TOMASZ MISIAK, Assistant
Faculty of Economics, University of Technology in Rzeszów, Poland

REAL AND NOMINAL GDP GROWTH DYNAMICS IN POLAND IN THE YEARS 1995-2001

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The present work states the analysis as well as opinion of dynamics of Gross Domestic Product real and nominal for Poland. The special equations of movement to analysis of dynamics were applied. The empirical data being acknowledged as reliable originate from statistical year-books of the Polish central statistical office GUS form the years 1995 – 2002, the websites of Eurostat and own calculations as well. The values of the Gross Domestic Product of the countries under research are expressed in US dollars so that the analysis of them is easier and they can be compared regarding time and space.

Key words: dynamics of economic processes, real GDP, nominal GDP, deflators GDP.

INTRODUCTION

The Gross Domestic Product is one of the most important economic barometers of each country. Although the shortcomings of this index are generally known it is the base for the conclusions regarding the economic condition of the countries. However, the prices of products and goods the GDP consists of changes every year - they become normally higher and not only because the quality of the products or services is higher or they provide for additional needs. The general price increasing that is the inflation is the cause of the rising prices. That means, even if the production does not increase compared to the prior year, the GDP would increase - the higher the price increase index for the entire economy system the higher the GDP.

Therefore, if the GDP shall provide a real information on the economic changes, the influences by the price changes must be eliminated. This operation would be needless only if the price level would be constant. Two price types shall be mentioned - fixed prices, that means basic year prices and running prices. The gross Domestic product calculated by fixed prices is called real and by running prices - nominal gross Domestic product.

The relations between the real and nominal GDP may be presented the following way

$$\text{real GDP} = \frac{\text{nominal GDP}}{\text{deflator GDP}} * 100$$

The GDP deflator is a price change index GDP referring to the total GDP, that is to the prices of consumer goods, investment goods and services as well.

The dynamics of both the nominal and real GDP is the subject of this paper. It shall give us the answer for the question of the influence of the inflation on the GDP value.

1. EMPIRICAL DATA

The empirical data being acknowledged as reliable originate from statistical year-books of the Polish central statistical office GUS form the years 1995 –2002, the websites of Eurostat and own calculations as well. The values of the Gross Domestic Product of the countries under research are expressed in US dollars so that the analysis of them is easier and they can be compared regarding time and space[1].

Many empirical data is of jumpwise nature. In this case an estimation of the here assumed definition of dynamics would be not possible. Therefore the jumpwise sets of the J_t values have been transformed into the S_t being assumed as continuous in the following way:

$$S_t = \sum_{t=1}^{n} J_t \qquad (1)$$

The introduced P_k value indicates the percentage of the final value of the S_k set in relation to the initial value S_p assumed as 100:

$$P_k = \frac{100 S_k}{S_p} \quad [\%] \qquad (2)$$

The P_t sets have been also investigated according to the formula:

$$P_t = \frac{S_t \cdot 100}{S_p} \quad [\%] \qquad (3)$$

[1] Statistical year-books GUS, Warsaw 1996-2002.

2. METHODS OF EMPIRICAL DATA ANALYSIS

The J_t sets of processes, selected from statistical year-books of the Polish statistical office GUS may not by a basis for the estimation of process dynamics because they are assumed to be of jumpwise nature, in particular taking into account the definitions of dynamics:

- **absolute dynamics** understood as the instantaneous speed and instantaneous acceleration achieved in an exactly defined way of value changes or in the exactly defined way of process run.
- **relative dynamics of economic processes** called specific dynamics and understood as the specific instantaneous speed specific and specific instantaneous acceleration achieved in an exactly defined way of value changes.[2]

In this paper simply models of motion dynamics are investigated. To this purpose the definition of economic model should be quoted.

- **economic model** – an intentional simplifying of reality in order to better understand and investigate the phenomenon under investigation.

The calculations focus on the aw curves as the described processes are curves of this type.

