THE FORECASTING OF THE WORLD OIL PRICE BY SUMMING UP LINEAR TREND AND PERIODIC FUNCTIONS[1]

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The article discuss the analysis of factors forming the world price for oil, the existing methods of forecasting have been considered, the model of forecasting the world oil price, the amounts of the linear trend and periodic functions have been offered on the basis of the theory of business cycles, restrictions on its use have been given grounds for.

FACTORS GENERATING FUTURE PRICES

Reliable forecasting of the world oil price dynamics for the nearest 5-7 years is an important condition on lessening the uncertainty of the budget and investment processes.

Compensation mechanisms for the negative effects of the internal market opening under conditions of degradation of the high technology branches of the processing industry are limited and one way or the other come to the usage of export revenues from gas and oil sales.

The intensity of the investment process in the state oil and gas complex itself depends on its size even more. That's why the forecasting of the world oil price on the medium-term outlook characterizes the extent of probability of this or that macroeconomic results achievements over a period of 2006-2020.

The forecasting difficulty is preconditioned by the diversity of factors, generating future prices, and lack of methodology of their synthesis in the framework of the common conception.

The most relevant factor complexes are identified rather fully with the help of the retrospective analysis of the actual oil price dynamics in the last 150 years. Here is the list of them:

1. Change in the extent of maximum and medium oil production costs as a function of mining and geological, national geographic conditions and scientific and technological progress;

[1] Reprinted from "Intellectual Service for Oil & Gas Industry: Analysis, Solution, Perspectives", Vol. IV, 2006.

2. Correspondence of the oil demand and manufacturing capacity of its production;

3. Rate of the world economic expansion;

4. Rate of the power consumption decline of the world public products;

5. Change in the world structure of the mineral resources used as sources of power;

6. Cyclical oscillations of the investment activity;

7. Political and military actions of state and international organizations;

8. Regulating effect of the International Energy Agency and OPEC;

9. Corporate strategies of the oil companies;

10. Peculiarities of the world oil market functioning (combination of exchange and off-floor sectors;

11. Cyclical (quasi-periodical) oscillations of the price level of different frequency, phase and amplitude of the ambiguous nature;

12. System (cybernetic) regularities of the transition processes (frequency, amplitude, inertia and speed of the oscillation fading);

13. Psychological shades and economic underlying reason of the reaction of the oil products consumers on the expected and actual situation on the oil market.

Simultaneous taking into account of such a diversity of mutually dependent factors is beyond the scope of nowadays capabilities of the applied models. And we have to move to the common conception of the price forecasting gradually, step by step.

Action mechanism of most factors is to some extent studied at least in the qualitative respect. There are perspicacious conjectures and important considerations on reasons of oil price oscillations, observed in the last 30 years, in most retrospective analytical surveys [1-3], [7] and others.

If one looks at the diagram of its change, he'll see that each peak or downfall is identified, i.e. correlated with the influence of the certain factor or group of factors. It may seem that one should do the same in relation to the future price level. However, a posteriori identification is one thing, and quite another thing is precise localization of time force and direction of each factor influence in the future, not to mention taking into account their synergism and multiplicativity. Such localization might be possible only in the framework of the common conception of the price dynamics, connecting all the

particular factors. In other words, scheme of interaction of separate factor complexes should be worked out. Its lack hinders the synthesis of the common forecasting conception.

Indefiniteness of the future price value cannot be eliminated fully. Not to mention principal limitations of the philosophical nature, we can point out to the inability to forecast political, military excesses, future mining and geological conditions, etc.

It's difficult to apply the theory of automatic regulation towards the estimate of the transition processes parameters, as it is impossible to make an clear experiment on imitation of the disturbing influences. That is why the forecasting will always contain incidental component, and therefore an error. But it can be gradually lessened by the consistent connection of separate appropriatenesses of the world price formation.

Here we can stick to two ways, apparently, we should follow them simultaneously. The first one is more detailed analysis of the phenomenology in the price dynamics; the other one is modeling of the interaction of fundamental factors exterminating it's level. In the end their convergence will bring to synthesis and will determine the structure of the future common conception of the forecasting.

MODERN FORECASTING PRACTICE

The former of the abovementioned trends is the content of the modern forecasting practice. Models of different types were worked out in its framework. Model TRIDENT, based on the idea of bipolar lack of OPEC opportunities on balancing the world oil market [2]. It's author E.M. Khartukov considers it to be compatible with the best among known foreign models and thinks that in some respects it's even better [3].

If we compare the forecasting of the Group for analysis and forecasting of the world power and raw materials market (GAF WPM), given in fig. 3 of E.M. Khartukov's article, with the forecasting results on 2000, 2001 and 2002, we should admit them to be precise. They are given in table 1.

