Cyclic Recurrence of Foodstuffs and Non-foodstuffs Price Level in Bulgaria during XX Century

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Summary: In this article the results from survey of dynamics of the foodstuffs and non-foodstuffs price index in Bulgaria are presented. There are two major aims – to detect the various types of waves and to make comparison of the phase shift of Kondratiev waves one to another. Also comparisons of the phase shift of the national long waves both to the long waves of world economy and to the period of the "socialist" state capitalism are made. Own modification of Bayesian spectrum analysis is used to detect the waves. The main obtained results are: a) the presence of long waves of the price index of foodstuffs and non-foodstuffs is undoubted; b) there are also three kinds of waves: 30-40 years Menshikov waves; 20 years Simon Kuznets building waves and middle waves; c) there are not presented short waves; d) the fourth wave of world economy and the long wave of the price index of foodstuffs and non-foodstuffs are identical both by period and by phase; e) the long wave of the price index of foodstuffs and non-foodstuffs is identical also with the period of "socialist" state capitalism in Bulgaria.

Key words: cyclic recurrence of economic development; Kondratiev waves; Bayesian spectrum analysis.

JEL: E32, C11, P22.

1. History and purpose of the study

The present article introduces the results of the fourth part of the study on the cyclical pattern of the economic development of Bulgaria in the 20 th century. In the first and second part, we have explored **physical indicators.** We also explored the cyclical pattern of **coal and copper ore** extraction per capita. In the third part, we started the study of **value** indicators. In this part, we considered the price of labour dynamics or, more precisely, the dynamics of **unskilled labour wage**. Interesting results came as an outcome of the three studies – some of them rather strange at first glance. For example, it was found that middle waves related to the industrial capital cycle in the second half of the century had an **amplitude twice as high as** in the first half[1]. This enters into contradiction with the official thesis that a society absolutely different from capitalism was created after 09.09.1944 in Bulgaria. On the contrary, it is a clear confirmation of the theory that the 9 th September Revolution was **bourgeois** in its character and that it gave a strong impulse to the advance of **the capitalist way of production** in Bulgaria. Another interesting result is the fact that short waves with duration of about 20 years (the so called

[1] See Najdenov, G., K. Haralampiev. The cyclic pattern of the economic development of Bulgaria in 20 th century (physical indicators – 2). In: "Tolerance and intolerance in international relations" – International scientific conference, Varna, 2006.

Simon Kuznetz "building cycles") and the waves of S.M.Menshikov with the duration of 30-40 years have been discovered[2], in addition to middle waves.

In the present article, we introduce the results of the study of food and non-food commodities retail prices dynamics. This study was much more difficult than the previous ones as gathering empirical information and building a dynamic row turned out to be rather complicated. It was necessary to link several different segments of the dynamic row by obtaining the value of indicators for years shared by neighbouring segments. In addition, as there was a long six years interruption, a necessary improvement of the software of primary information processing was performed. But the results were worth the efforts.

The purpose of the study is, in addition to exploring different kinds of waves, also making a comparison of phases with respect to long waves of world economy and with respect to the period of state capitalism. This was done by comparing the dynamic rows of food and non-food commodity prices with the ones of unskilled labour wage and of coal production per capita. The indicator of copper ore extraction per capita is not used as the dynamic row is too short and it is doubtful whether there is a long wave or a trend[3].

2. Work hypothesis

The work hypothesis is presented in the first part of the study – the period of state capitalism in Bulgaria (from the end of the 1940s to the end of the 1990s) is characterized by one of the long Kondratiev waves.

Previous studies have demonstrated that during this period of the economic development of Bulgaria, other market trend fluctuations can be discovered in addition to long waves. This is another confirmation that the proposed theory of state capitalism is correct (the theory that the so called "socialism" is a type of state capitalism).[4] It is logical to suppose that we can also expect to find the other types of waves also in this dynamic row.

It is also logical to suppose that this type of waves can be also found in the previous period, i.e. back at the beginning of the century, as during this period Bulgaria was an "open economy".

Nevertheless, despite the fact that during this period the non-monetary economy was prevailing in our country, the capitalist way of production was fast in its expansion.

3. Method

Bayesian Spectrum Analysis proposed by Bretthorst[5] was used to discover cycles in the present study. The content of the modification is explained below and the

[2] See Menshikov, S., L. Klimenko. Long waves in the economy. " International relations", Moscow, 1989, p. 122.
[3] See Najdenov, G., K. Haralampiev. Ibid.
[4] See Najdenov, G. What is going on?. VIKOM-KOS, Sofia, 1991; Najdenov, G. The hundred years paradigm. Sociological Institute – BAN, Sofia, 2003.
[5] The full description of the method is included in the book Bretthorst, L. Bayesian Spectrum Analysis and Parameter Estimation. In: *Lecture Notes in Statistics,* 48, Springer-Verlag, New York, 1988. Some important additional technical details are given in the article: Bretthorst, L. An Introduction to Parameter Estimation Using Bayesian Probability Theory. In *Maximum Entropy and Bayesian Methods,* P. Fougere *(ed.)*, Kluwer Academic Publishers, Dordrecht, the Netherlands, 1990. The two texts are available in the Internet at the address http://bayes.wustl.edu/glb/bib.html

similarities and differences are outlined, where necessary, in parallel with the original Bretthorst proposal.

