ENERGY COST AS AN INITIAL DRIVING FORCE OF MACROECONOMIC DYNAMICS: RESOURCE (ENERGY) MODEL OF ECONOMIC CYCLE

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Abstract. A new synthesis and general macroeconomic dynamics (economic cycle) model is proposed. Hidden value of an absolute resource deficit is proposed as an initial and common driving force of macroeconomic dynamics. Unambiguous and numerical definitions for perfect and effective competition, for macroeconomic equilibrium, and for natural and normal price are provided within the model. The absolute resource deficit is a result of cumulative microeconomic nonequilibrium and corresponding market imperfection of all markets. The model was successfully tested using the U.S. economy as a pattern. All the U.S. business cycles during the last 40 years were explained and identified by the absolute resource deficit only. Particularly, statistical relationship between crude oil prices and economic growth rate is explained. The model forecasting efficiency is compared to some of the most accurate probit models (Wright 's and Factor Based). Its main advantages are: no false signals; early recession forecasting – 10-12 months before inception.

1. Introduction

One of the most complicated problems of macroeconomic dynamics is well-timed identification and forecasting of economic cycle turning points. That is a general macroeconomic dynamics analysis in real time. However, modern macroeconomic models and methods face a problem of solving this task properly and unambiguously. As it is demonstrated in Niemira & Klein (1995), in Lahiri & Moore (1992), and in the Release (2011) any change of macroeconomic trend can be defined only post factum, with a considerable lag (up to 24 months). Not a single turning point of business cycle has yet been identified beforehand. Well-timed and precise identification of business cycle turning points is not only a theoretical problem**,** but also it is crucially important for all economic agent groups – businesses, government agencies, political institutions. For all these organizations it would suffice to know definite proximity of a turning point at least three months before it occurs. However, within the margins of traditional methods and models we are only able to determine this point definitely with the lag of 4 to 24 months. That is why the well-timed identification of business cycle turning points is in the focus of this work.

To solve the problem we do need to disclose the nature of mechanism, which changes economic trend. Standard models failed to solve it properly as there is no even common opinion about the initial driving force of cycles. As a result, some scholars reject the idea of economic cycles proposing instead the idea of *random fluctuations*. Random fluctuations, particularly, make identification of a recession starting point quite difficult. Hence, there arises a problem of effective regulation of economic crises and avoiding recessions. Thus, general determination of the nature of macroeconomic dynamics' driving force is a key point in solving of the mentioned problems.

1.1 Literature review

In general, there are two types of models that are used for macroeconomic dynamics analysis: *structural (theoretical) and non-structural (statistical, stochastic etc).* Every type has its specific drawbacks that make the analyses inaccurate.

In fact, all attempts to define any driving factors of a business cycle are made within every structural model. To these factors we can refer: 1) changes in volume of investments and/or interest rates (Keynes); 2) changes in money supply, compression and expansion of banking credit (monetarism); 3) innovation theory (Schumpeter, Minsky); 4) wages changes (Fisher, Dornbush); 5) changes in technology (Cassel); 6) depreciation, reinvestment and expansion of industrial fixed capital (Marx); 7) changes in psychology of economic agents (Pigou, Tobin); 8) theory of rational expectations (Lucas, Sergeant); 9) theory of overinvestment (Hayek); 10) theory of underconsumption (Foster, Castings); 11) institutional theory (Kaletsky, Nordhaus); 12) theory of real business cycles (Kidland, Prescott) 13) price/cost relations, profit margins model (Mitchell, Lescure); 14) multiplier – accelerator interaction models (Clark, Samuelson); 15) Growth-cycle models (Harrod, Hicks, Kaldor); 16) sun spots and weather (Jevons, Moor) etc. (History…, 1987-90, Niemira and Klein, 1995).

Each of the listed factors is valid for specific market conditions, but none could explain the driving force in general case. Some facts of the real world cannot be explained within any theory (for example, statistical correlation between economic growth rate and crude oil price). According to Samuelson (1993), in general case the driving force could be explained by many factors acting simultaneously. He wrote that all the theories reflect different aspects of the same process, because the factors are functionally interdependent by their nature. Functional interdependence means there is no clear difference between cause and effect. That is any separate factor could be considered as initial one, but at the same time, as local driving force that dominates the others under specific market conditions. In addition, the rest of factors would be explained on the base of this local driving force. However, after economic conditions change the dominating factor and corresponding model change too. Thus, there is no cause-effect type relationship between separate factors. The main problem is an impossibility to identify a trend change definitely when running, and it is much more difficult to forecast it.

It is reasonable to assume (as Samuelson did) that real and initial driving force of the economic cycle (if there is one) should be functionally independent from any other factors, i.e. it should not depend on any combination of market conditions (cause-effect, but not functional relationship). This hypothesis will be advanced, grounded and verified later.

While it is never known beforehand what factors will determine the driving force of economic cycle not only in the future, but also today, majority of economists (including National Bureau of Economic Research (NBER) USA) consider it impossible to determine initial and common driving force of a cycle as noted in Zarnovitz (1999). On the other hand, considerable number of models (factors) that explain the cycles, their localization and absence of cause-effect relations between them is an objective base for some economists to lose belief in cycles and consider economic activity swings as random fluctuations.

Analysis of structural models showed that all of them are characterized by at least two common drawbacks, which can explain their local character and models' impropriety for real time analysis.

At first, precise determination of the long-run "natural" (equilibrium) state of output is difficult, if not impossible. Attempts to determine this state by using "full employment level" of production (or "natural" employment level) are most likely an appropriate theoretical scheme, but they have a small practical importance.

Secondly, the fundamental drawback of the “supply-demand” model is the static nature of analysis. Both supply and demand depend on a big number of independent factors. Using supply-demand approach allows just one factor to be considered, while influence of the rest is assumed away through the *ceteris paribus* assumption. *Dynamics,* in these models*, is thought to be the movement of static (steady) state over time with fixed parameters*. Only these two drawbacks could explain the fact that practically all economic laws are only valid for specific market conditions, and models fail to capture universal aspects of macroeconomic dynamics.

Such economists as Schumpeter J., Struve P., Kondratyev N., Clark J., Soros G., and others (Kondratyev, 1989, History.., 1987-90) widely discussed inadequate interpretation of dynamics in economic models during 20th-21st centuries. It is interesting that Struve (1923) and Soros (1994) explained the problem of “statics-dynamics” in economic models by saying that specific mathematical methods are used in those models. Methods of mathematical analysis that are used in economics were originally developed for engineering analysis. This creates certain analytical stereotype of mechanicism and conditions static nature of methods in economics. To a certain extent, they are right. However, their explanation reflects rather an effect than a cause. As a result, this explanation is not constructive, because it does not allow us to develop ways of solving problems of “static nature in dynamics”. In general, a choice of any mathematical method is determined by basic principles of a model and its assumptions. *Per se* all typical economic models have static nature.

Two mentioned *drawbacks* can explain the fact that economic laws are not general, but are only true under certain market conditions. Therefore, it makes impossible to use structural models for macroeconomics analysis in real time. However, principal ability to explain forecast economic processes and events is the main *advantage* of structural models.

Noted problems of structural models determined preferential use of non-structural models (statistic, stochastic etc) for macroeconomics analysis in real time. Method of “leading indicators” is one of the most widespread examples of this kind of models. Lahiri and Moore (1992) described main drawbacks of such method. The idea of the method is to use a large amount of statistical data (different values and indices of economic activity) for the past period to try to detect any sustainable cause-effect relationships, which may help in identification and forecasting of turning points of economic cycles.

