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## Cyclical or countercyclical nature of prices and wages in the euro area

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### Abstract

**Aim/purpose** – The aim of the undertaken research is to analyse the interdependencies between cyclical changes in consumer prices, production prices, wages and production in the euro area in the period Q1.2010-Q3.2017.

**Methodology** – A literature review in the field of macroeconomics and international finance and statistical and econometric methods were used in this study.

**Findings** – The hypothesis that prices on the market follow the changes in the business cycle is a central aspect in research on business cycles. The results of the conducted research suggest no occurrence of the cyclical phenomenon of consumer prices, producer prices and wages in the examined period of time.

**Research implications** – The findings of the research are extremely important especially from the European Central Bank monetary policy point of view. The lack of cyclical changes in inflation, production prices and wages can lead to asymmetric monetary policy reaction to fluctuations in economic activity.

**Originality** – To date, no comprehensive research has been conducted into the phenomenon of price and wage cyclicity in the euro area. Therefore, this research fills the existing gap in this area, constituting a significant contribution to empirical research in the field of price cyclicity.

**Keywords:** prices, wages, business cycle.

**JEL Classification:** E31, E32, F44.

## 1. Introduction

The business cycle is usually defined as periodic fluctuations of aggregated economic values. Burns & Mitchell (1946) argue that the business cycle consists of successive phases of recovery, expansion, depression and recession. This sequence of events is repetitive, but not periodic. The duration of the cycle varies and ranges from one to ten, and sometimes even twelve years. In turn, Lucas (1977) and Kydland & Prescott (1990) define the business cycle as the deviation of aggregated real output from the trend.

The business cycle usually includes four phases: recovery, boom, slowdown, recession (Kydland & Prescott, 1990). The slowdown is a sign of a decline in general economic activity. This phase is characterised by investment inhibition, a fall in demand, and a fall in prices and interest rates. It is a time that is worth 'waiting' investing in money markets and in fixed-rate government bonds.

The recession is the lowest point in the cycle at which the level of economic activity stops falling and stabilises at a low level for some time (e.g. for several months). At this stage, unemployment is rising, living standards are falling, property prices are falling, access to credit is limited. Interest rates are still low. Investing, e.g. in gold or high-quality assets, whose valuation is crisis-proof, becomes attractive.

In the next phase, which is recovery, processes take place in the opposite direction. Prices and economic activity are slowly beginning to rise, and low interest rates are still dominating the market and beginning to affect investment growth. The strategy for this phase is investing in overpriced stocks of companies or raw materials.

The recovery goes to the peak of the boom economy. This phase is characterised by an increase in interest rates, easier access to financing and high asset prices, such as company shares, real estate, raw materials.

According to Lucas (1972), understanding the essence and course of the business cycle in the economy is the starting point when constructing the appropriate stabilisation policy of the country. Developing countries are different from highly developed economies with many elements, including the course of cyclical fluctuations. In developing countries, the cycles are shorter, hence it is necessary to modify the filtration procedure customarily used in industrialized countries.

Attempts to explain existing relationships between real and nominal variables are nowadays an important source of debate among economists. The procyclical price formation, commonly assumed by economists, though somewhat paradoxical, is analysed and explained using various macroeconomic models.

The conducted research in many cases presents evidence contrary to the generally accepted assumption about the cyclical nature of prices. These results, although difficult to explain with the use of standard business cycle models, are trying to relate to demand and supply shocks emerging in economies.

The hypothesis that prices on the market follow the changes in the business cycle is a central aspect in research on business cycles. In fact, this assumption is present in both classical and Keynesian models explaining the interdependencies between the business cycle and selected macroeconomic variables. The basic argument in favour of this hypothesis is the dominance of aggregate demand shocks over changes in aggregate production in the short term, as well as the occurrence of delays in adjusting inflation expectations to changes in supply and demand in various markets. In classical models, the rate of adjustment of inflation expectations is determined by the time when inflation increases accompanied by the increase in domestic production (Male, 2010).

Therefore, the purpose of the undertaken research is to analyse the interdependencies between cyclical changes in consumer prices, production prices, wages and production in the euro area member states (19 countries) in the period Q1.2010-Q3.2017. The article attempts to verify the hypothesis according to which the cyclicity of prices and wages occurs in the euro area – in accordance with theoretical assumptions adopted in the economic literature. Thus, this research fills the existing gap in this area, constituting a significant contribution to empirical research in the field of price cyclicity. The results of the research carried out are of key importance from monetary policy of European Central Bank point of view. In the paper was used a research method based on literature studies in the field of macroeconomics and international finance as well as statistical and econometric methods.

The results of the most important empirical studies on the cyclicity of prices and wages in highly developed and developing countries are presented in the first part of the paper. Then the methodology of the research is presented and the results of the author's research on the discussed issues are considered. Furthermore, in the last part of the paper are presented the most important conclusions resulting from the conducted research and the implications for the monetary policy of the central bank.

## 2. Literature review

An economic variable is pro-cyclical if its deviations from a trend are positively correlated with deviations from a trend in real GDP. Negatively correlated deviations generate a countercyclical variable, while variables which are neither procyclical nor countercyclical are called acyclical.

