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BUSINESS CLIMATE INDICATOR IN MANUFACTURING, MEDIUM- AND HIGH-TECH INDUSTRIES IN RUSSIA

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BUSINESS CLIMATE INDICATOR IN MANUFACTURING, MEDIUM- AND HIGH-TECH INDUSTRIES IN RUSSIA[3]

The paper presents the Business Climate Indicator (BCI) in the Russian manufacturing including the medium and high-tech (MHT) manufacturing industries. The authors explain the feasibility of a new alternative measure that summarizes common information of business tendency surveys cleared up of specific fluctuations in individual variables, and give arguments to prove its effectiveness. The resulting BCI reflects the quantitative changes in manufacturing growth more accurately and with a lead compared to the traditional confidence indicator. Identification of the BCI cyclic profile and its visualization through a tracer demonstrate all significant waves of manufacturers' optimism and pessimism for the period from January 2005 to January 2019. To construct BCI-MHT, the units of observation and the input information are divided into three groups according to the technological level of industries. The dynamics of BCI-MHT is close to those of BCI; however, during the protracted recession in 2016-2018, the sentiments of manufacturers of medium- and high-tech products were less pessimistic compared with the sentiments of all manufacturers.

JEL classification: C38, C82, E32

Key words: business tendency surveys, business climate indicator, medium- and high-tech industries, short-term cycle

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1 Introduction

Regular assessments of business tendencies using the results of business tendency surveys (BTS) are largely based on the interpretation, analysis and visualization of the entrepreneurial opinions. To improve users' perception of information, it is necessary to compress the input data into composite indicators. Such an aggregate presentation of entrepreneurial opinions is more user-friendly compared to the analysis of individual data. In monitoring of the Centre for Business Tendency Studies ISSEK HSE[4], a composite indicator is defined as an aggregated measure of the set of qualitative information regarding the scope, intensity and direction of sectoral economic development. Composite indicators are primarily considered as a means of initiating discussions and stimulating public interest in entrepreneurial opinions (Kitrar and Ostapkovich 2013a, 2013b, Kitrar et al. 2015).

The variety of economic information contained in the BTS results stimulate to expand the set of composite indicators, especially those aimed at the early assessment of cyclical development using a wider range of input information, and identification of unobserved components.

In this context, the paper presents a new composite BTS indicator – the Business Climate Indicator (BCI) in the Russian manufacturing, including the method of calculation and the relevant areas of analysis and visualization. The conceptual counterpart of BCI is a similar indicator, designed to analyze the European BTS data and published monthly by the European Commission and Eurostat (EC 2019b, Eurostat 2019) for the euro area. Its dynamics are considered to be closely correlated with the manufacturing development in the euro area. Integrating qualitative BTS data into BCI aims to solve the key problem: how to extract and aggregate common unidirectional information cleared up of specific fluctuations in individual variables, and thereby simplify information interpretation.

The second aim of this study is to construct BCI and assess business climate in medium- and high-tech manufacturing industries. For this purpose, it is necessary to differentiate the units of observation and the information coming from them according to their technological level. In international practice, there are several approaches to solving this problem. They are based on the following methodological assumptions:

- Aggregation of manufacturing industries depends on the technological complexity of production processes;
- The level of aggregation is determined by the goals of further analysis and the availability of information.

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The roots of the classification of industrial activities by their technological level are the research of Lall (2000), who sought to combine as many aspects of technological modernization as possible, based on the capabilities of national statistics. At the same time, each ‘technological’ classification is to some extent conditional, since all kinds of industrial activity, regardless of their technological level, are constantly being updated (UNIDO 2017).

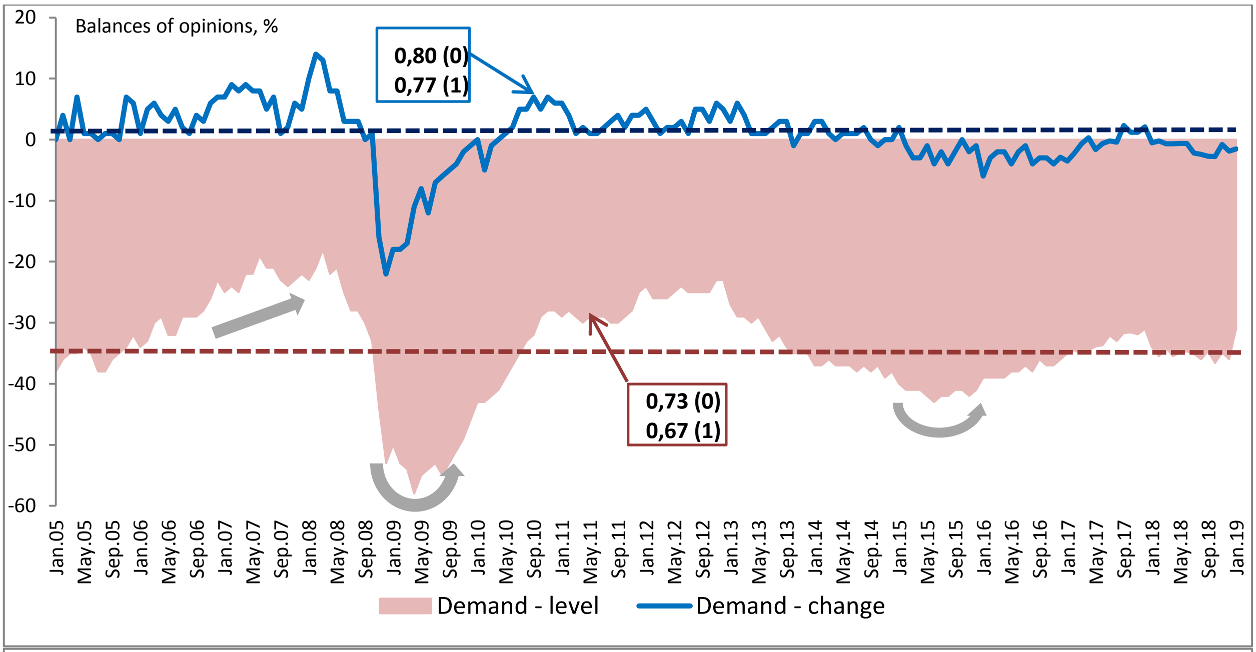
The BCI in manufacturing as whole and in medium- and high-tech manufacturing industries are calculated based on the results of the Russian BTS for the first time.

