Center for the Study of Democracy

MEASUREMENT OF AGGREGATE ECONOMIC ACTIVITY BY MEANS OF COMPOSITE INDICATORS

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The assessment of composite indicators is a new experience for East European countries. However, in the course of transition from central planning toward market economy the need for measurement of aggregate economic activity is obvious.

The Agency for Economic Cooperation & Development /AECD/ experts have begun to asses three barometers of aggregate economic activity since March 1992: economic activity barometer, economic expectation barometer and diffusion index. In that paper we share our experience on the assessment of composite indicators and their utilization in analyzing performance of Bulgarian economy on macro level.

The barometers are based on the classical idea of business cycle theory that the information from different economic indicators could be summarized in a composite indicator. The famous Harvard barometers, conceived in the USA in 1919s and 1920s, were the first step in assessing overall economic activity. Later, with the assessing of coincident, lagging and leading indicators in the National Bureau of Economic Research /NBER/ a new direction in composite indicators methodology had been set up. The new moment was, that the synthetic indicators summarized the individual indicators with similar cycle behavior. That idea underlies aggregate activity measurement of the Western economies.

The difficulties in assessing composite indicators for Bulgarian economy arises out of the lack of long enough time series about the output, price level, incomes, etc. That is why the formal application of methodology, used for assessing economic performance of the western economies, would result in doubtful figures. We should use a different approach in order to have reasonable measure of overall macroeconomic activity.

1. ECONOMIC ACTIVITY BAROMETER

The economic activity barometer /EAB/ summarizes the monthly data for industrial output and retail sale turnover in 01.1991 leva/seasonaly adjusted/, the average real wage in non-agricultural sector, and the number of employed in non-agricultural sector. There is empirical evidence that those indicators characterize the current economic activity pretty well.

The unreliable price indexes up to June, 1990 and new Accounting Law, which was introduced in April, 1991 account for the lack of long time series for Bulgarian economy. We should measure aggregate economic activity on the basis of short time series and small number of monthly published indicators.

The algorithm of assessment of EAB is:

1. The individual indicators are standardized in order to be transformed into variables with mathematical expectation 0 and variation 1. That transformation aims to removing the effect, caused by different units of measurement.

2. The principal components are estimated from the transformed data. The principal components are orthogonal linear combination, which contains all the variation of the original data-set.

3. The monthly values of the principal components are averaged. Every principal component is weighted with its eugenvalue.

Usually, the principal component analysis is applied in order to reduce the dimension of the original data-set. However, the small number of the individual indicators /only 4/ makes any reduction inappropriate. **We** apply principal component analysis in order to transform original data into orthogonal variables /principal components/. The following features of the principal components make them more appropriate for assessing aggregate economic activity:

1. Principal components have a natural criteria for weighting when they are averaged. The composite indicators are estimated as weighted mean of the component time series. The assignment of weights is very important for the overall process of estimation of aggregate

economic activity. In terms of classical approach the weight of every component is determined on the base of its economic significance, smoothness, availability, cyclical behavior, etc. The assignment of weights is not formal process. Due to short time series we do not have enough information to determine individual indicator weight and to apply a formal criteria instead: the eugenvalue of principal component.

2. Principal components are smoother than original data-set. The smoothing of original data in order to eliminate random and unsystematic variation is a necessary step toward composite indicator estimation. Smoothing by means of moving averages is not appropriate because of short time series. The transformation of component indicators into smooth, orthogonal linear combination /principal components/ is a substitution of moving averages smoothing.

3. Principal components are robust: when the value of component indicators changes, the changes in EAB are small. Monthly data for industrial output, retail sale turnover and average wage are preliminary estimated, because firms should prepare financial statement every 3 months according to the Accounting Law. That is why monthly data, which are based on financial statement are subject to errors. The nature of that errors is not examined and it is difficult to be measured. Because of the robustness the monthly values of EEB are not influenced by errors in component indicators. The negative side of the robustness is the lower sensitivity of EEB.

Since August, 1992 the private sector retail sales turnover are included in the EEB. According to the National Statistical Institute /NSI/ private sector accounts for about 40% of the overall turnover and 5% of the industrial output. There are empirical evidence, that private sector activity is higher in retail sales than in other sectors. Therefore, including private sector in retail sales turnover in EEB we are taking into account a sufficient part of the private sector activity. As NSI began publishing monthly data for private turnover since June 1992 we estimated EEB on the base of the following assumptions:

1. The volume of private retail sales in 1990 was very small and its influence on the overall economic activity is insignificant.