Generally speaking, the results of empirical analyses concerning the cyclical fluctuations in highly developed economies indicate the occurrence of the following regularities (Male, 2010):

1. There are persistent fluctuations in real output and fluctuations in the real exchange rate.
2. There is a similar variation in net production, consumption and exports, while the investment variability is 2-3 times higher, and the variability of government expenditure is lower by half.
3. There is a relatively stable relationship between production, consumption and inflation.
4. Consumption, investment, employment and inflation are pro-cyclical.
5. Real wages are pro-cyclical, while prices are anti-cyclical.

However, research carried out among developing countries indicates the following regularities (Male, 2010):

1. Business cycles are much shorter and more volatile than in industrialised countries.
2. Production is characterised by greater volatility than in economically developed countries, while consumption is characterised by greater volatility than production, which is different in relation to economically developed countries.
3. Consumption, investment and real wages are pro-cyclical, which is in line with what is observed in industrialised countries.
4. Prices are not countercyclical, and inflation is not pro-cyclical.
5. There is no strong relationship between government spending and domestic production.

Kydland & Prescott (1990) analysed the price cyclical behaviour phenomenon by examining the correlation of real gross domestic product (GDP) with the consumer price index (CPI) and real GDP with the gross national product deflator (GNP) in the USA in the period 1954-1989. These economists revealed the existence of a significant negative correlation between GDP and all price indices analysed, which indicated the existence of price countercyclicality. Studies con-

ducted by Cooley & Ohanian (1991) also confirmed the negative correlation between price changes and the course of the business cycle in the USA in the period 1948–1987. The calculated correlation coefficient between general price changes and production level was  $-0.67$  and after the trend was removed using the Hodrick–Prescott filter, the coefficient was  $-0.07$ .

On the other hand, Wolf (1991) analysed price developments in the USA in the conditions of changes in the business cycle in the period before and after 1973. The results of his research revealed the occurrence of the phenomenon of cyclical prices before 1973 and the occurrence of the phenomenon of anticyclicity of prices after 1973. Kim (1996) obtained similar results of his research. He revealed the existence of a negative correlation of consumer prices with the business cycle and a positive correlation of the inflation rate with the cyclic component of domestic production in Korea and Taiwan in the period 1995–1996. Thus, the results of the research confirmed the occurrence of the countercyclicality of consumer prices and cyclicity of inflation. Furthermore, Lee (2004) studied the interdependencies between domestic production and prices in Canada in the 20th century using the GARCH conditional correlation model. The results of the analysis confirmed the existence of significant interdependencies between the mentioned variables, but they changed significantly, in particular after 2000. What is more, the correlation coefficient between production and price dynamics changed its sign from positive to negative after 1970.

Tawadros (2010) obtained different results than the economists mentioned above. He analysed the cyclical changes in real prices and wages in Australia, using quarterly observations in the period 1984–2008. Research results show that both prices and real wages are pro-cyclical, suggesting that the change in labour demand is greater than the change in labour supply, which leads to pro-cyclical real wages, even when prices are pro-cyclical. This statement about pro-cyclical real pay is in line with the theorem formulated by theoreticians studying business cycles. Macchiarelli (2013) received similar results of the analysis to Tawadros; he conducted research on the synchronisation of inflation and GDP in the context of regional economic integration among the seven countries of Central and Eastern Europe in the period 1995–2010, obtaining ambiguous results of the analysis. Namely, cyclical changes in inflation were revealed only in five of the analysed countries (Poland, Lithuania, Latvia, Estonia, and Romania). What is more, in the case of Poland, Latvia, and Hungary, there was no similarity in inflation and production changes compared to the euro area member states.

In turn, Konstantakopoulou, Efthymois, & Kollintzas (2009) studied the phenomenon of the cyclicity of prices and the cyclical rate of inflation in nine OECD countries using quarterly data from the period 1960-2004. The results of the conducted research revealed the occurrence of anticyclical price phenomenon and the phenomenon of cyclical inflation in the countries studied. Considering the fact that the inflation rate is a temporary derivative of the price level, the difference in the obtained results of the analysis deserves attention. Analogous test results were obtained by Haslag & Hsu (2012) who studied the interdependencies between the business cycle and prices as well as the business cycle and inflation in the USA in the period 1947-2012. The results of the study confirmed the existence of a negative correlation between cyclical components of prices and production and a positive correlation between cyclical components of inflation and production in the USA. Furthermore, research conducted by Li (2015) on the cyclical behaviour of price levels and inflation rates in the United States in the period 1959-2013 confirmed the existence of a negative correlation between the cyclical components of the level of prices and production and the existence of a positive correlation of inflation and the business cycle. Thus, it meant that the price level was anti-cyclical, while inflation was cyclical. Similar research was carried out by Mazumder (2014) who investigated the interdependencies between profit margins of enterprises and individual phases of the business cycle in the industrial sector in the USA in the period 1960-2007. Thus, in this case, only price formation was not examined in the different phases of the business cycle, but changes in production costs in the conditions of changes in the business cycle were also taken into account. The conducted research revealed relatively high anti-cyclical profit margins of American industrial enterprises. What is more, it was revealed that anti-profit profit margins concerned mainly those enterprises that specialised in the production of non-durable consumer goods.

