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## **STRUCTURAL TRANSFORMATION MODEL FOR POLAND UNTIL YEAR 2000**

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In the paper the scenario of desirable structural transformation for Poland until year 2000 is presented. The economic structure is reflected via the structure of employment in three sectors: agriculture, industry and services. The desirable scenario is based on the concept of pattern derived from the structure of employment in the countries of European Union. To construct the scenario, multivariate statistical methods are used.

### **1. INTRODUCTION**

The theory of transformation from a centrally planned economy to a market economy emerges as the real processes of transformation occur in the economy. The methodology based on quantitative methods is often used to derive the models of transformation. Such methodology was proposed for example by Welfe (1994). In this paper we present the so-called analogy approach to propose the model of structural transformation.

The analogy approach proved to be useful in forecasting (see Cieślak 1993). Time-space analogy is very often used, particularly if there are indications that some processes occurring in one country can occur in another country after a time lag.

In this paper we use the time-space analogy to derive the model of structural transformation for the Polish economy. Here the economic structure of the country is reflected through the structure of employment in three sectors: 1 — agriculture, 2 — industry, 3 — services.

Since Poland wants to join the European Union by the end of this century, the economic structure of Poland should change in such a way that it resembles the economic structures of (at least some) EU countries. In this paper only the so-called universal structures are taken into account. Universal structure is meant to be such an economic structure which does not depend on the economic specialization of the country (resulting from natural resources, tradition etc.). For universal structure similar changes in time occur in different countries. The structure of employment in the three sectors mentioned above

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is a universal structure since there are similar changes of this structure in different countries (more people work in services, less in agriculture and industry). On the other hand, the structure of employment in different industries is not a universal structure, since it depends on the economic specialization of the country. Therefore in this paper by economic structure we mean the structure of employment in three sectors of the economy.

The paper presents the scenario of structure transformation for the Polish economy until the year 2000. This is a desirable scenario, given the efforts of Poland to join the EU by the end of this century. The proposed scenario is based on the analogy approach. To use this approach it is necessary to select a pattern country for Poland and then to determine the scenario of transformation.

The proposed procedure has three steps:

- Step 1 — Verification of the universality of the structure.
- Step 2 — Selection of a pattern country.
- Step 3 — Determination of transformation path.

## 2. THE SCENARIO OF STRUCTURAL TRANSFORMATION-METHODOLOGY

We consider the set of countries. Each country is described by the  $(T \times m)$ -matrix, called the structure matrix. The rows of this matrix correspond to years and the columns correspond to the elements of the structure. For example, the  $(i, j)$ -th element of the matrix is the value of the  $j$ -th element of the structure in the  $i$ -th year. The procedure of the determination of the structural transformation scenario is described in the following steps.

Step 1 — Verification of the universality of the structure.

As it was already mentioned, the universal structure is a structure for which the similar changes in time occur in different countries. To verify the universality of a structure, we use a so-called  $\alpha$ -similarity measure (see Strahl 1980). This measure is a distance measure and reflects the similarity of the structures of two countries, described by two structure matrices.

For  $n$  countries, exactly  $n(n-1)/2$  similarity values are obtained. The structure is regarded as a universal structure, when at least 50% of these values do not exceed the assumed threshold.

Step 2 — Selection of pattern country.

To select the pattern country, we impose five constraints to be met by this pattern.

1. The pattern country is higher developed than Poland.

To evaluate the level of the development of the country, different measures can be used. Most of them are aggregate measures, based on the general approach proposed by Hellwig (1968). Also proxy variables can be used, like GDP per capita.

2. The pattern country had in the past a similar structure as Poland has at present.

The similarity of the structures of two countries in two different years can be measured by similarity measures. As a rule, they are distance measures between two  $m$ -dimensional vectors, where  $m$  is the number of the elements of the structure. These vectors are two rows of two structure matrices. For example, the Bray-Curtis distance measure (see e.g. Walesiak 1993) proved to be very useful in reflecting the similarity of structures. Bray-Curtis distance is given by the following formula:

$$d_{ij}^{ts} = \frac{\sum_{k=1}^m |x_{ik}^t - x_{jk}^s|}{\sum_{k=1}^m |x_{ik}^t + x_{jk}^s|},$$

where:  $d_{ij}^{ts}$  – Bray-Curtis distance between the structure of the  $i$ -th country in the  $t$ -th year and the structure of the  $j$ -th country in the  $s$ -th year.

For each country the last year for which the Bray-Curtis distance between the structure of this country and the structure of Poland in 1990 is lower than the assumed threshold is chosen.

3. The pattern country faced significant changes of the structure in the past. The similarity of the structure of one country in two years is measured through a distance (for example the Bray-Curtis distance) between two rows of the same structure matrix. The changes of the structure are considered as significant if this distance is higher than the assumed threshold.

4. The pattern country faced development in the past. The development is reflected through the changes of the measure of the development (e.g. GDP per capita). Obviously, the positive changes indicate the development.