Main drawback of non-structural methods is impossibility to distinguish a true signal from a false one. Besides, a proper choice of indicators’ numbers and types is a subjective and ambiguous process. (as demonstrated in Niemira and Klein (1995), the U.S. and Japan use different types and number of indicators for their economy analyses). There is no way to be confident that any leading indicator in one business cycle will remain leading in another one. As shown in Niemira and Klein (1995), in Lahiri and Moore (1992), and in the Release (2011) **sometimes the signal of a recession starting point was generated with a *lag* of 21 months or with a *forestalling* of 13 months.** At other times, signals were generally *false*. Turning points of the US economy (1990-91 and 2001) recessions were officially identified by NBER in 20-21 months after they occurred. Still, the main advantage of non-structural models is the principal ability to analyze economy in real time and under any market conditions.

Yet, neither structural, nor non-structural models can provide reliable *ex ante* identification and forecast of macroeconomic dynamics at any point in time. *In order to avoid the drawbacks of both model types and to keep their main advantages at the same time, a general macroeconomic dynamics model is presented, here*.

The noted drawbacks of both model types cannot be eliminated within standard approaches. What prevents us from solving these problems?

2. Material and Methods of the Resource Model

While studying economics history from W.Petty and A. Smith until present (in Kondratyev, 1989, Samuelson, 1993, History.., 1987-90, Zarnovitz, 1999), we can notice a common conceptual problem for any period of economics history and for any model, the problem of "vicious circle" in economic valuation. The problem is price depends on cost, and the last one depends on prices of incoming goods and services.

It means that it is impossible to be confident in rationality (normality) of market valuations for any period. Rather market mechanism provides for some iterations (and correspondingly, time lag) before we may be confident in rationality of market valuations. Number and duration of those iterations mostly depends on a rate of market competition. In the long run, economic or financial crises may be considered as a final iteration with a corresponding market correction.

Thus, standard approaches posit rationality of market valuations, but are unable to verify their rationality rate. Rationality rate of any balance can be definitely identified *only post factum*, with a considerable *lag*. The lag is caused directly by the "vicious circle" problem in economic valuations. It is impossible at any moment of time and under any market conditions to verify if the market price is "normal" ("natural") or not. As a result, such basic economic categories as "normal" ("natural") price, "perfect" competition, and to some extent, "macroeconomic equilibrium" remain theoretical abstractions, as there is no method to determine them unambiguously and numerically.

As the "vicious circle" problem is naturally inherent to market mechanism, it cannot be solved properly within monetary valuations only. The problem is in the fact that money as a product of exchange (market), evaluate exchange processes directly. At the same time, production processes can be evaluated indirectly only in monetary terms. As a result, accuracy and objectivity of production expenditure evaluation in monetary terms directly depends on efficiency of exchange, on rationality of market valuations, and on competition rate. Only in case of perfect competition, the problem of "vicious circle" is absent and market valuations are rational.

However, resources deficit and increase in number of goods and services cause, actually, imperfect competition at any market. In general, all markets are not perfect, but to what extent? How does this imperfection affect the growth rates? There is no definite answer to this question. The attempt to answer these questions is presented next.

The "vicious circle" problem may be considered as a visualization of noted above drawbacks of structural and non-structural model types. Implementation of different static states (stationary, stable, steady ones) into economics may be considered as a specific solution of the "vicious circle" problem that provides some reference point among current market valuations. Moreover, noted above problem of economic analysis, referred as a "static character", has no adequate solution. In addition, the "vicious circle" problem causes functional (interdependent, non cause-effect) relationship between the factors, which explain the economic cycles driving force within the structural models noted in *1.1*. The same kind functional relationship exists between price and expenditures, as well as between all other economic values termed in monetary form.

If these conclusions are correct, it would be possible to assume that a proper solution of the "vicious circle" problem would lead to avoiding of mentioned above drawbacks of structural and non-structural models and open the way for general (not local) model building. As a result, a new synthesized model of economic dynamics can be proposed. It would contain main advantages of both well-known structural and non-structural models. It would help us to *eliminate lag* in macroeconomic dynamics turning points identification and to separate a trend from random fluctuation for any moment of time.

2.1. Alternative measure of cost

To solve the “vicious circle” problem Bandura (2003a, 2004) proposed to introduce *additional (to monetary)* measure of resource expenditures into economic valuations. The idea was that both exchange and production require their own unit of measure in order to reflect specific features of both of these fields. **While money is a natural measure for exchange, *available energy* is proposed as a common measure of resources used in production.** Therefore, cost can be measured in both relative (monetary) and absolute (energy) forms.

Original method for energy cost counting was proposed in Bandura (2003b, 2004). Input/Output tables provide a base for this method. To compare current price with energy cost the latter must be recalculated in monetary form, preserving the interindustrial proportions of corresponding relative energy costs. For this purpose a recalculation coefficient k_0 was proposed in Bandura (2003, 2004). **The coefficient k_o is based on a ratio of the money supply and the sum of primary energy of all resources used in GDP production. Multiplication of each energy cost quantity by k_o generates a vector of “natural” prices in monetary form (P_0).**

This approach allows us to determine unambiguously the natural price, the rate of market imperfection, and macroequilibrium. It is well known that *under perfect competition* all goods and services are produced using minimum resource expenses (technical efficiency). However, a problem arises in the valuation of resources. In monetary terms, minimum resources mean minimum monetary expenditure. In energy terms, minimum resource use is associated with minimum energy expenditure. Therefore, we have two minima of resource allocation depending on the term of measurement. They are not coinciding, in general. It seems reasonable that the state of minimum resource expenditure for aggregate income production should not depend on measurement terms.

It is natural to assume that the real state of economy, at which the minimum amount of resources is used for GDP production, should not depend on selected measure of those resources. Thus, there is the following determination of macroeconomic equilibrium proposed in Bandura (2003a): **long-run macroeconomic equilibrium is determined as a state where “natural” *(P_0) and market (P) price* levels *(GDP deflators) are numerically equal.*** At the same time, this *definition of macroeconomic equilibrium is a* ***definition of perfect competition***, as according to classical economics market and “natural” prices numerically coincide only under these ideal market conditions. *Separate determination of these prices* (market price is determined by demand-supply, and “natural” price is formed by natural laws, by technology structure) and the gap between them ($\Delta P = P - P_o$) allows us to *analyze imperfect markets without any assumptions*.

Such definition of macroequilibrium erases borders between macroequilibrium of the whole economy and microequilibriums of separate markets, because macroequilibrium here is simply an arithmetic sum of microequilibriums of all markets that make up economy. Microequilibrium of a separate market is an ordinary balance between supply and demand.

As a result, this approach eliminates the problem of a “vicious circle” in economic valuations as well as the mentioned above drawbacks of typical theories (in particular, static analysis). In addition, we can get rid of *any lag* in identification of economic values.

In this equilibrium-perfect state aggregate national product would be produced with both minimum monetary and energy expenses and, therefore, with minimum damage to the environment at the same time (as real expenditures of all physical resources are minimized). In this ideal state, a direct proportion between relative market prices and relative specific energy expenditures is established. It means that we choose the same production technology after both monetary and energy optimizations.

2.2. The resource model cycle

The authors propose a basic *hypothesis* that the current market price should gravitate towards values of such “energy prices” that would exist in a *perfect* market, or a vector of “natural” price in its classical definition. Taking into account that market and “natural” prices are determined independently and on the ground of different laws, it makes it possible for us to determine a rate of market imperfection (disequilibrium) in general. Then this market imperfection rate is estimated by the value of market price deviation from “natural” price. Basing on this assumption, a new ***general*** *model of macroeconomic dynamics* (economic cycle) is proposed.

This model was tested using the U.S. economy as an example (for a period of 40 years). The test has shown that market price dynamics gravitate towards “energy price” dynamics, and critical points of the proposed model determine turning points of real cycles of the U.S. economy, thus the basic *hypothesis is verified*.