A *harmonic model* of the following type is used to describe of the cycle:

$$f(t_i) = a.\cos\frac{2\pi t_i}{T} + b.\sin\frac{2\pi t_i}{T} \qquad (1),$$

Where t_i is the time and T is is the period of the cycle.

There are three unknown parameters in this model – the coefficients a and b and the period T. Their *a posteriori probability* is determined using Bayes theorem:

$$P(a,b,T | D,I) = \frac{P(D | a,b,T,I)\ .\ P(a,b,T | I)}{P(D | I)} \qquad (2),$$

Where:
D is the data;
I is *the a priori information*.
$P(D | a,b,T,I)$ is called *sample probability, sample distribution* or *plausibility;*
$P(a,b,T | I)$ – *a priori probability;*
$P(D | I)$ – *full probability*.

To calculate the a posteriori probability, it is necessary to determine the plausibility, the a priori probability, and the full probability.

The determination of plausibility and a priori probability is performed by the maximum *entropy method*.

To determine the plausibility, first the residuals (*noise*) are expressed:

$$\varepsilon_i = y_i - f(t_i) \qquad (3),$$

Where y_i are the factual values of the *dynamic row*.

These residuals must have zero as average value and some variance σ. The maximum entropy distribution satisfying these limitation requirements is the normal distribution[6]:

$$P(D | a,b,T,\sigma,I) = \frac{1}{(\sigma\sqrt{2\pi})^n}\, e^{-\frac{\sum_{i=1}^{n}(y_i - a.\cos\frac{2\pi t_i}{T} - b.\sin\frac{2\pi t_i}{T})^2}{2\sigma^2}} \qquad (4),$$

where n is the number of observations.

As the noise is unknown, a new unknown parameter σ, which must be added in both the a priori and the a posteriori probability, appears in formula (4).

To determine the a priori probability, the assumption is accepted that the coefficients a and b, the cycle period, and the variance are independent. Therefore:

$$P(a,b,T,\sigma | I) = P(a | I).P(b | I).P(T | I).P(\sigma | I) \qquad (5)$$

According to the maximum entropy method, when we do not have any a priori information about the unknown parameters, their a priori probability is a constant[7]. Therefore:

$$P(a,b,T,\sigma | I) = const \qquad (6)$$

The full probability is obtained through *marginalization*. As full probability plays the role of the so called normalizing *constant*, its calculation is necessary only when it is important to have the exact value of the a posteriori probability. Because the exact value of the a posteriori probability is not necessary for

[6] See Bretthorst, L. An Introduction to Parameter Estimation Using Bayesian Probability Theory. In *Maximum Entropy and Bayesian Methods,* P. Fougere *(ed.)*, Kluwer Academic Publishers, Dordrecht, the Netherlands, 1990, p. 5-7.
[7] Ibid. p. 5.

further explanation, full probability will not be calculated, and only the fact that it is a constant will be used.

After the plausibility is determined and it is established that the a priori and the full probabilities are constant, it follows that the a posteriori probability is proportional to[8]:

$$P(a,b,T,\sigma \mid D,I) \propto \frac{1}{\sigma^n} e^{-\frac{\sum_{i=1}^{n}(y_i - a.\cos\frac{2\pi t_i}{T} - b.\sin\frac{2\pi t_i}{T})^2}{2\sigma^2}} \quad (7)$$

To identify the cycle, Bretthorst proposes to successively eliminate coefficients *a* and *b,* and the variance σ from formula (7) integrating in the domain of their allowed values. Another alternative is used in the study: finding the highest possible combination of values of the known parameters. The two approaches are analogical and ultimately produce the same final results.

To find the most probable combination of the values of unknown parameters, the first partial quotients of formula (7) are set to zero:

$$\left| \begin{array}{l} \frac{\partial P(a,b,T,\sigma \mid D,I)}{\partial a} = 0 \\ \frac{\partial P(a,b,T,\sigma \mid D,I)}{\partial b} = 0 \\ \frac{\partial P(a,b,T,\sigma \mid D,I)}{\partial T} = 0 \\ \frac{\partial P(a,b,T,\sigma \mid D,I)}{\partial \sigma} = 0 \end{array} \right. \quad (8)$$

