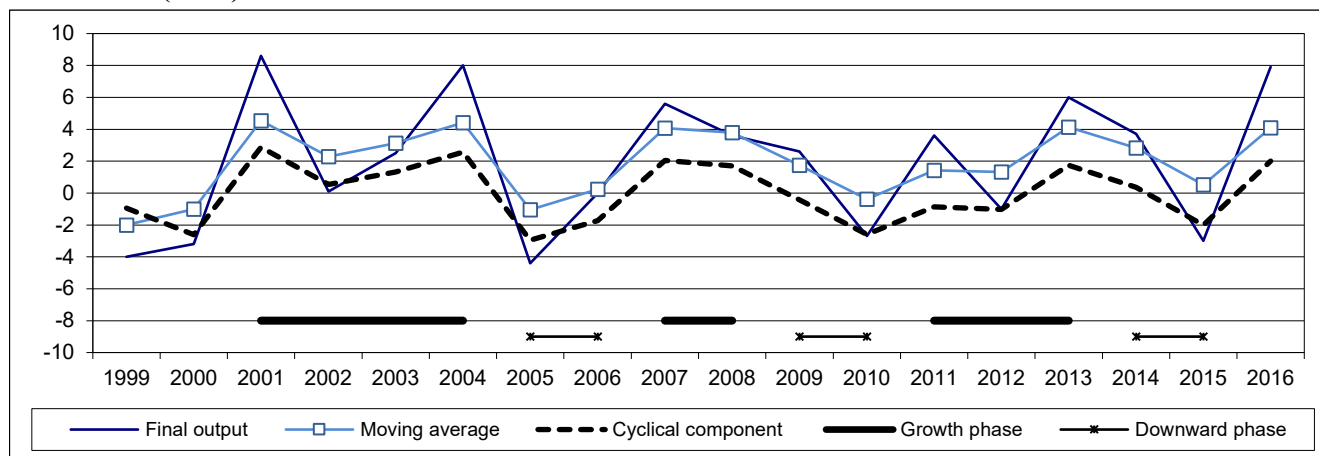
Source: author's calculations based on CSO (2001-2017)

2015, the average dynamics of production amounted to 2.2%, and the standard deviation was 4.0 percentage points. The coefficient of variation was at the level of 1.8. The standard deviation of the cyclical component of final agriculture output was much smaller. It amounted to 1.9 percentage points.

The use of statistical methods for separating cycles and adoption of specific assumptions regarding dating of the beginning and end of phases means that the obtained results are always sensitive to how the analysis is being conducted. This is also the case with the method described and used here. The basis for determining the length of the growth and downward phases, and thus the entire cycles, is the cyclical component of changes in final agriculture output. In the analyzed years, on this basis, starting from the first growth phase, three full business cycles in Polish agriculture were identified: 1) 2001-2006; 2) 2007-2010; 3) 2011-2015 (cf. JĘDRUCHNIEWICZ, 2018; SEREMAK-

BULGE, 2017; WALCZYK and SZAJNER, 2016; GRZELAK, 2014; GORZELAK and ZIMNY, 2012).

The lengths of all three cycles based on FAO were similar. They took 4-6 years (Table 1). The first cycle lasted the longest and the second one was the shortest. In two cycles, the growth phase was longer than the recession phase. However, in one cycle, they were identical (2 years). The growth phases in each cycle lasted a different number of years, i.e. from 2 to 4. While the downward phases always lasted the same (2 years). First and third cycles were similar in terms of the duration of the individual phases, and hence the length relation between them. The occurring asymmetry of the agricultural business cycle in Poland is also confirmed by the GRZELAK studies, which concern the years 2002-2013. "*Their asymmetry is noteworthy - the growth phase lasted longer, while the downward trend was usually more violent and lasted relatively shorter.*" (GRZELAK, 2014: 70-71).

Table 1.   Features of cycle of the final agriculture output in Poland

Cycle and phase	Period	Cycle duration and phases in years	Amplitude of actual production (in ppt)	Amplitude of cyclical component (in ppt)
Cycle	2001-2006	6	-0.4	-0.5
the growth phase	2001-2004	4	12.6	5.4
the downward phase	2005-2006	2	13.0	5.9
Cycle	2007-2010	4	1.7	0.4
the growth phase	2007-2008	2	10.0	5.0
the downward phase	2009-2010	2	8.3	4.6
Cycle	2011-2015	5	-0.3	0.6
the growth phase	2011-2013	3	8.7	4.3
the downward phase	2014-2015	2	9.0	3.7

Source: own study based on the CSO (2003-2017)

Fluctuations in final agriculture output in terms of the length of cycles and phases had most often the features of the modern business cycle. Due to the longer growth phase than the downward phase, the first and third cycles also corresponded to the modern cycle. However, the symmetrical relation of phase length in the second cycle makes it similar to the classic cycle.