Moreover, research on the phenomenon of cyclical wages was carried out by Gu, Prasad, & Moehle (2018), who analysed the cyclicity of total labour costs, both wage and non-wage in the USA in the period 1982-2014. The research results revealed that the total labour costs were countercyclical, especially since the financial crisis in 2008. The above regularity applied to both real wages and non-wage labour costs, which turned out to be contrary to the so-called standard approach, according to which pro-cyclical wages are assumed in the economy. Moreover, the countercyclical nature of real labour costs was higher when the production price index (PPI) was used instead of the consumer price index (CPI) as a price deflator.

The research carried out by Jędruchiewicz (2018) showed that the changeability of wages in Lithuania in the period 2004-2013 was the highest in sectors and industries such as mining and quarrying, manufacturing of base metals and fabricated metals and production of the most durable consumer goods. What is more, due to credit expansion during the expansion phases, wages in the sectors mentioned increased most rapidly, but during the recession phases, the decrease in wages was always the most dynamic in these sectors and industries.

All the presented results of empirical research indicate the importance of making a clear distinction between inflation and the cyclical component of the price level when reporting and interpreting stylised facts regarding business cycles. Presented above empirical findings do not take into account a potentially important factor that could lead to cross-country differences in the adjustment of real prices and wages over the business cycle. This factor is the nature of shocks because the adjustment of real prices and wages over the business cycle depends on the nature of the shock. Namely, supply shocks lead to mainly pro-cyclical changes of prices and wages, but demand shocks lead to counter-cyclical responses of prices and wages (Jędruchiewicz, 2018).

It should also be emphasised that measuring real prices and wages cyclical-ity at the macroeconomic level remains essential for understanding the aggregate business cycle movements. In the absence of microeconomic level data that are both adequately comparable among countries and cover long time periods, cross-country comparisons of real prices and wage cyclical-ity are only possible using macroeconomic data. The empirical studies presented in this paper indicate that the difference in existing estimates of real prices and wages cyclical-ity is not only due to differences across data and methods used. Those studies confirm that the cyclical-ity of prices and wages varies significantly across countries.

### **3. Research methodology**

In order to determine the correlation between changes in the economic situation, prices and wages in the euro area, it is necessary to distinguish cyclical changes in production and prices from a development trend. For this purpose, the Hodrick–Prescott filter is used in studies, which assumes that the cyclic component of a given variable is the difference between its current value and the trend value, which is the weighted average of past, present and future observations (Hodrick & Prescott, 1997). Then the price elasticity index for changes in the economic situation is defined as the percentage change in the deviation of

prices from the trend in relation to a one per cent change in the deviation of domestic output from the trend. In order to analyse the correlation between cyclical changes in production and consumer prices, producer prices and wages in the euro area, three models are used in this study, presenting the following equations:

$$cpi_t = \alpha + \sum_{i=1}^k \delta_i cpi_{t-1} + \sum_{i=1}^k \beta_i y_{t-1} + \varepsilon_t \quad (1)$$

where:

$cpi_t$  – cyclical changes in consumer prices (consumer inflation) in period  $t$ ;

$Y_t$  – cyclical changes in domestic production in period  $t$ ;

$\beta$  – coefficient of elasticity of consumer prices for changes in the economic situation.

$$ppi_t = \alpha + \sum_{i=1}^k \delta_i ppi_{t-1} + \sum_{i=1}^k \beta_i^* y_{t-1} + \varepsilon_t \quad (2)$$

where:

$ppi_t$  – cyclical changes in production prices (producer inflation) at the end of  $t$ ;

$Y_t$  – cyclical changes in domestic production in period  $t$ ;

$\beta^*$  – elasticity coefficient of production prices for changes in the economic situation.

$$w_t = \alpha + \sum_{i=1}^k \delta_i w_{t-1} + \sum_{i=1}^k \beta_i^{**} y_{t-1} + \varepsilon_t \quad (3)$$

where:

$w_t$  – cyclical changes in wages in period  $t$ ;

$Y_t$  – cyclical changes in domestic production in period  $t$ ;

$\beta^{**}$  – wage elasticity coefficient for changes in the economic situation.

All time series used in the models have a quarterly frequency and cover the period from the first quarter of 2010 to the third quarter of 2017. Then, the inter-relationships between cyclical price changes as well wages and cyclical changes in production are analysed using one of the most frequently used methods of causality analysis in Granger's econometrics. Its main assumption is the fact of a cause-and-effect consequence, according to which if the effect occurs in period  $t$ , the cause appears in the period  $t-k$ . The variable  $x$  is the cause in the Granger sense for the variable  $y$  if the current value of variable  $y$  can be predicted with greater accuracy using the previous values of  $x$  rather than without them, with the remaining unchanged information (Maddala, 2008).

The next step in the analysis is to determine the stationarity of the analysed time series. For this purpose, an extended Dickey–Fuller test – ADF (Augmented Dickey–Fuller) was used. In the case of stationary variables (the integration  $raw$  is 0), the model of vector autoregression (VAR – Vector Autoregression

Model) is used to analyse the correlation between cyclical changes in consumer prices, production prices, wages and production in the euro area (Sims, 1980). This approach was first used by McCarthy (1999), examining the various macroeconomic interdependencies in the member countries of the Organization for Economic Cooperation and Development (OECD). In the VAR method, the phenomenon is analysed using a system of equations, which, according to Sims' postulate, eliminates the problem of exogenous explanatory variables simultaneously.

The analysis assumes specific periods of time delay between the explanatory variables and the explained variable. The selection of delays is made in accordance with the results of the information criteria of the Akaike, Schwartz–Bayesian and Hannan–Quinn models.

