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REGIONAL PROBLEMS

The System of Short-Term Regional Economic Monitoring in Moscow

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Abstract—The article describes the system of short-term regional economic monitoring. The system has been developed by the authors and tested in Moscow since 2020. It consists of four hierarchical levels: aggregated regional economy, largest industries of regional economy, largest organizations by industry, small business. The system is a tool for short-term detailed analysis of regional economic performance. Both official national statistics and different auxiliary statistical sources have been embedded into the monitoring. Within the system a set of coincident indicators have been developed that allows for providing monthly estimates of gross regional product's growth rate with one month lag.

Keywords: regional economics, economic monitoring, composite coincident indicators, gross regional product

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Introduction. Economic management, both at the national and regional levels, and at the level of individual companies, requires operational monitoring of the most important processes for the level under consideration. Such monitoring is of particular importance during periods of economic shocks, when official statistics do not always accurately and within the required time frame reflect changes in the situation. At the same time, due to the development of information technology, the amount of socioeconomic data available for operational analysis is constantly increasing. These data, as well as constantly emerging new approaches to their collection, processing and analysis, can be effectively used both to optimize business processes and to make decisions in the field of economic policy in various countries and regions.

The traditional problem of official macroeconomic statistics at the regional level is a significant time lag that occurs in the process of calculating and publishing generalized data on economic development [1, 2]. This practically excludes the most important macroeconomic indicators from the contour of making operational decisions. Thus, the main indicator that characterizes the economic condition of the Russian regions is their gross regional product (GRP). The calculation of the GRP is carried out on the basis of an array of data received by Rosstat and its regional departments in the form of federal statistical observation directly from organizations and individual entrepreneurs. Collection, processing of these statistics and estimation of the GRP on its basis currently take more than one year (for example, the assessment of the GRP of Russian regions for 2019 became available only at the end of March 2021, and this is a standard situation).

Of course, in the process of managing the regional economy, other data can and should be used, including those with a higher frequency of publication (dynamics of prices, wages, industrial production, etc.). However, their changes can be multidirectional, and the impact of economic shocks on them can be distributed over time. Therefore, the presence of composite indices, which are a function of a certain set of operational indicators and reflect the main directions of economic development and the turning points of existing trends, can increase the efficiency of response to emerging economic risks and threats. The demand for such indicators was demonstrated by the last crisis caused by the COVID-19 pandemic: one of the most important and useful areas of economic analysis during this period was the construction of high-frequency indices, the dynamics of which characterizes the level of economic activity.

Naturally, composite indices of economic development are not something fundamentally new – they have been used abroad for decades [3–8], and in recent years in Russia [9–13]. However, for their effective use, it is not enough to simply apply methods tested in other regions and/or at other times: firstly,

because of the impossibility of maximizing the use of information technologies that continue to develop rapidly; secondly, due to the underestimation of country and regional statistical features. In this article, using the example of building an operational monitoring system for the economy of Moscow during the crisis of 2020 in general and composite coincident indices, in particular, another approach has been shown, within which an attempt has been made to overcome these limitations.

International practice uses composite indices to monitor the state of the economy. Composite indices can be divided into several main types (a detailed typology of composite indices is given, for example, in [14]) according to the following features (such a classification is not the only possible one, but it takes into account the main approaches to index construction):

1) By a temporal relationship with the described indicator (coincident, leading, lagging indices).

2) By the presence or absence of a reference indicator (i.e., an indicator, the dynamics of which, with some approximation, should repeat or predict the index).

3) By the source of the data used (this may be official statistics, survey results, etc.).

To solve the problems of operational monitoring, the most commonly used are composite coincident indices constructed on the basis of official statistical data for which there is a reference series. For example, for the regional level, the construction of an index is most in demand, the dynamics of which would reflect the GRP dynamics, which in this case acts as a reference series, through the use of various social and economic indicators published monthly and quarterly.