For easier explanation, Bretthorst symbols will be used[9]:

$$R = \sum_{i=1}^{n} y_i \cos\frac{2\pi t_i}{T}$$

$$I = \sum_{i=1}^{n} y_i \sin\frac{2\pi t_i}{T}$$

$$c = \sum_{i=1}^{n} \cos^2\frac{2\pi t_i}{T}$$

$$s = \sum_{i=1}^{n} \sin^2\frac{2\pi t_i}{T}$$

Some new symbols are also introduced:

$$m = \sum_{i=1}^{n} \sin\frac{2\pi t_i}{T}\cos\frac{2\pi t_i}{T}$$

$$R_t = \sum_{i=1}^{n} y_i t.\cos\frac{2\pi t_i}{T}$$

$$I_t = \sum_{i=1}^{n} y_i t.\sin\frac{2\pi t_i}{T}$$

$$c_t = \sum_{i=1}^{n} t.\cos^2\frac{2\pi t_i}{T}$$

$$s_t = \sum_{i=1}^{n} t.\sin^2\frac{2\pi t_i}{T}$$

$$m_t = \sum_{i=1}^{n} t.\sin\frac{2\pi t_i}{T}\cos\frac{2\pi t_i}{T}$$

After some transformations, the system (8) becomes:

$$\left| \begin{array}{l} a.c + b.m = R \\ a.m + b.s = I \\ a^2 m_t + a.b.s_t + b.R_t = b^2 m_t + a.b.c_t + a.I_t \\ \sigma^2 = \frac{1}{n}\sum_{i=1}^{n}(y_i - a.\cos\frac{2\pi t_i}{T} - b.\sin\frac{2\pi t_i}{T})^2 \end{array} \right. \quad (9)$$

This system has some specific characteristics.

First, the first formulas do not depend on the variance.

8 Ibid. p. 9.
9 Ibid. p. 10.

Second, Bretthorst uses Jeffrey's a priori probability[10] for the variance:

$$P(\sigma | I) = \frac{1}{\sigma} \qquad (10),$$

while constant a priori probability is used in our study. The only difference is that when using Jeffrey's a priori probability, the last formula in the system (9) is the following:

$$\sigma_J^2 = \frac{1}{n+1} \sum_{i=1}^{n} (y_i - a.\cos\frac{2\pi t_i}{T} - b.\sin\frac{2\pi t_i}{T})^2 \qquad (11)$$

This means the solution proposed in the study results in higher variance and is more conservative in this sense. On the other hand, it follows from the first specific characteristic that no matter what is the choice of $P(\sigma | I)$, it does not influence the first three formulas in the system, i.e. the values of a, b and T.

Third, a and b can be expressed only by the first two formulas:

$$a = \frac{R.s - I.m}{c.s - m^2} \qquad (12)$$

$$b = \frac{I.s - R.m}{c.s - m^2} \qquad (13)$$

Fourth, if the results of formulas (12) and (13) are substituted in the fourth formula of the system, a formula will be obtained for the direct calculation of the variance:

$$\sigma^2 = \frac{1}{n} (\sum_{i=1}^{n} y_i^2 - \frac{R^2.s - 2.I.R.m + I^2.c}{c.s - m^2}) \qquad (14)$$

An additional simplification is possible if formulas (12) and (13) are applied in reverse:

$$\sigma^2 = \frac{1}{n} (\sum_{i=1}^{n} y_i^2 - a.R - b.I) \qquad (15)$$

Fifth, if the results of formulas (12) and (13) are substituted in the third formula of the system, the obtained formula will be only with respect to T. Unfortunately, its solution is beyond out capacity[11]. An indirect approach to the solution of the problem is proposed, therefore. It consists in the following:

a) For each integer[12] value of T from 2 to ∞[13], the values of a, b and σ are calculated. The obtained values are substituted in formula (7). Then, the obtained a posteriori probabilities are equalized and the value T, corresponding to the highest a posteriori probability, is searched.

b) The described succession is used to identify the most probable cycle and the initial dynamic row. If there is another cycle, it is searched in the residuals, calculated by formula (3). The third cycle is searched in the residuals of the residuals, etc. The procedure can continue to infinity. Therefore, there must be a criterion for stopping the repetitions. Such a criterion is proposed by Bretthorst: "We can plot the estimated variance as a function of the degree of expansion order, (by expansion order we mean the total number of models functions). ... The total number of "useful" model functions is determined by the location of the break in the curve."[14] This means the procedure stops when reaching the period at which the variance is stabilized and its graphic,

10 Ibid. p. 16.

11 Moreover, it is difficult to assert if it is possible in principle to solve it or not.

12 Only integer values of T are used because in each specific study the time is a discrete value.

13 In practice, a specific numerical value has to be assigned to infinity. The used software works with a longest period T = 10 000.