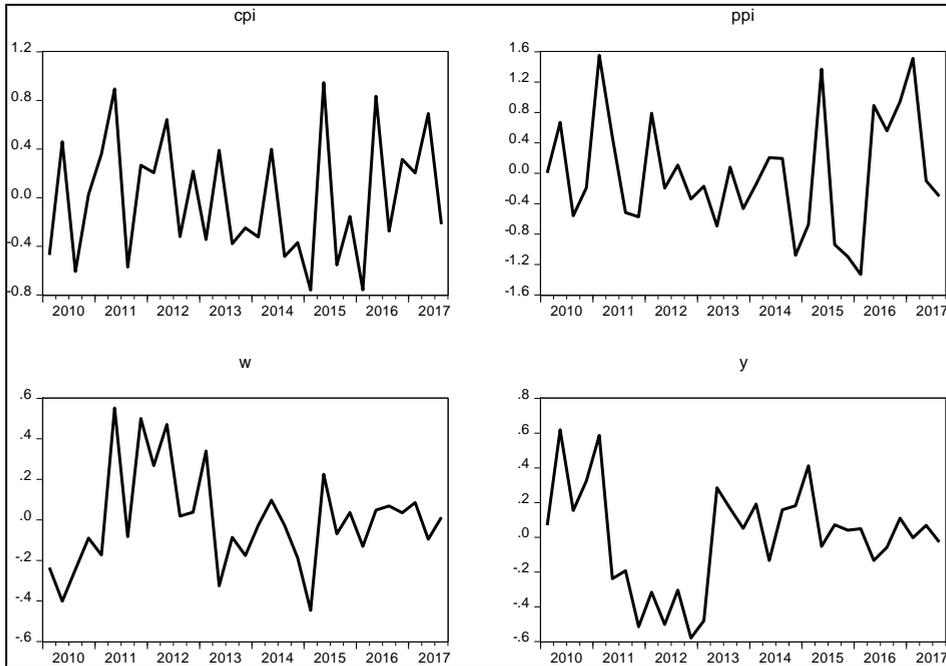
The next stage of the analysis is the measurement of the impact of cyclical changes in production on the cyclical changes in consumer prices, production prices and wages in the euro area. This measurement is carried out using the so-called impulse response function. This function determines the dynamic (time-resolved) reaction of the  $i$ -th endogenous variable in the VAR model to the disturbance of the  $j$ -th random component.

The final stage of the analysis is the decomposition of variance of the residual component. This procedure allows determining what share shocks influencing each of these variables contribute to explaining the variance of individual model variables. In other words, using the decomposition of variance, the percentage share of each of the individual shocks (variance disturbances) is measured in explaining the variability of individual variables of the model.

#### **4. Research findings**

In the euro area, relatively significant cyclical changes in consumer prices, production prices, wages and production took place in Q1.2010–Q3.2017. At the same time, it should be noted that the cyclical changes in production were relatively larger than the cyclical changes in wages, and these, in turn, were greater than the cyclical changes in production and consumption prices (Figure 1).

**Figure 1.** Cyclical changes in consumer prices, production prices, wages and production in the euro area in the period Q1.2010-Q3.2017 (in%)



Source: Own calculations based on the OECD database.

The absolute value of correlation coefficient between the cyclical changes in consumer prices and cyclical changes in production was 0.17, which indicated a relatively small linear relationship between the analysed variables. Therefore, on this basis it was possible to suppose in fact, the lack of occurrence and the cyclical nature of consumer prices in the euro area. A similar situation occurred in the case of correlation between cyclical changes in production prices and cyclical changes in production in the euro area. In this case, the correlation coefficient amounted to less than 0.08, which indicated a lack of occurrence of the cyclicity of production prices in the euro area. However, the absolute value of the coefficient of a correlation between the cyclical changes of wages and cyclical production was 0.78 at this time which could suggest the occurrence of the cyclical nature of the wages in euro zone (Table 1).

**Table 1.** Absolute values of correlation coefficients between cyclical changes in consumer prices, production prices, wages and production in the period Q1.2010-Q3.2017

Variable	CPI	PPI	W	Y
CPI	1	0.58	0.45	0.17
PPI	0.58	1	0.23	0.08
W	0.45	0.23	1	0.78
Y	0.17	0.08	0.78	1

In turn, the results of the Granger causality test carried out in fact showed that there was no significant relationship between cyclical changes in consumer prices, production prices, wages and cyclical changes in production in the euro area. On the basis of the results obtained, it can be concluded that there were no grounds to reject the null hypothesis, according to which cyclical changes in production did not cause cyclical changes in consumer prices, production prices and wages in the euro area in Q1.2010-Q3.2017. The calculations also showed that there were no grounds to reject null hypothesis, according to which cyclical changes in consumer prices and production prices they did not cause cyclical changes in production in the euro area. At the same time, it was found that the cyclical wages were a factor which to a large extent determined the cyclical changes in the production in the euro area in the period Q1.2010 Q3.2017 (Table 2).