2 Methodology and data

2.1 BCI calculation procedure

Variables for combining into BCI have been selected based on their high cross-correlation connection with the dynamics of a reference statistic, namely, the Industrial Production Index (IPI) in the Russian manufacturing. These components are seasonally adjusted balances[5] of entrepreneurial opinions on the main indicators of industrial activity: domestic and export demand (levels and changes), output (change), and business situation (change and expectation). Other opinion balances (on the levels, changes and expectations of prices, stocks and employment) are less correlated with IPI. Figure 1 shows the dynamics of seven components of manufacturing BCI and cross-correlation coefficients between them and IPI dynamics.

[5] In BTS, the balance of opinions is the difference between positive and negative answering options measured as percentage points of total answers (EC 2019a).


Balances of opinions, %
0,80 (0)
0,77 (1)
0,73 (0)
0,67 (1)
20
10
0
-10
-20
-30
-40
-50
-60
Jan.05
May.05
Sep.05
Jan.06
May.06
Sep.06
Jan.07
May.07
Sep.07
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Jan.18
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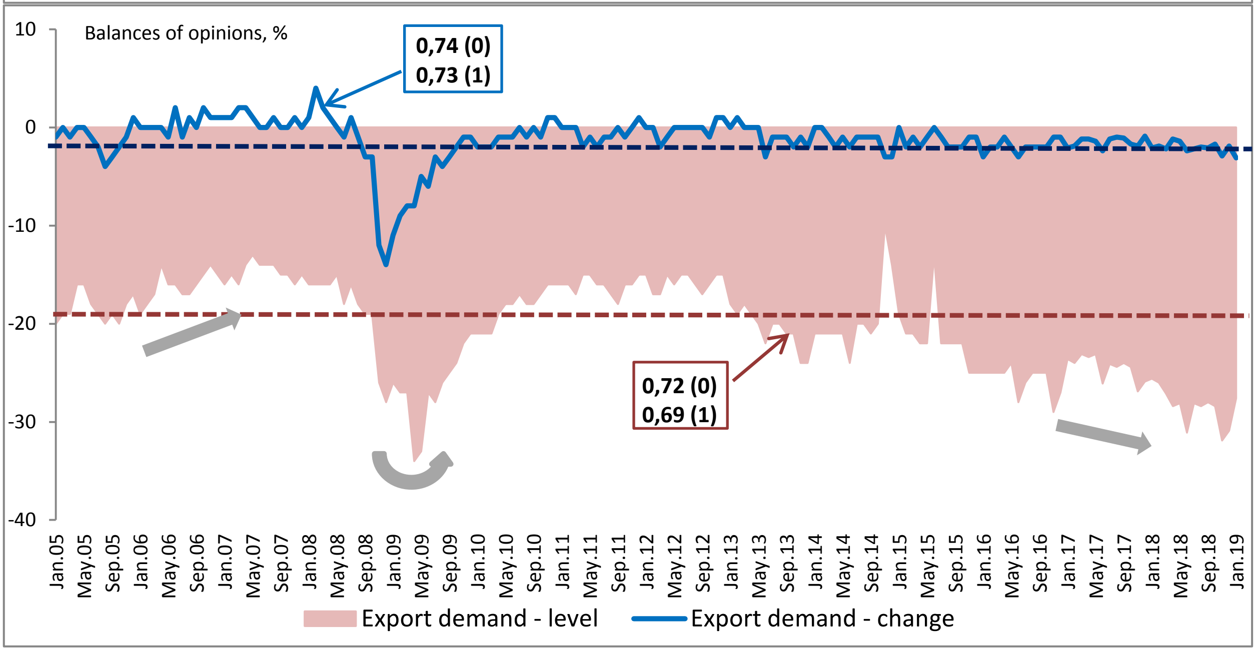
Sep.18
Jan.19
Demand - level
Demand - change


