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# THE CONDITIONS OF ECONOMIC GROWTH IN THE PERIOD FOLLOWING THE ECONOMIC CRISIS AND THE PROGNOSTIC ASPECT OF GDP OF POLAND IN THE PERIOD OF CRISIS 2008—2010

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The elaboration concerning the economic growth conditions and the state of economy after social-economic crisis 2008 includes the aspects of the environment that stimulates the growth GDP dynamics. The attention is paid to the prognostic features of the economic growth dynamics. In the empirical part, the economic growth dynamics in the period 1998—2010 was interpreted with the application of two-equation vector autoregressive (VAR) model. The forecasts of the indicators of the economic growth dynamics were determined for the following quarters of year 2010. The results of the estimation indicated a statistical significance of the influence of important macro-economic variables upon the growth dynamics.

**Key words:** gross domestic product (GDP), dynamics of production growth, forecast of the quarterly growth dynamics, vector autoregressive model.

Economic growth commonly constitutes an important element in the evaluation of the generally understood level of life and development within a country or region or, in a broader aspect, of a continent or globe. Some of the doctrinally comprehended formulas associate the economic growth with the quality of social life which is derived from the quality of life of the individual members. Anyway, the basic elements of the economic growth include such macro-economic values as gross domestic product (GDP), gross national product (GNP), unemployment rate, the indices of demographic development of societies related with the ageing of population, social group and others.

The level of GDP is a variable that is unchangeably associated with the economic growth in macro-economic categories. There is an effort to forecast or estimate this indicator of growth or the current state of economy by means of indices other than those based on National Income and Product Account (NIPA). The determination of the state of economic development should also include growth conditionings which are closely related to the economic cycle in the market economy. Economic cycle is an objective sign of fluctuation of economic growth and regardless of how it is viewed it influences the economic processes in an invigorating way, it eliminates the inequalities and directs the economy towards the upward path or to the condition of balance in a general sense. However, the elimination of economic cycles, possible in the management practice, enforces restrictive forms of economic management.

In the management practice there are various forms of bringing the economies out of recession, of noticing the symptoms of approaching recession in the period of economic prosperity, which aims at mitigation of the consequences of the crisis and so on. A particularly important period is the time following the economic crisis, especially if it has

a social substratum (and, basically, it always has). The only changeable element is the degree to what one perceives the recession of social processes, social groups' capacity of self-organization and, consequently, mitigation of results of the previous economic crisis implicating important social processes which, in contrast to economic processes, are characterized by a higher inertness both mental and philosophical sphere.

**Prognostic aspect of economic growth.** Changes of ingredients and their elements of the gross domestic product (GDP), as compared to the changes that occurred in the past, are the basis for economists to forecast the future condition of economy. The forecasts for the general economic situation based on GDP are the most labor-intensive. In the USA, for instance, the analysts from governmental institutions work on the forecasts on the basis of the latest report about GDP. All stock exchange institutions operate on their grounds. GDP index is the basis for analyses and investment decisions, and also for a majority of financial forecasts.

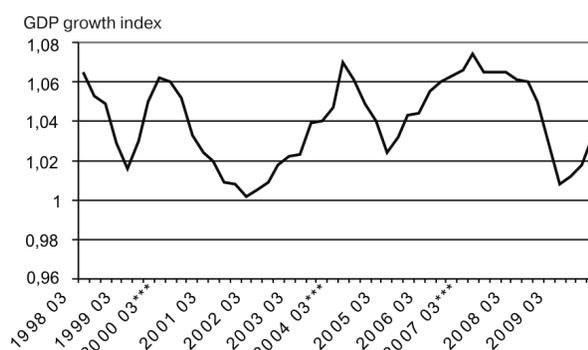
**Scenarios and economic conditions as the basis for decision making.** Making decisions without the knowledge concerning the previous results of the economy, its functioning in various periods specified in the scenarios, as well as the strength and weakness of particular sectors seems to be, with no knowledge of GDP, a highly lame task with regards to the correctness of the results verified by a real sphere of economy.

The analyses of economic growth apply a real and nominal GDP in view of the quality of economic growth measurement. It turns out that the real GDP, referring the results of the economy to the basis year, eliminates the uncertainty whether the observed growth of value of manufactured goods or services was caused by the rise of prices or production. In this version of GDP measurement we do with the effect of transformation of price structure from this year to the following periods and with the determination of relative weights, given to goods connected with prices. The bigger distance of the examined period from the adopted basis year, the more often the real GDP for that period turns out to be extortionate. In practice, the difference between the real and the nominal GDP is justified by inflation and is applied in the process of determining the inflation index.

