ACTA UNIVERSITATIS LODZIENSIS
FOLIA OECONOMICA 212, 2007

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ECONOMIC DEVELOPMENT AND ELECTRIC ENERGY CONSUMPTION IN THE EUROPEAN UNION COUNTRIES – COMPARATIVE ANALYSIS

1. INTRODUCTION

Economic development is defined as a long-term process of transformations taking place in the economy. The process includes not only quantitative changes related to increase in production, employment, investments, in the amount of functioning capital, incomes, consumption and in many other quantities which characterize economy from the quantitative aspect (economic growth) but also accompanied qualitative changes which include first of all technical and technological development, improvement of the system of intraeconomic connections and connections with the global economy, improved skills of labor force, the emergence of new products, etc.

It is very difficult to present the process of economic growth using one universal standard as one cannot objectively reduce all the various aspects of economic activity to one common denominator. It is widely assumed that the process of economic growth can be expressed in the most general way in a form of changes related to the Gross Domestic Product (GDP) or the Net Domestic Product (NDP)

Conducted research prove the inseparable connection between the economic growth and the amount of consumed electric energy used in every sector of the national economy (Jumbe 2004, pp. 61–69; Oh, Lee 2004, pp. 51–59).

That is why this study is mainly devoted to the assessment of the economic growth of the European Union countries measured by the GDP and of the extent to which this growth is influenced by transformations in the field of electric energy consumption in these countries.

The empirical part is devoted to the study of interdependencies between the analyzed quantities presented in a form of time series from the years 1980–2002.

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To this end I used the methods of the analyses of correlation, integration and cointegration of time series as well as linear functions of regression which describe the discussed quantities. All statistical-economic calculation were performed in the GRETL package for econometric analysis (Kufel 2002).

2. ECONOMIC GROWTH CRITERIA

Economic growth is a process of increasing the capacities of a given country to produce goods and services which satisfy the needs of its inhabitants. This process is accompanied by transformations in the structure of the national product and of the whole economy. Economic growth together with these structural transformations is jointly defined as economic development. Such a presentation of economic development emphasizes the integrity of the correlations between the growth and structural changes (Begg 1999, p. 87).

It is very difficult to present the process of economic growth using one universal standard as one cannot objectively reduce all the various aspects of economic activity to one common denominator.

The achieved level of economic growth (development) can be assessed (estimated) on the basis of various indicators and criteria of the achieved level of production of various material goods and services in the economy in a specified time (usually one year). To perform a more accurate assessment of economic development (growth) one should take into account the following various performance criteria (Zienkowski 2003, pp. 107–108):

- achieved level of individual and social work efficiency assessed on the basis of the amounts of generated products per one worker, in case of social work efficiency per all workers;
- efficiency of the production of generated goods measured by the relation between the amount of these goods and total outlays (expenses) incurred for their production;
- capital intensity of the production assessed by the relation of expenses incurred for the production;
- material intensity of the production calculated by the amount of used materials and raw materials per unit of a generated product;
- energy intensity of the production calculated by the amount of energy (in kilograms of conventional fuel) necessary for the generation of one unit of a product;
- productivity of the assets assessed by the relation of the size of the production per production fixed assets;
- efficiency of investments measured by the relation between annual increase in the national income and investment outlays incurred for its generation.

The following macroeconomic criteria of economic growth are widely used in the economy:

• the amount and structure of national assets, i.e. a stock of national goods accumulated in the national economy as a result of economic activities of people of former periods. These assets include production assets (buildings and structures, equipment, machines, work tools) and non-production assets (residential buildings, schools, theaters, hospitals, state administration buildings, defense equipment, etc.);

• the size and structure of the global social product which is a total of the productions of goods and services of all sectors of the national economy;

• the size and structure of the national income (product), which is a total of the newly generated value (usually calculated on an annual basis) and which is also defined as the so-called added value, i.e. a surplus over the value of used raw materials, materials, fuel, etc – the so-called transferred value;

• the rate of growth of the national income (product) (r) measured by the relation of the increase in the national income (AD) in a given period to the level of the national income in the preceding period (D)

$r = (\Delta D/D)*100$;

• increase of the national income per one inhabitant;

• rate of investment increase – the rate of increase in investments known as the share of investment outlays in the national income or the rate of growth of the accumulated national income or net investments per one inhabitant;

• consumption rate – a percentage share of individual consumption in the national income or the size / amount of national income consumed per one inhabitant;

• In further analyses of this study I shall use the level of GDP and its electricity density do assess economic development.