Balances of opinions, %
0,74 (0)
0,73 (1)
0,72 (0)
0,69 (1)
10
0
-10
-20
-30
-40
Jan.05
May.05
Sep.05
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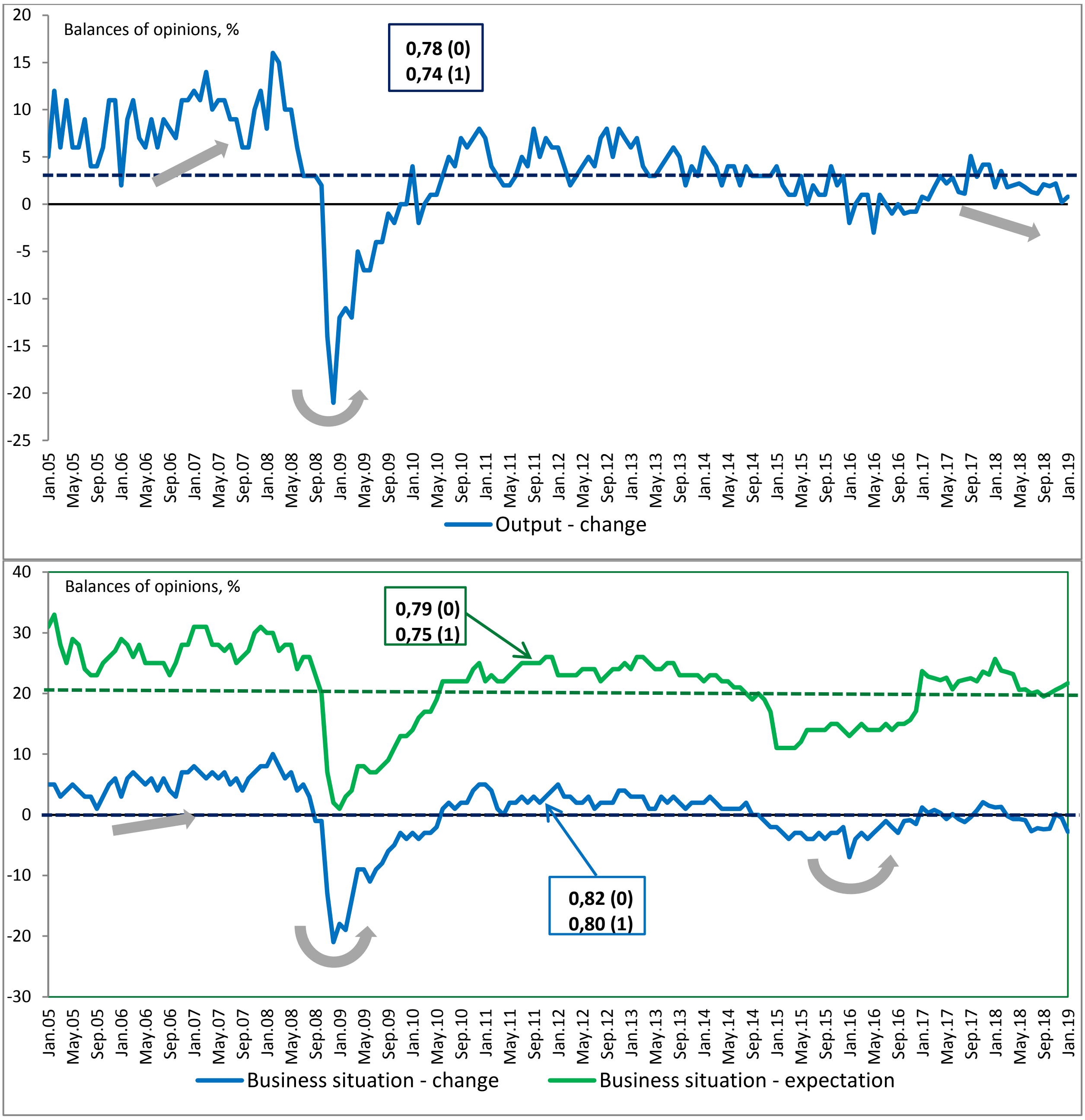
Jan.19
Export demand - level
Export demand - change



Note: Authors calculations. The dotted lines indicates the long-term historical averages of the indicators. The markers indicates the cross-correlation coefficients between BCI components with coinciding (0) and one month lagging (1) IPI dynamics.

Source: BTS results by Rosstat.

Fig. 1 Components of the manufacturing BCI

Each time series of balances can be represented as the sum of a ‘common’ component that reflects as close as possible the cyclical development of manufacturing, and an ‘idiosyncratic’ component that reflects the specific fluctuations. Both components are unobservable. The task, according to the key research question, is to extract only common unidirectional information from the analyzed time series and combine it in a single indicator. This procedure allows selecting key information contained in the survey results and excluding data that are not common and may even be contradictory. For example, at a particular moment in time, the balance of opinions on the demand level may indicate a low level, whereas the change in production looks promising. The calculation of a common factor facilitates the interpretation of all BTS results, since it compresses them and separates from idiosyncratic fluctuations in specific indicators.

All time series of BCI components are treated equal, without weighting information. The dynamics consistency, the absence of information gaps and the regular monthly updating allow using the static factor analysis, whereas in the case of components with a 'ragged edge' and a various frequency, the dynamic factor analysis should be used.

To combine the common information contained in the primary data set, we use the principle components method (PC) of factor analysis. The model can be written as follows (EC 2000):

$$y_{it=}\lambda_{i1}F_{1t} + \cdots + \lambda_{iJ}F_{Jt} + u_{it}, \ \forall i \in [1; I]. \quad (1)$$

where y_{it} is a standardized observed variable (balance of opinions on the indicator i) at time t;

I is a number of analyzed variables (I = 7);

J is a number of common factors (unobservable variables that summarize information);

F_{jt} is a value of the j_{th} common factor at time t;

u_{it} is a specific component of a variable i at time t.