The OECD draft guide on constructing leading, coincident and lagging indices [15] describes the steps to be taken when constructing composite indices with a reference series (each step is not limited to only one option, but involves choosing from a wide range of alternatives), including:

1) Choice of a theoretical framework (it is necessary to understand how individual indicators potentially included in the index can affect the reference series).

2) Data selection (selection of indicators included in the index).

3) Transformation and normalization of the initial data.

4) Selection of weights and aggregation of components into the final index.

Probably the most well-known composite indices are the two developed monthly by the American Conference Board: coincident and leading [16]. In particular, the Conference Board coincident index includes the following indicators, the weights of which are determined in accordance with the standard deviations of their values:

— Number of employees (excluding agricultural work)—the weight of this indicator in the index is 26%.

— Real incomes of the population minus social transfers—14%.

— Index of industrial production—7%.

— Sales volume in the manufacturing and trade sectors at constant prices—53%.

In addition to these indexes and the methodology underlying them, there are many other approaches to constructing composite indexes, each of which has its own characteristics. The following are several of these approaches; they are united by the fact that some principles of their construction can be used to one degree or another in the framework of the operational monitoring of the state of the Moscow economy described below.

The National Bank of Austria has developed an index of the national economy [17], with the help of which a weekly assessment of the impact of various economic indicators on the volume of gross domestic product (GDP) is carried out using the income method. The indicators included in this index are selected in such a way as to characterize the expenses of the population, the state and business:

— The amount of consumption in the private and public sectors (household spending is determined on the basis of weekly data on transactions of individuals using bank cards and an estimate by the Central Bank of Austria of the amount of out-of-pocket spending; for government spending, an annual growth assumption of 1.5% is used).

— The volume of exports (estimated on the basis of statistics on the mileage of freight and rail transport).

— The volume of investments (the volume of investments in capital construction is determined on the basis of data on registered unemployed in the construction sector, of other investments, on the basis of information on the amount of corporate debt).

Another approach to the construction of composite indices of economic activity is used by the Federal Bank of Germany [18]. To construct the index, a wide range of indicators is used that allow for a comprehensive assessment of the state of the national economy without resorting to the GDP modeling by one of the standard methods:

— Index of industrial production (monthly).

— Quarterly GDP.

— Electricity consumption (daily).

— Data on the mileage of trucks (daily).

— Number of flights around the world (daily).

— Indirect estimate of unemployment (weekly data on the number of searches for "unemployment" in Google).

— Indirect estimate of underemployment (weekly data on the number of searches for "underemployment" in Google).

— Number of passers-by on the "shopping" streets in major German cities (daily).

— Indirect assessment of government support for businesses and the population (weekly data on the number of requests for "government support" in Google).

— Concentration of nitrogen dioxide in the air (daily).

— Credit card payments (daily).

To construct a composite index, first, "quarterly" growth rates are calculated for the following indicators: 1) daily (which are reduced to weekly data, and then their rates are calculated for the last 13 weeks), 2) weekly (for the last 13 weeks) and 3) monthly (for the last 3 months). After that, on their basis, the index is estimated using the method of principal components.

As one can see, the last two indices are based on different methodological principles, but they have an important common feature: they allow not even monthly, but weekly, with a fairly high accuracy, assessing the change in the level of economic activity. Unfortunately, the peculiarities of Russian statistics at the moment do not allow adequately solving a similar problem. But the operational monitoring system described in this paper can be considered as one of the steps towards its solution.

Features of the construction of regional composite indices. The composite indices described above make it possible to quickly assess the current level of economic activity and emerging trends at the country level as a whole. But most countries are characterized by the presence of large economic centers at the regional level (cities, states, federal lands), the socioeconomic features of which can often differ significantly from the general country ones.