**Table 2.** Results of Granger's causality tests

<b>Null hypothesis:</b>	<b>obs</b>	<b>F-Statistic</b>	<b>Prob.</b>
y is not the cause of cpi in the Granger's sense	29	0.40442	0.6718
cpi is not the cause of y in the Granger's sense		0.94213	0.4037
<b>Null hypothesis:</b>	<b>obs</b>	<b>F-Statistic</b>	<b>Prob.</b>
y is not the cause of ppi in the Granger's sense	29	0.17521	0.8403
ppi is not the cause of y in the Granger's sense		0.59339	0.5604
<b>Null hypothesis:</b>	<b>obs</b>	<b>F-Statistic</b>	<b>Prob.</b>
y is not a cause of w in the Granger's sense	29	0.54985	0.5841
w is not the cause of y in the Granger's sense		2.81071	0.0800

Note: Lags – 2 quarters.

Similar conclusions can be drawn after estimating equations (1), (2) and (3) using the autoregression vector model. The calculated elasticity coefficient of cyclical changes in consumer prices for production cycles lagged by two quarters and turned out to be statistically insignificant, which proved that there was no cyclical phenomenon of consumer prices in the euro area in a short period of time. However, there was a significant and negative impact of cyclical changes in consumer prices on cyclical changes in production in the euro area (Table 3).

**Table 3.** Results of the estimation of the equation (1)

Variable	CPI	Y
CPI(-1)	-0.277911 (0.20869) [-1.33173]	-0.098923 (0.10544) [-0.93818]
CPI(-2)	0.122140 (0.20977) [0.58225]	-0.137656 (0.10599) [-1.29877]
Y(-1)	0.241119 (0.36668) [0.65757]	0.300747 (0.18527) [1.62327]
Y(-2)	-0.302835 (0.35456) [-0.85412]	0.188074 (0.17915) [1.04983]
C	0.008958 (0.09263) [0.09671]	-0.022870 (0.04680) [-0.48862]
R-squared	0.175210	0.330502
Adj. R-squared	0.037745	0.218919
Sum sq. resids	5.956326	1.520619
S.E. equation	0.498177	0.251712
F-statistic	1.274579	2.961937
Log likelihood	-18.19801	1.599364
Akaike AIC	1.599863	0.234527
Schwarz SC	1.835603	0.470267
Mean dependent	0.000433	-0.023676
S.D. dependent	0.507854	0.284811
Determinant resid covariance (dof adj.)		0.013807
Determinant resid covariance		0.009456
Log likelihood		-14.71313
Akaike information criterion		1.704354
Schwarz criterion		2.175835

Note: Standard error in () and statistic-t in [].

Similarly, the estimated elasticity coefficient of cyclical changes in production prices for cyclical changes in production lagged by two quarters and was statistically insignificant, which proved that there was no occurrence of the phenomenon of cyclical producer prices in the single-currency area in a short period of time. It was also revealed that there was no significant impact of cyclical changes in production prices on cyclical changes in production in the euro area (Table 4).

**Table 4.** Results of the estimation of the equation (2)

Variable	PPI	Y
PPI(-1)	0.112395 (0.19666) [0.57153]	-0.066659 (0.06230) [-1.06999]
PPI(-2)	-0.221927 (0.19769) [-1.12259]	0.018484 (0.06263) [0.29515]
Y(-1)	0.327923 (0.56851) [0.57682]	0.382984 (0.18010) [2.12653]
Y(-2)	-0.092560 (0.57111) [-0.16207]	0.199121 (0.18092) [1.10058]
C	-0.021023 (0.14962) [-0.14051]	-0.022426 (0.04740) [-0.47315]
R-squared	0.080696	0.311962
Adj. R-squared	-0.072521	0.197289
Sum sq. resids	15.57168	1.562729
S.E. equation	0.805494	0.255174
F-statistic	0.526679	2.720448
Log likelihood	-32.13251	1.203284
Akaike AIC	2.560863	0.261842
Schwarz SC	2.796603	0.497583
Mean dependent	-0.023267	-0.023676
S.D. dependent	0.777784	0.284811
Determinant resid covariance (dof adj.)		0.042228
Determinant resid covariance		0.028922
Log likelihood		-30.92263
Akaike information criterion		2.822250
Schwarz criterion		3.293732

Note: Standard error in () and statistic-t in [].

Different conclusions can be drawn after estimating equations (3) using the autoregression vector model. The calculated elasticity coefficient of cyclical changes in wages to cyclical changes in production lagged by two quarters and turned out to be statistically insignificant, which indicated a lack of occurrence of the cyclical nature of wages in the euro area in a short period of time. At the

same time, there was a strong and negative impact of cyclical changes in wages on cyclical changes in production in the euro area (Table 5).

