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International Financial Institutions Ask to Contribute to Climate Protection

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ABSTRACT

The **aim** of this article is to show in which way international financial institutions (IFIs) can contribute to climate protection projects. The principles of IFIs' project cycles are explained in the context of the new blending tool. The cooperation with other donors stands in the centre of EU project funding and the notion of leveraging allows to quantify the cooperative effect among different donors. The bulk of this article describes the most relevant IFIs and national development banks with an international focus: Green Climate Fund (GCF), European Investment Bank (EIB), European Bank for Reconstruction and Development (EBRD), French Development Agency (AFD), German Development Bank (KfW), World Bank (WB), Asian Development Bank (ADB), and the Asian Infrastructure Investment Bank (AIIB). For all these IFIs, descriptions are provided and their main fields of actions identified. The procedure of application (the "project cycle") is illustrated and an overview of their strategies is given. Thus, this article seeks to provide practical guidance on how to cooperate with IFIs and to direct funds into substantially valid and responsible climate projects.

Keywords: global warming; mitigation; project funding; International Financial Organisations; IFIs; infrastructure projects; environmental quality criteria; project cycle; application procedures; blended financing

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INTRODUCTION: SETTING THE SCENE

An **evolutionary** world view is valuable when following the ideas of both Teilhard de Chardin [1] and Vladimir Vernadsky [2] (compare [3]), hence by Western and Russian authors. Within this concept, the notion of transition is a valuable tool to describe present-day structural changes [4–13].

As mentioned, the EU preferably finances sustainable projects [14–20] and had set targets to no more promote fossil-fuel projects, and this mindset is even stronger than ever after the successful start of the "European Green Deal",[1] including the "European Energy Union"[2] as a tool towards this climate protection target. In this frame, a vast number of international and European projects[3] assessed and keeps assessing the states and

[1] EU (2020). The European Green Deal. URL: https://ec.europa.eu/info/strategy/priorities-2019–2024/european-green-deal_en (accessed on 22.06.2021). EC President (2020). Political Guidelines of the next European Union Commission. URL: https://ec.europa.eu/commission/sites/beta-political/files/political-guidelines-next-commission_en.pdf. (accessed on 22.06.2021).

[2] EnU (2020), The European Energy Union with its five dimensions. URL: https://ec.europa.eu/energy/en/topics/energy-strategy/energy-union (accessed on 22.06.2021).

[3] EBRD (European Bank for Reconstruction and Development) (2014). Innovation in Transition. London.
EBRD (European Bank for Reconstruction and Development) (2018). *Transition Report 2018–19 — Work in Transition.* London.
EBRD (European Bank for Reconstruction and Development) (2019). *Transition Report 2019–20 — Better Governance, Better Economies.* London.
EC (European Commission) (2014). *East Horizon EECA Cluster — ICT Environment, Innovation Policies and International Cooperation Report.* Brussels.
EY (Ernst and Young) (2017). *The IT Industry in Belarus: 2017 and Beyond.* London.
German Agency for International Cooperation (GIZ) (2011). *Current Situation of the Diaspora-Connected FDIs in Armenia.* Yerevan: GIZ Private Sector Development Program South Caucasus.
OECD (Organization for Economic Cooperation and Development) and others (2020). *Eastern Partner Countries 2020: Assessing the Implementation of the Small Business Act for Europe.* SME Policy Index. Brussels, Paris: European Union, OECD Publishing.
UNECE (United Nations Economic Commission for Europe) (2005). *Economic Survey of Europe, No. 2.* Geneva.
UNCTAD (United Nations Conference on Trade and Development) (1998). *World Investment Report — Trends and Determinants.* New York, Geneva.

stages of economic (and thus financial) transition [21–30] in countries that decades ago still were part of a much more secluded economic sphere [31–40], and thus had thrived less, economically and financially, despite their mostly healthy base of human capital. One of the most recent and most comprehensive reports is by UNECE [41]; thus, providing a cutting-edge and neutral set of assessments and recommendations for countries with a similar structure as Russia.

In recent years, one of the strongest promoters for socio-economic evolution is **climate change (CC)**, which already caused a number of positive effects on redirecting huge financial volumes towards **sustainable projects**. The present article provides concrete information on how to tap this considerable financial potential.

Moderation among differing standpoints is here achieved by dialogue and discourse, not by advocating military strategies of "strength".

SUSTAINABLE FINANCING — THE EXAMPLE OF IFCA

Such a blending instrument can be illustrated for the Central Asian (CA) region[4]: the IFCA (Investment Facility for Central Asia) pools resources and improves coherence or coordination of donors' actions supporting partners in their work *in true partnership* towards SDGs, i.e., *sustainable development goals* — which are popularised worldwide by "Global Studies" curricula: [43]. Also, it targets cross-cutting requirements, including adaptation to and mitigation of climate change results. Establishment of IFCA in 2010 promoted investments in CA through blending.