Using the cyclical component to determine the end of phases, turning points as well as turning zones were used. In the first and second cycle, turning points (2004 and 2010) and turning zones (2005-2006 and 2007-2008) occurred simultaneously. Therefore, these cycles in terms of this feature, cannot be clearly included in any type of cycle. Whereas the last cycle had only turning points. It met then the requirements of the classic cycle.

The cycle amplitude based on the original data was positive in one instance. However, in two cycles there was a negative amplitude. The inverse proportion was when the amplitude was calculated only for the cyclic component. A feature of the analyzed fluctuations was a large symmetry between the growth and downward phases in this regard. The amplitudes of all cycles were close to zero. It was the largest in years 2007-2010 (1.7 pp), and the smallest in years 2011-2015 (-0.3 pp). Similar amplitudes of the growth and downward phases make the three cycles consistent with the concept of the classic cycle.

The annual dynamics of production is important. However, in the analysis of cyclical fluctuations, the changes taking place in the entire growth phase and throughout the downward phase of the cycle are crucial. The results of the research on changes in the final output of Polish agriculture in particular phases in three cycles presented in Figure 2 show that in each growth phase there was an overall increase in production. This increase, except from the first cycle, oscillated around 10%. However, in each phase of the economic downturn, cumulative changes in real production values have decreased or been close to zero. In the first cycle, the decrease was 4.4%, while in the second and third changes were minimal. Such changes in the downward phase indicate a gentle adaptation of the final agricultural output to worse periods following the growth phase. Such gentle adaptions were influenced by many factors: in the downturn phases, there were years in which the absolute decreases in production did not occur; there was no recession in the entire Polish economy, only an economic slowdown (see BARCZYK, 2018; PIŁAT, 2017); in the agriculture of the European Union strong interventionism is applied, which reduces the decrease in agricultural production (SOBIECKI, 2015).

Strong increases in FAO during the phase of better economic condition and small decreases in the worse period mean that throughout the analyzed period of 2001-2015 there was a significant increase in agricultural production. For this sector, it was a very positive time in terms of changes in production (see NOWAK and WÓJCIK, 2013, POCZTA et al., 2009).