λ_{ij} are regression coefficients of factor j for estimating variable i, the specific components u_{it} over time do not correlate with each other and with common factors.

Each of λ_{ij}^2 is the fraction of the variance of the variable i, which is explained by the j_{th} factor. The sum $\sum_{j=1}^{J}\lambda_{ij}^2$ is the fraction of the variance explained by all factors, called the communality.

According to the logic of vertical integration of BTS qualitative data, the resulting BCI can be interpreted in relation to its average long-term (historical) value. We can also calculate the standard deviations on homogeneous parts of the BCI dynamics, extract a trend and a cyclical profile, use BCI in cyclical analysis and forecasting. In each period, an increase/decrease in BCI means that the common and unidirectional BTS results indicate an improvement/deterioration in business climate in the manufacturing industry compared to the previous period.

2.2 Medium- and high tech industries extracting

To calculate the BCI in the manufacturing industries with different technological levels, the observation units and the input information are differentiated into three groups. For this purpose, a classification developed by UNIDO[6] and recommended for use in the CIS[7] countries was applied (UNIDO 2017, Upadhyaya et al. 2016, Kitrar et al. 2016, UNIDO and GIZ 2015). The UNIDO classification is based on the International Standard Industrial Classification (ISIC), the Standard International Trade Classification (SITC) and the OECD classification (adapted to the CIS region) linking industry R&D expenditures with the value added and production statistics. In this version, the technological classification includes the following categories:

- Resource-based industries (RB);
- Low-tech industries (LT);
- Medium and high-tech industries (MHT).

The RB category consists of activities with a low level of technology, labour-intensive production processes and low capital intensity. The competitive advantages of such industries are mainly based on the availability of local natural resources or arise when the skills and technologies used in production are able to attract capital and promote new technologies (for example, modern manufacture of food products).

The LT category includes low-tech but more capital intensive industries. The technologies used in such activities are widespread and mainly impose relatively simple requirements for employees' qualifications and skills. The products are largely differentiated and competitive in term of price. Labour costs are one of the main cost elements in the competitiveness potential. In developed countries, the assembly operations of such industries are often transferred to economies with cheap labour and raw materials resources while keeping complex production and technological functions within the country.

In Russia, according to UNIDO recommendations, medium- and high technology industries are combined into one MHT category, characterized by more sophisticated technologies and high requirements for the qualification of personnel and technological activity. Medium-tech industries, as a rule, have production technologies with moderately high R&D levels, require advanced skills and long-term training. In particular, the production of machinery and equipment, transport vehicles need to implement 'best practices' of technological intensity, to improve equipment and optimize complex processes. Barriers to entering the foreign market are usually high; compliance with international standards is prerequisite. High-tech industries use advanced fast-changing technologies with high investment in R&D, technological

[6] United Nations Industrial Development Organisation.
[7] Commonwealth of Independent States.

infrastructure, and special technological skills. Many products of these industries require labour-intensive final assembly, while a high share of value added contributes to the economically beneficial placement of production processes in regions with low wages and energy costs. This contributes to the development of internationally integrated production systems, in which the separation and location of production is closely linked to the division of costs.

The main assumption of this technological distribution is the availability of comparable time series at the 2-digit disaggregation level over a long period. The problem is that Russian statistics are transiting to a new classifier of economic activities. For this reason, data for 2017-2019 correspond to the new national classifier of economic activities (OKVED 2), while data for 2005-2016 correspond to the previously used version (OKVED 2007)[8]. Since the level of disaggregation in OKVED 2 is higher, it is possible to obtain a comparable data set for a long period only based on OKVED 2007. Thus, some data for 2017-2018 should be combined to meet the level of disaggregation in 2005-2016.

Table 1 presents the technological distribution of industrial activities according to OKVED 2007 and OKVED 2. The level of disaggregation corresponds to those in the results of surveys submitted by the Federal State Statistics Service. The set of industries in each technological category is in line with UNIDO recommendations. This study explores business climate in MHT industries only.

Table 1. The technological distribution of industrial activities according to the Russian classifiers of economic activities OKVED 2007 and OKVED 2

	OKVED 2007 (2005-2016)		OKVED 2 (2017-2018)	
Resource-based industries(RB)	DA	Manufacture of food products, beverages and tobacco products	10	Manufacture of food products
			11	Manufacture of beverages
			12	Manufacture of tobacco products
	DD	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
	DE	Manufacture of paper and paper products; printing and reproduction of recorded media	17	Manufacture of paper and paper products
			18	Printing and reproduction of recorded media
	DI	Manufacture of other non-metallic mineral products	23	Manufacture of other non-metallic mineral products
	DJ	Manufacture of basic metals; fabricated metal products, except machinery and equipment	24	Manufacture of basic metals
			25	Manufacture of fabricated metal products, except machinery and equipment
Low technology industries (LT)	DB	Manufacture of textiles and wearing apparel	13	Manufacture of textiles
			14	Manufacture of wearing apparel
	DC	Manufacture of leather and	15	Manufacture of leather and related

[8] OKVED 2 is compatible with the NACE Rev 2 while the OKVED 2007 was compatible with the NACE Rev. 1.1.

		related products		products
	23.9	Manufacture of coke and refined petroleum products	19	Manufacture of coke and refined petroleum products
	DH	Manufacture of coke and refined petroleum products	22	Manufacture of coke and refined petroleum products
	DN	Other manufacturing	31	Manufacture of furniture
			32	Other manufacturing
High and medium technology industries (MHT)	DG	Manufacture of chemicals and chemical products	20	Manufacture of chemicals and chemical products
			21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
	DL	Manufacture of electrical equipment, electronic and optical products	26	Manufacture of computer, electronic and optical products
			27	Manufacture of electrical equipment
	38.9	Manufacture of machinery and equipment	28	Manufacture of machinery and equipment n.e.c.
	DM	Manufacture of transport equipment	29	Manufacture of motor vehicles, trailers and semi-trailers
			30	Manufacture of other transport equipment

The results of applying PC method for the seven balances of opinions for manufacturing as whole and MHT industries are presented in Table 2.