(Remark: as evident, IFCA is not an IFI in itself, but an EU instrument to include IFIs.)

Regarding the goals of leveraging, an additional core concept is "leverage"[5] [44] echoing a strategic inquiry: what amount of marginal (i.e., additional, in the sense of economics) funding triggers what quantity of overall funds being invested? Such quotient is called the leverage factor and proud officers boast achieving leverage factors by their programmes of five to ten.

We expect these sub-effects when appropriately leveraging:

- The meaning of *financial* leverage is to mobilise private or public resources with an intention of enhancing the developmental impact while effectively using funds;
- The meaning of *non-financial* leverage is improving projects' sustainability and impacting development while enabling earlier starting projects;
- The meaning of *policy* leverage is supporting reforms towards EU policies or those of partner countries;
- The targets of *aid effectiveness* are improving cooperation among EU and non-EU actors for aid;
- The meaning of *visibility* is providing better public visibility for EU's developmental funding.

Blending constitutes opportunities for engagement towards *dialogues* between regional governments and EU regarding specific multi-governmental sector policies.

This subsection deals with EU financial institutions' procedures. For blending operations, what are procedures practically?

This "EU blending project cycle" (*Fig. 1*) encompasses seven specific stages while crucial stakeholders share responsibilities, namely the EU Delegations in beneficiary countries, DG NEAR and DG DEVCO (at Brussels HQ = Headquarters), other partner countries, regional organisations, and financial institutions.

The single stages are in detail[6]:

UNCTAD (United Nations Conference on Trade and Development) (2019). *Investment Policy Review: Armenia*. Geneva.
UNCTAD (United Nations Conference on Trade and Development) (2020). *World Investment Report 2020 — Country Fact Sheet: Transition Economies*. Geneva.
UNCTADstat (United Nations Conference on Trade and Development Statistics) (2020). International Trade in Goods and Services (database). URL: https://unctadstat.unctad.org/wds/ReportFolders/reportFolders.aspx?sCS_ChosenLang=en (accessed on 22.06.2021).
World Bank (2020a). World Development Indicators (database). URL: https://data.worldbank.org/indicator (accessed on 22.06.2021).
World Bank (2020b). WITS (World Integrated Trade Solution) (database). URL: https://wits.worldbank.org/CountryProfile/en (accessed on 22.06.2021).

[4] EuropeAid (2015), Activities in Central Asia. IFCA. URL: https://ec.europa.eu/europeaid/2015-operational-report-2015-asia-investment-facility-aif-investment-facility-central-asia-ifca-and_en (accessed on 22.06.2021).

[5] EU (2019), Innovative financial instruments (blending). Brochure and information. URL: https://ec.europa.eu/europeaid/policies/innovative-financial-instruments-blending_en (accessed on 22.06.2021).

[6] DEVCO (2015), Guidelines on EU blending operations, Volume 1 "General", Brussels & Luxembourg, DG for developmental cooperation DEVCO. URL: https://europa.eu/capacity4dev/t-and-m-series/document/guidelines-eu-blending-operations (accessed on 22.06.2021) plus 3 more special reports.

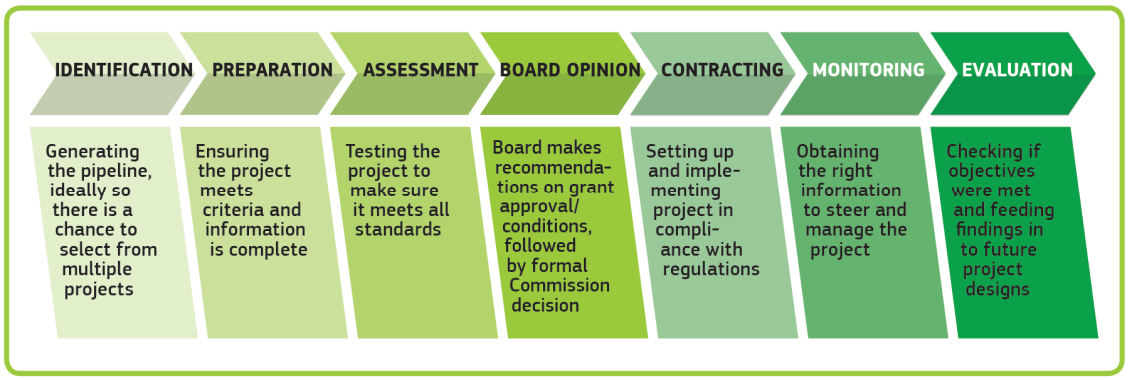

Fig. 1. **Stages of a project cycle in blending operations**

Source: DEVCO (2015), Guidelines on EU blending operations, Vol. 1 "General", Brussels & Luxembourg, DG for developmental cooperation DEVCO. URL: https://europa.eu/capacity4dev/t-and-m-series/document/guidelines-eu-blending-operations (accessed on 22.06.2021) plus 3 more special reports.