The ability to take into account the specifics of individual economic zones is important both at the level of national economic policy and in management at the regional level. So, in Russia there are territories with a pronounced specificity of the economy: in the Urals (Kurgan, Orenburg, Sverdlovsk, Chelyabinsk oblasts) the basis of the economy is industry, in the Far East (Republic of Sakha (Yakutia), Sakhalin, Magadan oblasts), mining and forestry, and in Moscow, for example, there is a significantly higher share of the service sector than in the whole country. Therefore, the same external factors may affect the situation in regions with such a different economic structure in different ways. In this regard, the role of obtaining operational information on the state of the economy of individual regions is growing.

But an attempt to directly transfer the experience and methods of constructing indices that characterize the state of the country's economy to the regional level can be difficult due to the impossibility of correctly calculating many important indicators (for example, foreign trade indicators and the volume of freight traffic) and, as a result, meaninglessness attempts to estimate the GRP directly by the use method. The use of the production method for the operational assessment of the GRP dynamics is also very difficult due to the lack of indicators that characterize with a sufficient degree of accuracy the change in the physical volume of gross value added (GVA) in each sector of the region's economy.

A more productive approach is to develop a composite regional index that does not exactly repeat the structure of the region's economy in terms of production or use, and at the same time approximates the GRP dynamics in the reporting period. The GRP in this case is used as a reference series. At the same time, it is advisable to include in the "perimeter" of operational monitoring of the state of the region's economy not only the summary indicator itself, but also the dynamics of its components. This allows getting a more complete picture and, in the event of a significant drop or increase in economic activity, localizing the area that is the driver of change.

Additional indicators for operational monitoring of the state of the regional economy. Despite the fact that a composite coincident index and its constituent indicators are necessary to monitor the state of the economy of a country or region as a whole, it is not enough to use them alone to develop support measures, since different industries can have different dynamics, sometimes even in different directions. A vivid example of such a situation is the latest crisis caused by the COVID-19 pandemic, when the service sector was the most affected. Thus, the index of the physical volume of paid services to the population in Moscow in 2020 amounted to 76.7% compared to 2019. At the same time, the crisis did not affect the Moscow industry. Moreover, the index of industrial production in the city increased in 2020 by 12.2% at once.

In the construction sector, a decline was first observed as the index of the physical volume of work by the type of economic activity "Construction" in January–May 2020 decreased by 8.4% compared to the same period in 2019 due to the suspension of construction work in the city. Then there was a sharp rise, which exceeded the previous year by 8.3%.

Due to the fact that the composite regional index and its indicators, despite their informativeness, still have a limited sectoral coverage, it is advisable that the