Figure 2. **Accumulated dynamics of the final agricultural output in the cycle phases (in %)**
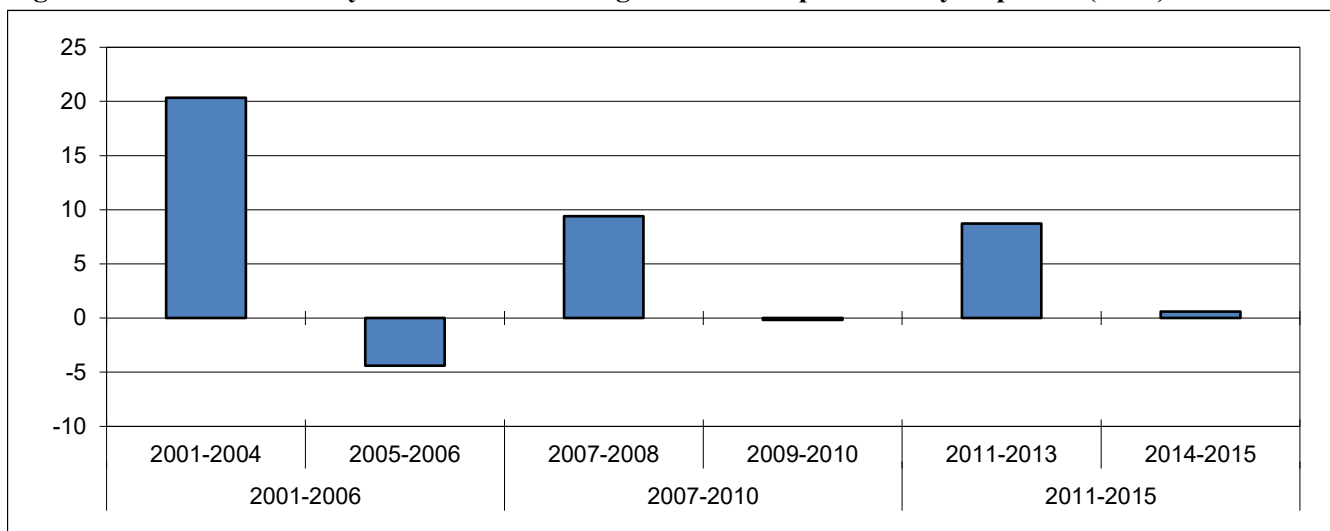
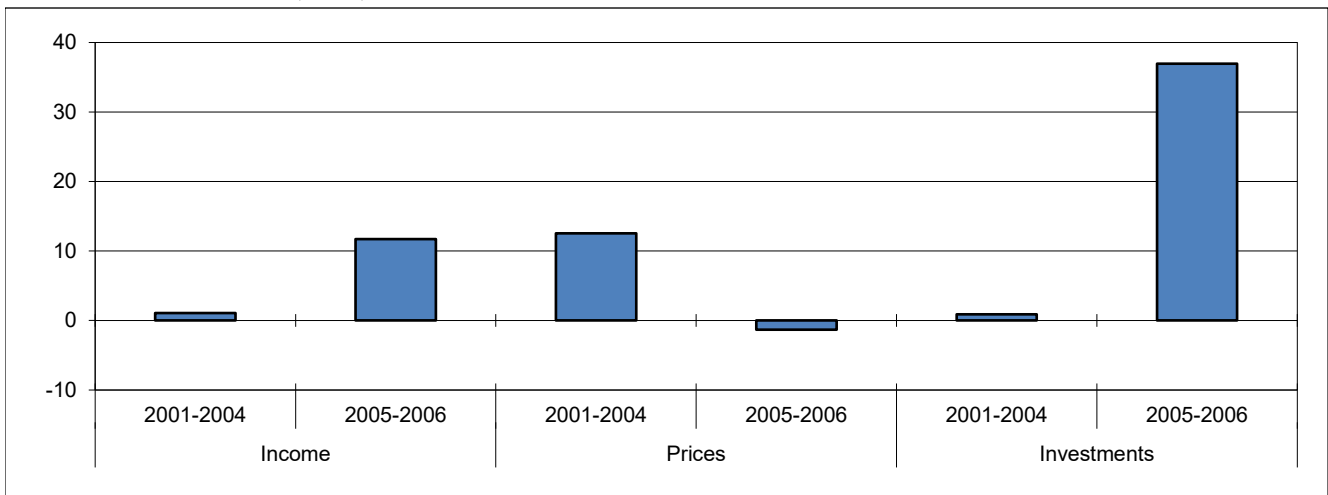Source: author's calculations based on CSO (2003-2017)

5 Characteristics of the Cycle in Agriculture between 2001-2006

In 2004, Poland together with other countries was admitted to the European Union. Agriculture was a sector for which accession meant the biggest changes. During this year, the peak of the cycle in Polish agriculture of years 2001-2006 also occurred. In the growth phase of 2001-2004, the cumulative dynamics of real gross disposable income in private farms in agriculture amounted only to 1.1% (Figure 3). The annual drop in real income occurred in 2002 and 2003. It was caused, among others, by unfavorable for agriculture price relations of products sold and purchased (Figure 4). In turn, in 2004, this income in-

creased by 6%. This was mainly connected with the implementation of the Common Agricultural Policy (CAP) of which the basic element are direct payments. These data indicate that without the EU support it would be difficult to increase the income of Polish farmers even in the favorable economic conditions of the entire economy. The fragmented area structure, growing production costs, low labor and capital productivity as well as insufficient investment expenditures contributed to a small increase in farm incomes (see ZEGAR, 2008).

The accession had a particular impact on the dynamics of categories in agriculture during the downturn of 2005-2006. At that time, the total increase in real disposable income was 11.7%, on average 5.7%

Figure 3. Accumulated dynamics of the main categories of Polish agriculture in cycle phases of 2001-2006 (in %)

Source: author's calculations based on CSO (2003-2008)