The speed increasing in the time is typical for the aw curves and the speed decreasing for the dw curves. The processes places themselves in the decreasing dynamics order according to the parameter series n in form:

$$...3aw \rightarrow 2aw \rightarrow 1aw \rightarrow 0w \rightarrow 1dw \rightarrow 2dw \rightarrow 3dw... \quad \longrightarrow$$

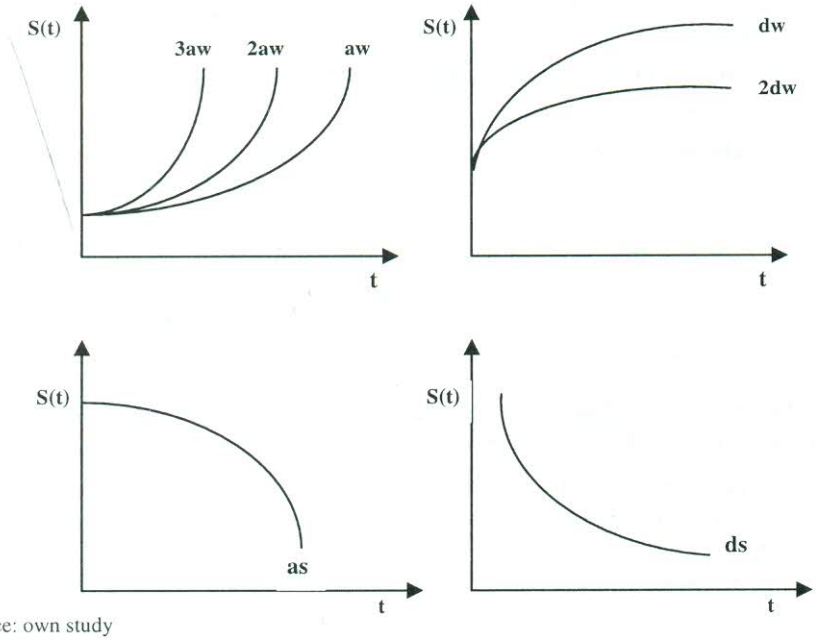
0w- linear dependence, instantaneous speed constant form of the straight line

$$S_t = W_0 \cdot t + S_0 \quad (4)$$

The S_t sets may be shown in form of curves with symbols: aw and dw (Fig. 1.).

[2] Kotliński W., Makarska A., Stokłosa K., Ocena dynamiki zmian procesów rozwojowych Jarosławia w latach 1994-1998. Printing House of Technical University of Rzeszow, Rzeszow 2001

Figure 1. **Forms of set curves S_t**



source: own study

2.1. Symbols used in this paper

process – commonly understood as changes of properties of systems in time and space,
t – time,
J_t – measure value in the t moment,
S_t – cumulated values of J_t, sets
P_t – S_t value in relative scale
aw – characteristic curve by gradually increasing of the value change speed in the time (a) and increasing of the value (w), concave curve,
dw – speed slowing down curve (d) with the value increasing (w), convex increasing curve,
W_n – constant speed of n value changes– of this order, dimension $[J^{1-n}t^{-1}]$
n – dimensionless order of functions and process,
V(t) – instantaneous transformation speed,

$$V(t) = \lim_{\Delta t \to 0} \frac{J(t + \Delta t) - J(t)}{\Delta t},$$

A(t) – economic aggressiveness, instantaneous acceleration, derivative of the instantaneous speed

e_m – standard deviation [%]
Gdy n = 0, then linear dependence 0w occurs.