Tab. 2 Eigenvalues of the principal factor analysis

Eigenvalues	Components						
	1	2	3	4	5	6	7
Manufacturing	5.761	0.497	0.369	0.176	0.113	0.047	0.035
MHT	5.581	0.620	0.361	0.219	0.100	0.076	0.042

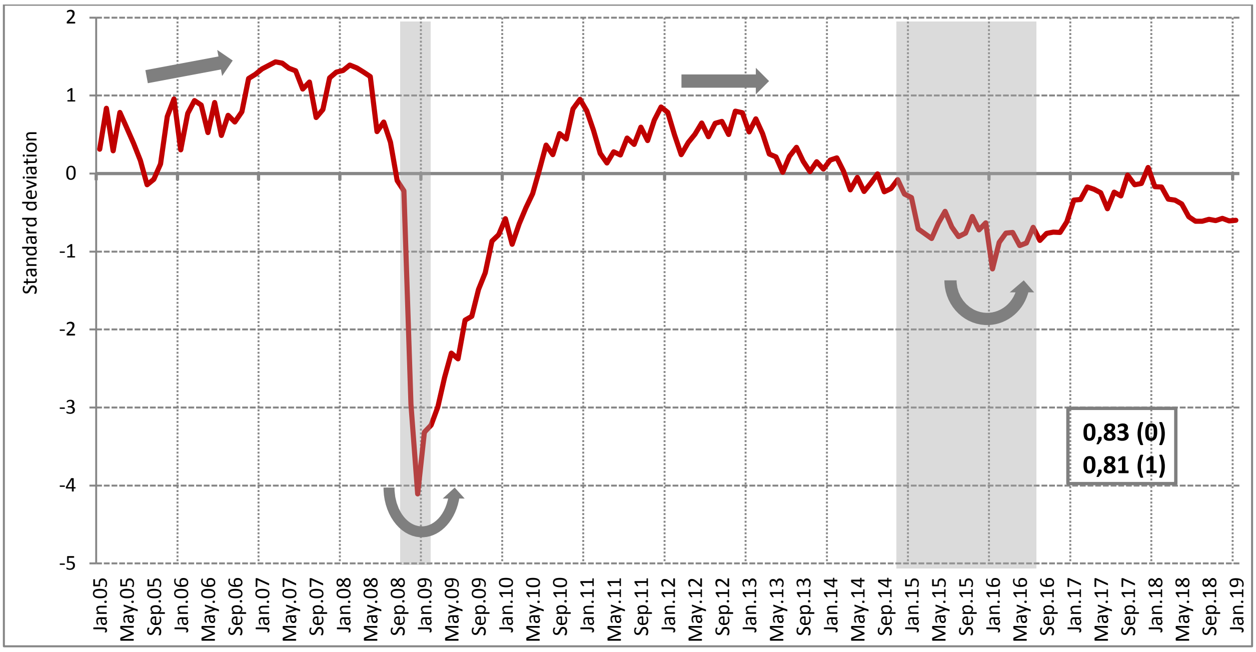
Source: authors' calculations.

In each case, the first eigenvalue is much larger than the others are. Thus, we consider the first common factor sufficient in explaining the main volume of unidirectional information contained in the opinions balances. The only common factor explains 82.5% of the total variance of seven opinion balances in case of manufacturing and 79.7% in case of MHT industries. These results statistically validate the PC method, which we chose to summarize the survey information in a single composite indicator.

3 Results

3.1 Business climate in manufacturing

The dynamics of the manufacturing BCI is presented in Figure 2.



Note: Authors calculations. The recession phases are highlighted with shaded areas. The arrows indicate the cyclical movements of BCI as a standardized time series with zero mean and standard deviation 1. The marker shows the cross-correlation coefficients between BCI and coinciding (0) and lagging by one month (1) IPI dynamics.

Source: BTS results by Rosstat.

Fig. 2 Business climate indicator in the Russian manufacturing

The indicator has a smoothed configuration with a pronounced short-term cyclicality over two years and frequent minor fluctuations. It is recommended to observe any fluctuations in his profile for at least 5-6 months to confirm significant cyclical events.