Figure 4. Price gap in Polish agriculture and price indices of products sold and purchased by farms in 2001-2006 (previous year = 100)
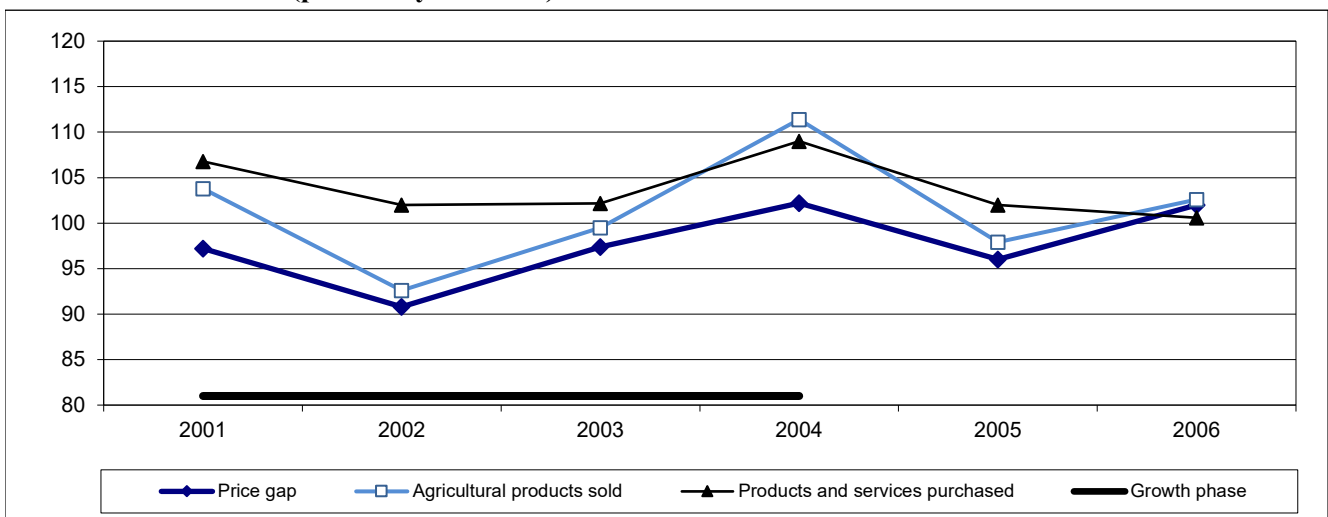
Source: author's calculations based on CSO (2003-2008)

annually. In one year, the increase in farm income was, therefore, larger than in the whole preceding growth phase. Real income in agriculture also grew the fastest in the economy. Thus, already in 2006, this income exceeded 80% of the income of households of employees (CSO, 2008). The main reason were, obviously, EU direct payments supplemented by subsidies from the national budget. Farmers' income in more than half began to depend on public funding. The introduction of such strong interventionism fundamentally changed the dynamics of agricultural incomes, which would occur in the decreasing phase in market conditions. Therefore, the real dynamics of this category was so different from what the theory of the agricultural business cycle says. *"The basic feature of the business cycle in agriculture, which distinguishes it from other industries, is a significant reduction of agricultural commodities prices and farmers' incomes in time of crisis (...)"* (STĘPIEŃ, 2015: 33). Additional favorable factors were: a strong increase in the export of Polish agri-food products (on average by 27.5% annually) and in 2006, favorable for agriculture, price gap.

Differently than changes in income, and to a large extent in accordance with the classic theory of cyclical fluctuations, changes in prices of global agricultural production occurred in the phases of cycle (Figure 3). In the growth phase, prices increased by 12.6% in total, while in the downward phase they decreased by 1.3%. The highest price increase occurred in 2004 (15.3%). In the growth phase, the average annual price increase was five times greater than the average decrease during the downturn. The strength of the drop in prices in this period does not confirm the above theoretical approach that the decline in prices of agricultural commodities is significant at that time. It is difficult to recognize the decline in agricultural production prices in Poland in 2005-2006 as large. It is rather symbolic, as for the entire downward phase. The reduction of price drop on agricultural markets was mainly due to state interventions and a good situation in the entire economy.

The impact of Poland's accession to the EU was most visible in unusual changes of investment outlays that took place in the phases of the analyzed cycle in agriculture (Figure 3). In the growth phase, that is within 4 years, investments increased less than symbolically (by 0.9%). During this time, the final production of agriculture increased by 20.3%. The reasons for such low dynamics of investment in Polish agriculture were: slight increase of income for farms,

limited amount of preferential loans, poor use of EU programs and unfavorable price gap for agriculture in 2001-2003 (Figure 4). However, in the downward phase, the overall investment dynamics was 37%, which is 17% on average annually. It was therefore multiple times larger than in years of prosperity. Such dynamics was primarily influenced by CAP instruments and programs, and not by the general economic situation in agriculture (see KULAWIK, 2016). Since 2004, the income situation of farms has improved. However, a key factor was the Sectoral Operational Program 2004-2006. The farms tried until the end of 2006 to benefit from the investment subsidy. That year, the estimated share of EU funds in financing investments in agriculture amounted to 59.3% (GRZELAK, 2013b).