However, the forecasting for 2003 has an inadmissable error (30%). E.M. Khartukov's statement as to the possibility of price forecasting on 10-15 years is likely to be said about some modernized version of TRIDENT.

Table 1

Actual and forecasting (according to TRIDENT model) level of price for one oil barrel, $USA (taken from fig. 3 [3 p.20])

Indices	year					
	2000	2001	2002	2003	2004	2005
Actual price	28,31	24,41	23,90	28,3	40,3	56
Forecasting GAF WPM	25,0	23,5	21,0	20,0	21,0	21,5
Forecasting error , %	12	4	12	30	48	61

Among the recent works on the problem of world oil price forecasting, V.V. Petrov and V.F. Artushkin's book is notable for its thorough analysis [7]. There are rather interesting generalizations as to the role of separate factor complexes in the framework of the actual price behaviors. On the basis of these generalizations the authors of the book worked out algorithmic scheme of medium term forecasting. The basic idea consists in building the periodic autocorrelation function of the change in increase of world oil demand according to its background. The forecasting oil price is viewed as dependent on future values of this function for price is more tightly correlated with the first differences in demand. Logic of such reasoning seems apparent but practical world price forecasting, made by V.V. Petrov and V.F. Artushkin, is insolvent. It may be seen in fig. 4.30 of the work [7, p.183] (fig. 1).

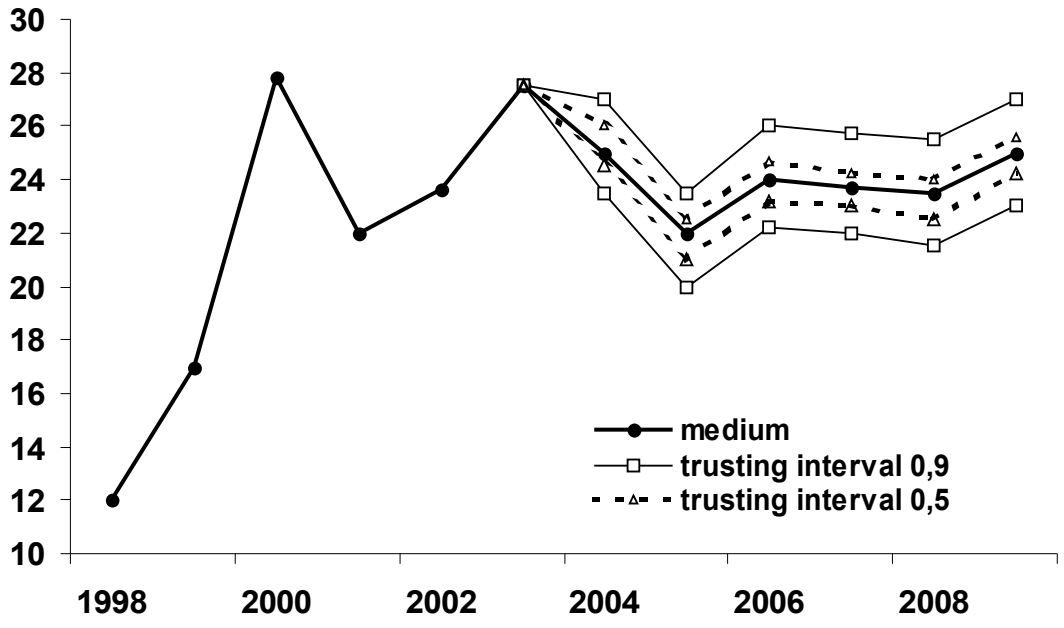


Figure 1. Price forecasting on four parameters

Actual oil price in 2004 and 2005 ($40,3 and $50 a barrel correspondingly) is almost two times higher than the authors' forecasting ($25 and $22 a barrel for the same years). Actual prices went far beyond the upper limit of rather strict (0.9) confidential interval. The authors were right to state that the lack of the confidential interval to the forecasting makes it of no value [7]. But as we may see, even such an interval doesn't necessarily guarantee trustworthiness of the price forecasting level with the stated value, if they were not received on the basis of an adequate conception. In fact, one may toughen the confidential interval to such an extent (e.g., to the probability of 0.997) that all the actual price values beyond it may be considered an incredible event. But on fig. 1 the limit of the confidential interval with such a probability is on the level of $33 a barrel whereas the actual price in 2005 wittingly will be no less than $50-60 a barrel. I.e. according to methodical approach, which was the basis for the forecasting in question, actual oil price in 2005 equal to $50 a barrel is a mere coincidence. Meanwhile during 2004, 2005 nothing extraordinary happened in the world. There was an ordinary intricate play of economic, political and natural forces, which in adequate forecasting conception should be inserted in the overall picture of interaction of determined and accidental factors. We think that the failure reason of V.V. Petrov and V.F. Artushkin forecasting consists in the fact that important separate correlations, disappeared by them, were not put into correlation with each other so, that there would arise a conceptual rod mechanism, determining future price dynamics. But there may be other explanation. Anyway, alongside with the improvement of the discussed models, there is point in testing other methodical approaches, based on the sum total of some evident signs of actual world price dynamics and theoretical considerations on their linking.