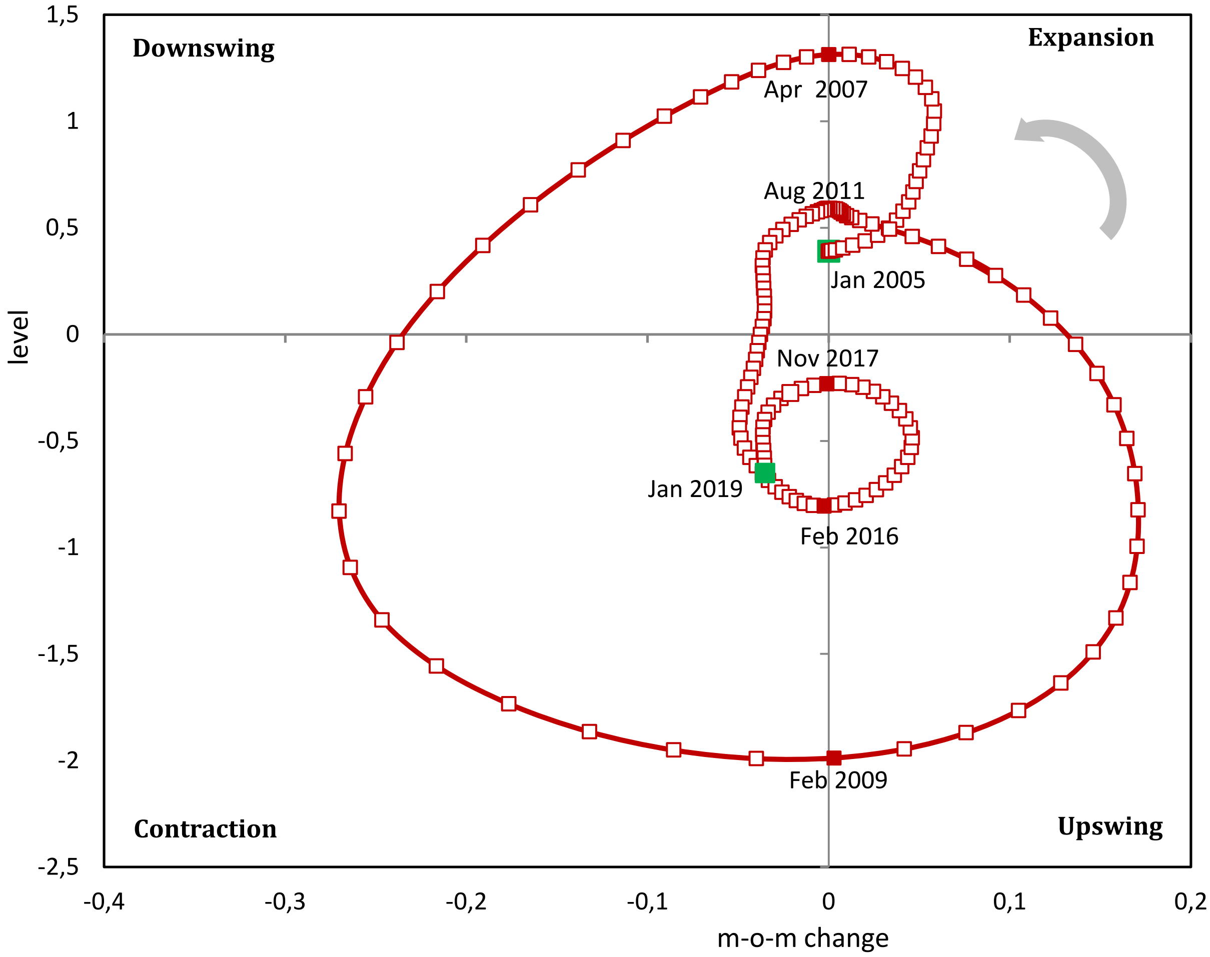
Consider the ability of a new composite indicator to track short-term changes in industrial production in comparison with a traditional confidence indicator. The direction and amplitude of cyclical fluctuations in the dynamics of these indicators, despite the differences in their composition and calculation methods[9], are close. The coefficient of synchronous correlation between the time series for the period from January 2005 to January 2019 is 0.932. Then, we compare the statistical connection between the time series of BCI and confidence indicator with the dynamics of Industrial Production Index (IPI) in manufacturing. BCI noticeably outperforms confidence in terms of coinciding and leading correlation with IPI: 0.835 with a lag (0), 0.808 (-1) and 0.767 (-2) against 0.724, 0.655 and 0.572, respectively, for the confidence indicator.

The decomposition of a cyclic profile with a smoothed amplitude, equal on average to 2.5 years, in the BCI dynamics is carried out through a single pass of the Hodrick-Prescott (HP) statistical filter (parameter λ = 523.53). This filter is commonly used for the time series of BTS

[9] The confidence indicator in manufacturing is calculated as a simple arithmetic mean of the three components (BTS results): current levels of demand and stocks of finished goods (the latter with the inverted sign), production output expectation. It is harmonized with a similar indicator calculated in all EU countries. In the study, the analyzed time series of confidence and BCI are shown with excluded seasonality from January 2005 to January 2019.

indicators (EC 2018, Nilsson and Guidetti 2008). The amplitude of smoothing (30 months) was defined empirically in previous studies (Kitrar et al. 2015, 2014).

Figure 3 shows the tracer of business climate cycle. The tracer visualizes the direction, amplitude and turning points in the BCI short-term cyclical development that reflects all significant waves of optimism and pessimism of Russian producers.