2. Private retail sales increased linearly during 1991. In other words the absolute rate of increasing in 1991 was a constant value.

3. In 1992 the private sector retail sales accounts for nearly 42% of the overall retail sales. That assumption rests on NSI estimations, which indicated a 41.7% share of private sector turnover in the first seven months of 1992, and a 42.7% share in July.

4. The seasonal pattern of private sector turnover did not differ from the public one.

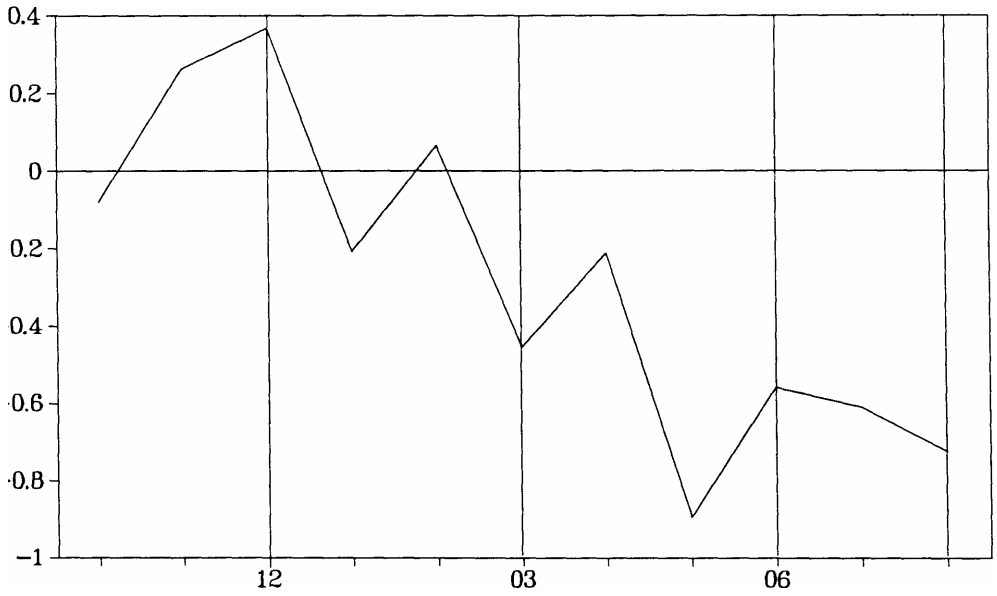
In handling the EAB we should take into consideration two extreme cases when it takes zero value:

- when component indicators are constant, i. e. they take zero variations, and

- when component indicators do not take zero variations, but upward and downward trends offset each other.

When the tendency toward decrease in the time series become more prominent as compared to the upward trends, EAB takes negative values. When upward tendencies are more prominent, the barometer assumes positive values.

The Economic Activity Barometer (EAB)



1991 1992

Souce: AECD

Sharp decreasing of EAB values during the first two months of 1991 reflects both political and economic instability, as well as keeping Bulgaria apart from international financial markets because of ceasing of foreign debt services. In the February-December 1991 period economic activities was low and variated somewhat. The inconsiderable downward trend in the period following December 1991 was indicative of the slightly predominant downward trends at work and provided an evidence that overall economic activity is still in a state of depression. There is a lot of inflationary potency in Bulgarian economy, caused by consequent price liberalization, higher wages demand and low liquidity of the firms. The ..price" for keeping inflation low was decreasing output, low consumer and investment demand, and higher rate of unemployment. All that processes are synthesized in downward tendency of the EAB values since December 1991. The barometer is nearly unaltered when private sector is included, which means that private sector is not strong enough to reverse downward tendency in aggregate economic activity.

1.1. Measurement of budget- receipts dynamic

Two factors underlay budget- receipts dynamic: economic activity dynamic and fiscal policy changes- changes in tax rates, tax preferences, etc. Both tax receipt irregularity and forthcoming changes in the tax law engender strong interest in measurement economic and legislation factors of tax receipts. Separately measurement of the two factors is useful for assessment of shortcomings of the contemporary tax law and what should be altered in it.

As EAB is the only monthly composite indicator, it could be applied for measurement of dynamic of those taxes, which are determined by current economic activity.