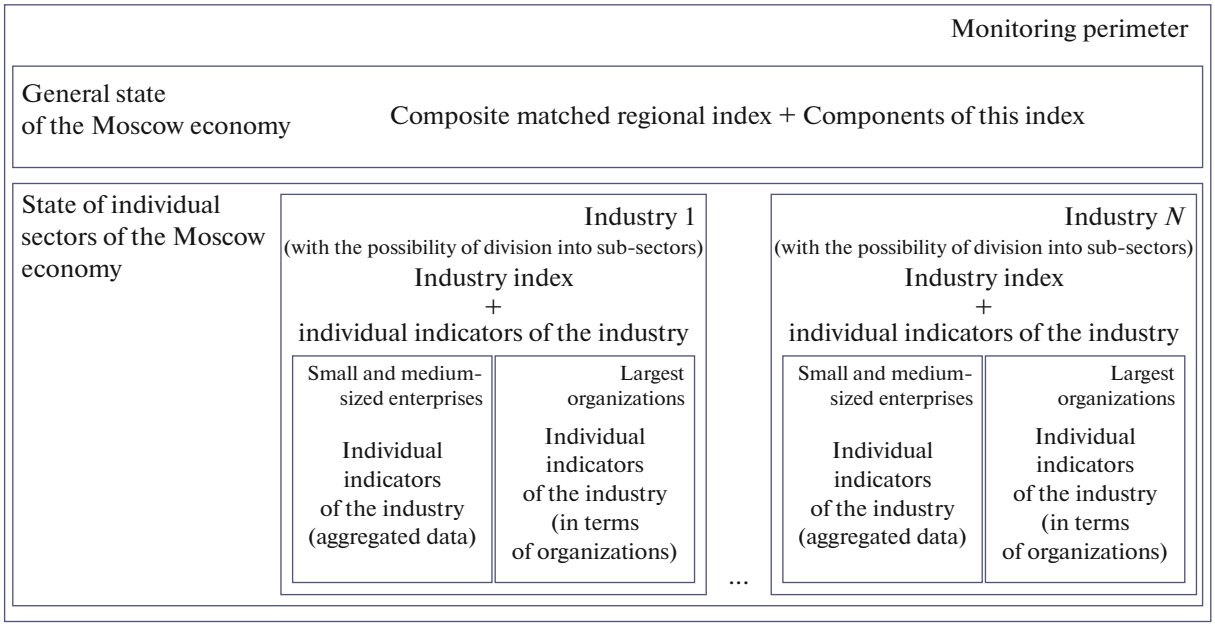

Fig. 1. Scheme of operational monitoring of the state of the economy of the region.

monitoring be supplemented with sections demonstrating the situation in individual sectors of the regional economy. As in the case of the GRP, the issue of operational assessment of the real state of the industry is also often quite complicated, since the sectoral GVA estimates are published by Rosstat with the same frequency and lag as the GRP, and therefore they are not applicable in operational monitoring. The solution to this problem is the development of indices that reflect the state of the main sectors of the regional economy separately. In this situation, it is optimal to use as sectoral indices indicators characterizing the physical volume of output in the industry, and in their absence, the turnover or volume of shipped goods, adjusted for various price indices. However, such indicators are not available for all industries, and, in addition, at the industry level, as a rule, there are no reference series of acceptable quality; in this case, the way out is to construct composite indices without association to any reference indicator.

In sectoral monitoring, as well as in monitoring the general state of the urban economy, it is advisable to analyze not only the developed indices, which characterize, first of all, the dynamics of output, but also other indicators. Some of them are common for all industries (number of tax-paying organizations, average wages in the industry), some are specific (for example, for construction—the area of commissioned residential real estate, for trading activities—retail trade turnover). This approach allows getting a more complete understanding of the economic situation and the processes taking place in each of the industries.

It should be emphasized separately that the use of high-frequency data in monitoring is sometimes associated with serious methodological problems. For example, the analysis of cash register equipment (CRE) data allows tracking most of the trade transactions on-line, including by industry. But in order for their dynamics to objectively reflect both trading activity and transactions in certain types of activities, comparability of the CRE sample is required, and it is extremely difficult to ensure this. In a large city like Moscow, hundreds of companies start and stop every week. Therefore, it is required to develop a special methodology to take into account CRE statistics. And this is just one example of the difficulties that arise when working with this kind of data.

Scheme of operational monitoring of the state of the region's economy. The proposed approach to operational monitoring of the state of the region's economy is presented in the form of a diagram in Fig. 1. As an example, we can consider the monitoring of the state of the construction industry in Moscow. The main index reflecting its dynamics can be constructed using the indicator "Physical volume of work by type of economic activity 'Construction'," and additional indices included in the monitoring perimeter are:

1) Number of people employed in the industry.

2) Index of entrepreneurial confidence in construction.

Table 1. Components of the industry-wide composite coincident index of Moscow

No.	Indicator	Weight in the index, %
1	Power consumption with eliminated temperature and calendar factors	34
2	Physical volume of paid services to the population	27
3	Industrial production index	19
4	Income to the personal income tax budget, adjusted for the consumer price index for goods and services	10
5	Retail trade turnover adjusted for consumer price index by goods (index of physical volume of retail trade turnover)	10

Source. Authors' calculations.

3) Rental rates for certain types of commercial real estate (office, retail, warehouse).

4) Number of organizations paying personal income tax (PIT).