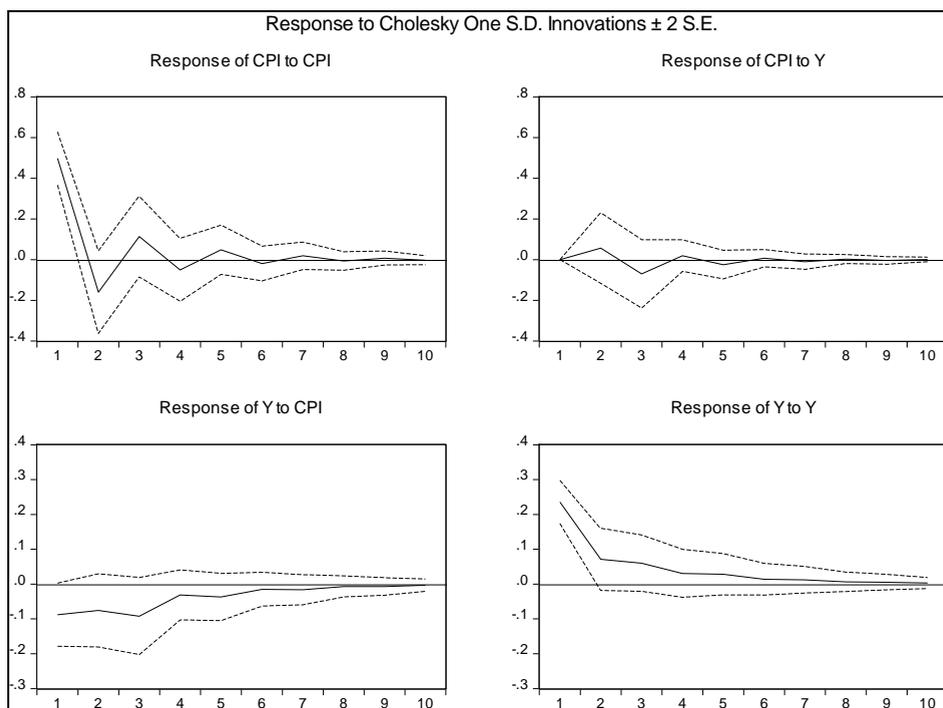
**Table 5.** Results of the estimation of the equation (3)

Variable	W	Y
W(-1)	-0.088444 (0.30716) [-0.28795]	0.022197 (0.31394) [0.07070]
W(-2)	0.531888 (0.27975) [1.90131]	-0.675051 (0.28593) [-2.36092]
Y(-1)	-0.151136 (0.27530) [-0.54899]	0.386536 (0.28138) [1.37372]
Y(-2)	0.251166 (0.24436) [1.02785]	-0.252318 (0.24976) [-1.01025]
C	0.021246 (0.04281) [0.49632]	-0.021738 (0.04375) [-0.49682]
R-squared	0.177376	0.414969
Adj. R-squared	0.040272	0.317463
Sum sq. resids	1.271961	1.328772
S.E. equation	0.230214	0.235299
F-statistic	1.293733	4.255861
Log likelihood	4.188452	3.554877
Akaike AIC	0.055969	0.099664
Schwarz SC	0.291710	0.335404
Mean dependent	0.021940	-0.023676
S.D. dependent	0.234994	0.284811
Determinant resid covariance (dof adj.)		0.001287
Determinant resid covariance		0.000881
Log likelihood		19.69448
Akaike information criterion		-0.668585
Schwarz criterion		-0.197104

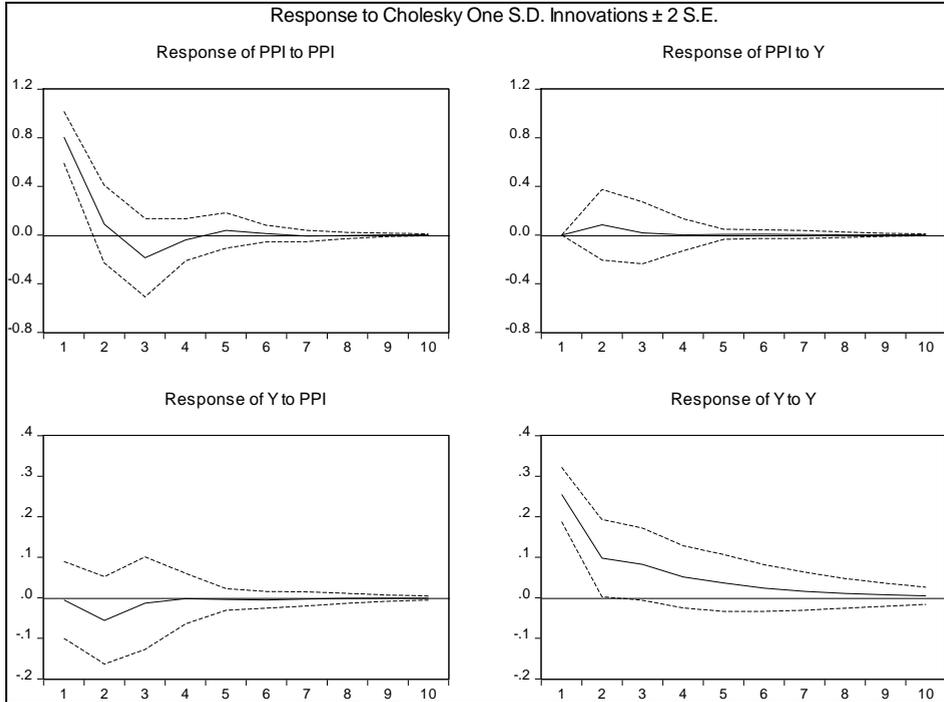
Note: Standard error in () and statistic-t in [].

The next stage of the analysis was to measure the impact of cyclical changes in production on the cyclical changes in consumer prices, production prices and wages in the euro area in period Q1.2010-Q3.2017 using the so-called impulse response functions (Figure 2).