The current economic activity, measured by EAB, explained nearly 50% of turnover tax and customs duty receipts and 40% of the axcize receipts. In other words, the influence of economic and legal factors on the tax receipts in the budget was almost equal since the beginning of the 1991.

Because of advanced payment, profit- tax depends on the profit, registered 3 months ago. Therefore, profit- tax lags economic activity 3 months and EEA could not fully explain its dynamic.

2. ECONOMIC EXPECTATION BAROMETER

The economic expectation barometer /EEB/ summarizes the information of the NSI/AECD entrepreneurial surveys, carried out among state industrial firm managers monthly. Entrepreneurial surveys encompass three main group of questions: assessment of current level of output, sales, and purchases; assessment of inventory level; and assessment of the level of output and sales in the next 2-3 months period. The last question concerns price expectation. There are three grades of assessment: low, normal, or above normal /referred to the inventory level/, and no change, fall, and increase registered /referred to the remaining answers/. What is important with this scale of assessment is the difference between the shares of the negative and positive answers. Thus, EEB summarizes the answers reflecting change in current and future business situation when neglecting the answers, which reflect no change.

Questions in entrepreneurial survey correlate in different manner with economic expectations of the respondents. The element of expectation" is much less represented in the assessment of the current level of output and sales and purchases than in the assessment of the level of inventory, purchases and especially short term prognosis. That is why the questions concerning current level of output and sales are excluded from the EEB. The price level expectations are also excluded from the barometer because price expectations do not depend only on the business activity expectations.

The algorithm of assessment of EEB is quite similar to the EAB algorithm.

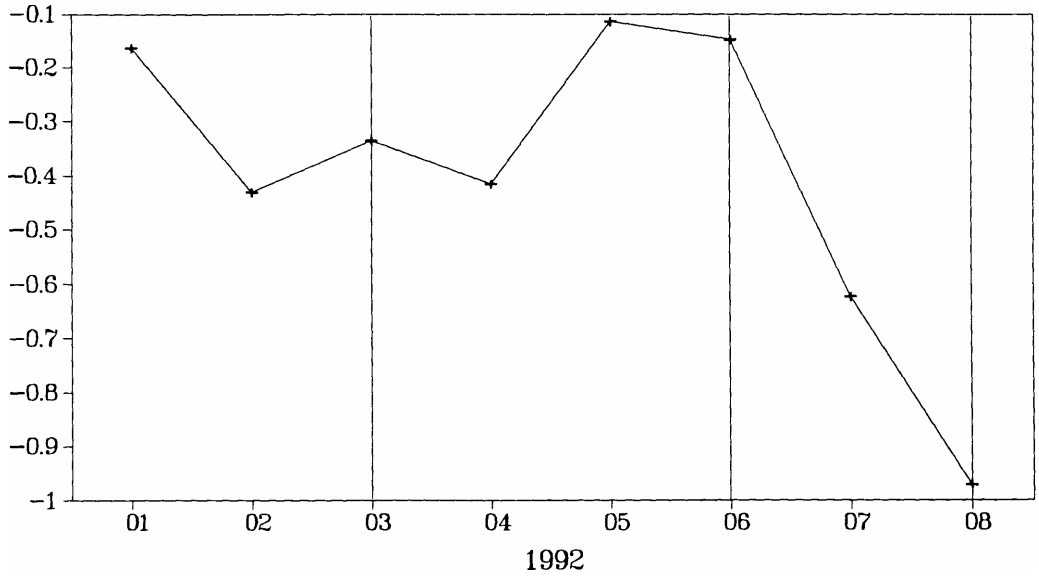
1. Principal component analyses is applied to the balances of answers of the respondents on negative or positive changes in output, sales, purchases, est. Geometrically, every industry branch could be represented as a point in the principal component space.

2. The principal components for every branch of industry are weighted against their eugenvalues and averaged in order to have EEB on the branch level.