**Expectation of GDP movements. Quarterly result of GDP.** It is obvious that the forecasts based on the behavior of a given economic indicator that influences the economic growth or fall, company profits and stock prices will not allow for a proper picture of economy. It is similar in case of real GDP. However, in this case it can be stated that quarterly growth rate (dynamics) of GDP, viewed in a yearly calculation, is the most important value out of all values given by governmental agencies. However, a strong positive result is usually a symptom of economic growth and a favorable provenience of all key macro-economic values. Yet, this is not the case as it comes to the value of bonds. The growth of GDP, pointing to the development of economy, causes a decrease in value of securities with a stable income because the economic growth, especially a rapid one, usually results in the growth of inflation and inflation, in turn, influences the value of bonds.

**The dynamics of quarterly changes of GDP in a yearly context and the economic activity.** A quarterly result in a yearly context is not as important for economists as the change of GDP year by year. A longer time perspective in the aspect of noticing the approaching recession or economic growth is then easier to notice. Such an effect of expectation is illustrated by figure 1. Date of quarters denoted by asterisks refer to quarterly moments that signal falls in changes of GDP.

From the point of view of influence exerted by economic activity on the calculation of GDP we can observe two side of such an activity. These are expenses and incomes. The so far remarks concerning GDP corresponded to expenses. Generally, the income method does not identify branches or products that are in the process of production and, therefore, it is less informative and, as a result, less attractive for analysts, which has already been mentioned.



**Fig. 1.** Dynamics of quarterly changes of GDP in years 1998—2009

Source: elaboration own.

**Expectation of GDP movements and a demand gap.** In expectation of GDP movements the elements of NIPA are simply the benchmarks of economic activity. However, investors apply other indicators to expect GDP movements. Usually there is an effort to expect the GDP level by means of indicators announced monthly or weekly. The GDP announced quarterly also shows economic relations and dependences that are not as useful in forecasting as, for instance, those indicators. In spite of this, the strategy of estimating the demand gap is based on the data from the GDP Report. Demand gap is defined as a difference between a real and a potential level of production that reflects the capacity of economy, allows for the evaluation of economic conditionings such as employment level and inflation.

In estimation of this value, equivalent to determination of trend level, economists use the principle of defining it at the level of maximum tempo of economic development that will not cause the growth of inflation. Generally, the value of basic interest rate of the Central Bank follows the demand gap; if the gap increases the interest rate increases as well, and the other way round.

### **Econometric model of analysis concerning the economic growth in the post-crisis period**

#### *Indicators of economic situation cycles as the indicators of economic growth.*

The searched indicator that at the same time could expect a direction and tempo of eco-

conomic growth has not been created yet. While some indicators perfectly model the level of economic activity but they do not reflect trends, other indicators identify the aspects of strength and weakness of economy but they do not measure a broadly comprehended effectiveness. The index of these indicators is called the Index of Leading Indicators. This and other indices can be presented in three categories:

- 1) indices of leading indicators;
- 2) index of lagged indicators;
- 3) index of coincidental indicators.

The index of *leading indicators* indicates future trends and turning points in the provenience of economic growth. The index of *lagged indicators* confirms that such events (turns in economic growth) actually happened. The index of *coincidental indicators* identifies the forming trends. All these indices change in time and they undergo modifications together with the change in the structure of economy.

*Composition of economic indices.* *Coincidental index* consists of four elements: the number of employees on non-agricultural payrolls (in thousands), achieved from the survey carried out in approximately 160 thousand of enterprises by Bureau of Labor Statistics; personal income minus transfer payments (nominal rate in \$ milliards from 1996, transfer payments–expenses on social insurance, militant pension); index of industrial production (1997 = 100) — manufacturing and trade inventories and sales (\$ millions from 1996).

*Leading Economic Index* is as follows: 1) average weekly number of work hours in manufacturing industry; 2) average number of weekly applications for payment as a title to insurance against unemployment; 3) new producers' orders for consumption goods and materials; 4) index of diffusion of slower deliveries as a measure of effectiveness of the contractor; 5) new producers' orders for investment goods, not related to defense; 6) monthly number of building permit (private residential buildings); 7) stock prices of 500 selected companies; 8) money supply M1, M2, M3 (dollars from 1996); 9) the range of interest rates between 10-year-bonds and a basic interest rate Fef (Fed funds); 10) index of consumers' expectation. Regardless of the relevance of other indicators, it is stated that the basic criterion of the selection of leading economic index is their capacity of anticipating the economic activity. Feature such has the supply of money.