The use of such different indicators for monitoring makes it possible to "highlight" various aspects of construction activity and mark key trends in the development of the industry.

By analogy with the allocation of individual sectors (corresponding to sections of OKVED2) when monitoring the state of the region's economy, it is advisable to divide industries into separate subsectors. This is due to the heterogeneity of the types of activities included in the industry. For example, professional, scientific and technical activities, according to OKVED2, include such different types of activities as:

— Activity of head offices.

— Scientific research and development.

— Advertising activities.

— Veterinary activities.

Obviously, the state of each of these activities is not directly related to the state of others, so their dynamics can vary significantly.

The next level of detailing in monitoring (the general state of the economy, the state of individual industries, the state of individual subsectors) is the level of individual organizations. Due to the complexity of conducting a complete analysis at this level in each sector under consideration, it is advisable to single out the largest and most significant companies for monitoring purposes. This is especially relevant for industries in which the activities of a small number of large organizations significantly affect the state of the entire industry. For example, in contrast to the trade sector, where the number of taxpayers to the budget of Moscow in 2020 amounted to 118.3 thousand organizations, in the industry "Mining" there were only 972 such organizations, while 20 of them accounted for 88% of tax receipts.

In addition to monitoring the largest organizations, it is also useful to analyze the activities of organizations related to small and medium-sized enterprises (SMEs), since it is they who are most at risk during periods of crisis. But because of their very large number and small size, it is neither necessary nor possible to consider the state of each organization separately. It is sufficient to analyze aggregated indicators for all SMEs in the relevant industry. For their monitoring, data from the Federal Tax Service published in open access in the Unified Register of SMEs can be used, containing, among other things, information about the category of an SME entity (microenterprise, small enterprise, medium-sized enterprise), information on the types of activities carried out, licenses, the average number of employees and products.

The next step in developing an operational regional monitoring system is to determine the most effective ways to present data, with particular attention to the following aspects:

— The number of indicators being monitored (it is necessary to find a balance between the inclusion in the monitoring of all possible types of representations for the completeness of displaying the available information and the possibility of perception and analysis by a person of a large data set).

— The specifics of indicators (it is necessary to consciously approach the choice of representations of each indicator, without leading them to excessive uniformity, since individual indicators may have their own content and methodological features).

Operational monitoring of the state of the economy of Moscow. The scheme described above was applied to the monitoring of the state of the economy of Moscow and certain key sectors of the city's economy in the context of the crisis caused by the coronavirus pandemic.

The proposed monitoring system consists of four types of visualized indicators (dashboards): industry-wide, sectoral, a dashboard for the largest taxpayers and a dashboard for SMEs. One of the indicators of the industry-wide dashboard is the industry-wide combined coincident index, which characterizes the

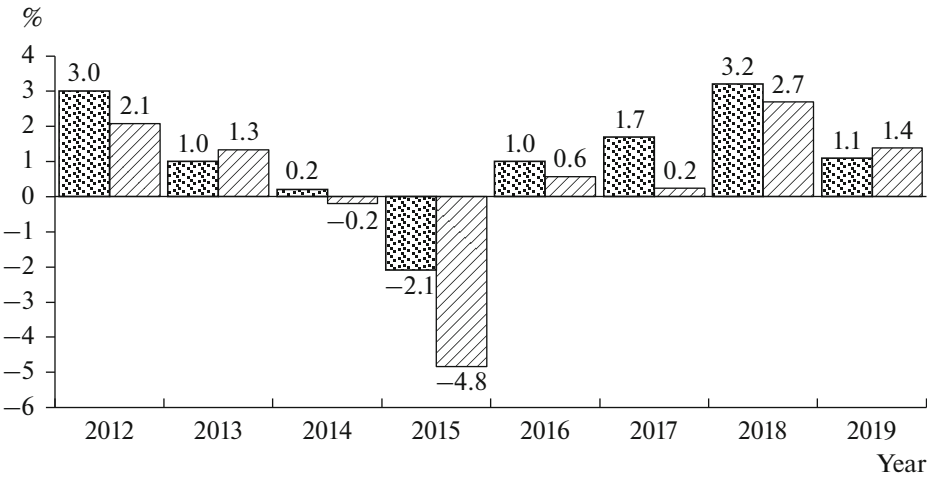

Fig. 2. Composite coincident index and index of the physical volume of the GRP in Moscow in 2012–2019, % to the previous year:
GRP; composite coincident index.
Source: authors' calculations.