3. The EEB for the whole industry is estimated as an average value from the branch's EEB.

Theoretically, EEB's values could fall within (+50 -50) range. The upper limit corresponds to unanimously shared optimism among respondents. The lower limit corresponds to unanimously shared pessimism. In order to be handled easily, EEB values are normalized within (+1 -1) range

The Economic Expectations Barometer (EEB)

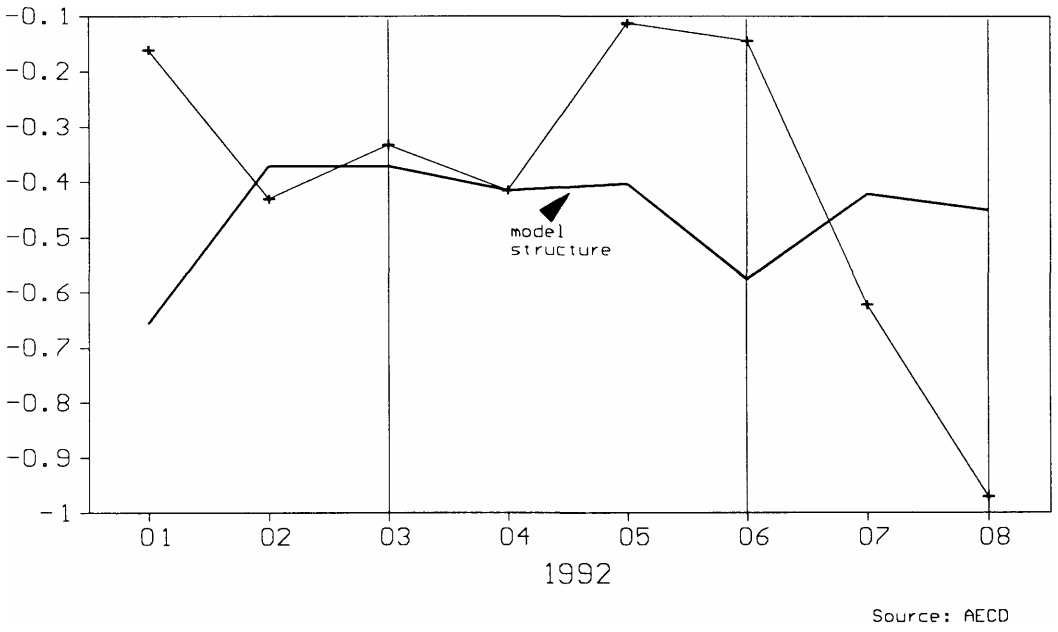


Source: AECD

The values of EEB are strongly negative since January 1991. The August value nearly reached theoretical minimum. The comparison between EEB's dynamic and the average balances of answers for industry indicates that relatively slight changes in balances correspond to major changes in the barometer's values. For instance, the average assessments of respondents in August did not differ substantially from the July ones, but the barometer's value dropped by nearly 15 percentage points against July.

The reason for discrepancy between EEB's variation and answer's variation could be sought in the degree of correlation among manager’s answers by industrial branches. The values of principal components depend not only on the balances of the answers, but on the coherency among the answers as well. The more coherent the answers are, the higher the value of EEB is. As the EEB's values reflects both the assessments of respondents and degree of coherency of the assessment, it is useful to measure the contribution of the two effects to the overall value of EEB. EEB's assessment at fixed correlation of answers /model structure for short/ eliminates that part of variation in the barometer's value, which are caused by changes in the correlations of answers.

The Economic Expectations Barometer (EEB)



EEB's assessments differ when using different model structure. This arises the problem for the criteria for the choice of an appropriate model structure.

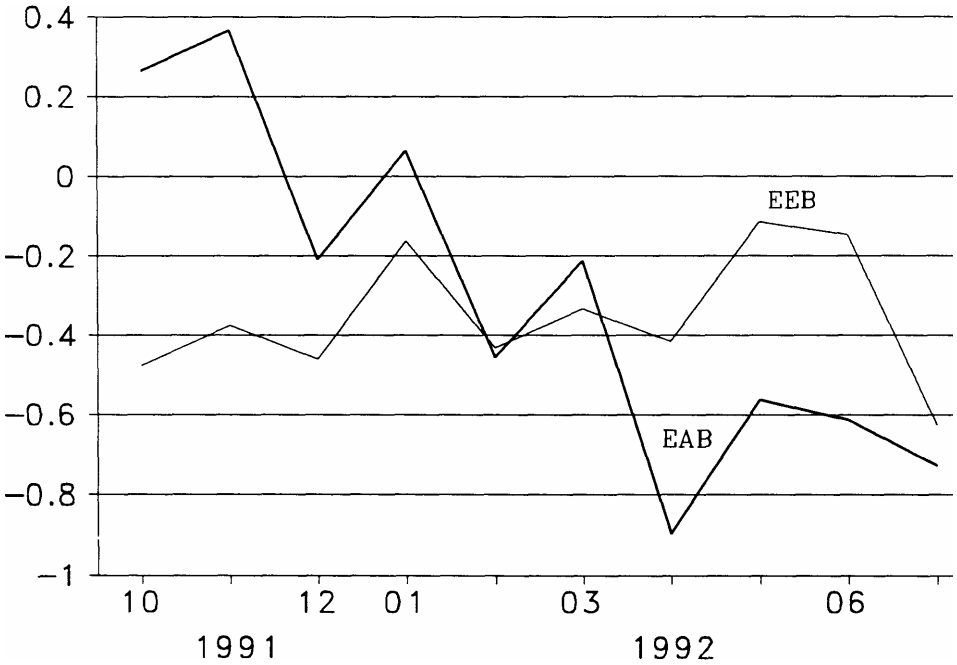
Two options emerge: to use one of the monthly structure of answers, or to construct an abstract model /for instance, by averaging of the monthly structures/. We think, that the first option is better then the second one. The average monthly structure will undergo monthly changes, while the model is supposed to have a temporal stability.