14 See Bretthorst, L. Bayesian Spectrum Analysis and Parameter Estimation. In: *Lecture Notes in Statistics,* 48, Springer-Verlag, New York, 1988, p. 65-67.

afterwards, becomes an almost straight line. As a result, the dynamic row is described as a sum of ***k*** harmonic models:

$$f(t_i) = \sum_{j=1}^{k} (a_j.\cos\frac{2\pi t_i}{T_j} + b_j.\sin\frac{2\pi t_i}{T_j}) \qquad (16)$$

Here, a significant difference between the proposed modification and the original Bretthorst method can be noticed – he uses the described method of searching cycles **only in *stationary* dynamic rows.** When the row is not stationary, however, ***Bretthorst*** uses a mixed model, in which the *trend* is described by a polynomial, and the cycles – by harmonic models[15]. Furthermore, the evaluation of the trend is done simultaneously with the evaluation of cycles instead of the usual practice of first evaluating the trend, and then removing it and looking for cycles in the obtained residuals. According to him, "Normally, this is a bad thing to do, because the trend and the signal of interest are not orthogonal."[16] Nevertheless, Brethorst has no objections against using the analogical approach when a trend is missing: "We can do this here because the orthogonality properties of multiple harmonic model functions ensure that the error is small. But, we stress, it is only the special properties of the sine and cosine functions that make this possible."[17] Thus, according to Bretthorst, the procedure described above can be applied only in the case of a missing trend, because the harmonic models are mutually orthogonal, but not in the case when a trend is present, because the polynomial and the harmonic model are not.

Other than using a polynomial, the trend can be described also by harmonic models. This is illustrated in Figure 1 of the appendixes. In practice, the segments A and C of the harmonic model make a sufficiently good approximation of a first order polynomial and the segments B and D – of a second order polynomial. In addition, the harmonic model in the total ABCD segment is a sufficiently good approximation of a third order polynomial. Thus, formula (16) describes the **dynamic row as a whole**, where some of the harmonic models describe the trend and others describe the cycles.

A problem arises in relation to defining the frontier between the two components of dynamics, i.e. if a harmonic model with a certain period is found out, then how to determine whether it describes a cycle or a trend. It is not possible to answer this question unambiguously, but the following practical recommendations should be taken into account:

a) if the discovered cycle has a period that is much longer than the length of the row, this means the harmonic model most probably describes a linear trend;
b) if the discovered cycle has a period that is twice as long as the length of the row, this means the harmonic model most probably describes a trend in the form of a second order polynomial;
c) if the discovered cycle has a period that is approximately equal to the length of the row, this means the harmonic model most probably describes a trend in the form of a third order polynomial;
d) if the discovered cycle has a period that is about two thirds of the length of the row or lower, this means the harmonic model most probably describes a real cycle.

15 Ibid. p. 137.
16 Ibid. p. 111.
17 Ibid. p. 111.

It is obvious that the procedure of description of the dynamic row has several steps. At each step, a new harmonic model is generated. Harmonic models with periods longer than the length of the row describe the trend. Harmonic models with periods shorter than two thirds of the length of the row describe cycles. The procedure stops when the variance of residuals is stabilized.

The final result of the application of this procedure is the model described by formula (16). Its coefficients a_j and b_j do not have meaningful interpretation, but the model can be presented as follows:

$$f(t_i) = \sum_{j=1}^{k} A_j.\sin(\frac{2\pi t_i}{T_j} + \varphi_j) \quad (17),$$

Where:
A_j represents the *amplitudes;*
φ_j – *the phases of* the harmonic models:

$$A_j = \sqrt{a_j^2 + b_j^2} \quad (18)$$

$$\varphi_j = \begin{cases} \text{arctg}\frac{a_j}{b_j}; & b_j > 0 \\ \text{arctg}\frac{a_j}{b_j} + \pi; & b_j < 0 \end{cases} \quad (19)$$

The amplitude shows the maximum deviation "in plus" and "in minus", and using the phase, it is possible to determine the beginning of the harmonic model and its distance with respect to the beginning of the dynamic row. This is achieved in the following way:

$$\sin(\frac{2\pi t_i}{T_j} + \varphi_j) = \sin(\frac{2\pi t_i}{T_j} + \varphi_j + 2q\pi) = \sin\frac{2\pi[t - (-\frac{\varphi_j T_j}{2\pi} - q.T_j)]}{T_j} \quad (20)$$

where q is a random integer. Therefore:

$$t_0 = -\frac{\varphi_j T_j}{2\pi} - q.T_j \quad (21)$$

To find the beginning of the harmonic model, q must be chosen in such a way that the obtained result has the lowest absolute value.

4. Data

The following data are available:

a) The extraction of coal for the period 1896 – 1997. Information is missing for 1946 and 1947;
b) Base indexes of unskilled labour wage (base 1895 = 100 %) for the period 1896 – 1946;
c) Average yearly wage of workers in manufacturing for the period 1948 – 1996. After 1996, a new nomenclature of professions is introduced. Industrial branches, in which wage and salaries are accounted, coincide. The monetary reform in the period 1948 – 1952 is also taken into account.
d) Actual working days per worker in manufacturing for the period 1961 – 1991.
e) Base indexes of the food and non-food prices (base – 1898 = 100 %) for the period 1899 – 1989. Information for the periods 1946 – 1951, 1958, 1959 and 1971 is missing. Monetary reform in the period 1948 – 1952 is also taken into account in the choice and calculation of the base.