The main task here is the same forecasting task - i.e. to single out a chief determinant of the future dynamics in the previous price oscillations. As there is no other empirical basis for its solving except factual dynamics row, there is nothing left but to believe in appropriate and accident inertia, found in previous data, even if its origin is not yet clear. The question is how to single out dominant harmonic in the complex range of price oscillations. We think that one should begin with singling out the simplest and explicable elements.

THE FORECASTING OF THE WORLD OIL PRICE

From fig. 2 one can easily figure out: trend with a slight tendency to rise, probably caused by inflation and average rate of the world economic growth; certain inertia; marked recurrence with complex inner structure of the macrocycle; accidental impulses and transition processes.

In order to form forecasting, it is necessary to represent analytically each of the abovementioned components and correlate their description with the main tendency, embodied by the trend, i.e. synthesize a formal structure of the forecasting model, and then discuss the correlation of its estimate results and substantial factor analysis, determining future price dynamics.

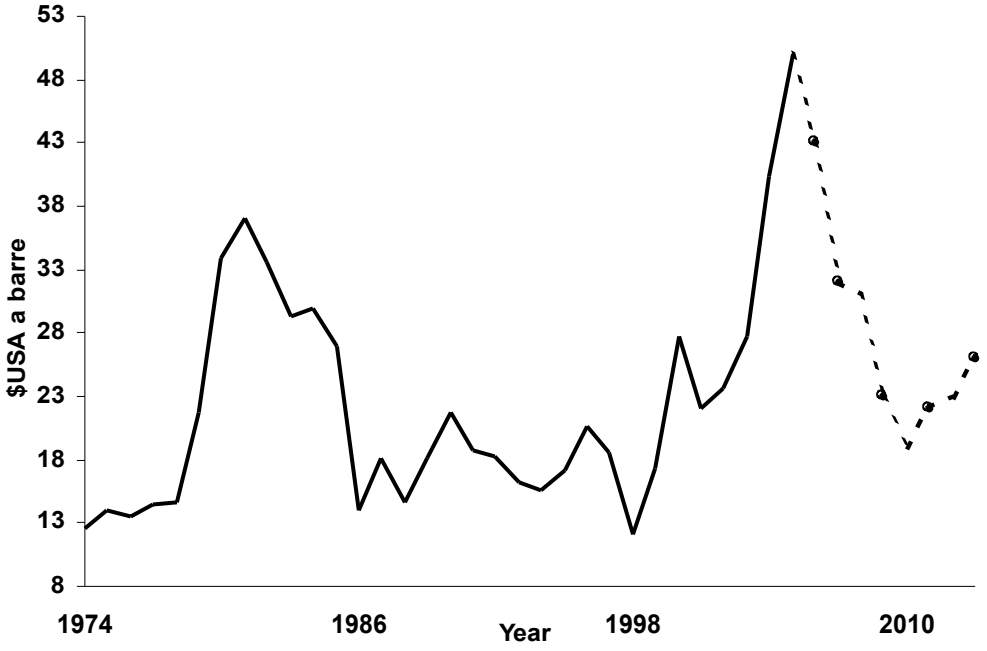


Figure 2. Actual average world oil price dynamics and its forecasting by combination of linear trend and cyclic component

Following this succession, one should proceed from the fact of division the previous price dynamics into 2 quasistationary regimes: one took place before series of powerful raising impulses of 1974-78, the second emerged after it. The reason of the jump in price in 1974 and subsequent transition process is known. It's a cardinal redistribution of natural rent in flavor of oil producing countries of Near and Middle

East, which was achieved by nationalizing of the oil industry in 1973-76. generalized scheme of rent redistribution is shown on fig. 3.