1. **Identification**: IFIs and EU Delegations identify suitable projects, jointly with partner countries or relevant regional organisations [42]. Coherence of these projects with EU's policy objectives and sector priorities is ensured by EU Delegations. Here occurs the generating of a so-called project "pipeline".

2. **Preparation**: A leading IFI (or financial institution, FI) is responsible for submitting the project proposal or IFIs, EU DGs and FIs hold trilateral consultation to secure matching criteria.

3. **Assessment**: Responsible EU's services evaluate (a) alignment with objectives of their policies, (b) justifying added value or need, (c) environmental, social and climate change aspects of a project, (d) financial structure, given political barriers & similar actions (see detailed project criteria in the annex of [45]).

4. **Board opinion**: Decisions on grant requests to EU are made in consensus by a pertinent "Blending Framework Board" (voting are: EEAS, Commission and the EU MS = Member States); and only afterwards the Commission (Com) takes a decision.

5. **Contracting**: When Com decides to proceed with a project, this allows them to formally contract and to sign a Del agreement with the FI leading.

6. **Monitoring**: Responsibility for implementing a project (procurement & tendering) and reporting/ monitoring (financially & operationally), founded on indicators mentioned, lies with the leading FI.

7. **Evaluation**: This responsibility is delegated to the FI leading.

At least two donors are required for blending: one from the EU plus at least one IFI.

THE SINGLE IFIS AND THEIR POTENTIAL CONTRIBUTIONS

THE GREEN CLIMATE FUND (GCF)

The institution of the "Green Climate Fund"[7] was established within the UNFCCC framework meant to assist developing countries for mitigating and adapting CC. Geographically, it is located in the new Songdo district of Incheon in South Korea, and governed by a Board of 24 members while initially supported by a Secretariat.

The core objective of GCF is to "support projects, programmes, policies or other activities in developing country Parties using thematic funding windows"[8] [3]. The year 2020 was a record year, in which GCF funding amounted to 4900 M€.[9] Already, disbursement of GCF financing is accelerating, as the Fund follows its major focus to implement approved projects.

During Cancun's COP-16, the matter of GCF governing was allocated to a freshly founded "Green Climate Fund Board", while **World Bank** was chosen as a temporary trustee.

[7] GCF (2017a), The Green Climate Fund. URL: http://www.greenclimate.fund/what-we-do/portfolio-dashboard (accessed on 21.05.2018).

[8] GCF (2017a), The Green Climate Fund. URL: http://www.greenclimate.fund/what-we-do/portfolio-dashboard (accessed on 21.05.2018).

[9] GCF (2017a), GCF Annual Report 2020. URL: https://www.greenclimate.fund/sites/default/files/document/gcf-annual-results-report-2020.pdf (accessed on 21.05.2018).