The beginning of the dynamic rows of coal extraction and the unskilled labour wage indexes, which are earliest in time, have been chosen as a start of the studied period (1896). The year 1989 was chosen as an end of the period, because a radically new stage of the economic development of Bulgaria starts afterwards. The following dynamic rows are available as a result:

- the extraction of coal per capita (94 years period, number of observations – 92);

- the unskilled labour wage (94 years period, number of observations – 92);
- food and non-food price indexes (91 years period – 1899 – 1989, number of observations – 82).

The extraction of coal per capita[18] and the unskilled labour wage indexes[19] have been already explored by previous studies. There are two divergences, however. First, the explored period in the first study is 1986 – 1997. Second, we have interpolated the missing values. This interpolation, however, is a requirement of the software, not of the method. The newer software version allows working with missing values.

These two differences result in different results and here, for this reason, in addition to the analysis of food and non-food price indexes, the new results of the study of the extraction of coal per capita (Table 2), as well as the unskilled labour wage (Table 3), are included without detailed comments.

5. Results

The procedure described above was repeated 20 times for the dynamic row of food and non-food price indexes. The dispersion of residuals as a percentage of total dispersion is presented in Figure 2. The dispersion becomes stable and its graphics represents almost a straight line after a 25-year period. The obtained harmonic models are presented in Table 1. The graphic of the model is presented in Figure 3. In accordance with the practical recommendations for distinguishing the trend from the cycles, it is assumed that harmonic models with periods less than 61 years describe real cycles (Figure 4).

6. Analysis of the results

6.1. Without any doubt, a **long cycle** of economic trends is present in the food and non-food prices. Its length is 45 years and its amplitude is large. There are two full cycles completed in the studied period. During the phase of the "socialist" state capitalism, the lowest point of the cycle was in the mid-'70s, and its highest point – in the mid-50s.

6.2. Three additional types of waves besides long waves have been identified in the development of food and non-food prices.

6.2.1. The waves of S. M. Menshikov with 30-40 years duration related to transition to intensive type of investments – in this case, the wave length is 29 years.

6.2.2. Simon Kuznetz building cycles with 20 years length, related to the change of generations – in this case, the wave length is 21 years;

6.2.3. Waves of average length, related to the cycle of industrial capital – in this case, the wave length is 13 years

6.3. It is interesting that short waves related to trade capital cycle are missing. Taking into account that such waves are missing also in the extraction of coal per capita, as well as in the unskilled labour wage, it is appropriate to ask the question whether it is due to the fact that in the first half of the century a significant part of the economy was non-monetary or within the limits of simple commodity production, while in the second half the combined capitalist – the party-state apparatus – **had a monopolistic position on the market.** Alternatively, the

[18] See Najdenov, G., K. Haralampiev. State capitalism in Bulgaria and Kondratiev long waves. In: Scientific Proceedings of the Scientific-Technical Union of Mechanical Engineering. IV International Scientific Conference "Management and Engineering '06", Sozopol, 2006.
[19] See Najdenov, G., K. Haralampiev. State capitalism in Bulgaria and Kondratiev long waves – third part (unskilled labour wages). Sociological problems, to be published.

row might be too long and as two qualitatively different periods are part of it, this could result in mutual cancellation of short cycles. Moreover, in a previous study[20], the extraction of coal per capita was analyzed and short cycles were found.

6.4. The question mentioned above is appropriate also because there is a **specific quality** of middle waves – they are one or two years longer than the typical wave length for the capitalist way of production (13 or 14 years, not 12). It is possibly due to the underdevelopment of capitalism in the first half of the 20 th century and the monopolistic position on the market of the combined capitalist – the state, during the second half.

6.5. In a previous study, a question was raised whether there is a possible coincidence of phases, or a phase displacement, or reciprocity of labour price with respect to other indicators. The present study **started the clarification** of this issue[21]. Unambiguous **reciprocity** is present in both cycles between unskilled labour wage and extraction of coal per capita. In the first cycle, there is also reciprocity between the wage and food and non-food price indexes. In the second cycle, the reciprocity of food and non-food prices is slightly displaced towards the price of labour. Nonetheless, it is rather **reciprocity** than phase displacement. This clash is due to the fact that the labour price cycle is 56 years and the one of food and non-food prices is 45. It is obvious that the results of this study are sufficiently persuasive and confirm the assumption included in the previous study that it is more probable to expect **reciprocity** than phase displacement or coincidence of phases. There is no doubt about the fact that in "socialist" state capitalism workers in the phase of **depression** have mechanisms efficient enough to maintain high level of payment.

6.6. It is necessary to precise that "socialist" state capitalism was established in Bulgaria soon after the fourth rising wave had started in the world economy[22]. The rising wave started in 1939, and the "socialist" revolution was in 1944. Moreover, the "tender" revolution in 1989, which ended "socialism", happened soon after the start of the fifth rising wave of world economy – in 1985. This development is also totally in the context of the **second empirical rule** of Kondratiev that rising wave periods of longer cycles are more intensive in major social cataclysms and of social life disturbances (revolutions, wars, etc) than periods of decline of the world economy.