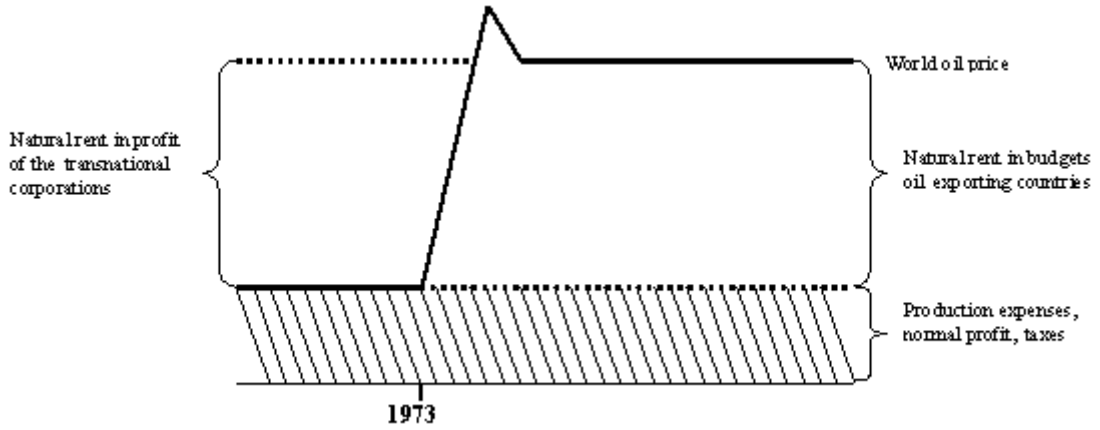


Figure 3. Price regime change as a result of natural oil rent redistribution

Prolonged transition process of 1980-86 towards new stationary regime of price dynamics 1986-2003 is accounted for by lack of effectively stabilizer in the system of oil price market. Regulating mechanism of OPEC was weak and decrease in demand by introduction of energy conservation technologies took some time and yielded results only from 1980. By 1986 oil costs per GDP unit was reduced by 25% in comparison with that of 1973, including the USA - 1.5 times, Japan - 2 times. But further possibility of this index decrease in the developed countries (in any case, economically justified) are limited by the thermodynamic limit, which is expressed by the efficiency formula of ideal Karno cycle:

$$\eta_{max[} = \frac{T_н - T_к}{T_н} \qquad (1)$$

where: η_{max} - max achievable efficiency of the ideal thermal process;

$T_н$ - initial (working) process temperature ;

$T_к$ - final temperature.

Modern power machines (which certainly don't have an ideal thermal cycle) work with $T_н$ = 800-1200^{0}K, and min $T_к$ even with complete thermal utilization is 293 ^{0}K.

Therefore, max achievable efficiency is $\frac{1000 - 293}{1000} = 0,7$

But in practice actual efficiency cannot be increased up to max efficiency out of economic reasons. Analysis of the costs indices to the reducing of the specific fuel expenses shows that their increase with the efficiency rise is like resistance of the compressed spring: they increase progressively with the efficiency rise. This dependence is expressed in the formula:

$$Z = Z_0 \frac{КПД_{max} - КПД_0}{КПД_{max} - КПД} \quad (2)$$

where: Z_0 - costs, connected with economy of 1 ton of conditional fuel with the achieved efficiency index $КПД_0$;

Z - costs, connected with economy of 1 ton of conditional fuel with any variable efficiency index $КПД \leq КПД_{max}$;

$КПД_{max}$ - current variable efficiency index;

Economically justified limit of the further decrease in GDP power consumption by technical means (not to mention structural) may be determined, taking into account the fact that world price for closing fuel (bituminous coal) is $50 a ton conditional fuel. As soon as Z equals the price of the closing fuel, further efficiency increase of the thermal machines and aggregates is of no economical value.

Index Z_0 depends on the initial conditions, i.e. on achieved efficiency $КПД_0$. In its average value in the developed countries Ef-0.45 costs of 1 ton conditional fuel conservation Z_0 =$15. Hence:

$$Z = \frac{15(0,7 - 0,45)}{0,7 - КПД} \quad (3)$$

Solving equation (3) as to the variable efficiency if Z equals the closing fuel price ($50 a ton conditional fuel), we find out that nowadays economically justified efficiency value $КПД$ is 0.65.

Reserve of decrease in GDP power consumption is still available but it's not high, especially if we take into account how difficult is to economize every other ton of

conditional fuel in the asymptotic sphere, i.e., near economic efficiency limit 0.65. Therefore it's no surprise that after a sudden decrease in specific power consumption in the period of 1973-1986, as a reaction on oil price jump, it slowed down, and beginning with 1993 it almost ceased. Further possibilities of energy conservation and mechanism quality, eliminating oil price increase, considerably more modest than in 1974-1986, excluding Russia, China and India.

From these positions cycle of price change in 1974-1986 is characterized by large, but explicable amplitude, which may be viewed as a transitional process towards the new price forming regime, while is distinguished by considerable cyclic oscillations as to the weak increasing linear trend. In our opinion their description is the chief task of phenomenological approach to the explanation of price dynamics in 1986-2004 and its forecasting for upcoming years.

Let's start with singling out the simplest elements. A weak linear trend can be seen on the background of not rather regular price oscillations (fig. 2). It is revealed in any case: whether we take a row of the last 18 years (from 1986) or 32 years (from the beginning of the oil crisis 1974). Trend equation is obtained out of table 2 data for the last 32 years (from 1974).

Here is equation of linear trend:

$$Y = 17{,}6 + 0{,}3t \qquad (4)$$

where: Y - price of a barrel for oil type "Brent" in t-year (1974=1).