**Figure 2.** Impulse response function for the equation (1)

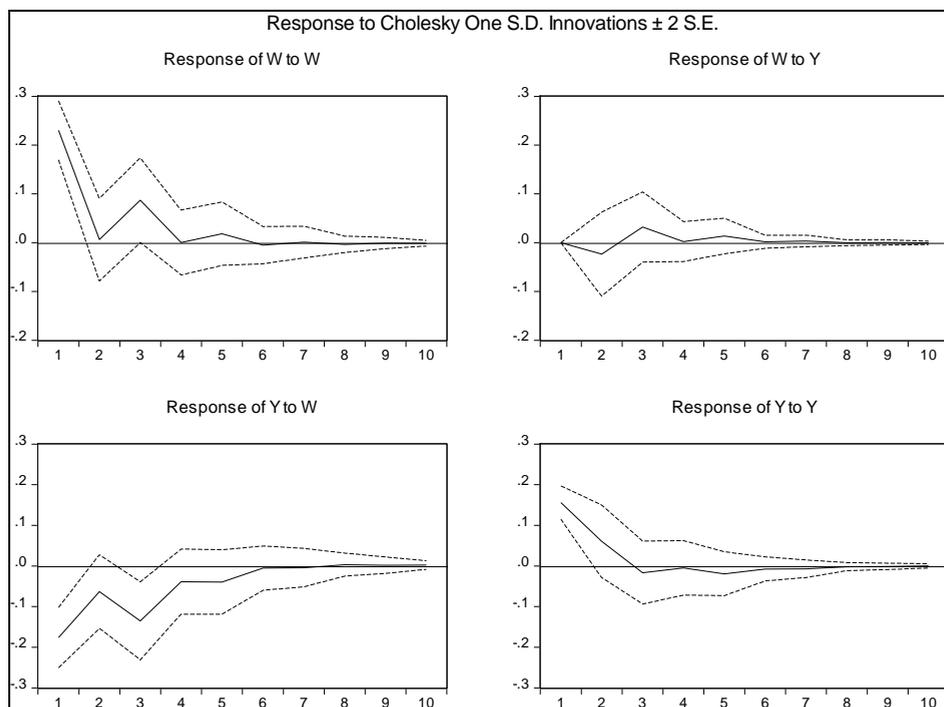


Based on the above figures, it can be noticed that the shock increase in cyclical production led, in principle, to relatively small changes in cyclical inflation within ten consecutive quarters since the appearance of the shock change. Thus, the thesis was confirmed that there was no cyclical occurrence of consumer prices in the euro area in the analysed period. At the same time, it is possible to indicate a relatively strong reaction of cyclical production to cyclical changes in consumer prices within ten consecutive quarters from the moment of the appearance of a shock change of a given factor (Figure 3).

**Figure 3.** Impulse response function for the equation (2)

In turn, analysing the above figures, it can be seen that the shock increase in cyclical production led to slight changes in cyclical production prices within ten consecutive quarters since the appearance of a shock change in cyclical production. Therefore, this meant that there was no occurrence of the cyclicity of producer prices in the euro area in the analysed period of time. Similarly, the issue was related to the impact of cyclical changes in production prices on cyclical production in the euro area (Figure 4).

**Figure 4.** Impulse response function for equation (3)



However, analysing the above figures, it can be noticed that the shock increase in cyclical production led to relatively small changes in cyclical wages within ten consecutive quarters since the appearance of a shock change in cyclical production. This meant that there was no occurrence of the cyclical nature of wages in the euro area during the period considered. However, one can notice a relatively strong reaction of cyclical production to changes in cyclical wages in the euro area.

The next step in the analysis was decomposition of variance of the residual component. In this case, the variance of cyclical variations in consumer prices, production prices and wages was carried out to estimate the impact of changes in the analysed factors (lagged cyclical changes in consumer prices, producer prices, wages and output) on the volatility of the cyclical consumer prices, production prices and wages in the euro area during the period Q1.2010-Q3.2017 (Table 6).

**Table 6.** Decomposition of the residual component variance for cyclical changes in consumer prices, production prices and wages in the euro area in the period Q1.2010-Q3.2017

Variance Decomposition of CPI:		S.E.	CPI	Y
Period				
1		0.498177	100.0000	0.000000
2		0.526213	98.83192	1.168083
3		0.542879	97.23374	2.766258
4		0.545554	97.13386	2.866143
5		0.548243	96.95727	3.042734
6		0.548619	96.94595	3.054053
7		0.549037	96.91681	3.083187
8		0.549087	96.91553	3.084469
9		0.549153	96.91081	3.089190
10		0.549159	96.91068	3.089321
Variance Decomposition of PPI:		S.E.	PPI	Y
Period				
1		0.805494	100.0000	0.000000
2		0.814675	98.94549	1.054510
3		0.835956	98.95301	1.046992
4		0.836910	98.95508	1.044925
5		0.837765	98.95299	1.047007
6		0.837882	98.94538	1.054622
7		0.837933	98.94313	1.056868
8		0.837945	98.94268	1.057320
9		0.837947	98.94243	1.057571
10		0.837948	98.94225	1.057749
Variance Decomposition of W:		S.E.	W	Y
Period				
1		0.230214	100.0000	0.000000
2		0.231501	98.96506	1.034944
3		0.249434	97.45049	2.549506
4		0.249444	97.44247	2.557531
5		0.250472	97.17386	2.826137
6		0.250531	97.17067	2.829333
7		0.250555	97.15407	2.845934
8		0.250579	97.15457	2.845435
9		0.250581	97.15447	2.845529
10		0.250584	97.15425	2.845748

Based on the data from the above table, it can be noticed that cyclical changes in production explained less than 3% of the volatility in cyclical consumer prices in the euro area during ten quarters since the shock production change occurred. Nevertheless, cyclical changes in production explained to the smallest extent (about 1%) the volatility of cyclical production prices during ten quarters since the shock change occurred. However, cyclical changes in production explained almost 3% of the volatility in cyclical wages in the euro area within ten quarters of the appearance of a shock production change. Thus, it can be stated that the volatility of cyclical consumer prices, production prices and wages in the euro area was to a small extent determined by cyclical changes in production in the euro area in period Q1.2010-Q3.2017.