6.7. How is the cyclical pattern of the food and non-food prices positioned with respect to: a) the cyclical pattern of other indicators of "socialist" state capitalism; b) the cyclical pattern of world economy; c) the stage of state capitalism?

6.7.1. In relation to unskilled labour wage in the first cycle, the waves are mutually reciprocal. In the second cycle, a slight phase displacement is present as the two dynamics are with different cycle length – food and non-food price indexes have a cycle length of 45 years, and those of wage – 56 years. When food and non-food prices are declining, unskilled labour wage is already in depression. For the same period, the extraction of coal per capita is rising.

6.7.2. The comparison to the cyclic pattern of world economy demonstrates, first, that the length of cycles of the fourth wave and of both

[20] See Najdenov, G., K. Haralampiev. The cyclic pattern of the economic development of Bulgaria in 20th century (physical indicators – 2). In: "Tolerance and intolerance in international relations" – International scientific conference, Varna, 2006.
[21] For more details on the struggle of hired labour under the conditions of state capitalism see Najdenov, G. The hundred years paradigm. Sociological Institute – BAN, Sofia, 2003, pp. 102-111.
[22] See Kondratiev, H. Long supercycles. In: "Problems of economic dynamics", Economy, Moscow, 1989, pp. 203-205.

long waves of food and non-food prices is almost the same – 47 and 45 years, respectively. They coincide not only in their length, but also in their phase – the displacement of food and non-food prices in the second cycle comes only four years later than world market dynamics.

6.7.3. The length of the second cycle of food and non-food prices coincides with the length of "socialist" state capitalism in our country. It is interesting, though, that growth started together with the so called "socialist" revolution and ended in the mid-'50s. And the period of **industrialization**, which ended in the mid-'70s, coincided with the period of decline and depression of food and non-food prices. This is a **polyvalent** result. It can be interpreted differently, which is the subject of future studies. ИА

Appendixes

Table 1. Open cycles of food and non-food price indexes during the period 1899 – 1989

Period	Amplitude	Beginning (Basis 1895 = 0)
10000	1186932,87	19,8
45	7385,47	2,8
95	5 555,57	-31,7
29	4643,27	-5,0
21	2540,15	7,9
17	1986,16	1,5
13	1597,09	1,2
129	1459,70	15,9
25	1293,50	-3,4

Table 2. Open cycles of coal extraction per capita during the period 1896 – 1989

Period	Amplitude	Beginning (Basis 1895 = 0)
10000	76,94	19,8
88	0,69	-20,8
35	0,26	-9,4
25	0,18	-10,2
20	0,12	6,9
143	0,10	-47,8
55	0,07	-0,6
16	0,05	4,3
14	0,06	0,5

Table 3. Open cycles of unskilled labour wage during the period 1896 – 1989

Period	Amplitude	Beginning (Basis 1895 = 0)
10000	2731230,41	22,4
108	39055,22	-30,6
56	8675,08	26,0
39	5334,66	8,8
30	4581,83	-3,3
10000	100706,67	17,0