Whatever jumps and failures were there in the price development, from time to time inflation "pulls it up". But as the inflation rate is not high, it's hardly noticeable in the drawing and creates an illusion of stable average level.

A complex process is evident, the vector of which is determined by the sign of difference: "(inflation rate + average growth rate of world gross product)- (average rate of decrease in oil production costs + average rate of decrease in oil consumption of world gross product)"*.

* For large rates the given difference is substituted by expression $\left[\frac{(1+J)(1+q)}{(1+u)(1+e)} - 1\right] * 100$, where J- inflation rate, q- world product growth rate, u- rate of decrease in oil production costs , e - rate of decrease in oil consumption of world product.

During the last 32 years it went with fairly noticeable sign "plus". The abovementioned wordly formula in numbers gives difference : (3+3)-(2.5+1.7)=1.8% a year*.

Table 2

Factual levels of average world oil price in 1974-2004 and price forecasting for 2006-2013** (in $USA a barrel)

Index	year									
	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Actual price	12,52	13,93	13,48	14,53	14,57	21,67	33,89	37,05	33,55	29,3
Forecasting by the method of exponential smoothing	12,52	12,52	13,68	13,41	14,24	14,53	20,24	31,16	35,87	34,01
a_t	0	-1,41	+0,2	-0,12	-0,33	-7,14	-13,65	-5,89	+3,3	+4,71

table 2 continued

Index	year									
	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Actual price	28,88	26,99	14,0	18,13	14,56	18,08	21,76	18,7	18,2	16,14
Forecasting by the method of exponential smoothing	30,24	29,15	27,42	16,68	17,82	15,22	17,51	20,91	19,14	18,39
a_t	+1,36	+2,16	+13,42	-1,45	+3,26	-2,86	-4,24	+2,21	+0,94	+2,25

table 2 continued

Index	year									
	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Actual price	15,51	17,14	20,64	18,53	12,04	17,26	27,7	22,0	23,71	27,71
Forecasting by the method of exponential smoothing	16,58	15,72	16,86	19,88	18,80	13,40	16,49	25,45	22,70	23,50
a_t	+1,07	-1,42	-3,78	+1,35	+6,76	-3,86	-11,21	+3,45	-1,01	-4,19

table 2 continued

Index	year			
	2004	2005	2006	2007
Actual price	40,3	50,0	-	-
Forecasting by the method of exponential smoothing	26,87	37,6	47,5	47,5
a_t	-13,43	-12,4		

* 3% - average rate of world product growth since 1972; 3%- average yearly inflation rate; 2.5% - average yearly of decrease in oil production costs; 1.7% -average yearly rate of decrease in energy consumption of world product.

** Data for 1974-2003 are taken from Energy Information Administration Monthly Energy Review, data for 2004-2005 accounting the current quotations.

If we proceed from trend equation parameters (4), we'll have almost the same value:

$$\frac{0,3 \cdot 100}{17,6 + 0,3} = 1,7 \ \%$$ a year

The underlying reason of the weak trend is cleared out, and it has to some extent regulated the study of interaction of all the system of abovementioned factor complexes.

It's evident that it's necessary to determine the origin of yearly deviation from the linear trend, as it characterizes the common tendency, and estimation of future yearly deviation is necessary for a middle term forecasting.

Adaptive forecasting by evolution equation is somewhat more sensitive towards the cyclic price change [4, p.124]

$$Z_t = \lambda \sum_{i=1}^{\infty} (1 - \lambda)^{i-1} Z_{t-i} + a_t \qquad (5)$$

Where: Z_t - price level of t year;

λ - coefficient of exponential smoothing;

Z_{t-i} - price level in t-I year of previous data;

a_t - accidental component of price of t year.

Since it is necessary to sum infinite number $\lambda (1 - \lambda)^{i-1} Z_{t-1}$, and there is finite row, then sum $\lambda \sum_{i=1}^{\infty} (1 - \lambda)^{i-1} Z_{t-i}$ is changed by exponential average t year [5 p.56].

Then price forecasting for t+1 year will be:

$$Z_t = \lambda \sum_{i=0}^{t-1} (1 - \lambda)^i Z_{t-i} + (1 - \lambda)^t Z_0 \qquad (6)$$

$$Z_{t+1} = \lambda \sum_{i=0}^{t-1} (1 - \lambda)^i Z_{t-i} + (1 - \lambda)^t Z_0 + a_t \qquad (7)$$

where Z_0 - initial price level in t-year.

If accidental impulses a_t are not correlated with each other, then the forecasting for t+1 year is Z_t. However in the observed row (table 2) there was found out some correlation between a and a. That's why it would be right to determine forecasting for t+1 year as a component of gliding trend Z_t plus sum of exponentially considered

accidental components for all the previous years, which is identified as accidental component of t+1 year (a). Initial dynamic row, calculated levels Z_t and price forecasting for 2006-2007 are shown in table 2.