3. NUMBER OF INHABITANTS, THE GDP LEVEL AND ELECTRIC ENERGY CONSUMPTION IN THE EUROPEAN UNION COUNTRIES

Electric energy is a factor which influences without doubt economic and civilization development of the world. We need it for almost everything: from household applications to agriculture, transport and industry. Obviously the level and dynamics of energy consumption in individual countries depends on many factors. The most important ones are: number of inhabitants, rate of economic development and effectiveness of energy consumption. Demographic forecasts did not show the existence of limitations in the world population increase rate for a long time. However the last few years have shown that since 1990 annual growth rate has been decreasing considerably (Duda 2001, p. 9).

In the majority of Union countries one can observe an increase in the number of inhabitants. The highest population growth in 2002 compared to 1980 (Table 1) can be observed in Cyprus (31%) and Estonia (28%). Other states with a high level of population growth are Luxembourg (25%), Malta (22%) and Ireland (15%). Only four countries (the Czech Republic, Lithuania, Latvia and Hungary) recorded a decrease in the number of inhabitants.

Table 1. Dynamics of GDP changes, electric energy consumption and a number of inhabitants in the years 1980–2002 in the European Union countries

Country	GDP		Electric energy consumption		Number of inhabitants	
	2002/1980	average rate of changes	2002/1980	average rate of changes	2002/1980	average rate of changes
Austria	1.6047	1.020	1.6247	1.020	1.0742	1.003
Belgium	1.5331	1.018	1.7685	1.024	1.0457	1.002
Cyprus	2.9129	1.046	3.6756	1.056	1.3093	1.011
The Czech Republic	1.2092	1.008	1.1153	1.005	0.8984	0.997
Denmark	1.5165	1.018	1.4269	1.015	1.0449	1.002
Estonia	1.3394	1.012	0.9017	0.996	1.2813	1.000
Finland	1.7042	1.022	2.1116	1.032	1.0879	1.004
France	1.5667	1.019	1.7535	1.024	1.1108	1.004
Greece	1.5855	1.019	2.3227	1.036	1.1380	1.005
Spain	1.8098	1.025	2.1803	1.033	1.0916	1.004
The Netherlands	1.7258	1.023	1.7287	1.023	1.1365	1.005
Ireland	3.0943	1.048	1.7277	1.023	1.1500	1.006
Lithuania	1.2583	1.010	0.7751	0.989	0.8792	0.995
Luxembourg	2.5302	1.023	0.9108	0.996	1.2500	1.006
Latvia	1.0560	1.002	1.5620	1.019	0.9404	0.997
Malta	2.3896	1.037	4.2490	1.062	1.2188	1.008
Germany	1.6402	1.021	1.1546	1.006	1.0528	1.002
Poland	1.2820	1.010	1.1033	1.004	1.0854	1.003
Portugal	1.8886	1.027	2.6758	1.042	1.0287	1.001
Slovakia	1.4534	1.016	1.0046	1.000	1.0131	1.001
Slovenia	1.4799	1.016	1.1917	1.007	1.0205	1.001
Sweden	1.5709	1.019	2.1803	1.033	1.0674	1.003
Hungary	1.3798	1.014	1.2768	1.010	0.9262	0.997
Great Britain	1.7024	1.022	1.3948	1.014	1.0486	1.002
Italy	1.4918	1.017	1.7277	1.023	1.0186	1.001

S o u r c e: Own calculations on the basis of http://www.eia.doe.gov (20.03.2005).

In the demographic structure a relation of the population of the rural and urban areas plays an important role in the development of electrical power engineering. One predicts that the share of the rural population will be on a steady decrease. On the contrary huge urban agglomerations should be on the increase. Thus one should expect an increase in the demand for electric energy in highly concentrated regions.

After the World War II, regardless of certain deviations in some years one could observe that the global GDP had been increasing linearly in time, which means a decreasing annual rate of growth. In the 1960s it amounted to about 5% annually, in the 1970s to about 4%, in the 1980s just over 3% and in the 1990 under 3% (Duda 2001, p. 9).

The European Union member-states are characterized by their own specificity of development which is connected with their geographical position, structure and national history. When one assesses data on the GDP level in member-states expressed in billions USD (fixed prices of 1995) one can by no means compare them in absolute terms. The best way of assessing these data is to compare the annual growth rate over the analyzed years in each member-state with changes in the year 2002 compared to the year 1980 (similarly as in the case of the number of inhabitants). In Cyprus, Ireland and Luxembourg the level of the GDP in the year 2002 compared to the year 1980 almost doubled. In other countries this growth is much slower and almost identical. It is contained the range of 45–70%. In Poland, the Czech Republic and Lithuania this growth amounts to about twenty-some percent. The slowest growth rate in the analyzed period could be observed in Latvia and it amounted only to 5.6%.