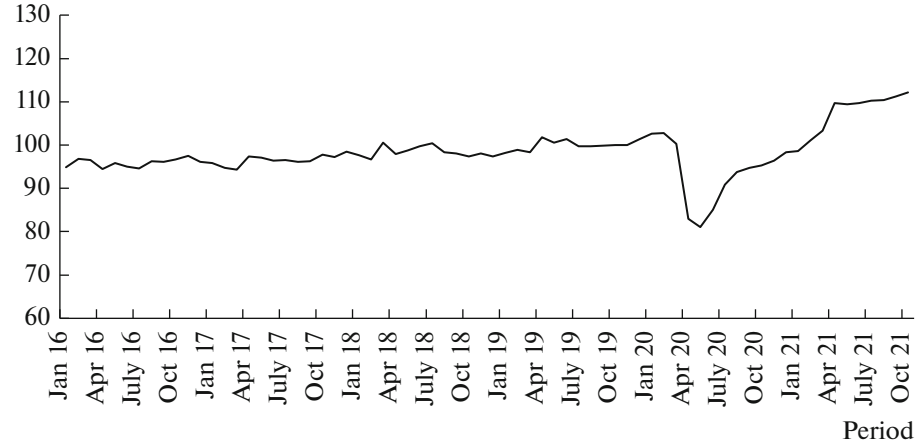

Fig. 3. Composite coincident index of the Moscow economy in January 2016–October 2021 (seasonally adjusted), the average month of 2019 = 100.
Source: authors' calculations.

state of economic activity in Moscow as a whole. Table 1 shows the components of this index and their weights.

The weights in the developed industry-wide index, using mathematical and statistical methods, are estimated in such a way that its reporting dynamics is as close as possible to changes in the GRP of Moscow in the reporting period. However, compared directly with the GRP indicator, its advantage lies in the ability to assess the state of the city's economy on a monthly basis with a time lag of just over one month after the end of the reporting period. In addition, it allows for short-term "inertial" forecasting of the level of economic activity: the forecasting horizon in the monitoring system is three months. Figure 2 presents the results of assessing the growth rates of the physical volume of the GRP of Moscow based on the constructed composite coincident index in comparison with the actual growth rates of this indicator in 2012–2019, and Fig. 3 shows directly monthly values of the composite coincident index since January 2016.

Since two of the five indicators included in the index have a higher frequency (electricity consumption and retail trade turnover according to CRE data are available on a daily basis), it is possible to obtain a preliminary assessment of the state of the economy with high efficiency. As an example, we can cite the change in the amount of electricity consumed (with the elimination of temperature and calendar factors)