Cumulative calculation of the suspended algebraic sum of accidental components a for all the previous years in addition to the constituent of the gliding trend is more exact than ordinary exponential smoothing when making forecasting for 1-2 years. But blind and somewhat lagging adaptation to the last actual price level doesn't give any possibility to foresee it's unexpected changes of the cyclic character. At the same time it may be seen in fig. 2 that in relation to the trend level actual prices make quasiperiodical oscillations of different frequency, amplitude and origin.

The 24-year megacycle with 12-year macro cycles, in which structure there are cycles of less duration, is easily distinguished on the drawing.

It is known that harmonic analysis enables to reproduce dynamics of such kind quite exactly during the previous years of the process as well as in the future. However, in order to have the right to translate the obtained data for the forecasting period, it is necessary to determine the beginning of mega- and macro cycles, constituting sub cycles and find reasoning in flavor of regular reproduction of circumstances, which arouse cyclic oscillations of main frequency.

Price oscillations preconditioned objectively, is based on the known achievements of the theory of business cycle and static criteria of existence of different frequency pleats.

As for 12-year macro cycle, it is expressed explicitly in fig. 2. Concerning it's nature it is undoubtedly a well-known 12-year cycle of investment activity of Samuel-Hicks [6], the lowest points of which are 1974, 1986 and 1998. It's rather stable and is reproduced regularly. There is a sub cycle of 8-year duration in it, which is connected with rapid period of production machinery renewal in the most dynamic and technically developed complexes of different branches. 6-, 4-, 3-year oscillations, probably preconditioned by logs, are put over the macro cycle and 8-year sub cycle. This picture gets complicated by accidental (in the static meaning) impulses, generated by political, war excesses and numerous non-identified minor factors. The latter cannot be sensibly divided into periods and predetermine an unavoidable error of the analytical price dynamics description.

The 24-year megacycle (1974-1998) is so clearly shown through on the drawing that we cannot ignore it. The nature of oscillations of such periodicity is not quite clear, but we can presume that they are connected with large structure changes in the production machinery and technology, which can't keep within 12-year cycle.

As for the megacycle, 12-year macro cycle as well as 8-year, 6-year and 4-year sub cycles we proceed from the fact of their regular reproduction.

On the basis of the abovementioned preconditions, we have made harmonic analysis of the actual dynamics of oil price, given in table 3. The middle level of the process is linear trend. In order to process the initial data from table 2, the trend constituent (4) was excluded from the actual price value, this constituent comes into the concluding equation as an independent item(11).

The cyclic price variable is expressed in the equation:

$$Y_{t_ц} = \sum_{\frac{p}{\tau}} \left[A_{\frac{p}{\tau}} \sin\left(\frac{2\pi}{\tau} t\right) + B_{\frac{p}{\tau}} \cos\left(\frac{2\pi}{\tau} t\right) \right] \quad (8)$$

where: $Y_{t_ц}$ - the cyclic price variable of t-year;

t-ordinal year number, starting from 1974=1;

p- number of previous to the process years (32 years);

τ - oscillations periods

$A_{\frac{p}{\tau}}$, $B_{\frac{p}{\tau}}$ - coefficients of the corresponding pleats;

$2\pi=360^0$

Estimate of parameters $A_{\frac{p}{\tau}}$, $B_{\frac{p}{\tau}}$ is made by the method of the least square based on the table data and trend equation (7) using the formulas:

$$A_{\frac{p}{\tau}} = \frac{2}{p} \sum_{t=1}^{p} Y_t \sin\left(\frac{2\pi}{\tau} t\right) \quad (9)$$

$$B_{\frac{p}{\tau}} = \frac{2}{p} \sum_{t=1}^{p} Y_t \cos\left(\frac{2\pi}{\tau} t\right) \quad (10)$$

Automatism of the harmonic analysis technique revealed those sub cycles durations, which are most substantial in forming the cyclic price oscillations. As it is proved by the qualitative analysis, coefficients A and B of the megacycle, 12-year

macro cycle, 8-, 6-, 4-, and 3-year macro cycles (sub cycles) are the most significant ones.

Together with the trend equation the obtained harmonic has made up a forecasting function:

$$Y_t = 17,6 + 0,3t + 12,8 \sin 15t - 3,6 \cos 15t - 3,6 \sin 30t - 5,7 \cos 30t - \\ - 0,05 \sin 45t + 3,9 \cos 45t + 2,74 \sin 60t - 0,11 \cos 60t - 2,84 \sin 90t + \\ + 2,2 \cos 90t - 1,46 \sin 120t - 1,5 \cos 120t \quad (11)$$

Six harmonics make the description of different periods cycles, latent in the actual price dynamics, complete and flexible.