When one compares in a similar way the amount of consumed electric energy one can observe that Malta (325%), Cyprus (267%), Portugal (168%), Greece (1325), Sweden (118%) and the Netherlands (118%) are the countries with the fastest growth in the analyzed period. Only in case of three members of the Community (Estonia, Lithuania and Luxembourg) the amount of electric energy consumption decreased.

The level of growth in the demand for energy is connected with prognoses concerning the rate of economic growth by the so-called coefficient of energy density and electricity density of the GDP (Kumanowski 1997, p. 200). These quantities are calculated as a relation of energy or electric energy consumption to the GDP level. In the majority of the EU countries these coefficients are smaller that the unit and they are contained in the range from 0.2 to 0.3, which means, that a generation of one GDP unit requires the consumption of 0.2–0.3 unit of electric energy. One can isolate a group of countries in which this coefficient is higher that the unit. These countries include: the Czech Republic, Estonia, Ireland, Latvia and Slovakia. Poland's situation with its coefficient level at 0.7 is similar to that of Hungary and Sweden. The lowest electricity density of the GDP can be observed in Denmark, the Netherlands and in Germany.

4. INTEGRATION AND COINTEGRATION

A time series with a trend is non-stationary. If for the purpose of the analysis of the regression one takes two series with a trend (non-stationary) than one is very likely to obtain a model with good results of the tests verifying its "goodness", even when the regression does not make any sense. One of the basic tests which enables to find out whether there are some defects in the assessed model is the Durbin-Watson statistics which confirms the existence of autocorrelations. The above-mentioned analyses lead to a conclusion that the analysis of a regression is purposeful only in case of these data which are not influenced by the trend. Since, however, almost all series of economic data include a trend, it should be removed before the analysis of a regression can be performed. A convenient way of getting rid of the trend is the application of the first increments instead of the levels of the variable. In some cases in order to achieve this stationarity one needs to calculate the increments more than once. In this context is it convenient to use the notion of integrated series (Charemza, Deadman 1997, pp. 113–122).

In 1987 Engle and Granger defined an integrated series of a–d level as a non-stationary series which could be reduced to a stationary series by means of calculating the increments *d* number of times. Such a series is marked with a symbol $x_t \sim \mathrm{I}(d)$. In practice there are no integrated series of the level higher than 3. If a series undergoes periodic fluctuations then it is often necessary to calculate both the periodic and the ordinary increments.

Integration level necessary for a determination and further correct analysis of the studied process can be examined with the help of simple integration tests. Nowadays the most popular tests are: *Dickey-Fullera* (*DF*) test and *Augmented Dickey-Fullera* (*ADF*).

Dickey-Fullera (*DF*) test, which is also known as a unitary root test, consists in testing the parameter adjacent to the explanatory variable delayed in a one-equation model (1) estimated by means of the least squares method.

While analysing the occurrence of the unitary root one considers the following model:

$$y_t = \rho\, y_{t-1} + \varepsilon_t \tag{1}$$

where:

y_t – dependent variable

y_{t-1} – delayed dependent variable

ε_t – random component

ρ – structural parameter

If $|\rho| < 1$ then the process generating y_t is an integrated process of zero level, so stationary.

DF test is based on the estimation of the equation (2) which is such a transformation of the equation (1), that:

$$\Delta y_t = \delta\, y_{t-1} + \varepsilon_t \tag{2}$$

where:
Δy_t – increment of the dependent variable
y_{t-1} – delayed dependent variable
ε_t – random component
δ – structural parameter

Model 2 can be also written as

$$\Delta y_t = (1+\delta) y_{t-1} + \varepsilon_t \tag{3}$$

Where:
$\delta = 1 - \rho$
Δy_t, y_{t-1}, ε_t, δ – as in the equation (2).

If one wants to find out whether the variables are stationary or non-stationary the estimation procedure should begin from the verification of the zero hypothesis which says that a series is not stationary in comparison with alternative hypothesis according to which the analyzed series is stationary.