Finally, in accordance to mentioned above definitions of macroequilibrium and perfect competition, the authors proposed a new ***resource (energy) model of economic cycles*** (Fig.1)***,*** main principals of which were described in Bandura (2003, 2004). The model explains the ***initial driving force of macroeconomic dynamics for general case***. Figure 2 is a scheme of general economic activity dating over time. Macroequilibrium is viewed as a dynamic balance between levels of market and natural prices (GDP deflators). The trend (curve) of “natural” price is determined independently from market conditions and “supply-demand” influence. Equilibrium curve (of natural price) divides the phases of growth and recession.

If the level of natural prices is higher (lower) than the current market price level, then the latter price is underestimated (overestimated) as compared with natural price. It makes potential for growth (recession) as market production expenditures are higher (lower) than natural ones, and potential profit is higher (lower) than natural one. Any deviation ($\pm\Delta P$) from equilibrium (P_0) causes the rise of resource over-expenditures in energy terms (real resources Δe) or ***absolute resources deficit***. This deficit is ***“hidden”*** for standard monetary analysis. Points of O-type (O_1, O_2) are points where this *hidden deficit* reaches its maximum value. The hidden resource deficit value provides natural limits both for growth and recession (they cannot be endless).

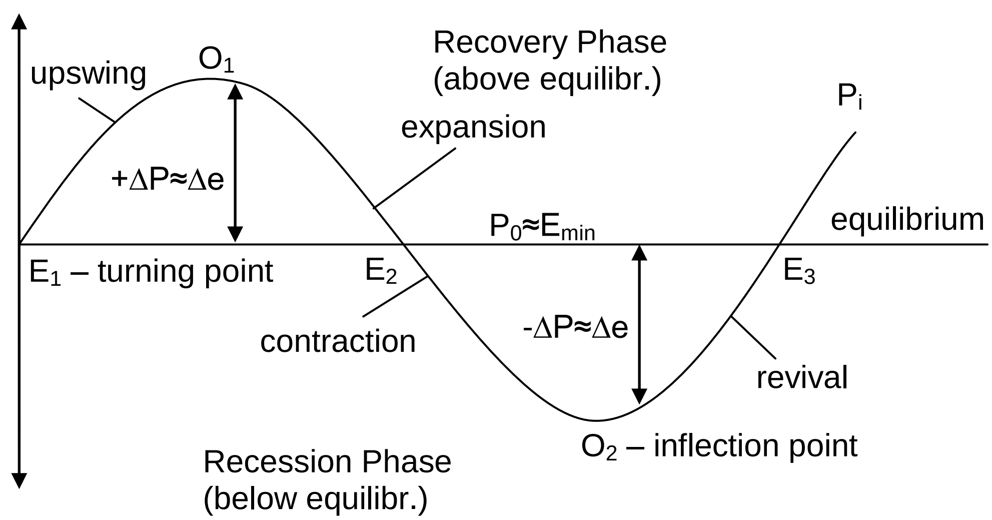


Fig. 1 Resource (energy) model of business cycle

Critical points: E_1, E_2 – macroeconomic equilibrium points, turning points of economic cycle;
O_1, O_2 – Inflection points, economic growth tendency changing
E_1,E_2,E_3,O_1,O_2 – five critical points for every cycle.

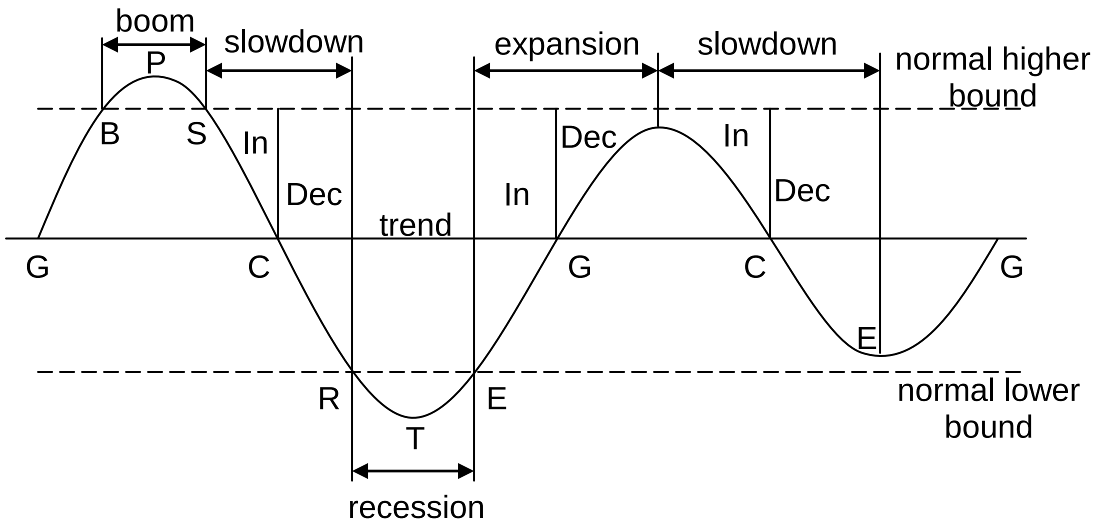


Fig. 2 US National Bureau of Economic Research view of business cycle: Classical business cycle and growth (deviation) cycle schemes.
B – boom; S – slowdown; C – contraction; P – peak; R – recession; T – trough; E – expansion;
G – growth; Inc – increasing rate; Dec – decreasing rate. **P,T – two critical points for every cycle.**

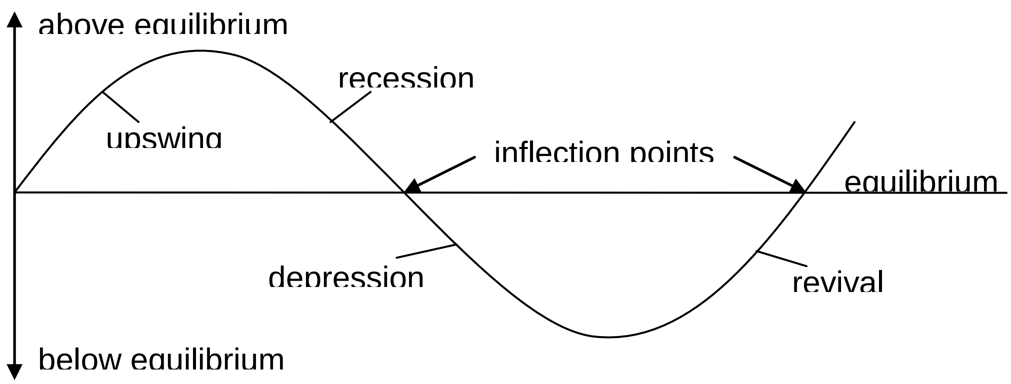


Fig. 3. Schumpeter's view of business cycle. **Inflection points – three critical points for every cycle.**

The resource model is a *synthesis* between *structural* and *non-structural* models, as, from one side, every critical point of the model has its theoretical grounding (in distinction from well-known *non-structural* models), from the other side, the model includes the principal elements of these *non-structural* models with different dating principles of economic activity over time (Fig.1-3). As described in Niemira and Klein (1995) Figure 3 reflects American school of macroeconomic dynamics. It describes two versions of real data series dating: classical business cycle and deviation cycle, developed by the NBER. Figure 4 presents Schumpeter's view on cycles dating principles (Austrian school).

As we can seen from Figure 1-3, the resource model (which is initially based on theory, but it is not a simple graphic reflection of statistic data) is characterized by *five* critical points per cycle: *three* equilibrium points (E-type) and *two* points of tendency changes within a cycle phase (O-type). None of two critical points of the USA model and of three points of Schumpeter model is theoretically grounded, but every critical point of the resource model has economic and physical essence, as it is a result of the synthesis. It allows us not only to explain the initial reasons of turning points occurring, but also to identify and forecast them reliably, to determine changes of growth rates within every phase of the cycle (O-type.)