The right to transfer the oscillations, expressed by the equation (11) to the period following 2005, is determined by the exclusive stability of the Samuelson macro cycle* and its inner structure, as well as their coordinate to the qualitative analysis of the stages of the world economy development.

Hypothesis of the periodical recurrence of the circumstances, preconditioning the beginning and end of the of cyclic price change of different frequency and amplitude, is well grounded in some aspects (e.g., recurrence of investment activity cycles). But it is still quite vulnerable as to the recurrence of all range of oscillations within macro cycle and it will require great effort to confirm it, especially in relation to the nature and stability of short-term sub cycles. As for the forecasting force of the model based on this hypothesis, i.e. formula (11), it can be estimated by experts on the forecasting results (table 3 and fig. 2)

Table 3

Forecasting of one barrel (world average basket)
by harmonic analysis for 2006-2013 ($USA)

Year	2004	2005**	2006	2007	2008	2009	2010	2011	2012	2013
Actual price	40,3	50,0	-	-	-	-	-	-	-	-
Forecasting over the formula (11)			43,0	32,0	31,0	23,0	19,0	22,0	23,0	26,0

* sometimes it is also called Hick's cycle
** preliminary estimate

Weak points of the suggested model are evident: it does not include political and accidental components. It reflects only trend and dynamics of the economic cycle. Taking into possible further complication of difficult political situation in and near the most important oil exporters: Iran, Venezuela, Nigeria, the forecasting, given in table 3, should be viewed upon as a lower price boundary provided stable situation in the abovementioned countries and their relation with USA.

Proceeding from the analysis of factual price displacement on political reasons in 1973-2005, we may presume, that in moderate aggravation of the situation in the given countries and around them, one barrel oil price will increase in 2006 up to 60 $USA a barrel, in critical situation development up to 80-100 $ a barrel , in most critical situation - up to 200 a barrel. Hence, central role in middle-term world oil price forecasting is seemed to shift from economists to geopolitics. Nevertheless, inertia force of the economic mega- and macro cycle enables us to say that relative prices in the forecasting period (2006-2013) will depend on the tendency, stated in table 3 (although absolute levels will depend on the political situation around the oil producing countries).

To some extent this model overcomes the drawbacks of the evaluation equation (6), but still lays within sphere of phenomenology, as it doesn't take into account the fundamental factor, which determines world price of non-reproducible resources: point of intersection of integral curve of distribution of production utmost expenses with line of oil demand.

World oil market is largely deregulated by the exchange process, which results in fixing the price on the level of utmost expenses of oil field with the worst conditions, which is being developed to satisfy the additional oil demand (say, the last demand, closing this year backlog of business).

Such price forming mechanism may be reproduced in a diagram and analytical construction of integral curve of distribution of utmost expenses in world oil industry. It is made by orderly location of the manufacturing capacity of separate oil fields on the horizontal axis (axis of demand and supply). Oil fields are located on it in order of increase of oil production expenses. Their manufacturing capacities are located on the abscissa axis according to the chosen scale. Production expenses of each oil field are marked on the ordinate. Joint by a smooth line they make up an integral curve of

distribution of utmost expenses (fig. 4). Therefore, potential supply is projected on the horizontal axis. World demand can also be fixed on this axis.

Raising a perpendicular from the point of demand fixing to intersection with integral curve of distribution of the utmost expenses, we shall have balanced oil price.

Integral curve of distribution of utmost expenses near ordinate steeply goes up and becomes almost vertical. Hence even slight demand change (to 1-2 %) causes a sharp jump in this or that way, even the least shift of the demand line greatly displace the point of its intersection with the integral curve. Coefficient of price flexibility on demand near the ordinate can achieve 5-10 or even more . When demand changes on 2% the relative price displacement can achieve 20%. This fact accounts for actual jumps of such kind and their occurrence in future.

Form of the curve is mostly calm without any excesses and is easily expressed by equation of cubic parabola:

$$Y_t = [a + bQ_0 J_э J_и J_н + c(Q_0 J_э J_и J_н)^2 + d(Q_0 J_э J_и J_н)^3] J_z \qquad (12)$$