*Money supply M2*, in free interpretation, is usually a sum of money in the economy. Out of three listed types of money aggregates in the context of importance and use of econometric model M2 is the money supply that we are interested in. In the leading economic index money supply M2 accumulates: cash in circulation, bank deposits and financial means on current bank accounts, as well as share in trust funds of the financial market and other liquid assets such as "overnight" repurchase contracts concluded with commercial banks. Money regarded as "fuel in a tank" of the economic activity is highly related (its level) to the level of economic growth.

*Lagged index.* In view of the consideration of labor market situation in the econometric model it is important to discuss also this index. It includes seven indicators: 1) average duration of unemployment; 2) ratio of manufacturing and trade inventories to sales; 3) work costs in manufacturing industry calculated per one product unit; 4) average "prime rate", i.e., interest rate for customers with the least risk; 5) liabilities in trade

and industry; 6) ratio of value of consumer household loans to the sum of its income; 7) change of the consumer inflation index (CPI). Lagged index, following the average three months after the economic fall and fifteen months after the economic growth, seems to be useless in anticipation of falls and growth of GDP. However, it is significant with regards to the application of this index in confirming the turning points. Thanks to this fact it allows for avoidance of transmitting false signals.

*Two-equation model, quarterly dynamics of GDP and employment rate.* In the considered exemplary econometric model, whose aim is to develop a dynamic dependence between certain macro-economic values and the economic growth in the periods of decrease of this dynamics, two values play the role of endogenous variables: the rate of quarterly growth of GDP and the quarterly rate of unemployment.

The model includes explanatory values such as GDP and unemployment rate denoted by  $Rt\_unpl$  with 5. lags. It also takes into consideration *Export* variable that represents export with 1. and 3. lags. And denote *Exp*. Additionally, the final tested version of the model includes a pawn credit rate denote  $Rt\_Cred$  and money supply  $M2$ . It also takes into account a linear drift, which in other versions of the model can be broadened by a polynomial drift in view of the nature of time series generated by the variables of the model with non-stationary characteristics. Introduction of a drift guarantees the required features of the estimators of the model parameters, determined by means of least squares methods which, as a result, have a character of an asymptotic normality and standard statistics are asymptotically convergent to their distributions typical for least squares method.

The existence of linear (in view of trend time) or polynomial drift is related to the occurrence of variables characterized by a constant growth in time. This principle is typical for the majority of macro-economic variables. It is caused by the fact that a variable consists of either a deterministic trend with a stationary random variable that expresses deviations from this trend or it is characterized by the fact that it generates data laden with the so co called “long memory”. This refers to the data generating process, called random walk.

The model considered in order to describe the process of the growth dynamics, mainly of GDP, is a vector autoregressive model, VAR. This model has a peculiar feature, namely it does not have to reflect the real relations that result from the theory of economics.

The analytical form of this model is as follows:

$$\begin{aligned}
 GDP &= const_{GDP} + \sum_{i=0}^5 \alpha_i \cdot GDP\_i + \sum_{i=0}^5 \beta_i \cdot Rt\_unpl\_i + \gamma_0 \cdot Exp + \\
 &+ \gamma_1 \cdot Exp\_1 + \gamma_3 \cdot Exp\_3 + \sum_{i=0}^{2\sqrt{3}} \zeta_i \cdot t^i + \sum_{i=0}^5 \rho_i \cdot M2\_i + \sum_{i=0}^5 \varepsilon_i \cdot Rt\_Cred + \lambda_i + \xi_{1i}; \\
 Rt\_unpl &= const_{Rt\_unpl} + \sum_{i=0}^5 \varepsilon_i \cdot GDP\_i + \sum_{i=0}^5 \lambda_i \cdot Rt\_unpl\_i + v_0 \cdot Exp + \\
 &+ v_1 \cdot Exp\_1 + v_3 \cdot Exp\_3 + \sum_{i=0}^{2\sqrt{3}} \varphi_i \cdot t^i + \sum_{i=0}^5 \rho_i \cdot M2\_i + \sum_{i=1}^5 \varepsilon_i \cdot Rt\_Cred + \xi_{2i}.
 \end{aligned}$$

Both equations of the vector autoregressive model have the same structure, which is a typical feature of these models. Random disturbances  $\xi_1, \xi_2$  in VAR model are called shocks, impulses or innovations. A formal record of equations shows that they have a form that is analogous to the equations that test causality in Granger sense; by their means the causality can be tested. In such cases it is assumed that each equation includes  $k$  lagged values of endogenous variables. Endogenous variables as they are defined by the model equations and not the functions that generate their values.