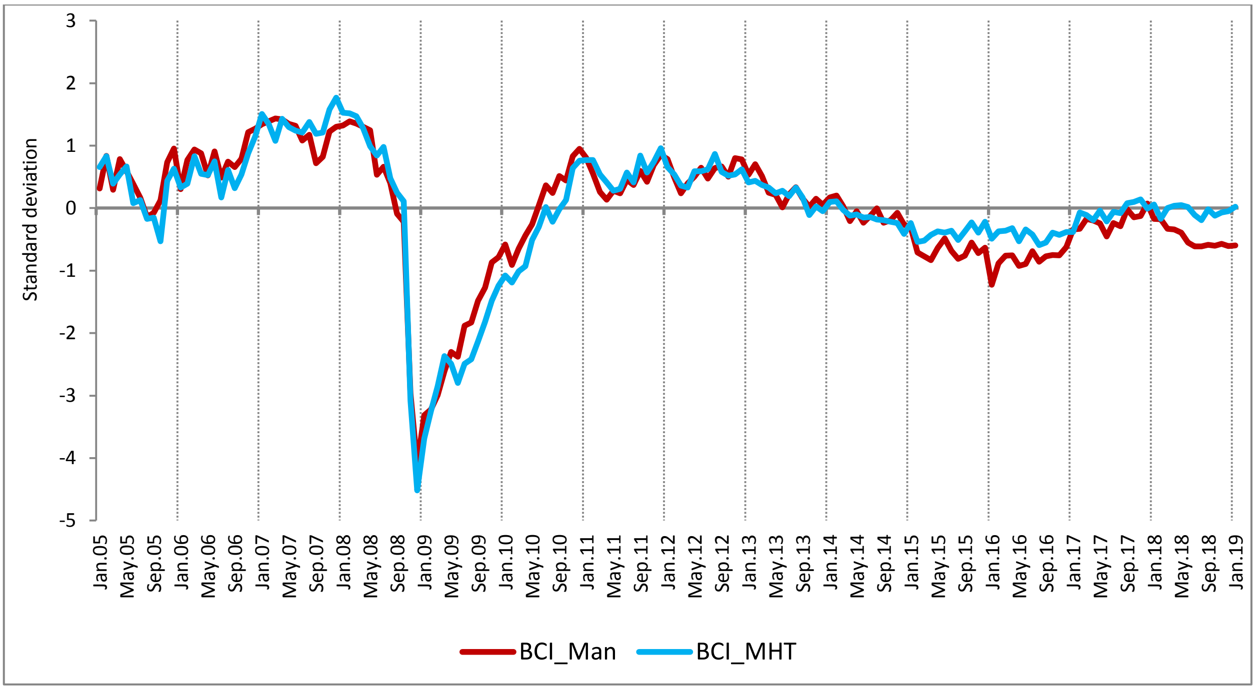
Note: the authors' calculations. The tracer visualizes short-term cyclical indicators (Kitrar et al. 2015, 2014, EC 2019b). In this study, it is based on the calculation of the short-term cyclical component of the BCI time series with amplitude of 2.5 years. The standardized values with zero mean and standard deviation of one are plotted along the y-axis, and their monthly changes (absolute growth) along the x-axis. The tracer counterclockwise movement along the four diagram quadrants reflects the four phases of growth cycle that the indicator passes; cyclical peaks are located in the upper central area of the diagram, and cyclic troughs – in the lower central area.

Fig. 3 The tracer of business climate cycle

Since January 2005, we identify the complete growth cycle (from one cyclical maximum to another) in the BCI time series, which begins at the highest point in April 2007, passes an obvious crisis level in February 2009 and, after more than the two year recovery, ends with a peak in August 2011. At this moment, we can date the beginning of the second short-term cycle in the BCI dynamics – the phase of slow unstable stagnation, growth retardation and increasing pessimism. Then, since May 2014, the sharp contraction of external commodity markets and oil prices, significant currency depreciation, sanctions imposition, increased economic uncertainty, and other shocks significantly reinforce the depressive sentiment of entrepreneurs. The BCI cyclical movement reaches its minimum in February 2016. However, recession events in 2018 does not allow the indicator to enter the zone of optimism growth. Compared with the crisis 2008-2009 and the subsequent period of rapid recovery, the new round of pessimism is less sharp and deep, but is more protracted.

3.2 Business climate in medium- and high-tech industries

Figure 4 presents the dynamics of BCI in medium- and high-tech industries (BCI-MHT); the manufacturing BCI (BCI-Man) is plotted for comparison.



Source: BTS results by Rosstat, authors' calculations.