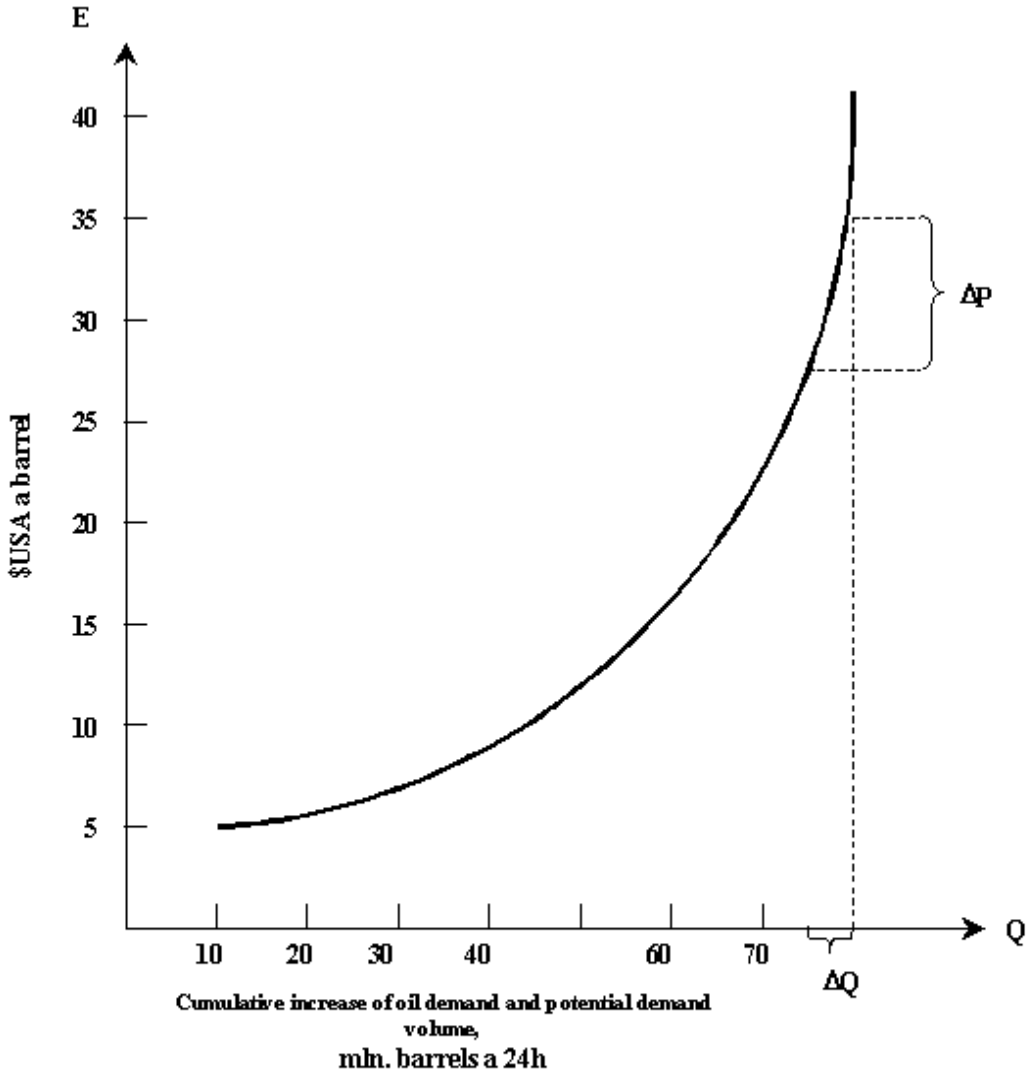
where:

Y_t - world oil price in t-year;

- a,b,c- statistically definable parameters of integral curve of distribution of utmost expenses of oil production in t-year;

$J_э, J_и, J_н, J_z$ - indices of accordingly economic growth, inflation, world oil consumption and expenditure on oil production in t-year in relation to the levels of the initial year t_0.

The problem of taking into account cyclic recurrence of the price change is not removed but transferred into the plane of forecasting of world economic growth rate $J_э$, as well as $J_н, J_z$. The last model is viewed as the most fundamental approach in the discussed sphere. However, it's realization is a whole program for working out a system of interconnected forecasting of world economic growth $J_э$, inflation $J_и$, oil consumption $J_н$ and others. It is clear that all this is a subject for special consideration.



E – utmost expenses (economical), Including exploitation expenses, ordinary profit, indirect taxes and transactional expenses;
ΔQ – demand variation;
ΔP –price variation as a reaction to ΔQ.

Figure 4. Integral curve of distribution of the utmost expenses of oil production in 2003

CONCLUSIONS

The proved forecasting for the world oil price is extremely topical for the Russian economy and the entire world economy due to the fact that it extremely depends on export earnings gained from energy resources supplied.

To date, the diversity of interrelated factors determining the dynamics of the price, non-availability of the methodology to synthesize within the framework of a united concept makes it impossible to formulate a forecasting procedure acceptable to

the majority of researchers. The practical forecasts related to the world oil price suggested by individual scientists, competent research centers and various government structures in mos cases prove untenable.

The world oil price forecast in the model offered is presented in the form of the sliding trend and the amount exponentially weighed incidental components over all the past years. The cumulative account of the weighted algebraic sum of incidental components over the past years in addition to the constituent of the sliding trend is more precise than a regular exponential smoothing while preparing the forecast.

Obvious drawbacks of the model offered: reflected the trend and the dynamics of the economic cycle, it does not include a political component.

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