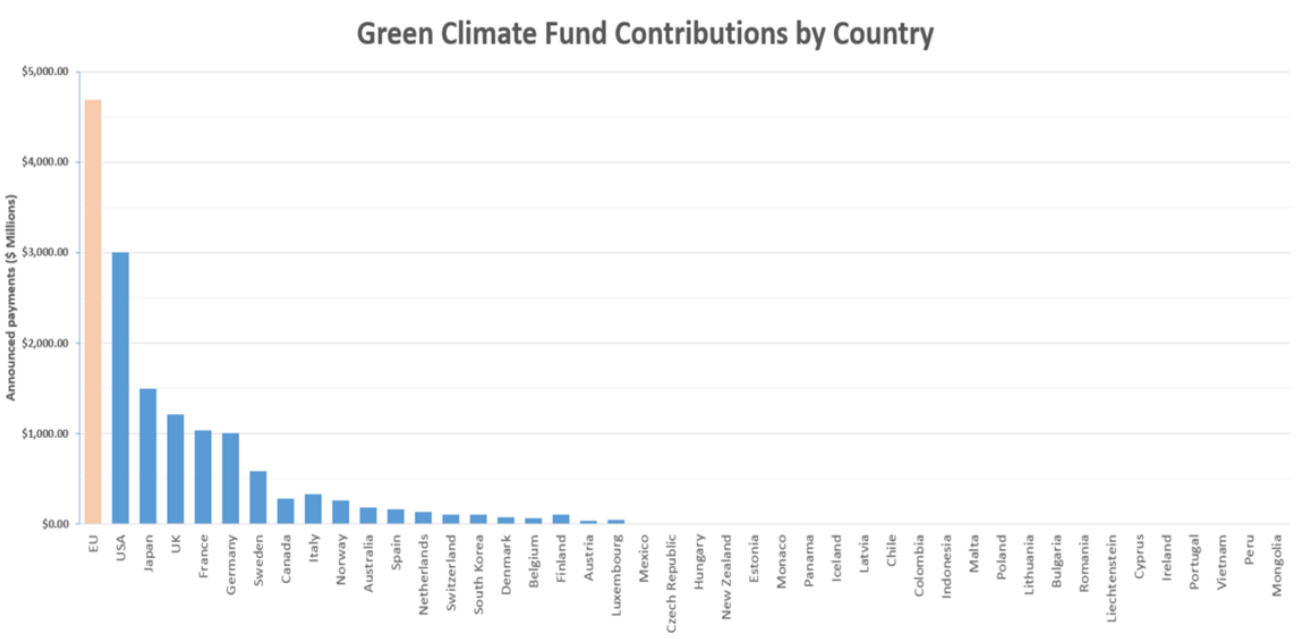

Fig. 2. **Overview over funds in the GCF pledged contributions to the GCF by country**

Source: GCF (2019), The Green Climate Fund. URL: https://en.wikipedia.org/wiki/Green_Climate_Fund#Sources_of_finance (accessed on 21.12.2019).

Advanced economies did formally agree to **mobilising jointly 100 billion $ per year** by 2020 (*Fig. 2 and*[10]) from several sources, in order to address both pressing mitigating and adapting needs for developing countries. Also, governments declared to channel a share of new multilateral funding through this newly established GCF.

Sustainable Financing and Bankable Projects

To decide if or not a project is deemed bankable depends on procedures and criteria required from each single FI or source. A good project proposal best secures financing when fulfilling all criteria. Criteria for CC adaptation projects include: providing the most benefits to a large number of people; providing effective implementation while being sustainable for long time. Such durable quality is documented by a national government's willingness or ability to carry through projects beyond the period of initial investment or finance. A recent GCF Regional Workshop focused on Central Asia and Eastern Europe in Tbilisi.[11]

GCF project cycle

GCF utilises various financial instruments such as concessional debt financing; grants; equities or guarantees. The Global Climate Fund's private sector support also assists actors in tapping finance markets. GCF's invests via grants, loans, equity or guarantees.[12]

The Global Climate Fund develops its initial strategic planning as guidance for ongoing work. One such plan was endorsed by its Board in March 2016 at its twelfth meeting,[13,14] and its 2017 plan is available here,[15] as confirmed recently.[16]

The main steps of the GCF project cycle are (*Fig. 3*): "**I.** Country, regional and/or accredited entity programmes,

[10] GCF (2017a), The Green Climate Fund. URL: http://www.greenclimate.fund/what-we-do/portfolio-dashboard (accessed on 21.05.2018).

[11] GCF (2017a), The Green Climate Fund. URL: http://www.greenclimate.fund/what-we-do/portfolio-dashboard (accessed on 21.05.2018).

[12] GCF (2017a), The Green Climate Fund. URL: http://www.greenclimate.fund/what-we-do/portfolio-dashboard (accessed on 21.05.2018).

[13] GCF (2016), The Green Climate Fund. URL: http://www.greenclimate.fund/who-we-are/about-the-fund/governance (accessed on 21.12.2019).

[14] GCF (2017b), The Green Climate Fund. URL: www.greenclimate.fund/meetings/2017/tbilisi (accessed on 21.05.2018).

[15] GCF (2017c), The Green Climate Fund. URL: https://www.greenclimate.fund/documents/20182/239759/Proposal_Approval_Process__Updated_.pdf/53357eae-1a4d-48da-99c5-e11c5ef7761c and URL: https://www.slideshare.net/Ecofys/a-nama-for-the-electrification-of-sialkot-with-pv-technology (accessed on 21.05.2018).

[16] GCF (2017d), The Green Climate Fund. URL: https://www.greenclimate.fund/boardroom/meeting/b29 (accessed on 21.05.2018).