3. Forecasting economic cycles

The authors successfully tested the resource (energy) model using the USA economy as a pattern (a period of consideration is 40 years). This test completely proves the basic hypothesis and all definitions and conclusions of the model (real facts coincide with the theory for almost 100%). Earlier this model was tested on the economy of ***Spain*** *(18 years is a period of consideration) in Bandura (*2003b) *that additionally proves the model to be general.*

Figure 4a presents dynamics of current market price (P_i) and "natural" price (P_0) levels (GDP deflators). This figure shows the business cycle resource model (analogous to Fig. 1), but built up in real time (1970-2008). The base year for price indices calculation chosen here is 1996 (earlier it was 1987, however, the base changing does not affect the analysis results). Figure 5b presented dynamics of real GDP growth rates (%), which is marked by critical points in accordance with the resource model. Comparing Fig. 4a and 4b demonstrates efficiency of macroeconomic dynamics critical points dating in accordance with the resource (energy) cycle model.

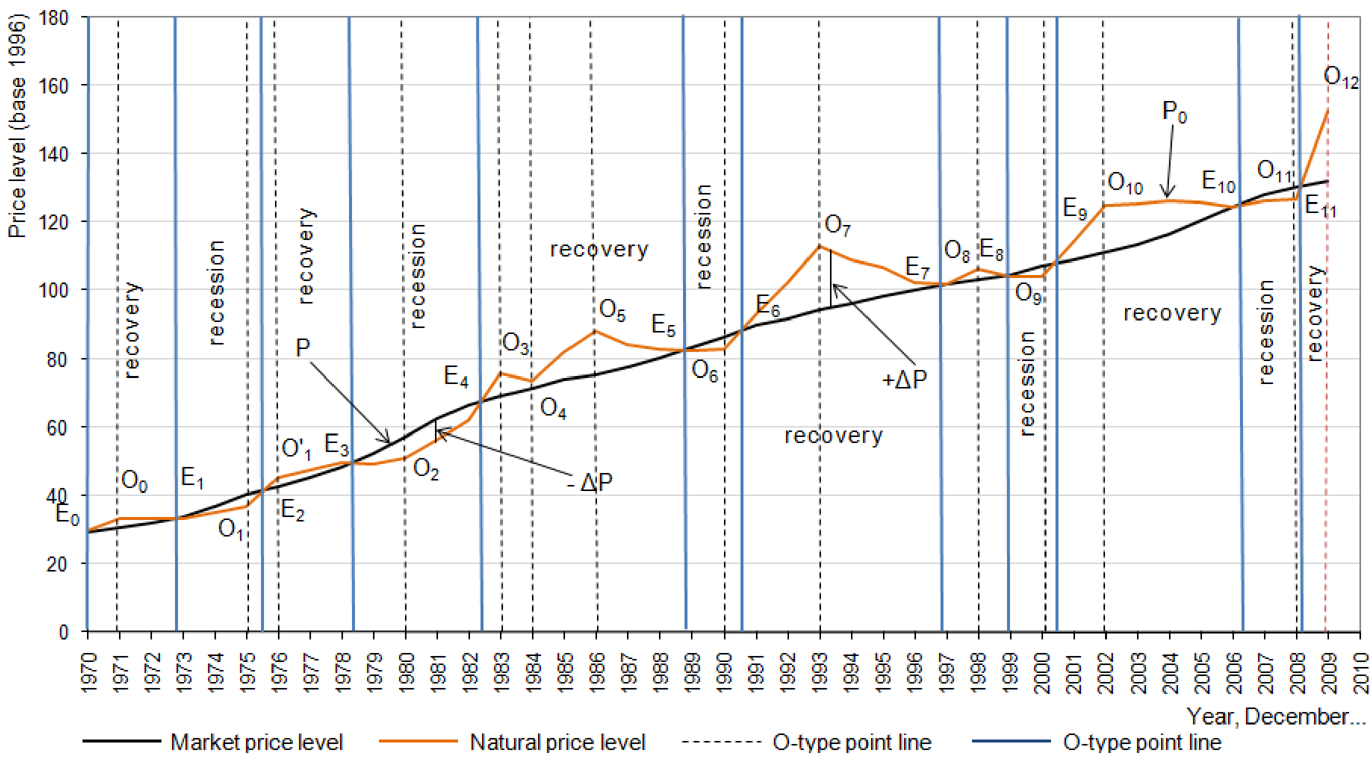


Fig. 4a. Market and natural price levels of the U.S. economy, dated in accordance with the resource model of macroeconomic dynamics.

As shown on fig.4b points E_1, E_3, E_5, E_8, and E_{10}, the model makes it possible to identify recessions long before GDP turns negative, that is because after these points GDP growth only decelerates.

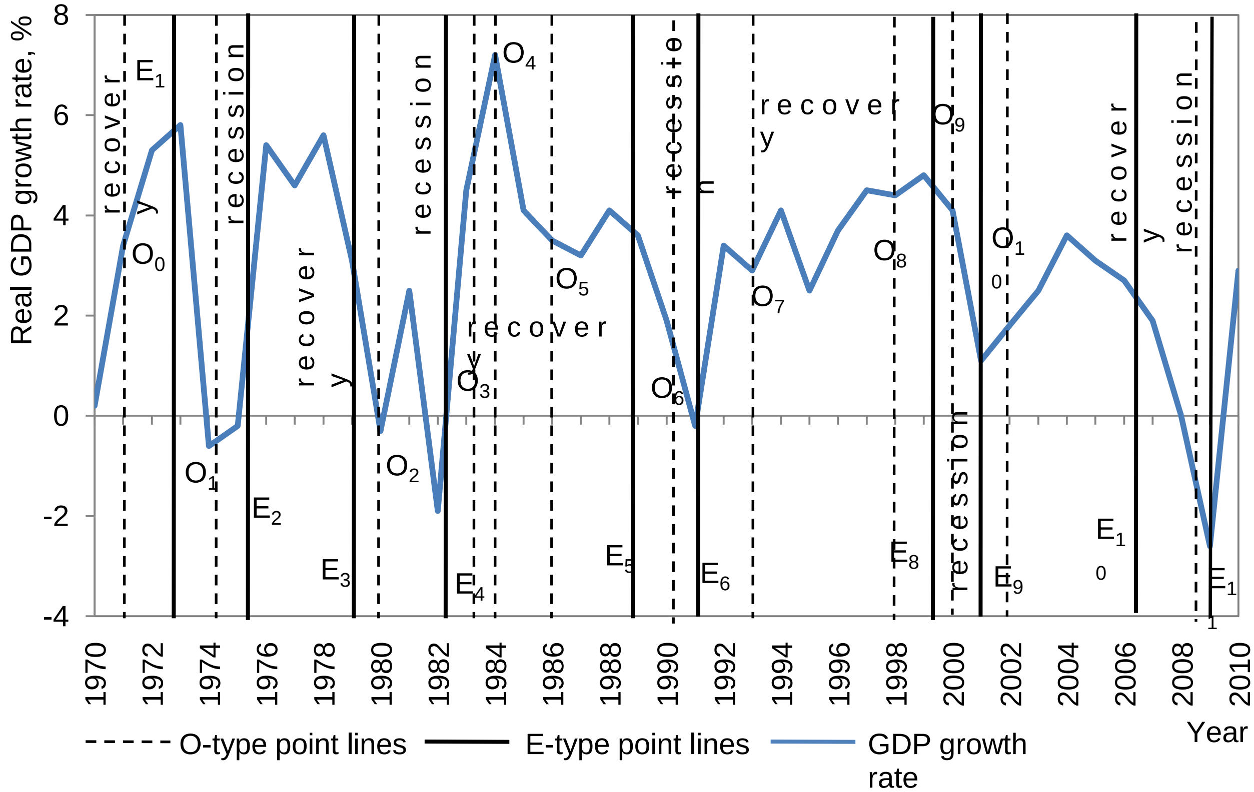


Fig. 4b. Real GDP growth rate for the US economy dated according to critical points of the resource model. Source: U.S. Bureau of Economic Analysis Release.