6 Processes Occurring in Cycle of 2007-2010

Changes in income, prices and investments of Polish agriculture in particular phases of cycle of this sector occurring in 2007-2010 were in line with the general theoretical characteristics of the behavior of these categories in the business cycle. In the growth phase, the real gross disposable income of farms increased overall by 7.9%, which is 3.9% on average annually (Figure 5). However, this was less than in the preceding phase during the economic downturn of 2005-2006. In 2007, farmers' income increased by 10.1%. In turn, 2008 was the only year after accession to the EU when farm income decreased (by 2%). In the downward phase of this cycle, real income of farmers increased symbolically (by 0.1%) despite the unfavorable economic situation in the entire economy. This is in line with the theory of the modern cycle as income in this period has relatively decreased compared to the period of better economic situation. The reasons for the lack of an absolute drop in income include: direct subsidies, exceptionally favorable for agriculture price gap in 2010 and a strong increase in exports of agri-food products this year, which was driven by a significant depreciation of the zloty in the previous year.

"In 2007, market conditions were particularly favorable for agriculture." (SEREMAK-BULGE, 2008: 3). This was reflected in the dynamics of prices of global agricultural production. This year they have increased the most in the entire analyzed period (by 18.3%). This was favored by: an increase in agricultural prices on global markets, stagnation of production in the

Figure 5.   Accumulated dynamics of income, prices and investments of Polish agriculture in the cycle phases of 2007-2010
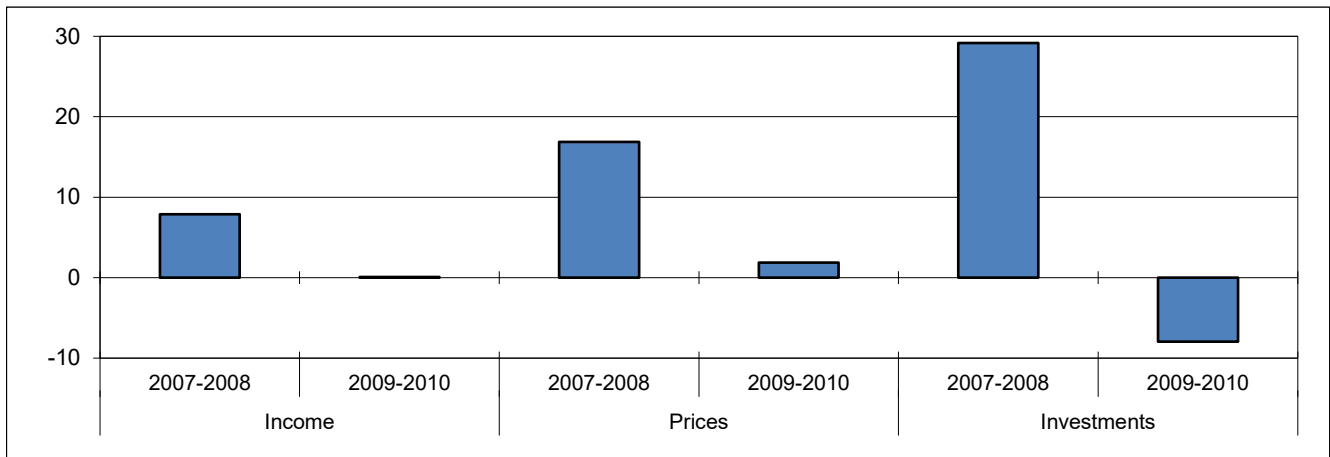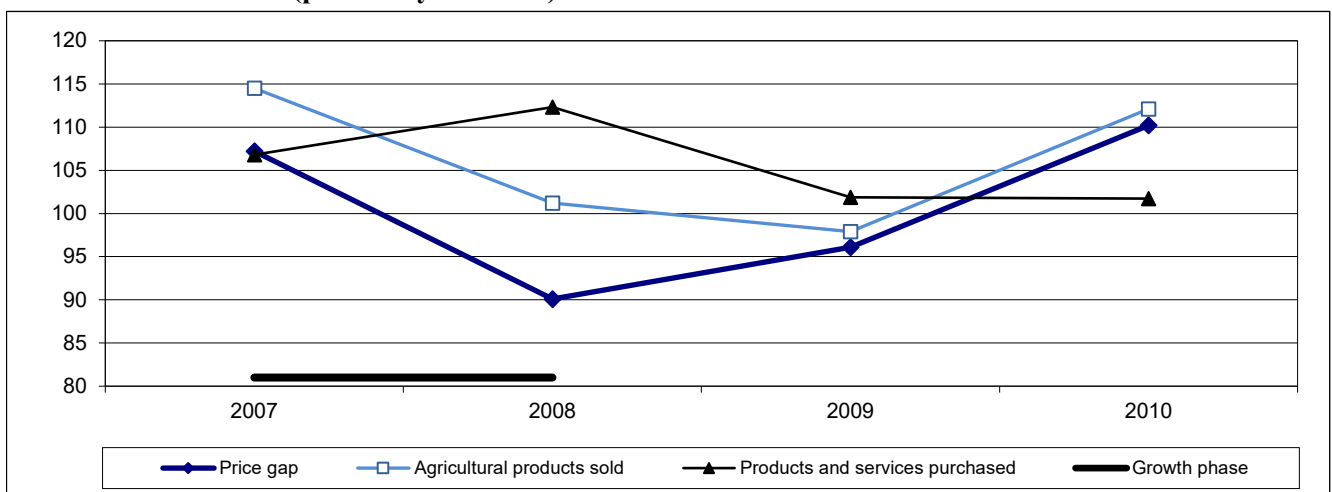