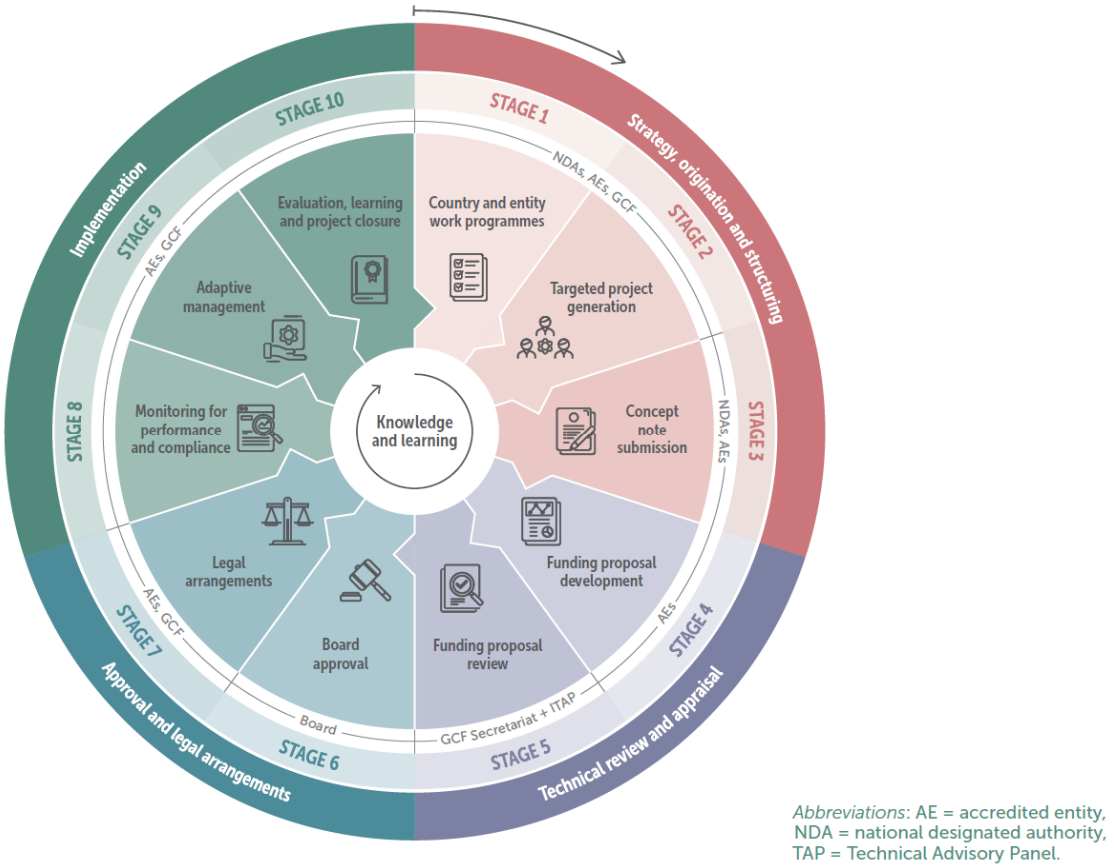

Fig. 3. **The GCF project cycle**

Source: GCF (2020), GCF Programming Manual. An introduction to the Green Climate Fund project cycle and project development tools for full-size projects. URL: https://www.greenclimate.fund/document/programming-manual (accessed on 26.10.2020).

II. Generation of programme or project funding proposals, **III.** Concept note (Voluntary), **IV.** Funding proposals, **V.** Secretariat analysis and independent technical assessment and recommendations to the Board, **VI.** Board decision, **VII.** Legal arrangements for approved proposals".[17]

THE EUROPEAN INVESTMENT BANK (EIB)

The EIB[18] "represents the interests of EU member states'" and is the EU's long-term non-profit lending banking institution as established under the Treaty of Rome in 1958. The EIB is not to be confused with the European Central Bank. The EIB (whose shareholders are the member states of the EU), as a "policy-driven bank" uses its financing operations to *enhance social cohesion and European integration*.

Mission of EIB

Often nicknamed "the Bank of the European Union", EIB's mission is to *make a difference* to the living future of Europeans and EU partners by supporting solid investments that promote goals of EU policies. Especially, EIB strongly supports the SME sector.

Although some 90% of EIB-financed projects are geographically located in EU member states, the bank funds projects in over 150 other countries such as non-EU South-Eastern European countries, Mediterranean partner countries, ACP group countries, countries in Asia and Latin America, Eastern Partnership countries and Russia.[19] EIB works in these countries in order to implement the

[17] GCF (2017a), The Green Climate Fund. URL: http://www.greenclimate.fund/what-we-do/portfolio-dashboard (accessed on 21.05.2018).

[18] EIB (2017a). The European Investment Bank. URL: http://www.eib.org/about/index.htm and related sub-pages (accessed on 21.03.2020).

[19] EIB (2017b), The European Investment Bank's Central Asian Engagements. URL: http://www.eib.org/projects/regions/central-asia/index.htm (accessed on 21.03.2020).

Fig. 4. **Structure of the EIB project cycle**

Source: EIB (2018), The European Investment Bank's Project Cycle. URL: http://www.eib.org/projects/cycle/index.htm (accessed on 21.03.2020).

financial pillar of the EU policies on external cooperation and development by encouraging development of the private sector, security of energy supply, development of infrastructure and a sustainable environment.

Outside the EU, EIB's lending strategy follows priority objectives for its lending activities:

- Development of private sector.
- Development of financial sector.
- Development of infrastructure.
- Energy supply security.
- Environmental sustainability.
- EU presence.

How the EIB acts

- **Lending**: A wide majority in its financing works through loans, while EIB also offers microfinance, equity investment, guarantees, etc.
- **Blending**: European Investment Bank support unlocks financing from other sources, particularly from the EU budget. This is blended with loans to form a full financing package.
- **Advising**: Often, lack of finance is not the key barrier to investment, as described above. Thus, EIB helps with project and administrative management capacity to facilitate investment.