If $\Delta P > 0$ (current prices level (P_i) is less than "natural" (P_0) level), the economy is in a phase of growth. If $\Delta P < 0$ (current prices level (P_i) is higher than "natural" (P_0) level), than the economy is in a phase of recession. Intersection points of these prices level curves ($\Delta P = 0$) are turning points of business cycles (of macroeconomic dynamics). In general, initial force that turns the economy to macroequilibrium is proportional to a gap value ΔP. The bigger is the gap, the bigger are hidden energy overexpenditures (Δe) (or absolute resource deficit) above achievable technological minimum. The greater is ΔP, the greater is the force, restoring equilibrium once it is disturbed (Fig.1, 4).

Permanent change of relative prices leads to permanent change (update) of production technologies (sometimes as technology revolutions). Their efficiency in physical (energy) terms is decreasing along with deviation from macroequilibrium state. As a result the energy-termed resources become relatively cheap in monetary terms that leads to their intense consumption and, therefore, to the rising the hidden deficit of those resources. However, over time increasing deficit will lead to the price climb for excessively consumed resources. This over-consumption of resources causes the market prices to rise further. In a case of long stage of growth, it may even lead to a *price shock (for crude oil, for example.* See section 4.). We can characterize this *hidden deficit as an **absolute** deficit*, as its reference level is physical only, and it does not depend on market conditions (it depends just on technological progress).

Outside of perfect markets, market (P) and natural (P_o) prices do not coincide. Separate determination of these prices and gap (ΔP) allows us to analyze imperfect markets without any assumptions. In general, actual market price reflects a balance of all possible market forces and conditions for any moment in time, which allows this analysis to be general as well. However, any standard economic model noted above may be used within this analysis for a special case.

In accordance with the resource (energy) model, recessions in the economy of the USA during the last 40 years occurred in 1969-70, 1973-75, 1979-82, 1989-91, 2000-01. A s*tarting point of the most recent recession (2007-09) in the U.S. was accurately forecasted one year before it had occurred (see also table 1) in Bandura, 2007*.

Comparing fig. 4a and 4b, we can see that ***all (without exception) recession starting points*** ($\Delta P = 0$) were identified in *6-12 months* ***before (without lags)*** statistical data was able to show it. During these months the recession potential ($-\Delta P$) grows from zero up to the sufficient level for majority of statistic indicators to prove the recession starting point. For instance, the recession starting points (E_1, E_3, E_5, E_8, E_{10}) are identified in 6-8 months before real GDP value became negative and majority of static indicators made the recession evident for everybody. Thus, the ***ΔP value is really a leading indicator*** that can be ***used under all possible market conditions***.

Both recovery and recession are characterized by O-type points, which are also critical points in the resource (energy) model. At these points, *hidden resource deficit* as well as deviation from macro equilibrium state reaches (Δe, ΔP) their maximum (for any of cycle phase) (Fig. 1). Theoretically, it means that we should see some slowdown of economic growth rate exactly before these points and growth acceleration just after O-type points. This conclusion is proved by the USA statistics. As shown at Fig.4, where yearly GDP growth rate dynamics are presented, acceleration effect of growth rates just after O-type points is observed after points O_1, O_2, O_3, O_6, O_7, O_8, O_{10}, O_{11}, It additionally proves the verity and the general application of the resource model.

On one hand, all the U.S. economic cycles for the last 40 years were explained by the absolute resources deficit (one-factor model). *On the other hand*, at least four-five local models (multi-factor models) were used for the same period to explain these cycles. Taking into account this fact, we can conclude that *the* ***absolute resources deficit (Δe, ΔP))*** *is a* **single and general** *driving force of* **macroeconomic dynamics** *(economic cycles).* In this case, all local *(typical) models (section 1.1)* present ***not initial driving force*** *of cycles exactly, but* ***its <u>form</u> of manifestation****, which depends on current* ***combination of market conditions****.* Clearly, some new and unique market conditions may lead to a new local model to be proposed or "old" model to be advanced correspondingly. At the same time, *various forms of manifestation or local factors (e.g. change of interest rate, overinvestment, change in money supply, wage rate, excess crediting, and real estate sector crisis, etc) are functionally* ***interdependent****, but the absolute resource deficit is functionally* ***independent*** *from its manifestation forms, from any of local factors.* From this point*, there is a* ***cause-effect*** *(not functional) relationship between the absolute resource deficit and any of local factors.*

In its turn ***the hidden resource deficit is a result of cumulative market imperfections (nonequilibrium)*** caused by different reasons (monopoly, government regulations, market speculations etc.). According to the resource model of macroeconomic dynamics, in general, economy is out of equilibrium, and markets are always imperfect. Economy can reach equilibrium and market can reach perfection for only a moment. Therefore, **the initial driving force of macroeconomic dynamics provides <u>objective</u> fundamentals for** ***economic crises. Market mechanism of economic valuations generates economic cycle and crisis <u>endogenously</u>*****.** *Clearly,* ***all possible <u>subjective</u> factors (such as market expectations, regulations, speculations, etc) may strengthen or weaken*** *these fundamentals.*

It is impossible to find two identical cycles for the USA economy within all analysis period (from 1969 until present). Every cycle has its specific features and configuration inherent just to this cycle. This fact demonstrates why P. Samuelson proposed to consider every cycle as **one-**

factor and **multi-factors (complex**) model at the same time (Samuelson, 2003). Here, we can realize this idea.

On one hand, according to resource model, every cycle is dated on the ground of single indicator ∆P, which characterizes the initial driving force of any cycle. On the other hand, various local and functionally dependent factors (value of money supply, interest rate, innovations level, investments, market participants' expectations etc.) are already embodied into the value of ∆P. In other words, these local factors are manifestation forms of a single initial driving force. Thus, the absolute deficit of resources (∆P) is a complex and general driving force of aggregated economic activity at the same time.

4. Forecasting crude oil price

One of these tasks is to *explain actual statistical correlation between* ***economic growth and crude oil price***. A. Greenspan in his last speech (before he retired) as the Head of the Fed (The WSJ, 2003) spoke that there is no model that will be able to explain it, but the explanation is highly important for improving the economy regulation efficiency. Specifically, there is no answer for the question: why oil price growth on 10 dollars per barrel ($/bbl) in the price range 15-25 $/bbl actually does not affect the economic growth, however, the price rise on the same value, but in the range 25-35 $/bbl considerably decreases economic growth? *The resource model of macroeconomic dynamics provides this explanation*.

To demonstrate it let us additionally consider yearly dynamics of crude oil prices at New York Merchandise Exchange (NYMEX) shown in Fig.5. In the Figure, critical points of economic cycle (E- and O-type) are dated in accordance with the proposed model. At the same time, we consider the dynamics of the USA economy growth rates (Fig. 4b).