2.2. Aw type equation

$$V(t)=W_n \cdot S_t^{\,n} = \frac{dS_t}{dt} \quad \text{dimension} \left[S \cdot t^{-1}\right] \tag{5}$$

$$W_{n>0},\ n \geq 0,$$

where: W_n- constant speed with dimension $\left[S^{1-n} \cdot t^{-1}\right]$;n- dimensionless function and process order [5]

Note:

If n = 1aw:

$$W_1 = \frac{1}{t} \ln \frac{S_t}{S_o} \quad \text{and} \quad \widehat{S}_t = S_0 e^{w_1 \cdot t} \tag{6}$$

Constant period of dimension value doubling:

$$t_2 = \frac{\ln 2}{w_1} = \frac{0{,}693}{w_1} \tag{7}$$

If n < 1aw:

$$W_n = \frac{1}{(1-n) \cdot t}\left[S_t^{\,1-n} - S_0^{\,1-n}\right] \quad \text{and} \quad \widehat{S}_t = \left[S_0^{\,1-n} + W_n \cdot (1-n) \cdot t\right]^{\frac{1}{1-n}} \tag{8}$$

If n = 0, then linear dependence 0w occurs.

If n > 1aw, then:

$$W_n = \frac{1}{(n-1) \cdot t}\left[S_0^{\,1-n} - S_t^{\,1-n}\right], \quad \widehat{S}_t = \left[S_0^{\,1-n} - W_n (n-1) \cdot t\right]^{\frac{1}{1-n}}, \tag{9}$$

and trend break down period:

$$t_\alpha = \frac{1}{S^{n-1}(n-1) \cdot W_n}$$

3. CALCULATION RESULTS

Tab. 1. **Gross Domestic Product of Poland in billion USD for the years 1995 – 2001.**

T[l]	year	GDP						
		nominal - process I			deflator [%]	real – process II		
		J_t	S_t	$\hat{S}_t$		J_t	S_t	$\hat{S}_t$
0	**1995**	127,1	127,1	127,1	28	99,297	99,296	99,296
1	**1996**	143,8	270,9	266,7	18,7	121,146	220,443	216,809
2	**1997**	144	414,9	416,2	14,0	126,316	346,758	347,665
3	**1998**	158,4	573,3	572,5	11,8	141,682	488,44	488,234
4	**1999**	155,2	728,5	734,1	6,8	145,318	633,758	636,577
5	**2000**	157,6	886,1	900,2	11,3	141,599	777,35,	791,463
6	**2001**	183,0	1069,1	1070,1	4,2	175,624	950,981	952,033
Pk		**143,98**	**841,15**	**841,94**		**176,87**	**957,7**	**961,65**

Source: own study

Tab. 2. **Simple equations of process motion in absolute scale according to decreasing dynamics**

GDP	n	W_n	S_t model	e_m
real	0,18aw	47,48	$[43,4+38,93\cdot t]^{1,2195122}$	0,51%
nominal	0,12aw	74,291	$[71,064+65,376\cdot t]^{1,13636364}$	0,504%

Source: own study

Specification of processes in relative scale P_t

Tab. 3. **Simple equations of process motion in relative scale according to decreasing dynamics**

GDP	n	W_n	S_t model	e_m
real	0,18aw	47,7	$[43,7+39,1\cdot t]^{1,2195122}$	0,51%
nominal	0,12aw	60,1	$[57,54+52,89\cdot t]^{1,13636364}$	0,504%

Source: own study

The determined models are aw type models and characterized by value increasing with the time, if the speed increases. If the n order increases the aw process has more and more accelerating factors.

The results of the applied process dynamics evaluation method - indirectly through the S_t and P_t were positive. The standard deviations of the applied models do not exceed 0,55%, so we may say that the models are very well adapted to the empirical data.