VAR model includes also exogenous variables. With regards to the features of VAR model, out of which the most spectacular one results from the structure of equations, where only the history of economic processes form the present (the regressors are the previous observations based on endogenous variables), this model expresses the concept of causality in Granger sense, according to which only the past defines the present.

The estimation of model parameters was performed with the application of GRETL programme based on data concerning the dynamics of changes of the relative values of changes period by period published in the bulletins of the Central Statistical Office in Warsaw (CSO). The data concern all the quarter of years 1998—2009. The purpose was to verify (graphically observed in figure 1) the phase of growth of quarterly dynamics of GDP, beginning from the fourth quarter of 2009. It is an informal documentation of the fact that Poland is a “green island” among the European countries with a relatively high level of GDP from the time of the crisis caused by Lehman Brother bank in 2007.

*Calculation results.* As a result, for the applied data and for the performed experiments we achieve estimations which are illustrated in table 1 and table 2.

**Estimated parameters of model equation 1**  
**Equation 2: GDP**

Table 1

Parameters	Coefficient	Stand.error	t-Studenta	p value	d.s.
Const	0,502343	0,130099	3,8612	0,00090	***
GDP_1	0,415771	0,156809	2,6514	0,01493	**
GDP_2	-0,35422	0,158933	-2,2287	0,03689	**
Rt_unpl_1	-0,542468	0,119918	-4,5236	0,00019	***
Rt_unpl_5	0,922172	0,178999	5,1518	0,00004	***
M2_2	0,215776	0,0742435	2,9063	0,00844	***
M2_4	-0,189939	0,0580974	-3,2693	0,00366	***
Exp	0,0591289	0,0201749	2,9308	0,00799	***
Exp_1	0,0753566	0,0217734	3,4609	0,00234	***
Rt_Cred	0,137468	0,0582664	2,3593	0,02807	**
Rt_Cred_1	0,139187	0,0589484	2,3612	0,02796	**
Rt_Cred_2	0,113909	0,0489069	2,3291	0,02992	**
Rt_Cred_4	-0,156672	0,0588154	-2,6638	0,01453	**
Time	-0,00802749	0,00173136	-4,6365	0,00014	***
t_2	0,000144668	3,17238e-05	4,5602	0,00017	***

Source: elaboration own.

Note: Abbreviation d.s. variable is measured by the degree of significance stars.

Table 2

**Estimated parameters of model equation 2**  
**Equation 2: Unemployment rate ( $Rt\_unpl$ )**

Parameters	Coefficient	Stand. error	t-Studenta	p value	d.s.
$GDP\_4$	-0,400278	0,184653	-2,1677	0,04182	**
$PKB\_5$	0,350728	0,13712	2,5578	0,01833	**
$Rt\_unpl\_1$	0,951696	0,132904	7,1608	<0,00001	***
$Rt\_unpl\_4$	0,683377	0,202481	3,3750	0,00286	***
$Rt\_unpl\_5$	-0,976985	0,198382	-4,9248	0,00007	***
$M2\_2$	0,184148	0,0822829	2,2380	0,03619	**
$M2\_4$	-0,111487	0,0643884	-1,7315	0,09803	*
$Exp$	0,0491052	0,0223596	2,1962	0,03945	**
$Exp\_1$	0,0568874	0,0241311	2,3574	0,02818	**

Source: elaboration own.

Note: Abbreviation *d.s.* variable is measured by the degree of significance stars.

On the basis of data included in table 1 and table 2 we can state which parameters are statistically significant at the probability level of at least 0,05 (denoted by asterisks, the more asterisks, the stronger the statistical significance). The equation related of GDP indicates that the quarterly rate of GDP growth, when it is explained in the configuration of model variables, is influenced by: GDP with 1. and 2. lags, unemployment rate with 1. and 5. lags as well as money supply  $M2$ , adopted by National Polish Bank as measure of money, with 2. and 4. lags. A very important variable for the changes of  $GDP$ , namely export affecting directly or export from the previous quarter, pawn credit rates, as well as variable time and  $t_2$  are introduced into the model in order to improve the properties of estimators of least squares method, disturbed by the existence of co-integration of variables and their growths.

The second endogenous variable — unemployment rate, denoted by  $Rt\_unpl$  is significantly statistically dependent, within the arrangement of variables introduced into the model, on  $GDP$  variables with 4. and 5. lags, unemployment rate with 1., 4., and 5. lags, export simultaneous with the endogenous variable and export with 1. lag. It is not influenced, at least directly, by a pawn credit rate. This variable is stationary, which is observed in other studies, and therefore, variables time and  $t_2$ , which disintegrate the character of model variable, are not significant. In both equations of VAR model the coefficient of determination is high and it equals.  $R^2_{DGP} = 0,975$  and  $R^2_{Rt\_unpl} = 0,9869$ , respectively. Moreover, for lag 5. the value of Akaike Information Criterion is lower than for lag 4., which means that lag 5. is more appropriate than lag 4. The value of AIC equals 15,06. This result explains the application of lag in the model.