Source: author's calculations based on CSO (2009-2012)

previous year and a good economic situation in the entire economy. However, in 2008 due to the deterioration of the situation in the global and domestic economy caused by the crisis and good harvests in the previous year, agricultural prices decreased by 1.2%. In the entire growth phase, prices increased by 16.9% (Figure 5). The dynamics in this phase of the economic situation was greater than the dynamics in the period of worse economic conditions. At that time, the price dynamics was also positive. It was due to state interventions on agricultural markets and the improvement of the market situation in 2010. These changes do not confirm the theoretical description of the agricultural cycle according to which during the recession the prices of agricultural commodities are significantly reduced (STĘPIEŃ, 2015). It is also worth

noticing that during the downward phase of the analyzed cycle, as well as in this phase of the previous cycle, prices have absolutely risen in the last year (see TOMEK and ROBINSON, 2003). This proves a rapid response of agricultural prices to the emerging demand growth at the end of the recession period.

In years 2007-2010, the average annual price gap ratio amounted to 100.9. The prices of sold agricultural products increased on average by 6.4%, and the prices of goods and services purchased by farmers for the purpose of current agricultural production and investments by 5.7% (Figure 6). In terms of price dynamics, it was a positive period for agriculture. GRZELAK (2013a) came to similar conclusions. Although the average price gap were small, the period was characterized by exceptionally high volatility.

Figure 6.   Price gap in Polish agriculture and price indices of products sold and purchased by farms in 2007-2010 (previous year = 100)

Source: author's calculations based on CSO (2009-2012)

This increased the uncertainty of production in this sector (HAMULCZUK, 2014). In 2008, which was the last year of the growth phase, price gap reached the lowest level (90.1) in the whole period of 2001-2015. However, in 2010, which was the last year of the downward phase, their level in the analyzed years was the highest (110.2). The main reason for such changes was the crisis in the global economy and a relatively fast growing demand for agricultural products afterwards.

Accumulated changes of investments in particular phases of the cycle in Polish agriculture of 2007-2010 ran inversely than in the phases of the first cycle. They were in line with the theoretical characteristics of changes in this category during cyclical fluctuations. In the growth phase, investments increased while in the downward phase they decreased (Figure 5). The total investment increase in 2007-2008 amounted to 29.2%. Such dynamics was encouraged by market conditions as well as agricultural support policies. The most advantageous for this sector was 2007. At that time, investments grew the most (18.3%). The following factors contributed to this: an increase in income, prices and exports of agricultural products, a continuation of the favorable trend of price gap and a good situation in the entire economy in Poland (see KUSZ and GĘDEK, 2015). Also this year, a new EU program, RDP 2007-2013 has started. The operation "Modernization of agricultural holdings" significantly supported agricultural investments. However, in years 2009-2010 investments were limited by a total of 8.0%, which is much less than increased previously. From this period, the most unfavorable for agriculture was 2009. In this year, the impact of the global crisis on the entire economy and

agriculture has already been significant. Agricultural prices and exports decreased, farmers' income stagnated, the unfavorable tendency of the price gap index continued. In 2010, the investment dynamics was already slightly positive.

7 Changes in Agriculture in 2011-2015

In 2011-2013 conditions were favorable for agriculture, and the best was 2011.*"In 2014, the market conditions of agricultural production clearly deteriorated compared to the previous year. They were also worse than two years ago, although much better than during the crisis in 2008."* (SEREMAK-BULGE, 2015: 3). In this and in 2015, the special condition was the embargo imposed by Russia and other countries in connection with political problems and the outbreaks of African swine fever (ASF) occurring in Poland. Also 2014 was the time of entering agriculture into a period of recession.