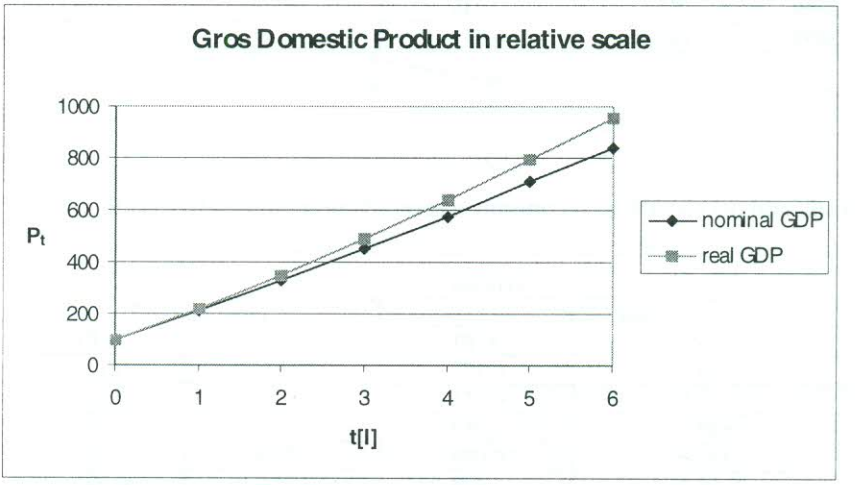
The tables 2 and 3 contain the processes ordered depending on decreasing dynamics. It appears that the GDP nominal growth process dynamics is lower than the GDP real growth process one. Below a comparison of both processes in relative (%) scale is presented, where the initial values of all processes are 100%.

Tab. 4. **Comparison of dynamics in relative scale P_t**

T[l]	nominal GDP	real GDP
0	100	100
1	209,74	218,3
2	331,76	349,9
3	450,06	491,2
4	577,1	640,3
5	707,65	796,03
6	841,2	957,4

Source: own study

Fig. 2. **Processes I and II in relative scale**



Source: own study.

Tab. 5. **Speed and acceleration models in absolute and relative scale**

process	absolute scale	
	speed models	acceleration models
real GDP	$V(t) = 47{,}48 \cdot S_t^{0{,}18}$	$A(t) = 8{,}55 \cdot S_t^{-0{,}82}$
nominal GDP	$V(t) = 74{,}291 \cdot S_t^{0{,}12}$	$A(t) = 8{,}915 \cdot S_t^{-0{,}88}$
	relative scale	
real GDP	$V(t) = 47{,}7 \cdot P_t^{0{,}18}$	$A(t) = 8{,}586 \cdot P_t^{-0{,}82}$
nominal GDP	$V(t) = 60{,}1 \cdot P_t^{0{,}12}$	$A(t) = 7{,}212 \cdot P_t^{-0{,}88}$

Source: own study

Tab. 6. **Speeds and accelerations (economic aggressiveness) in absolute scale**

t[1]	process				
		real GDP		nominal GDP	
	year	V(t)	A(t)	V(t)	A(t)
0	1995	108,63	0,197	132,9	0,125
1	1996	125,4	0,102	145,5	0,064
2	1997	136,06	0,071	153,14	0,044
3	1998	144,71	0,053	159,2	0,033
4	1999	151,66	0,043	163,8	0,027
5	2000	157,33	0,036	167,7	0,023
6	2001	163,15	0,031	171,6	0,019

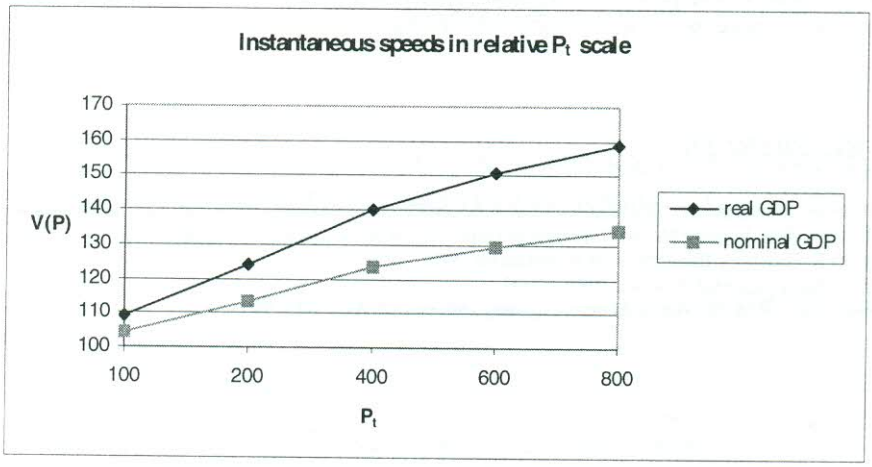
Source: own study

Tab. 7. **Speeds and accelerations (economic aggressiveness) in relative scale**

P[%]	process			
	real GDP		nominal GDP	
	V(P)	A(P)	V(P)	A(P)
100	109,3	0,197	104,44	0,125
200	123,8	0,111	113,5	0,068
400	140,2	0,063	123,3	0,037
600	150,9	0,045	129,5	0,025
800	158,9	0,036	134,0	0,020