We accepted April 1992 structure of answers as a model structure. Our choice was determined by the assumption that the higher correlation of respondents' assessments corresponds to a higher degree often ability. The high correlation of the answers means that output and sales expectations for the forthcoming months rely rather on the level of orders, raw material stock and finished product inventories than on other factors. It was the April correlation that exhibited the highest degree of consistency, and we can hardly expect its increase in the forthcoming months. Therefore the structure of April assessment is stable from the viewpoint of the chosen criteria and can be used as a model structure.

EEB's dynamic at fixed correlation among respondents' assessments is much smoother than the barometer's dynamic at changing structure. It means, that the changes in the coherence among menagers' expectations about output, sales, inventories and new orders have been the factor, which underlies EEB's dynamic. The absolute values of expectations have much less influence on the barometer's dynamic.

EEB summarizes short-term economic expectations. In time the EEB is ahead of current economic activity, measured by EAB. The values of the barometers since the beginning of 1992 proved the assumption true: EEB's dynamic leads EAB's dynamic with one month. We need of more observation in order to specify dynamic characteristics of both indicators. Eight months is rather short period of time to determine leading or lagging nature of the barometers.

EEB and EAB with 1 month lag



3. DIFFUSION INDEX

The idea of diffusion index /DI/ is rather simple. At any point of time some series out of a specified set increase while the other decrease. The DI is calculated as relative number of series which move upward. The greater the relative number of increasing/decreasing time series, the stronger the expansion/contraction of the economy is. DI is a quantitative measure of how the economic activities „diffuse" over time throughout the economy.

Burns and Moore proposed the following algorithm for estimation of the DI:

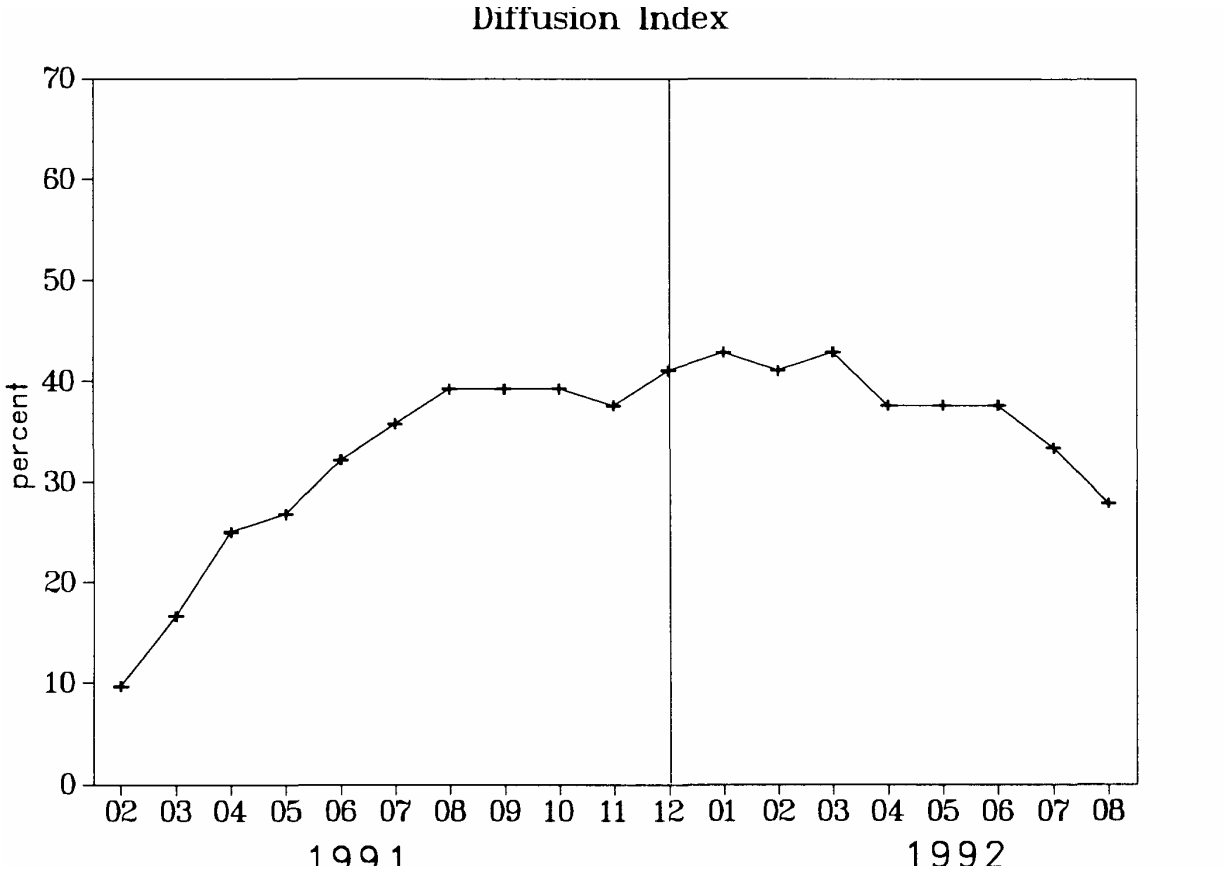
1. Lower and upper turning points for each component time series should be determined. These turning points are connected by straight lines, giving a picture how business cycle wanders through the individual time series. The points on the lines are used instead the original points when diffusion index is estimated.

2. The DI is calculated as relative number of upward sloping lines at each point of time. It reaches maximum value of 100%, when all series increase, and its minimum of 0% when all series decrease.

Obviously, this algorithm of constructing DI imply, that turning points of each time series are known, e. g. we have exact knowledge of cyclical movement of the time series.

Due to the small number of observations we could not specify the cyclical component and turning points of the time series set. That is why we work with the original points at any point of time, instead with the points on straight lines between turning points.

The following time series form a specified set for assessing DI: Industrial production in real terms, seasonally adjusted; turnover in real terms; real wage and number of employees in non-agricultural sector; broad money M2 in real terms; consumer price index; credits to non-financial public enterprises and private sector. It is assumed, that both M2 and consumer price index have countercyclical movement, e.g. they increase during a recession and decrease during recovering. Diffusion index is smoothed by means of 3 terms moving averages in order to eliminate high frequencies.



If the value of DI falls within interval 0%-50% or 50%-100% the economy is on the way to contraction, respectively expansion. The DI is in the interval 20%-50% since the beginning of 1991. In terms of DI dynamic there is no sign of recovery since the beginning of the economic reforms - February 1991.

CONCLUSION

The proposed composite indicators are the first step in measurement overall activity of Bulgarian economy and they proved to be very useful. In the course of time new market structures become clearly distinguishable and a measure of -macroeconomic performance is needed. The GDP data, published by National Statistical Institute quarterly, are not compatible in terms of price changes because of the lack of the system of deflators. The composite indicators, published by AECD, are monthly available and compatible.

The dynamics of the three considered composite indicators /BEA, BEE, and diffusion index/ unanimously indicate a depression of national economy. The subsequent decreases in the last three months suggest that economic depression continues. The economic data on micro-level also suggest that depression is in progress. Clear tendency toward increasing short term debts, low level of liquidity and increasing inter-firm credit among non-financial enterprises speaks of a decrease in output in 1992. The consistency of the barometers with the microeconomic data suggest that they are relevant measure of aggregate activity of Bulgarian economy. Given the lack of long enough time series the consistency of the barometers with the data on micro-level is a useful criterion about the relevance of barometers with the real economic processes.

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