The **EIB Project cycle** includes: Application for a loan; Appraising; Deciding; Procuring; Monitoring; Repaying (*Fig. 4*).

THE EUROPEAN BANK FOR RECONSTRUCTION AND DEVELOPMENT (EBRD)

The EBRD (European Bank for Reconstruction and Development), founded in April 1991, headquartered in London, represents a multilateral developmental investment bank and an IFI. it uses investments as a strategic tool to build market economies. While EBRD initially focused on the former Eastern Bloc, it meanwhile expanded to support development in over 30 countries from CE (Central Europe) to CA (Central Asia). EBRD member countries come from Europe, and five more continents (na, af, as, au, [3, p. 334]), whereof the US are the biggest single shareholder. Formally, the 65 countries and 2 EU institutions own the EBRD. While its shareholders represent the public sector, EBRD mainly invests into private enterprises, and does so jointly with commercial partners.

As the largest single donor to the EBRD, the European Union, accounts for over a third within total EBRD grants since its foundation. In 2016, EBRD received contributions of over 289 M€ from the EU, which represents 2/3 of entire donor funding delivered for the EBRD's projects.

In a nutshell: EU & EBRD

- EU = EBRD's single largest donor.
- This amounts to over 1,990 M€ of all donors' contribution.
- Meaning 378 M€: contributions in 2019 for EBRD projects.
- As the largest single donor to the EBRD, the EU has accounted for about 40 per cent of total donor funds channelled through the EBRD since the Bank's inception.[20]
- 3% share in capital.

[20] EBRD (2021) EU: EBRD shareholder profile. URL: https://www.ebrd.com/who-we-are/structure-and-management/shareholders/european-union.html (accessed on 21.03.2021).

EBRD focuses on Environment

The EBRD considers itself the first developmental multilateral bank to have explicitly required by mandate ensuring of environmentally sound sustainable development. As follows, EBRD describes itself:

- EBRD applying strict social and environmental standards for all its financed projects. Such is regulated by its "Environmental and Social Policy and Performance Requirements".[21]
- EBRD acts as one of the largest investors for environmentally focussed projects for its operating countries, including 12,200 M€ in climate change, EE and resource financing under EBRD's approach abbreviated "GET" (**Green Economic Transition**). This GET approach contains projects summed up under two earlier initiatives, namely the "Sustainable Resource Initiative" plus the "Sustainable Energy Initiative".

EBRD rolled out and officially adopted its GET approach already in 2016.

Financing procedure for EBRD projects

From initiation to repayment, the total lifecycle of an EBRD project could vary from 1 year (e.g., for trade financing or working capital projects) to 15 years (e.g., for sovereign long-term infrastructural projects). An EBRD procedural cycle as described[22] contains the following principal stages (*Fig. 5* shows identical key steps):

Concepts' review: The OpsCom (Operations Committee) of EBRD, consisting of senior mgt. from banking, Chief Economist's Office, General Counsel's Office, Finance, and Evaluation & Operational & Environmental Support) approve a project's concepts and its entire structure, containing financing structures proposed plus supportive obligations. A mandate letter is signed at this stage by the EBRD and the client; it is to outline project plan plus expenses or responsibilities for its development.

Final reviews: After the basics of a business deal has been negotiated (incl. a term sheet signed) and every investigation has been substantially finished, a project receives their final reviews by the OpsCom.

Board reviews: Presidents of EBRD & EBRD's operations teams present this project for approval to their Board of Directors.

Signing: Client and EBRD sign this deal and thus it is binding legally.

Disbursement: After the conditions for repayment are agreed upon and EBRD's conditions are met, these funds are transferred to client's account from EBRD's account.

Repayment: Under an agreed schedule, client will repay to EBRD the amount of loan.

Sale of equity: On a non-recourse basis, EBRD sells its equity investments.

Final maturity: The amount of final loan is due for being repaid to EBRD.

Completion: The full loan is entirely repaid or EBRD's equity investment is divested.

THE FRENCH DEVELOPMENT AGENCY (AFD)

The "French Development Agency" (*Agence française de développement* AFD) is France's public national FI, "contributing to implementation of state *ODA policy* abroad" and working for fighting poverty and promoting sustainable development.

A Common World: The AFD adopted such a new slogan for inspiring all its teams. To build both a more sustainable and fairer world that leaves no one behind — a "world in common" — is seen to imply five key transitions, in both France and target countries, regarding energy, social, digital, territorial or civic spheres. Achievement of SDGs depends on mastering such structural shifts [47, 48] and transitions.