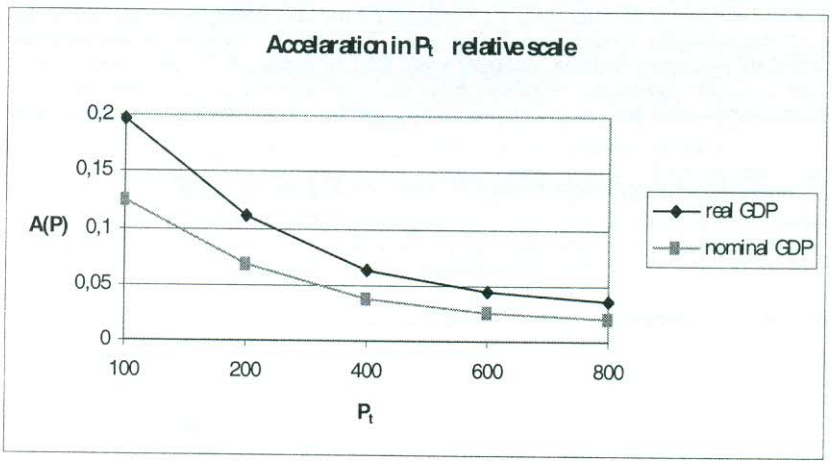
Source: own study

Fig.3. **Processes I and II in relative scale**



Source: own study.

Fig. 4. **Acceleration of processes I and II in relative scale**



Source: own study.

It has been noticed that the inflation index in form of the GDP deflator is lower and lower from year to year (Tab. 1). Therefore, if the inflation index shows a significant decrease tendency, the nominal Domestic product will show a lower growth dynamics compared to the real one. The nominal Gross Domestic Product is described by the 0,12aw curve, and the real one by the 0,18aw. Both processes have more accelerating factors compared to the slowing down ones. The I process has a lower

process dynamics. This fact is confirmed by the relative scale speeds and P_k values shown in the table 1. The process I has lower speeds than the process II. At higher naw orders the speeds increase faster than at lower orders.

REFERENCES

1. Kotliński W., Makarska A., Stokłosa K., Ocena dynamiki zmian procesów rozwojowych Jarosławia w latach 1994-1998. Printing House of Technical University of Rzeszow, Rzeszow 2001
2. Milewski R. Podstawy Ekonomii. PWN Warszawa 2002
3. Roczniki statystyczne GUS za lata 1995 – 2002.
4. Wyplosz. Ch, Burda. M; Makroekonomia , podręcznik europejski. PWE 1995.

Sažetak

REALNA I NOMINALNA DINAMIKA RASTA GDP-a U POLJSKOJ OD 1995. DO 2001. GODINE

Rad iznosi analizu ali i mišljenje o dinamici realnog i nominalnog bruto nacionalnog proizvoda za Poljsku. Primijenjene su posebne jednadžbe kretanja i analize dinamike. Empirijski podaci ocjenjeni kao pouzdani preuzeti su iz statističkih godišnjaka Poljskog središnjeg ureda GUS za godine 1995 – 2002, web stranica Eurostata i također iz vlastitih kalkulacija. Vrijednosti Bruto nacionalnog proizvoda za promatrane zemlje izražene su u američkim dolarima kako bi se olakšala njihova analiza i uspoređivanje uzimajući u obzir vrijeme i prostor.

Ključne riječi: dinamika ekonomskog procesa, realni BNP, nominalni BNP, deflatori BNP-a.