5. The pattern country has the structure that can be regarded as universal. The structure of pattern country is regarded as universal, if it is similar to the structures of at least 50% of the countries considered. Certainly, other more restrictive constraints can be used as well.

The country which meets all five constraints is selected as the pattern country. Also the year for this pattern country is selected. If more countries meet these constraints, either an additional criterion is used to select one of them, or the abstract pattern country is determined, being some kind of “aggregate” of these countries.

### Step 3 – Determination of the transformation path.

The transformation path is the projection of the structure for the consecutive years so that the structure of a pattern country in the selected year is achieved by Poland in the year 2000. This equals the determination of the projected structure matrix for Poland. The rows of this matrix correspond to the years for which the projection is made, the columns correspond to the elements of the structure. To derive the projection, the crawling trend method (proposed by Hellwig) is used. The linear trend models are estimated using moving time series, where in each of consecutive time series the oldest observation is omitted and the projected observation is added – in such a way that the structure of the pattern country is finally obtained.

## 3. EMPIRICAL RESULTS

The proposed procedure was applied to derive the scenario of structural transformation for Poland, so that the economic structure of Poland in the year 2000 is the same as the structure of pattern country in the selected year. Clearly, economic structure is understood here as a structure of the employment in three sectors of the economy.

The set of countries consists of 15 countries. These are: Poland and fourteen EU countries. Due to some difficulties with obtaining the data, Luxembourg was not taken into account. For each country, data for the period 1960-90 were considered in the studies. Thus for each country the structure matrix consists of 31 rows and 3 columns.

The results of the proposed procedure are as follows.

### Step 1 – Verification of the universality of the structure.

The universality of economic structure was verified by the use of  $\alpha$ -similarity measure. Since more than 50% of similarity values were lower than threshold (equal to 0.011) thus the structure can be considered as a universal structure.

### Step 2 – Selection of pattern country.

Pattern country has to meet all five constraints presented in the previous section. The first condition was satisfied by all 14 EU countries. As a measure of development, GDP per capita was used. Clearly, all countries had a higher GDP per capita in 1990 than Poland in 1992.

To verify the second constraint, Bray-Curtis distances were calculated to determine the similarity of the structure of Poland in 1992 and the structure of 14 EU countries in years 1960-90. Therefore for each EU country 31 distance measures were obtained. Using these results three countries were selected as

candidates for a pattern country. For each country one year was selected. The selected countries and years are: Greece (1987); Spain (1977); Portugal (1984).

It turned out that all three countries satisfied the third, the fourth and the fifth constraint. This means that three countries faced significant changes in the past, they faced the development, finally, the structure of these countries can be regarded as a universal structure.

As far as the selection of a pattern country is concerned, two different solutions were tried. In the first solution Portugal was selected as the pattern country, since the economic structure of Portugal was more similar (than those of Greece and Spain) to the structure of Poland. The structure of Portugal in 1984 is given as a three-dimensional vector:

$$[17.5 \quad 34.2 \quad 48.3].$$

In the second solution the pattern country is an abstract country, the structure of which is the average of of the structures of the three mentioned countries. The structure of this abstract country is given as a three-dimensional vector:

$$[17.1 \quad 30.3 \quad 52.6].$$

### Step 3 – Determination of transformation path.

The application of a crawling trend method gave the transformation path for economic structure of Poland in years 1993-2000 for both proposed cases of pattern country.

If the pattern country is Portugal in 1984 then the  $(8 \times 3)$ -matrix containing the transformation path is given as:

$$\begin{bmatrix} 27.7 & 32.5 & 39.8 \\ 25.9 & 32.9 & 41.2 \\ 24.7 & 33.0 & 42.3 \\ 23.2 & 33.2 & 43.6 \\ 21.7 & 33.5 & 44.8 \\ 20.3 & 33.7 & 46.0 \\ 18.9 & 34.0 & 47.1 \\ 17.5 & 34.2 & 48.3 \end{bmatrix}$$

The rows of this matrix correspond to consecutive years of the period 1993-2000. If the pattern country is an abstract country, then the  $(8 \times 3)$ -matrix containing the transformation path is given as:

27.3	31.4	41.3
25.5	31.3	43.2
24.3	31.2	44.5
22.8	31.0	46.2
21.3	30.8	47.9
19.9	30.6	49.5
18.5	30.5	51.0
17.1	30.3	52.6

It can be seen that the second scenario means more dynamic growth in the third sector than in the first scenario. It is worth comparing both scenarios to the real growth, since some data is already available. The empirical structure of the economy was:

- in 1993: [27.0 30.2 42.8],
- in 1994: [26.9 30.0 43.1],
- in 1995: [26.9 30.4 42.7].

It is worth noticing that the second scenario is closer to reality.

## CONCLUSION

The empirical studies showed the usefulness of the proposed method. It seems that such studies should continue in future.

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