Priority fields: In these areas, AFD works for the above targets: FI and supporting the private sector (the vast majority); Agriculture & food security; Biodiversity; also minor fields within Climate; Water; Local communities and urban development; Sustainable energy; Education and training; Transportation; and Health. In general, its projects refer to Sustainable consumption and production, Climate, Employment and shared prosperity, Water and sanitation, Forests and biodiversity, Hunger and food, Inequality, Infrastructures, Peace and justice, Oceans, Health, Global partnerships, Sustainable cities, Education, Poverty, Energy, and Gender equality.

[21] EBRD (2017a), The European Bank for Reconstruction and Development. Environmental project criteria. URL: http://www.ebrd.com/who-we-are/history-of-the-ebrd.html, http://www.ebrd.com/news/publications/institutional-documents/basic-documents-of-the-ebrd.html, http://www.ebrd.com/news/2016/ebrd-investment-in-central-asia-reaches-record-14-billion-in-2015.html (accessed on 21.03.2021).

[22] EBRD (2017b), The European Bank for Reconstruction and Development. URL: http://www.ebrd.com/work-with-us/project-finance/funding-process.html%20 (accessed on 21.03.2020).

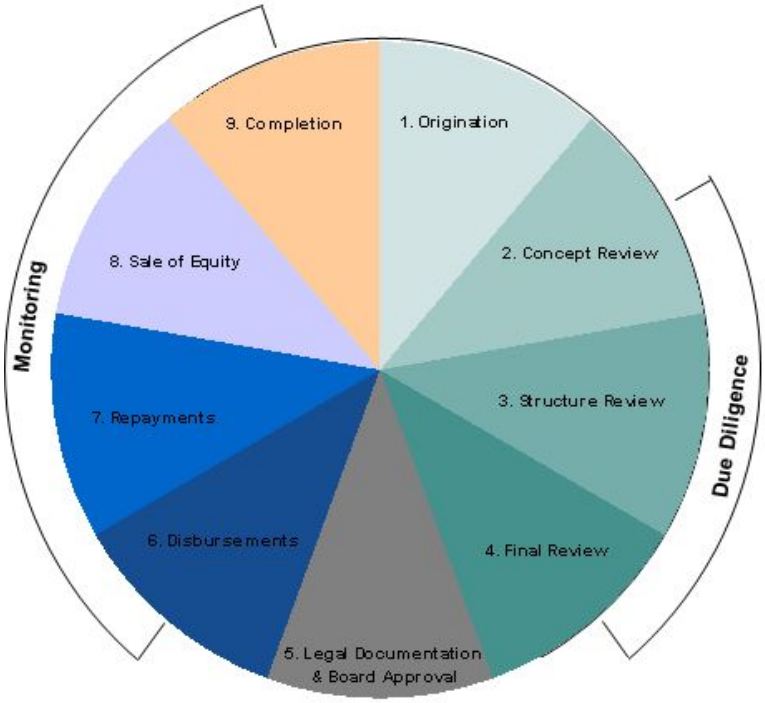

Fig. 5. **The EBRD project cycle**

Source: EBRD (2016), The European Bank for Reconstruction and Development. URL: http://www.ebrd.com/work-with-us/project-finance/funding-process.html%20 or https://www.slideshare.net/CentralEuropeanInitiative/ebrd-presentation-october-2015-innovation-bootcamp-1 (accessed on 21.03.2020).

With 14.1 billion euros committed in 2019, AFD Group (with its subsidiary Proparco and in connection with the French technical cooperation agency Expertise France) finances and supports development projects in 115 countries, while 815M€ come from financial resources allocated by the state, 706 M€ are delegated resources (of which 506€ come from the EU), and more than three quarters, namely 6400 M€ are borrowed from markets.[23]

Within France, main ODA stakeholders are the French Ministries for Europe, for Foreign Affairs, Education and Research, and Economy, as well as French public actors like CIRAD or IRD.[24]

The motto of its **project cycle** (*Fig. 6*): *Report, inform, dialogue.*[25]

THE GERMAN DEVELOPMENT BANK (KFW)

The German "Kreditanstalt für Wiederaufbau" (Reconstruction Credit Institute) located in Frankfurt/Main represents German government-owned developmental banks and is owned by the Federal Republic of Germany (80%) plus its Federal States (20%). After WWII in 1948, the Marshall Plan formed this institution. KfW meanwhile covers > 90% from the capital markets what it needs for borrowing; and this allows KfW advantageous funds raising conditions.

The KfW is promoting social and economic progress in emerging or developing countries in order towards improved lives for people. KfW Group defines their task as to provide advice or support for reformatory procedures or in investing for emerging or developing states. Thus, KfW defines the following targets:

- Improving social or economic conditions sustainably.
- Reduce impoverishment.
- Protect climate and environment.
- Promoting the financial sector.

KfW's partners can be both (non-)governmental institutions or governments, including multilateral or bilateral donors.

KfW's priority areas

KfW Development Bank (KfW Entwicklungsbank, in German) supports many developing areas worldwide by

[23] AFD (2020).