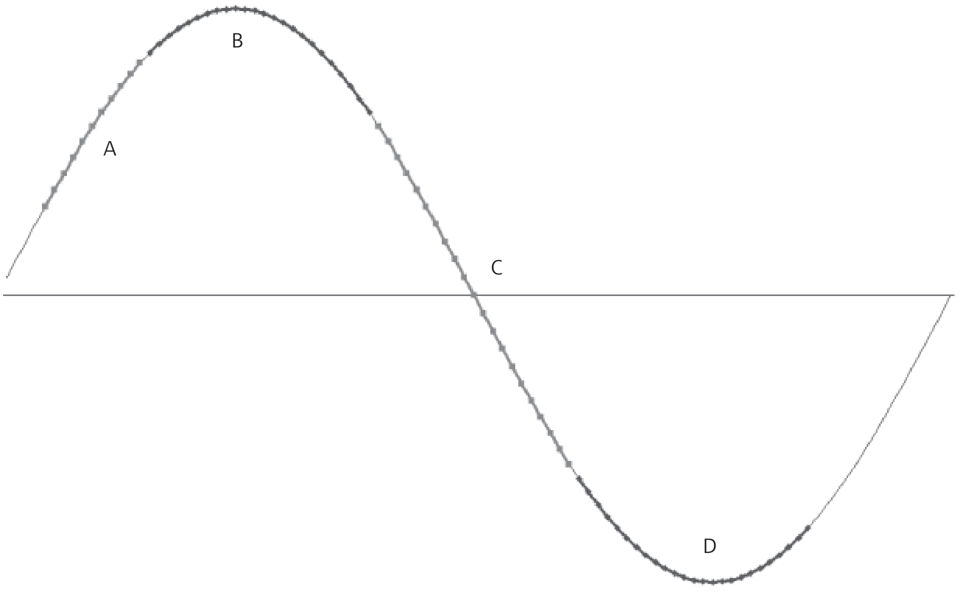

Figure 1. Segments of the harmonic model

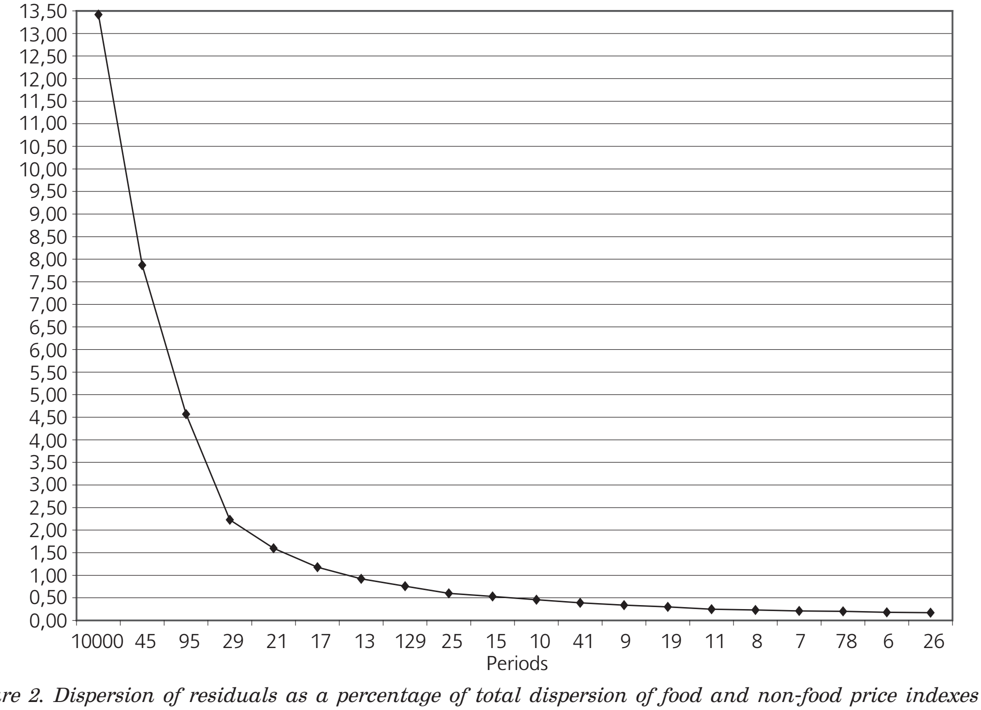

Figure 2. Dispersion of residuals as a percentage of total dispersion of food and non-food price indexes during the period 1899 – 1989