$H_0 : \delta = 0$ (the series has a unitary root, the series is non-stationary)

$H_1 : \delta < 0$ (the series does not have a unitary root – the series is stationary)

While assessing the hypothesis concerning a single parameter, one verifies the zero hypothesis on the basis of a mutual relation of the parameter δ and its standard error (Gruszczyński, Podgórska (eds) 2003, p. 185) obtained with the help of the least squares method, i.e.:

$$DF = \frac{\delta}{S(\delta)} \tag{4}$$

where:
DF – the value of Dickey-Fuller statistics
δ – the assessment of the structural parameter
$S(\delta)$ – standard error in the assessment of the structural parameter.

Owing to the fact that for the value of the Dick-Fuller statistics one does not know the distribution t-Student and one does not know the limiting normal distribution, either, one has to use tables of the tests *DF* and *ADF* in order to determine the critical values. One can read from the tables two critical values: the lower value DF_d and the upper value DF_g.

When one compares the value DF with the values DF_d and DF_g one take one of the following three decisions:

$DF < DF_d$ – reject H_0 – the process is stationary

$DF > DF_g$ – there are no grounds to reject H_0 – the process is non-stationary

$DF_d \leq DF \leq DF_g$ – one cannot determine the existence or the non-stationarity of the analyzed process.

If the analyzed series turns out to be non-stationary, so there are no grounds to reject H_0 then one should move on to testing increasingly higher level of variable integration. A series which is not integrated in the zero level, may be integrated at a higher level or not integrated at all.

While retesting the zero hypothesis that has the same formula but other reading one checks the first level of integration.

One still analyzes the negativity of the parameter δ, but in the following equation:

$$\Delta\Delta y_t = \delta\, \Delta y_{t-1} + \varepsilon_t \tag{5}$$

where:

$\Delta\Delta y_t$ – second increment of the dependent variable

$[\Delta(y_t - y_{t-1}) = y_t - 2y_{t-1} + y_{t-2}]$.

According to the zero hypothesis the variable y_t is integrated at a higher level that one and according to the alternative hypothesis the integration amounts to one.

When one repeats the whole estimation procedure one does not use the first increments, but the second increments. If also in this case there are no reasons to reject the zero hypothesis one should check if $y_t \sim I(2)$ in the following equation:

$$\Delta\Delta\Delta y_t = \delta\, \Delta\Delta y_{t-1} + \varepsilon_t \tag{6}$$

where:

$\Delta\Delta\Delta y_t$ – third increment of the dependent variable.

The procedure presented above should be repeated until one determines the integration level or finds out that such a level cannot be determined. The variable may turn out to be non-stationary and it may not be "reduced to stationarity" by calculating consecutive increments. Calculating consecutive increments is thus pointless as one can implement the subtraction operator too many times. It is the so-called "excessive calculation of increments" which may result in huge convergences between the assessments of the parameters in a model for the levels of the processes and the assessments of the parameters in a model for the increments of the processes (Piłatowska 2003, pp. 165–167).

The *DF* test does not take into account the existence of the autocorrelation of the process which generates the random component. This component which is not a process of white noise renders the assessments of the parameters of a given equation by means of the least squares method ineffective.

The existence of the phenomenon of the correlation of the random component necessitates the implementation of the Augmented Dickey-Fuller test instead of the Dickey-Fuller test. The increments of the dependent variable are in this case explained by a delayed dependent variable and subsequent delays in its increments:

$$\Delta y_t = \delta\, y_{t-1} + \sum_{i=1}^{k} \delta_i \Delta y_{t-i} + \varepsilon_t \tag{7}$$

Similarly to the deliberations concerning the *DF* test the above equation refers to the first increments. If necessary it can be supplemented with subsequent increments, which was the case in the *DF* test. In the *ADF* test the estimation procedure is similar to the presentation of the *DF* test described above, while the tables of the critical values are the same.

Bringing a non-stationary series into a series of basic characteristics (the mean and the variable) that are unchanged in time with a method consisting in the calculation of the increments results in the fact that the variables lose their long-term properties, because the model based on the increments does not have a long-term solution. One can only obtain information on short-term influences of the individual variables upon the explained variable.

So the determination of the existence of long-term relations for non-stationary variables is a fundamental question for the formulation of an appropriate model for the analyzed variables.

5. MEASUREMENT OF THE CORRELATION AND THE LEVEL OF INTEGRATION

Table 2 includes values of the estimated coefficients of the correlations between the GDP level and the electric energy consumption level in all analyzed Union countries.

In the majority of cases this interdependence is very strong and of a positive character. A negative interdependence and also weak (or very weak) can be observed in Estonia, Luxembourg, Lithuania and Slovakia. In case of Poland this correlation amounted to the value of 0.52, which in comparisons enables to classify our country into the same group as Germany.