The results of the conducted research suggest no occurrence of the cyclical phenomenon of consumer prices, producer prices and wages in the examined period of time. Therefore, prices as well as wages are acyclical in the euro area. These results largely coincide with the results of other empirical analyses, indicating relatively stable changes in prices and wages in the upward phase of the business cycle in highly developed countries. The results appear to robustly support those found by Kydland & Prescott (1990) as well as by Cooley & Ohanian (1991) for developed economies. However, the detrending procedure seems to influence the empirical findings. Prasad & Chadha (1992) argue that determining the cyclical behaviour of prices by using the same stationarity-inducing transformation to the levels of both output and prices, and investigating the correlations of the resulting series, can be misleading. A more suitable method is to examine the correlations between the inflation rate and the level of the cyclical component of output.

## **5. Conclusions**

To date, no comprehensive research has been conducted into the phenomenon of price and wage cyclicity in the euro area. The analyses carried out so far have focused only on certain euro area member countries, not including all euro area countries. In addition, these analyses concerned only the phenomenon of cyclicity of consumer prices or cyclicity of wages. Furthermore, the paper provides a comprehensive review of the available economic literature on the issue of cyclicity of prices and wages in various economies, both developed and developing, which is a good point of reference for the results of the research presented in this paper, which seems to be a significant added value of the study. Therefore, this research fills the existing gap in this area, constituting a significant contribution to empirical research in the field of price cyclicity. At the same time, the results of the conducted research can be a starting point for further, more in-depth research on the effectiveness of the monetary policy of the European Central Bank in the absence of adequate cyclical prices and wages in the economy.

The results of empirical analyses regarding the cyclicity of prices and wages in other economies are heterogeneous. Therefore, it is difficult to indicate possible factors determining differences or similarities in this respect in relation to other countries. It should be noted that country differences in real prices and wages cyclicity remain important even after controlling for differences in data

and methods used. However, it seems that the cyclical nature of prices and wages decreases as inflation in the country decreases and as the central bank's anti-inflationary monetary policy tightens.

This situation is to a large extent a derivative of the effective monetary policy of the central bank, strongly focused on stabilising prices (inflation) in the country and the so-called inflation inertia, which is a characteristic feature of highly developed economies. Another factor of relative stability of prices and wages is the progressive process of globalisation of the world economy.

Anti-inflation policies adopted by the majority of central banks in the world and greater confidence to central banks in relation to their commitment to maintaining low inflation help anchor inflation expectations of market participants. This means that companies and employees do not react nervously to positive or negative unexpected changes in inflation, which is why wages and prices do not change relatively frequently. Therefore, a strong anchoring of inflation expectations leads to a smaller fluctuation of cyclical prices and wages.

Globalisation is another factor that explains the fact that inflation is currently less dependent on changes in the economic situation. The reduction of trade barriers and transport costs have facilitated the replacement of goods produced in one country with goods produced in other countries, so that the domestic prices of these goods do not differ too much from the prices of similar goods produced abroad. Consequently, their prices do not depend on the local production gap only, but also on the degree of resource use at the global level.

The research results have important macroeconomic implications, as they are particularly important from the point of view of the monetary policy pursued in the country. Well, the lack of cyclical changes in inflation, production prices and wages can lead to asymmetric monetary policy reaction to fluctuations in economic activity. That is, since there is no dependence between consumer prices, production prices, wages and cyclical changes in production in the euro area, in the conditions of economic downturn, insufficient consumer prices, production prices and wages limit the central bank's ability to support economic activity through a reduction of interest rates. Lack of support from monetary policy may intensify further economic downturns and even delay the economic recovery phase. However, in the conditions of the growing economic situation, the lack of price and wage pressure does not ensure the central bank's appropriate freedom in terms of its monetary policy, which may delay the tightening of the monetary policy in the euro area.

It seems that one way to return to 'normality,' i.e. to restore the appropriate cyclicity of prices and wages in the euro area, is to modify the inflation target and the nature of the European Central Bank's monetary policy. This modification should be aimed at increasing both the inflation target and the ECB's attitude toward expected inflation. Namely, easing the ECB's stance on inflation in the euro area would lead to a real pattern of inflation and thus to a greater degree of shifting economic changes to prices and wages in the euro area.

Therefore, the results of the conducted research contribute to a significant deepening of both theoretical and practical knowledge in the scope of the possibility of the monetary policy pursued by the central bank influencing as well as the government's fiscal policy on the economic activity of the country. The research results also allow the construction of an appropriate economic policy of the state (macroeconomic policy) that can be used to stabilise the economic situation in the country.

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