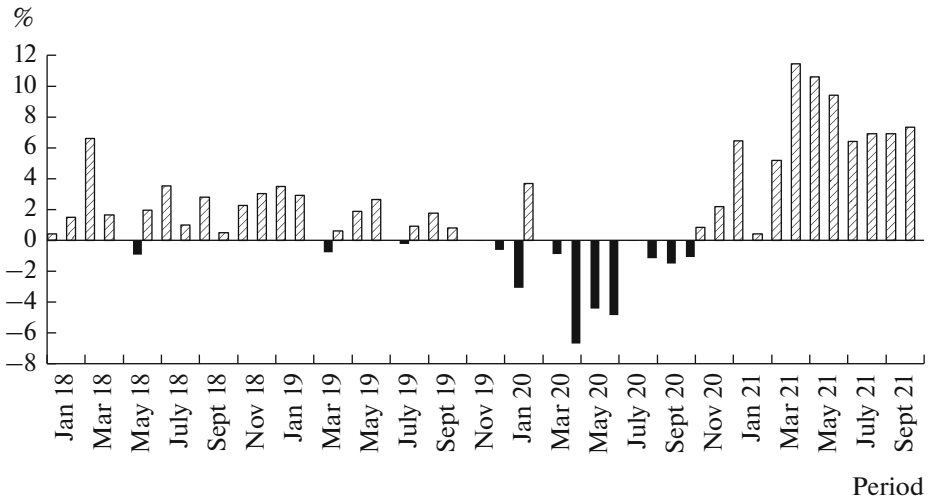

Fig. 4. Electricity consumption in the Moscow agglomeration with eliminated temperature and calendar factors, growth rates for the month compared to the same month last year.
Source: authors' calculations.

in the Moscow agglomeration (summary data for Moscow and the Moscow oblast) during the coronacrisis period. As can be seen from Fig. 4, this indicator quite accurately reflects the state of the regional economy and the impact of the epidemic situation and restrictive measures on it.

For eight key sectors of the economy of Moscow, in accordance with the monitoring scheme, sectoral indices were constructed, sets of key indicators of the activity of the sector/subsectors, lists of the largest companies in the sector in terms of various statistical indicators, and, where possible, SME statistics were formed.

The number of industries selected according to the criterion of contribution to the Moscow GRP included:

— Trade.

— Manufacturing industries.

— Construction.

— Activities in the field of information and communications.

— Mining.

— Operations with real estate.

— Financial and insurance activities.

— Professional, scientific and technical activities.

As an example, the Appendix presents sets of indicators proposed for monitoring the general state of the economy of Moscow and two sectors of the city's economy: manufacturing and trade.

Conclusions. The developed system of operational regional economic monitoring, tested in Moscow in 2020–2021, allows simultaneously solving several problems at once:

— Monthly, with a monthly lag, estimating the dynamics of the main indicator characterizing the development of the urban economy – the index of the physical volume of the GRP of Moscow, while official statistical estimates are developed only on an annual basis and are published with more than an annual lag.

— Monthly evaluating the approximate dynamics of the output of the largest sectors of the urban economy.

— Analyzing sets of the most important indicators characterizing various aspects of the functioning of both the city's economy as a whole and its individual sectors.

— Analyzing individual sectors of the urban economy, not only on the basis of aggregated industry indicators, but also data from the largest companies in the sectors under consideration.

— Analyzing the performance of small and medium-sized enterprises.

— Constructing high-frequency indicators that can characterize the dynamics of the city's economy not only on a monthly basis, but also on a weekly and even daily basis.

At the same time, the created system is flexible and allows adding, deleting and modifying the indicators and approaches to their analysis in a very short time. Such a system makes it possible to effectively use both traditional official statistical indicators and various, including high-frequency, data developed at the regional level.

APPENDIX

List of indicators included in the monitoring of the state of economic sectors in Moscow