A next step in the analysis of the collected statistical material is the verification of the level of the integration of the time series. The value of the *ADF* statistics can be found in Table 3. The critical values taken from the tables for the level of significance 0.05 amount in this case to the values $ADF_d = -2.33$ oraz $ADF_g = -2.11$. For nine countries *ADF* statistics is smaller $ADF_d = -2.33$ and that is why the hypothesis H_0 should be rejected for the sake of H_1. In other words one should state that the analyzed processes are stationary and one should move on to assessing the models which use the presented processes either as dependent or independent variables. The above-mentioned nine countries include: Austria, Belgium, Cyprus, Finland, the Netherlands, Malta, Portugal, Great Britain and Italy. In case of other countries there are no reasons (at a given level of significance) to reject. While testing the hypothesis of higher integration levels similar results were obtained, which enables to put forward a hypothesis that the analyzed time series are not stationary. In such a case in the estimation process one should use methods other than the least squares method or consider another form of the econometric model.

Table 2. The value of the coefficient of the correlation between the GDP and the electric energy consumption in the European Union countries

Country	Correlation coefficient	Country	Correlation coefficient
Austria	0.9647	Luxembourg	–0.3593
Belgium	0.9924	Latvia	0.8573
Cyprus	0.9909	Malta	0.9801
The Czech Republic	0.8321	Germany	0.4199
Denmark	0.8786	Poland	0.5158
Estonia	–0.5041	Portugal	0.9930
Finland	0.9340	Slovakia	–0.1569
France	0.9811	Slovenia	0.9597
Greece	0.9806	Sweden	0.9877
Spain	0.9790	Hungary	0.7527
The Netherlands	0.9933	Great Britain	0.9913
Ireland	0.9458	Italy	0.9936
Lithuania	–0.1611		

S o u r c e: Own analysis.

Table 3. The value of the testing statistics in the Dickey-Fuller (ADF) test for the GDP level and the level of electric energy consumption (EEC) in the European Union countries in the years 1980–2002

Country	ADF (GDP)	ADF (EEC)	Country	ADF (GDP)	ADF (EEC)
Austria	–2.86408	–3.37831	Luxembourg	–1.45629	–1.03931
Belgium	–2.88086	–3.76254	Latvia	–2.42381	–2.07988
Cyprus	–2.87013	–2.00156	Malta	–2.83655	–2.11665
The Czech Republic	–2.06015	–4.33891	Germany	–2.30113	–3.40891
Denmark	–1.11832	–0.63240	Poland	–2.4405	–4.00171
Estonia	–2.30934	–1.22773	Portugal	–3.37826	–0.82168
Finland	–2.65324	–3.35528	Slovakia	–2.03826	–1.77048
France	–2.82232	–1.54791	Slovenia	–2.17188	–1.58824
Greece	0.37226	–1.05058	Sweden	–2.01339	–0.05030
Spain	–3.16354	–0.05030	Hungary	–2.03609	–2.60466
The Netherlands	–2.29496	–2.71771	Great Britain	–2.93537	–3.41433
Ireland	–0.01358	–2.63574	Italy	–2.90322	–2.63574
Lithuania	–2.34289	–1.15474			

S o u r c e: As same as Table 2.

6. FUNCTIONS OF THE REGRESSION

The last stage of the analysis presented in this study consisted in the assessment of the linear functions of the regression which describe analyzed correlations. As in this case one can observe the existence of a two directional correlation so as a result of the estimation one obtained functions describing the changes of the GDP in relation to the level of electric consumption (EEC) and functions describing the level of EEC in relation to the GDP changes. The results of the estimation are presented in Tables 4 and 5. The obtained results confirmed earlier analyses. In case of countries for which the time series of the discussed quantities turned out stationary, the models matched very well the empirical data. Unfortunately in some cases one can clearly see autocorrelations of the random component.

Table 4. Linear function of the regression which describe the relation of the GDP size to the electric energy consumption in selected European Union countries in the years 1980–2002

Country	Estimation result	R^2	Se	DW
Austria	GDP = 21,399 + 4,455ZE	0.927	9.299	2.170
Belgium	GDP = 64,365 + 3,183ZE	0.984	4.790	0.470
Cyprus	GDP = 1,325 + 3,175ZE	0.981	0.320	0.860
Finland	GDP = 40,841 + 1,521ZE	0.860	7.530	0.402
The Netherlands	GDP = 5,130 + 4,905ZE	0.980	8.695	0.687
Malta	GDP = 0,687 + 1,789ZE	0.960	0.172	0.872
Portugal	GDP = 29,029 + 5,518ZE	0.990	2.530	0.684
Great Britain	GDP = –388,169 + 4,956ZE	0.980	24.300	1.260
Italy	GDP = 300,744 + 3,225ZE	0.980	15.400	1.150

Source: As same as Table 2.