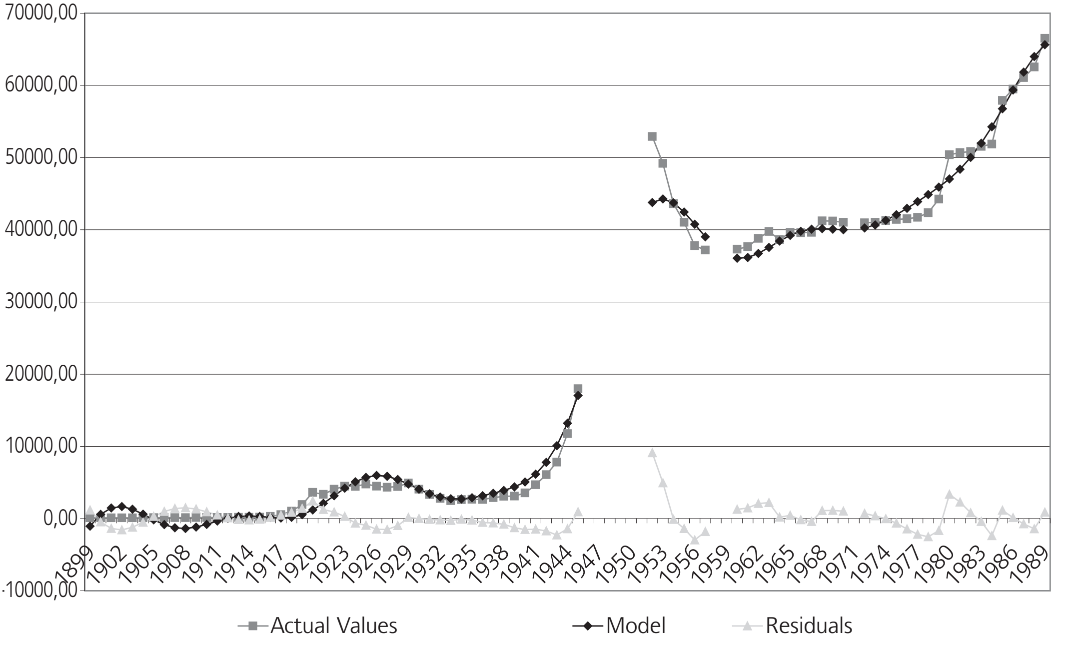

Figure 3. Food and non-food price indexes during the period 1899 – 1989

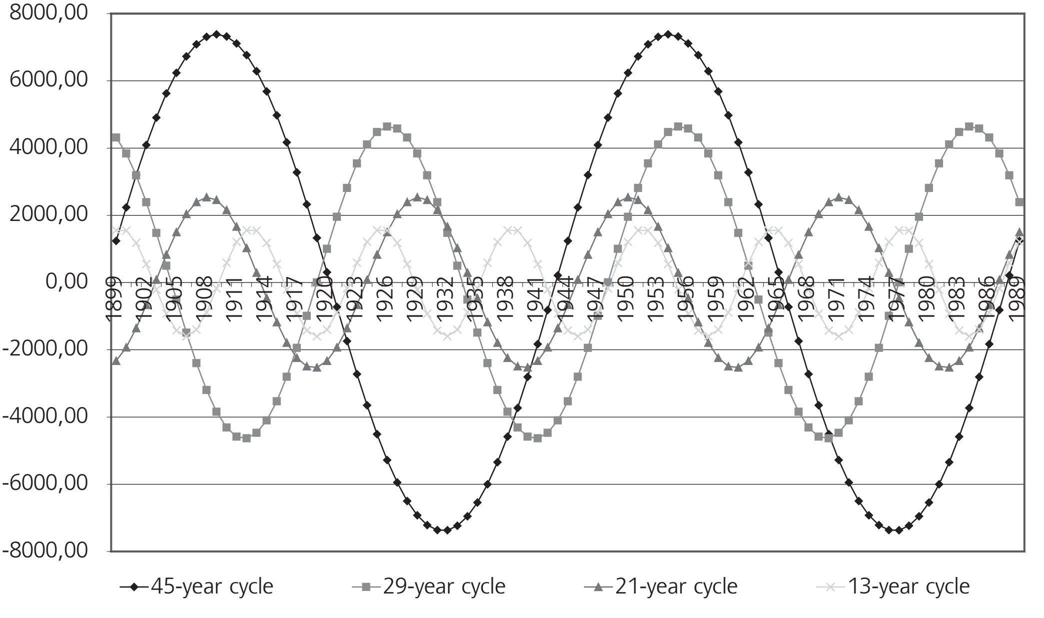

Figure 4. Open cycles of food and non-food price indexes

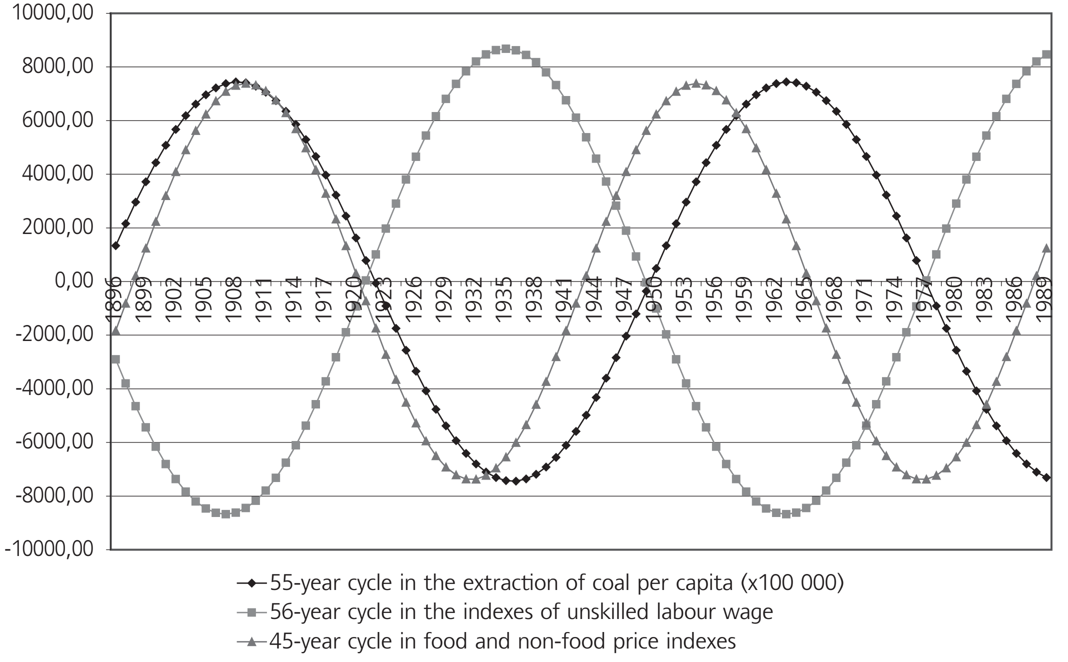

Figure 5. Kondratiev long waves in extraction of coal per capita, in the indexes of unskilled labour wage and in food and non-food price indexes