In the entire growth phase, real disposable incomes in agriculture increased by 7.6%, that is on average, 2.4% annually. The most significant increase was in 2013 by 4.6%. There was no year in this phase that income would have decreased. During the downturn, they also increased (by 3.4%) (Figure 7). The dynamics of real farm incomes was characterized by high stability. This means that the situation on global agricultural markets as well as in the entire Polish economy had a limited impact on the changes of this category. Income of farmers grew even when in 2012-2015 price gap were unfavorable for this sector. They depended to a large extent on direct payments. In this

Figure 7. **Accumulated dynamics of income, prices and investments of Polish agriculture in the cycle phases of 2011-2015**
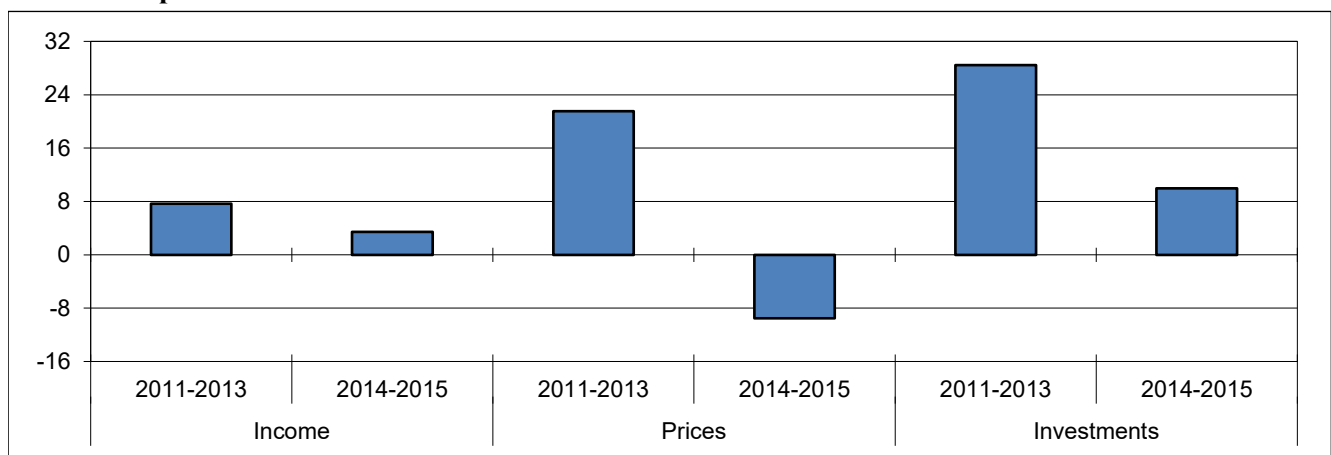
Source: author's calculations based on CSO (2013-2017)

cycle, changes in income corresponded to the theory of the modern cycle. Their cumulative and average increase in the growth phase was larger than the increase in the downward phase.

In the analyzed cycle, unlike in the previous cycle, the dynamics of agricultural production prices in Poland was entirely consistent with the theory of classic cyclical fluctuations. In the growth phase, prices increased by 21.5%, while in the downward phase they decreased by 9.5% (Figure 7). The reasons for such changes were, on the one hand, growing domestic and foreign demand for agricultural commodities, and on the other, price declines in global markets, better harvests and imposed embargoes. The recurring regularity concerning prices in three agricultural cycles was their increase in each growth phase. The prices grew within the limits of 12.6%-21.5%. This is confirmed by MAŚNIAK'S research (2016).

In 2011-2015, the average annual price gap index amounted to 99.7. The prices of sold agricultural products on average increased by 2.7%, and prices of goods and services purchased by farmers for the purposes of current agricultural production and investments by 2.9%. In the growth phase, in almost all years the price gap index was below 100 (Figure 8). Thus, it affected adversely the situation of farms. The trend of this indicator was accurately assessed by ZIĘTARA (2009: 6) that *"The occurring tendencies are characteristic for all countries with a market economy. They have the character of timeless regularities and cause a decrease in the unit profitability of agricultural production."* An important source of improving the economic and financial situation of Polish agriculture was the Common Agricultural Policy.

In 2011-2015, farm investment increased each year. In the growth phase, the accumulated increase amounted to 28.4%, which is on average 8.7% annually (Figure 7). It was a high average dynamics, but much smaller than in the growth phase in the previous cycle. On the other hand, investment changes differed during the downward phases. In 2014-2015, their increase was 9.9%, while in the previous phase they declined. The investment volatility has clearly increased.