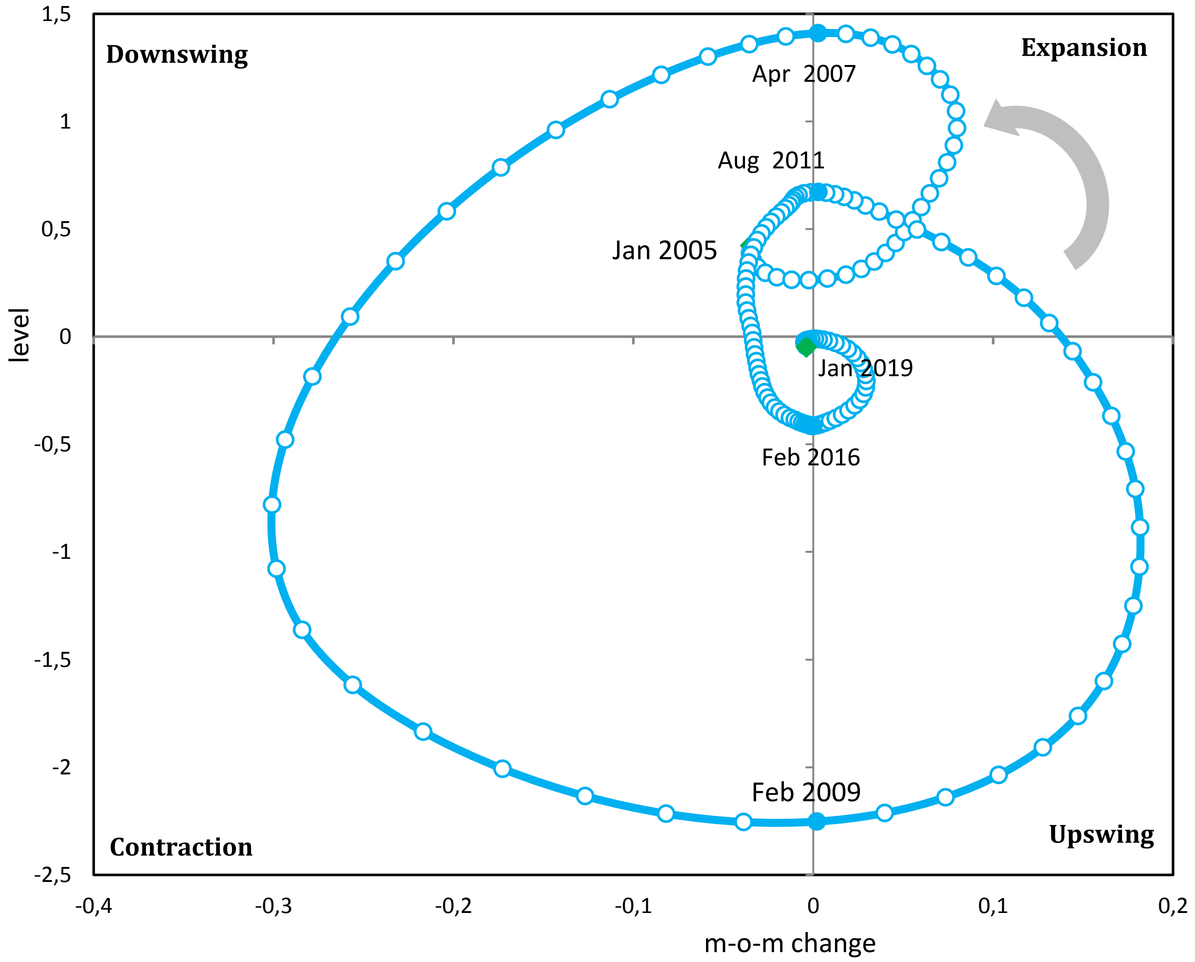
Fig. 4. Business climate indicator in MHT industries

The time series of BCI-MHT, similar to the manufacturing BCI dynamics, has a two years cyclical profile and minor monthly fluctuations.

After the 2008-2009 recession, the BCI-MHT dynamics shows a more stable profile compared to the cyclical changes of BCI for the manufacturing as a whole. Since 2017, BCI-MHT has been fluctuating in a narrow range (from -0.1 to +0.1 standard deviations) around its long-term average value (0). A short-term deterioration in the business climate was noted in June 2017

(-0.21), in February 2018 (-0.20), and in August 2018 (-0.19), but there were no significant growth episodes over this period.

Figure 5 shows the tracer of BCI-MHT, which visualizes the cyclical profile in business climate in medium- and high-tech industries.



Note: the authors' calculations. The tracer visualizes short-term cyclical indicators (Kitrar et al 2015, 2014, EC 2019b). In this study, it is based on the calculation of the short-term cyclical component of the BCI-MHT time series with amplitude of 2.5 years. The standardized values with zero mean and standard deviation of one are plotted along the y-axis, and their monthly changes (absolute growth) along the x-axis. The tracer counterclockwise movement along the four diagram quadrants reflects the four phases of growth cycle that the indicator passes; cyclical peaks are located in the upper central area of the diagram and cyclic troughs are in the lower central area.

Fig. 5. The tracer of business climate cycle in MHT industries

The cyclical evolution of BCI-MHT is very close to those of BCI. The first complete growth cycle (from one cyclical maximum to another) lasts from April 2007 to August 2011. The second cycle reaches the lowest point in February 2016. However, the level of BCI-MHT in the second cycle is higher than the level of manufacturing BCI; in 2018, the BCI-MHT tracer almost reached positive values. Thus, during the last protracted recession (2016-2018), the sentiment of manufacturers of medium- and high-tech products was less pessimistic compared with the sentiment of all manufacturers.

4 Concluding remarks

The paper presents the Business Climate Indicator (BCI) in the Russian manufacturing, including the method of calculation and the relevant areas of analysis and visualization. Integrating qualitative BTS data into BCI allows extracting and aggregating common unidirectional information cleared up of specific fluctuations in individual variables. This increases the probability of transmitting positive/negative changes in the composite indicator to the reference time series (IPI). The resulting BCI tracks quantitative changes in manufacturing growth more accurately and with a lead compared to the traditional confidence indicator. The tracer of business climate cycle visualizes the direction, amplitude and turning points in the BCI short-term cyclical development that reflects all significant waves of optimism and pessimism of Russian producers.

To construct BCI and assess business climate in medium- and high-tech (MHT) manufacturing industries, we differentiate the units of observation and the input information into three groups according the technological classification developed by UNIDO and recommended for use in the CIS countries. The dynamics of BCI-MHT is close to those of BCI; however, during the last protracted recession (2016-2018), the sentiments of manufacturers of medium- and high-tech products were less pessimistic compared with the sentiments of all manufacturers.

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