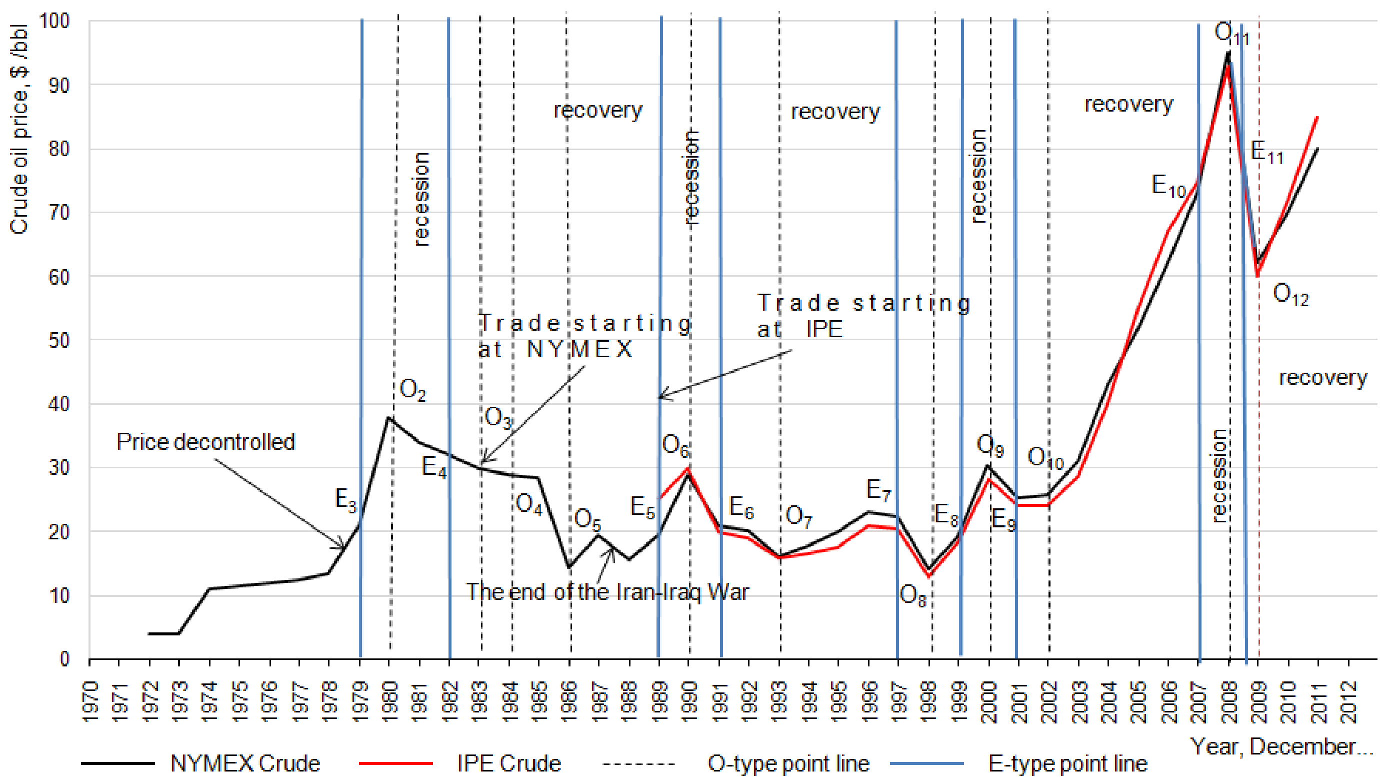


Fig. 5. Average Crude Oil Price dynamics at NYMEX and IPE dated according to the resource model of business cycle. Source: NYMEX Crude Oil Futures Quote.

As it is shown in Fig. 4,5 at O-type points (pp. O_3, O_5, O_7, O_8) with $\Delta P > 0$ the tendency of oil prices is changing from decreasing to increasing. At these points, in accordance with the model, the absolute resource (energy) expenditures are the highest, but market oil prices are the lowest (in the range 15-20 $/bbl, Fig. 5). In this case, a negative (for growth) effect of oil price increase (just after O-type points) is neutralized by diminishing of the hidden absolute resources (energy) expenditures for GDP output.

Because of a sharp reduction of hidden resource deficit, economic growth rates actually do not decrease in spite of oil price growth. Moreover, economic growth rate can even rise slightly (pp.O_3, O_5, $O_{7,}$ O_8) Fig 4, 5), if decreasing rates of resource deficit (those rates are highest just after O-type points) exceed oil prices growth rates. Actually, after every such point there is a quarter of a year where growth rates considerably exceeded average.

Thus, if an increasing oil price is accompanied by a decrease of the absolute resource deficit, economic growth rates will, actually, not decrease, regardless of the rising oil prices. They can even increase just after O-type points. *It makes no difference from which absolute value the price starts rising after O-type points.* For example, it makes no difference from which value the price starts rising: from 15-20 $/bbl after O_3, O_5, O_6, points or from 25-30 $/bbl after O_8 point.

This also explains the fact that (after p.O_8) since 2003 the oil price *sharp* increase during four years in a row did not lead to the USA economy recession. It explains as well why, for instance, in the 3d quarter of 2003 the USA economy growth rates temporarily sharply increased just after O_{10} point (up to **7, 4%).** Then, according to the model, the US economy growth rates should slow down as the rate of the resource deficit decrease passed its maximum. Actually, quarterly GDP growth rates did not exceed **4%** after 2003.

Further decrease of ΔP value (up to $\Delta P = 0$ at E-type points, where the absolute deficit is equal to zero) will lead to the oil price growth rate to be above the absolute resource deficit decrease rate. Then further oil price increase will lead to a slowdown of economic growth rates (near E_5, E_8 points, where the oil price is in the range 25-35 $/bbl, Fig. 5).

If ΔP value becomes negative, the absolute resources deficit will start rising again. It strengthens negative effect from the rising oil price. As a result, economic growth rate decreases sharply, and becomes negative; the economy turns into a recession. This scenario was realized during the recent recession (p.E_{10}), for example.

As we can see in Fig. 4, 5, the oil price increase just after pp. O_5, O_7, O_8 and O_{10} does not influence the growth rates as the hidden deficit decrease supports the growth. It is important to note that the *effect of oil price increase on growth rates depends mostly on a business cycle phase (E- and O-type points location), rather than on nominal price value*. Thus, the proposed resource (energy) model of economic cycles allows us to explain actual relationship between crude oil price and economic growth rates.

In accordance with the resource (energy) model, the authors propose **two** simple **rules to determine direction of oil price trend** (Fig. 1, 4, 5).

1) Oil price tendency to decrease (P, $/bbl, ↓) 1) is observed between starting point of the revival phase (from O-type point with $\Delta P < 0$) and the end of the expansion phase (up to O-type point with $\Delta P > 0$).

For instance, the price trend is down **(↓)** between p.O_2 ($\Delta P < 0$) and p.O_5 ($\Delta P > 0$), between p.O_6 ($\Delta P < 0$) and p.O_7 ($\Delta P > 0$), between p.E_7 ($\Delta P = 0$) and p.O_8 ($\Delta P > 0$), between т.O_9 ($\Delta P < 0$) and p.O_{10} ($\Delta P > 0$), from p.O_{11} ($\Delta P < 0$) until present (up to the next p. O_{12} ($\Delta P > 0$)).

2) Tendency of oil prices to increase (P, \$/bbl, ↑) is observed between the expansion phase starting point (from O-type point with $\Delta P > 0$) and the end of contraction phase (up to O-type with $\Delta P < 0$).

For instance, the price trend is up **(↑)** between p.O_5 ($\Delta P > 0$) and p.O_6 ($\Delta P < 0$), between p.O_7 ($\Delta P > 0$) and p.E_7 ($\Delta P = 0$), between p.O_8 ($\Delta P > 0$) and p.O_9 ($\Delta P < 0$), between p.O_{10} ($\Delta P > 0$) and p.O_{11} ($\Delta P < 0$).