**Scenario result of the forecast.** The forecasts of GDP and unemployment rate, taking into account the selected paths of economic development for estimation purposes, require the consideration of scenarios for export and also other exogenous variables of the model, including also endogenous variables. For this purpose let us consider the case of an optimistic and pessimistic scenario, adopting in the pessimistic version for quarters of 2010 (1<sup>st</sup> and 2<sup>nd</sup> quarters of the forecast are already realized) a version of ex-

port decrease and growth of unemployment rate up to the level of even 16%, stability in the area of money supply, a slight decrease of export related to an adverse situation of the external environment, as well as, a decrease of credit rate in view of a stable money situation in the country.

The result is presented in table 3 for confidence interval 95%,  $t(21, 0,025) = 2,080$ .

Table 3

**The results of a pessimistic forecast of GDP in the quarters of 2010**

Observation	GDP	forecast	error ex ante	confidence interval 95%
2010:1	0,900	1,032	0,0033	1,025—1,039
2010:2	1,000	1,036	0,0038	1,028—1,044
2010:3	1,000	1,050	0,0043	1,041—1,059
2010:4	0,900	1,064	0,0043	1,055—1,074

Source: elaboration own.

The result is that the forecasts of GDP, in spite of a pessimistic version of the macro-economic situation development, reversed the downward trend and they returned onto the upward path. In the second, optimistic, version we assume the growth of GDP and decrease of unemployment for endogenous variables, while for exogenous variables — the growth of pawn credit rate, decrease of money supply, which with regards to the model lags does not have such an influence on the value of forecasts, as well as the growth of export. On the basis of the results presented in table 4, for confidence interval 95%,  $t(21, 0,025) = 2,080$ , we can observe, in spite of non-overrated quarterly changes of GDP, a positive turn of the dynamics onto the upward path.

Table 4

**The results of an optimistic forecast of GDP in the quarter of 2010**

Observation	GDP	forecast	error ex ante	confidence interval 95%
2010:1	1,034	1,048	0,0033	1,042—1,055
2010:2	1,035	1,072	0,0038	1,064—1,080
2010:3	1,033	1,099	0,0043	1,090—1,108
2010:4	1,038	1,107	0,0043	1,097—1,116

Source: elaboration own.

The ex post measures of the forecasts exactness for both versions show that the estimation of forecasts in the periods (quarters) of 2010 are laden with an error that is typical for such estimations.

**Summary.** The presented elaboration of the implications of specified economic activities was based on the analysis of dynamics of quarterly GDP in Poland. The studies included an eventful period for Polish economy, i.e., years 1998–2010. In the period of these 12 years the economy was generally developing in a yearly upward trend, but it was characterized by the phases of growth and falls. Due to a short period of the analysis the attention was paid to the quarterly changes of GDP. This is not the most adequate way to examine the behavior of the economy in the periods following such economic crises as this one observed in Poland in 2005. However, they are as deep as the one generated by the external environment in 2007.

Therefore, the attention was paid, in a formal evaluation of the growth of quarterly dynamics of GDP, to the provenience of GDP in the quarters of 2010. The analyses did not indicate that the economic growth noticed ex post (1 and 2 quarter of 2010) in Poland was temporary. The introduction of adverse disturbances into financial-monetary processes did not cause a permanent “pushing” the quarterly changes of the GDP dynamics aside from the upward path. Of course, the analyses presented here have a quite simplified character and only partly can they aspire to constitute a basis for formulation of general and permanent conclusions.

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## УСЛОВИЯ ЭКОНОМИЧЕСКОГО РОСТА В ПОСЛЕКРИЗИСНЫЙ ПЕРИОД И ПРОГНОЗЫ РОСТА ВВП ПОЛЬШИ

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Исследование условий экономического роста и состояния экономики Польши после социально-экономического кризиса 2008 г. Особое внимание уделено прогнозам динамики экономического роста. Динамика экономического роста в период 1998—2010 гг. анализируется с использованием двухмерной модели векторной авторегрессии (VAR-модель). Определены прогнозы показателей динамики экономического роста. Результаты оценки показали статистическую значимость влияния важных макро-экономических показателей на динамику роста.

**Ключевые слова:** ВВП, динамика роста производства, модели векторной авторегрессии.