Table 5. Linear regression functions describing the electric energy consumption from the GDP size in selected European Union countries in the years 1980–2002

Country	Estimation results	R^2	Se	DW
Austria	EEC = –1,417 + 0,209PKB	0.927	2.010	2.340
Belgium	EEC = –18,996 + 0,309PKB	0.984	1.490	0.465
Cyprus	EEC = –0,376 + 0,309PKB	0.981	0.102	0.877
Finland	EEC = –16,023 + 0,573PKB	0.860	4.625	0.397
the Netherlands	EEC = –0,019 + 0,201PKB	0.980	1.761	0.670
Malta	EEC = –0,324 + 0,537PKB	0.960	0.094	0.893
Portugal	EEC = –10,991 + 0,391PKB	0.990	1.001	0.679
Great Britain	EEC = 82,016 + 0,198PKB	0.980	4.862	1.270
Italy	EEC = –89,190 + 0,306PKB	0.980	4.747	1.160

Source: As same as Table 2.

CONCLUSIONS

Obviously not all questions connected with the assessment of the economic development of the European Union countries and with the relation of the changes taking place at its level to the electric energy consumption were presented in this paper. However one can draw the following conclusions:

• there is a strong correlation between the GDP level and the amount of electric energy consumption;

• the level and dynamics of energy consumption and the GDP level in individual European Union countries depend on many factors. Beyond doubt the most important ones are number of inhabitants, economic development level, efficiency of energy consumption, geographical position and the share of individual sectors of the economy in the GDP structure;

• the time series which include information on these quantities cannot always be treated as stationary;

• an important issue seems to be the assessment of the integration and cointegration of the analyzed time series as a tool facilitating the creation and estimation of the parameters of "suitable" econometric models.

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ROZWÓJ GOSPODARCZY A ZUŻYCIE ENERGII ELEKTRYCZNEJ W KRAJACH UNII EUROPEJSKIEJ – ANALIZA PORÓWNAWCZA

Definiując rozwój gospodarczy można stwierdzić, że jest to długofalowy proces przemian dokonujących się w gospodarce. Obejmuje on zarówno zmiany ilościowe, dotyczące wzrostu produkcji, zatrudnienia, inwestycji, rozmiarów funkcjonującego kapitału, dochodów, spożycia

i innych wielkości ekonomicznych charakteryzujących gospodarkę od strony ilościowej (wzrost gospodarczy), jak również towarzyszące im zmiany o charakterze jakościowym. Do tych drugich zaliczyć należy przede wszystkim postęp techniczny i technologiczny, doskonalenie systemu powiązań wewnątrzgospodarczych i powiązań z gospodarką światową, wzrost poziomu kwalifikacji siły roboczej, pojawienie się nowych produktów itd.

Proces wzrostu gospodarczego niezmiernie trudno jest przedstawić za pomocą uniwersalnego miernika, ponieważ nie można w sposób obiektywny sprowadzić do wspólnego mianownika różnych wyników działalności gospodarczej. Na ogół uważa się, że w sposób najbardziej ogólny można go wyrazić za pomocą zmian w czasie Produktu Krajowego Brutto (PKB) bądź Produktu Krajowego Netto (PKN).

Przeprowadzane badania dowodzą, że wzrost gospodarczy nierozerwalnie związany jest z poziomem zużycia energii elektrycznej wykorzystywanej w każdym dziale gospodarki narodowej.

Dlatego podstawowym celem tego opracowania jest ocena rozwoju gospodarczego państw Unii Europejskiej mierzonego PKB oraz wpływu na jego wielkość zmian zachodzących w poziomie zużycia energii elektrycznej w tych krajach.

Część empiryczną stanowią pomiary współzależności rozważanych wielkości ujętych w postaci szeregów czasowych z lat 1980–2002. Do realizacji tego celu zostały wykorzystane metody analizy współzależności, integracji i kointegracji szeregów czasowych oraz liniowe funkcje regresji opisujące omawiane wielkości. Wszelkie obliczenia statystyczno-ekonometryczne wykonano w pakiecie ekonometrycznym GRETL.