During the whole history of crude oil trading at NYMEX, only one short-termed exception from the rule was observed in 1987-88 (Fig.6). However, a *strong force major factor* (which was acting opposite to the trend) simply explains this single exception from the rule: it was the end of the war between Iran and Iraq (No.2 and No.3 crude oil producers in OPEC by volumes of production). *Thus, in general, crude oil (energies) price dynamics is well predictable using the resource model of business cycle.*

In April 2006 oil price reached its "another historical maximum" and exceeded 75 \$/bbl. Again, this provoked the next dispute between economists regarding possible recession, as historical experience evidenced that this maximum was specific for recessions starting points in the past. Relying on this experience economists predicted the beginning of recession when the oil price reached 50, 60, 70 \$/bbl etc. However, ΔP indicator had positive value for all these oil prices. In accordance with the resource model, absolute price value is not essentially important. Much more important is the cycle phase determined by ΔP indicator. Until $\Delta P > 0$, any rise in oil price will not lead to recession. It allows us to identify current situation *definitely and without lag*.

However, the higher oil price, the faster ΔP value will become negative, in particular, because of the fact that excessive oil price increase accelerates inflation. The value of ΔP was less than zero by the end of 2007. Then oil price increase from this point leads to recession according to the resource model.

That is why in **January 2007** we forecasted the **starting point** of the next ***recession in the USA*** as the 4^{th} quarter of 2007 or the 1^{st} quarter of 2008 in Bandura, 2007, (Fig.4). In fact, it was one year before the recession took place. The forecast was 100% accurate, as during the last 40 years, there was not a single mistake in identification of recession starting points in the United States economy. Clearly, the forecast would help to raise economy regulation efficiency and, as a result, to weaken the negative effect of recession or even avoid it at all.

As we can see in Fig. 1, 4a, the last phase of expansion (O_{10}-E_{10}) was the longest one for the last 40 years. Taking into account mild recession of 2001, it could make an illusion that government regulations became efficient enough to avoid deep recessions. The illusion forms too optimistic expectations that provide grounding for creation of numerous "bubbles" in many sectors of the economy (real estate, finance, construction etc). In addition, the longest expansion provides enough time for creation of "bubbles" that substantially strengthened the recession fundamentals, determined by resource deficit (ΔP). This is a way to explain extraordinary depth of the recent recession on the base of the resource model. Clearly, only anti-bubble actions initiated at least one year before their actual realization could have made the recent recession mild or avoided it at all.

At the same time, the authors made a forecast of oil prices trends for 2007 and most part of 2008. As shown on Fig.4a, 5, oil price was rising between points O_5 and O_6, O_8-O_9, O_{10}-O_{11}. We can divide those intervals of sharp oil price growth between O-type points into two stages: O_5-E_5 and E_5-O_6, O_8-E_8 and E_8-O_9, O_{10}-E_{10} and E_{10}- O_{11}. In spite of oil price sharp increase between points O_{10}-E_{10} (from 2002 to 2006), it was just the first stage of price increase. That is why, when oil price was at the level of 52-55 \$/bbl (in February 2007), the next stage of sharp oil price increase also was forecasted for 2007 and part of 2008 in Bandura, 2007. Then, after p.O_{11}, there was an expected sharp drop in oil price.

Table 1 presents the results (accuracy) of several forecasts based on the resource model.

Table1. Accuracy of the authors' forecasts made using the resource model of economic cycles.

Forecasts made in December 2006	Facts of real world
1. The crude oil price is expected to be rising sharply during 2007: from 55 to **70** $/bbl in summer with its further increase up to next **all time high** at the end of 2007 and beginning of 2008. New peaks are expected up to next O-type critical point (p.O_{11}). Then the price will drop sharply (Bandura, March 2007).	**1.** The oil price has reached 70 $/bbl (in July) and 99 $/bbl (in November) 2007. The price reached 147 $/bbl in July 2008. The price has dropped sharply (more than 100$/bbl after July 15, 2008) just after the p.O_{11} passing (in April of 2008).
2. Starting point for the U.S. **recession** is expected at **4th quarter of 2007** or **1st quarter of 2008**. (Bandura, March 2007)	**2.** The U.S. National Bureau of Economic Research declared the recession starting point as **December 2007** in December 1, 2008.
3. Extraordinarily powerful financial crisis is expected to hit in fall (October - November) of 2008. It will occur because of a very short time period (3 months) between two critical points of the cycle, which will cause two consecutive drops of global indices with the same interval of 3 month (July and October)*.	**3.** The strongest after the Great Depression decline of global market indices in October of 2008. (Bankruptcy of some of the world's largest companies and devaluation of Hryvna – Ukrainian currency)
4. Recession in the U.S. will be replaced by economic growth in July-August of 2009. (Bandura, July 4, 2009a)	**4.** On September 20th, 2010 the U.S. officially dated the end of recession June 2009.
5. A new financial crisis is expected to hit in the first quarter of 2010. It is expected to be mild with DJIA retreating no less than 800 points. (Bandura, September 7, 2009b)*	**5.** DJIA fell 817 points from 01.20.10 to 02.09.10, there was a follow up retracement of 1389 points from 04.27.10 to 05.07.10.
6. Since the middle of 2010, growth rate of the U.S. economy will slow down, which will spark talks about possible double-dip recession. Yet, recession will not occur and growth rate will accelerate again. (Bandura, October 5, 2009c).	**6.** Double-dip recession rumors indeed took place, but growth started accelerating since the second quarter of 2011 and the second dip of recession did not happen.

*Explanation of financial crises nature and their forecasting requires a separate article, which we are planning to write later.

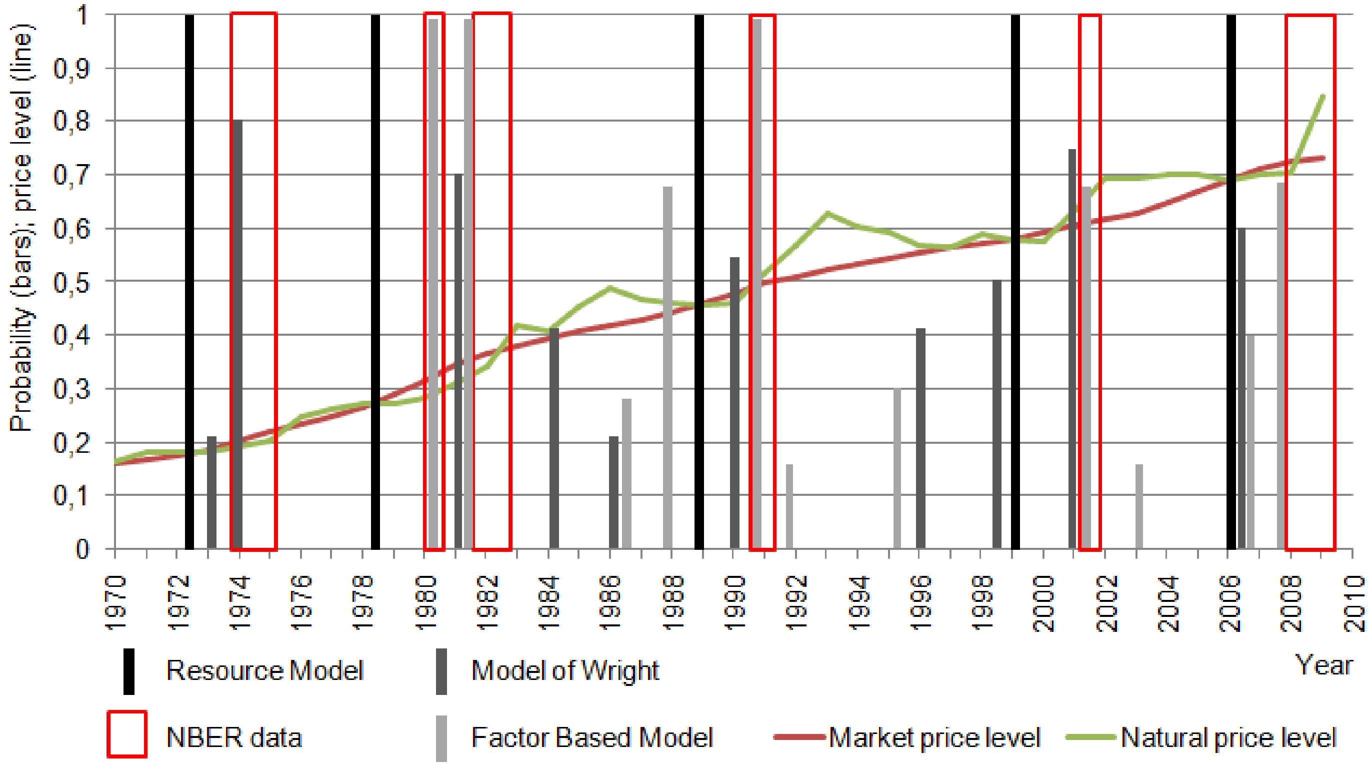
Thus, the absolute accuracy of the forecasts, which were never revised (permanent revision of forecasts is typical for all institutions occupied with this problem), is an additional confirmation of the model's verity. Additionally, this high forecasting accuracy of recessions is another argument for economic cycles approach (classical) that is in opposition to random fluctuation approach.