No.	Indicator name	Period/date	Value	Growth rate to the previous year/to the beginning of the year, %
	General state of the economy of Moscow			
1	Index of the state of the economy of Moscow	2020		−4.6
2	Power consumption with eliminated temperature and calendar factors	2020	100.9 billion kWh	−1.3
3	Paid services to the population	2020	1471.1 billion rubles	−23.7
4	Industrial production index	2020		12.2
5	Income to the budget of Moscow for personal income tax	2020	1.1 trillion rubles	12.3
6	Inflation in goods and services	2020		2.9
7	Commodity inflation	2020		3.3
8	Services inflation	2020		2.3
	State of the industry "Manufacturing industries"			
1	Industry index	2020		7.4
2	Tax receipts	2020	160.3 billion rubles	16.8
3	Number of organizations paying taxes to the budget of Moscow	2020	25.9 thousand units	−5.8
4	Number of organizations paying personal income tax	2020	22.4 thousand units	−4.6
5	Number of operating legal entities (LE)	January 1, 2021	35.5 thousand units	0.1
6	Average number of employees	2020	376.2 thousand people	1.3
7	Average monthly nominal accrued wages	2020	80.2 thousand rubles	6.0
8	Shipped goods of own production	2020	5.9 trillion rubles	1.4
9	Production index for "Manufacturing industries" in the Russian Federation	2020		1.4
10	Production index for "Manufacturing industries" in Moscow	2020		16.4
11	Manufacturing producer price index	2020		−0.5
12	Share of overdue debt in total debt	January 1, 2021	6.50%	0 p.p.
13	Total debt	January 1, 2021	15498.8 billion rubles	22.2
14	Overdue debt	January 1, 2021	1067.1 billion rubles	11.6
15	Investments in fixed assets	2020	101.3 billion rubles	3.1
16	Entrepreneurial confidence index in industry (for Russian Federation)	January 1, 2021	−2 p.p.	1 p.p.
17	Energy consumption of industrial consumers	2020	4764 mllion kWh	−6.2
18	Export volume (excluding mineral products)	2020	39.8 billion dollars	31.4
19	Number of organizations with industrial sites in Moscow	Dec. 2020	3014 units	–
	State of the industry "Trade"			
1	Industry index	2020		−1.7
3	Tax receipts	2020	399.9 billion rubles	11.2
4	Number of operating LEs	January 1, 2021	198.3 thousand	0.0
5	Number of organizations paying taxes to the budget of Moscow	2020	118.3 thousand	−9.8
6	Number of organizations paying personal income tax	2020	97.3 thousand	−8.7
7	Average number of employees	2020	1006.1 thousand people	−2.3
8	Average monthly nominal accrued wages	2020	79.1 thousand rubles	4.2
9	Turnover of wholesale trade of wholesale trade organizations	2020	24.5 trillion rubles	−2.0

Table. (Contd.)

No.	Indicator name	Period/date	Value	Growth rate to the previous year/to the beginning of the year, %
10	Turnover of wholesale trade of wholesale trade organizations, excluding fuel trade	2020	18.4 trillion rubles	10.6
11	Retail business confidence index	4th qtr. 2020	–0.12	–1.7
12	Turnover of wholesale trade	2020	30.3 trillion rubles	–3.7
13	Retail turnover, according to Mosstat	2020	5.1 trillion rubles	0.0
14	Retail trade turnover, according to cash register equipment (CRE)	2020	4.9 trillion rubles	14.0
	including:			
15	food trade	2020	1.2 trillion rubles	–2.5
16	non-food trade (without vehicles)	2020	2.6 trillion rubles	20.0
17	trade in vehicles	2020	1.0 trillion rubles	24.0
18	Retail turnover of SMEs, according to CRE	2020	768.6 billion rubles	3.4
19	Online trading turnover	2020	806.9 billion rubles	48.9
20	Share of overdue debt in total debt	January 1, 2021	1.56%	0.0 p.p.
21	Total debt	January 1, 2021	14199.5 billion rubles	9.4
22	Overdue debt	January 1, 2021	222.1 billion rubles	0.0
23	Number of trade objects	Dec. 2020	86.5 thousand	–3.3
24	Shopping mall attendance	2020	255.6 thousand people/1000 m^2	–31.5
26	Registration of new cars, according to Autostat	2020	214 thousand	–12.0
27	Inventory in retail	Dec. 2020	442.9 billion rubles	0.8
28	Beverage production index	2020		37.9
29	Food production index	2020		208.7
30	Import of food products	2020	10.9 billion dollars	0.2
31	Import of textiles	2020	8.3 billion dollars	–6.7
32	Car import	2020	6.1 billion dollars	–21.7

Conflict of interest. The authors declare that they have no conflicts of interest.

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