Farms mostly invested in machinery, equipment and tools as well as buildings. A part of the investment had an obligatory character resulting from the fulfillment of the requirements of environmental and animal welfare. In the analyzed cycle, they increased investments when the price gap index was unfavorable for agriculture. Therefore, same as in case of agricultural incomes, the main factor determining the increase of investment outlays in this sector was the EU financial support. In these years, the RDP 2007-2013 has been replaced by the RDP 2014-2020 program.

8 Conclusion

The research conducted in the study of years 2001-2015 which was based on annual real changes in final output allowed to identify three full cycles in Polish agriculture: 1) 2001-2006; 2) 2007-2010; 3) 2011-2015. The analysis of fluctuations showed that all cycles lasted from 4 to 6 years. Growth phases took from 2 to 4 years, and all downward ones lasted 2 years. Due to the length of the growth and downward phases, the first and third cycles corresponded to the modern

Figure 8. **Price gap in Polish agriculture and price indices of products sold and purchased by farms in 2011-2015 (previous year = 100)**
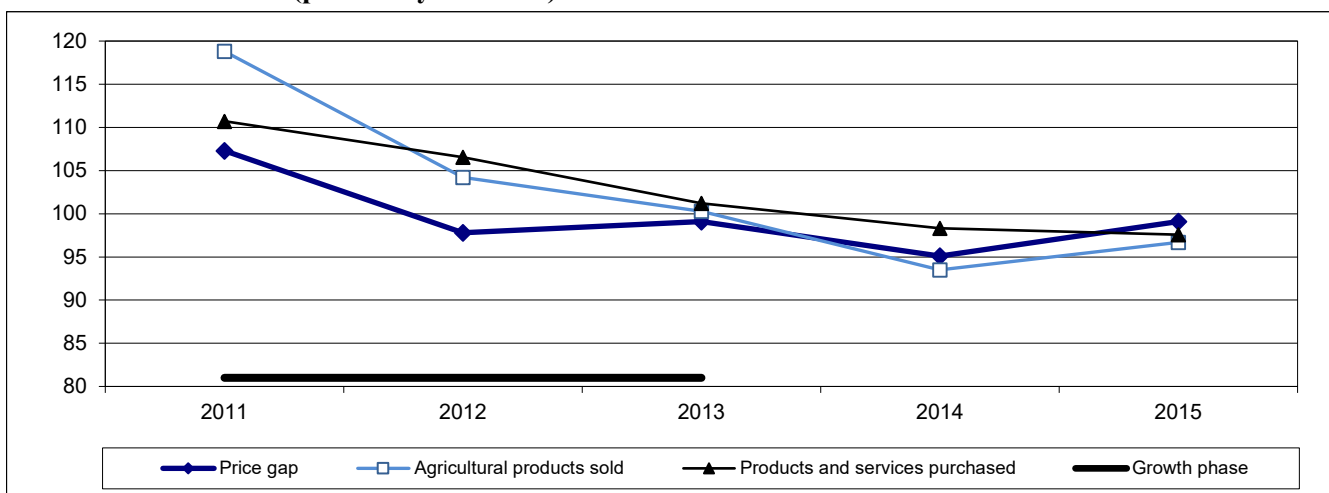
Source: author's calculations based on CSO (2013-2017)

cycle, and the second to the classic cycle. In terms of amplitude, the analyzed cycles were characterized by a large symmetry between the growth and downward phases.

The analysis of accumulated dynamics of production, income, prices and investments in particular phases of the business cycle in Polish agriculture shows that in each growth phase all categories have increased. In almost all cycles, the dynamics of these categories in the growth phase was greater than the changes during the downturn. The value of agricultural production and prices changed the most which is in line with the theory of the classic cycle. In each growth phase these categories increased, while in almost every downward phase they decreased. The value of production slightly increased only in the period of recession in years 2014-2015, whereas prices only in years 2009-2010. This means that these categories are strongly dependent on market conditions. Due to them, for the entire studied period the average price gap were unfavorable for farmers. The dynamics of agricultural incomes was positive in all downward phases. Therefore, changes in this category in most cases had the features of the modern cycle. On the other hand, changes in investments in the downward phases were diversified. Poland's accession to the EU was a factor strongly disrupting income and investment behavior in the period of the economic downturn of 2005-2006. At that time, these categories grew at a much larger rate than in the growth phase. The analysis of dynamics in various phases of the cycle indicates that agricultural income and investments in Poland was also affected by the Common Agricultural Policy.

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