5. Comparing forecast efficiency to *probit models*

5.1. Interpretation of probability

In Wright's (Wright, 2006) and Factor Based (Silvia at al., 2008) models and in (Berge at al, 2011), in those few cases where probability of a recession is over 90% (1980, 1991), signals are generated too late and almost post factum. In the resource model, signals that indicate inception of recession with complete probability are generated for every recession from 1970 to 2010 6-12 months beforehand, as shown on fig. 6A,B.

A)



B) Probability of a U.S. recession using CLI (Composite Leading Indicator) data

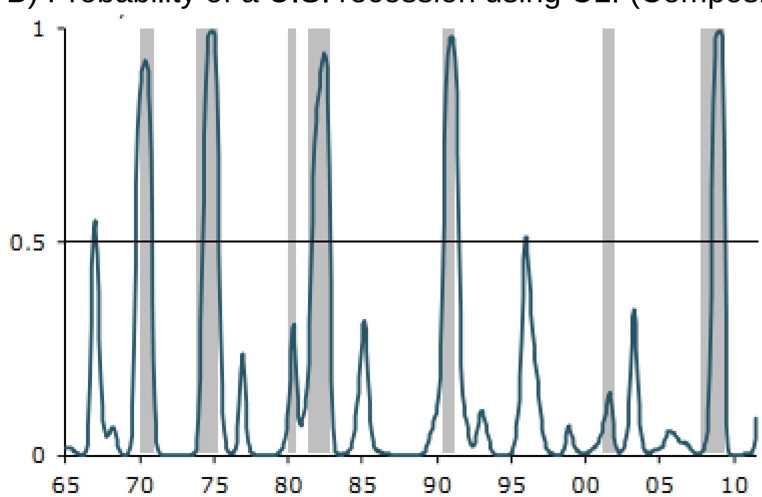


Fig.6 Forecast efficacy comparison of the Resource Model to the Model of Wright and the Factor Based Model and CLI one.

5.2. Recessions and slowdowns

Specified models do not show any difference between recessions and slowdowns. They generate the same signals for recessions as for temporary economic weaknesses.

The resource model views recessions and slowdowns differently. For instance, probit models generated signals with a low probability of recession in 1986 and 2002, while the resource model explicitly shows temporary slowdown in these years. In 1996 there really was a very high risk of recession, but in this case resource model showed that the recession would be barely avoided. It is interesting, that probit models showed low probability of recession in 1996, just like in 1986 and 2002.

5.3. False signals amidst uncertainty

Both probit models have misleading signals, which is a common drawback of all nonstructural models (see 1.1). It is difficult to interpret false signals as, for example, Wright's model shows higher probability of recession in 1986, than accurate signals' probability of the next two recessions.

Probit models often give low probability signals that are not followed up by recession. Forecasts, based on such signals carry a lot of uncertainty. As we showed in sec. 1.1, these common drawbacks of nonstructural models – false signals (low probability signals that are not succeeded by recession) – are a direct consequence of a "vicious circle" problem. Therefore, it is difficult to obtain unambiguous forecasts even theoretically, without solving this problem. During the testing period of 40 years, some probit models show better results on one time span, others show better results on another. .An important distinctive feature of the resource model is that if it generates a signal, the upcoming recession date is known with an error of one quarter.

The resource model not only hasn't generated a single false signal for the past 40 years, it allowed to "differentiate" recessions from slowdowns. That is a direct result of synthesis of structural and nonstructural model qualities in one business cycle model. The fact that solution of "vicious circle" problem leads to elimination of false signals indicates that the hypothesis, stated in *1.1* is true.

6. Conclusions

In order to solve "vicious circle" problem in economic valuations the author proposes to introduce "available energy" as an additional (to monetary) measure of all resources used in GDP production. It allows us to determine the "natural" price vector quantitatively and unambiguously and to propose, on its base, a *new approach for macroeconomic dynamics analysis.* Within this approach, we are able to determine the competition perfection rate and macroeconomic equilibrium state in general case. Then we can analyze imperfect markets in real time with no assumptions, to distinguish market fluctuations from a fundamental trend at any moment and to eliminate any lag in identification of economic activity indicators.

The authors proposed criteria of competition efficiency (market perfection rate) both for any certain market, and for the whole economy. In general, macroequilibrium state is equal to perfect competition and can be reached even in a case when all separate markets are out of ideal (normal) microequilibrium ($\Delta P_i \neq 0$). It can happen when "positive" ($P_0 - P > 0$) deviations from equilibrium on some particular markets are neutralized by "negative" ($P_0 - P < 0$) deviations on some other markets. Then definition of general equilibrium by L.Walrus is a specific case of the macroequilibrium definition proposed here (in case when $P_0 - P = 0$).

Within the proposed approach a new *general resource model* of macroeconomic dynamics (economic cycle) is proposed. It is shown that**,** in general, the *initial driving force of macroeconomic dynamics is a permanent imperfection and disequilibrium of markets.* It is embodied in value of *absolute and hidden deficit of all resources* used in GDP production. As any deviation from macroequilibrium causes the resource deficit to rise, this deficit increase provides an objective limit as for growth and recession phases as, actually, for any economic indicator dynamics.

This initial driving force of macroeconomic dynamics provides objective fundamentals for economic crises. Market mechanism of economic valuations generates economic cycle and crisis endogenously. All possible subjective factors (e.g. market expectations, regulations, speculations, etc) may strengthen or weaken these fundamentals.

The resource model is a *synthesis* of well-known *structural and nonstructural* models. Specifically, a complete microeconomic grounding for macroeconomics is provided. In other words, *neoclassical synthesis* is fully realized, as the macroequilibrium state here is determined as a simple sum of microequilibrium states in all markets of economy.

Any synthesis should provide new possibilities in solving of non-solved problems before. Following examples demonstrate solutions of some of them: 1) *explanation of actual statistic correlation between economic growth rates and crude oil (energies) prices; 2) advance in forecasting accuracy of recession starting points.*

The resource model actually allows us to identify and forecast recession as early as 6-12 months before its occurring (there are no false signals for the ΔP indicator during the last 40 years). Clearly, it opens for us new possibilities in anti-cycle policy implementation, sustainable growth maintenance and possible elimination of recession at all, as these policies can be initiated at least half a year earlier than they usually are.

Two simple *rules to determine direction of oil (energies) price trend* is proposed. They are confirmed for the whole period of energies trading at NYMEX.

Taking into account that there was no restricting assumptions during the model elaboration, the model is *general and can be used at any market conditions for any country*. The model has proved accurate and been tested on the USA economy using a 40-year period data. Earlier this model was successfully tested on the economy of Spain (18 years is a period of consideration) that additionally proves the model to be general.

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