[24] AFD (2018). Agence Française de Développement. URL: https://www.afd.fr/en/development-aid-whats-it-all-about (accessed on 21.03.2020).

[25] AFD (2015), Agence Française de Développement. URL: https://issuu.com/objectif-developpement/docs/csr_gri_report_2015_afd_group (accessed on 21.03.2020).

Beneficiaries of financing States, companies, local authorities, NGOs	Agence Française de Développement contributes to financing projects
1 – Project idea Submitted to AFD for financing	**2 – Analysis of proposals** Especially of the project's objectives and conformity with AFD's priorities for operations in the country in question
3 – Feasibility study Generally entrusted to external consulting firms	**4 – Analysis of feasibility studies and financing requests** Analysis of the economic, social and environment effects of projects, their compliance with France's aid policy, the financing plans, corruption, environmental, social, economic risks…
5 – Negotiation on the financing terms	
6 – Financing requests sent to AFD Agreement on project content and financing terms	**7 – AFD makes decision on the financing**
8 – Signing of loan or grant agreements	
9 – Physical implementation of projects Selection of companies in accordance with local law and in compliance with AFD's procurement principles (competitive bidding in particular)	**9 – Disbursements of financing** Control of compliance with the clauses set out in the agreement. Vigilance over the risks of money laundering, terrorist financing and corruption. Technical and financial monitoring of the project.
10 – Repayment to AFD in the case of loans	
***Ex post* evaluation of the project** Evaluation of the achievements, their viability and their economic, social and environmental impact. 30 project evaluations	

Fig. 6. **The AFD project cycle for group financing**

Source: AFD (2015), Agence Française de Développement, p. 21. URL: https://issuu.com/objectif-developpement/docs/csr_gri_report_2015_afd_group (accessed on 21.03.2020).

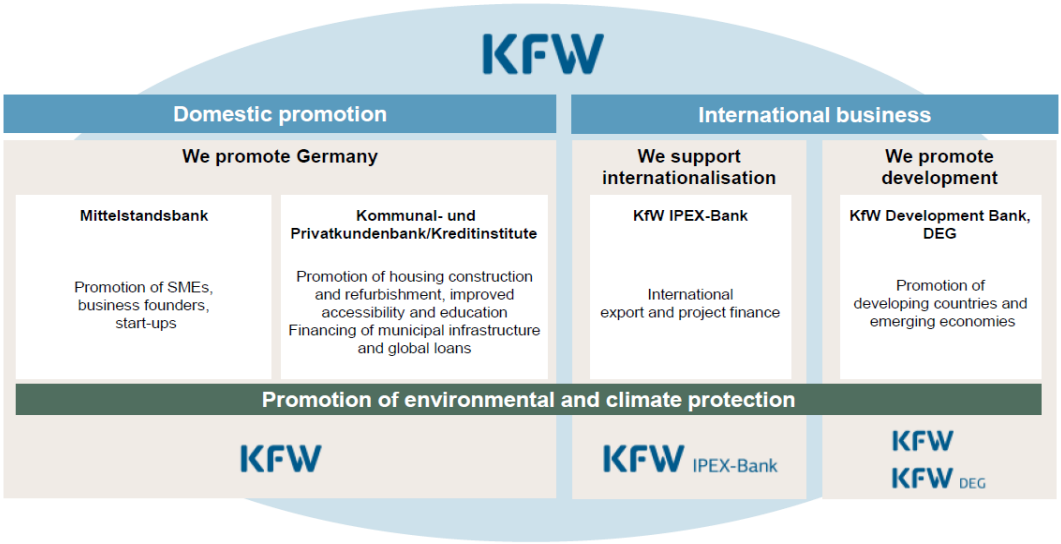

Fig. 7. **KfW's internal structure; it was also called KfW Group or KfW Bankengruppe**

Source: KfW (2018), Kreditanstalt für Wiederaufbau. URL: https://www.kfw.de/KfW-Group/About-KfW/Auftrag/Entwicklungsfinanzierung/ (accessed on 21.03.2020).

promoting economies, reducing poverty and providing population with education, health care and a future. Meanwhile, KfW did turn into one of the globally biggest developmental banks. DEG, as a KfW subsidiary, is financing companies investing and creating jobs for developing regions. KfW's preferred activity areas comprise **economic development and poverty decrease, education, health care, good governance, plus protection of the environment and the climate**. Thus, the bank supports the Federal Government of Germany to achieve its political development targets.

KfW's project cycle

KfW's **preparatory phase** means *analysing and conceiving,* while in line with updated countries' strategies by the responsible German Federal Ministry of Economic Development and Cooperation (BMZ). Undertaking *on-site audit* analyses on-site conditions.

KfW's **executing phase** comprises a *financial agreement* and the executing on a technical level, if a partner country's ownership is to be reinforced, for example by local agencies performing the project, in responsibility for all actions.

KfW's **inspecting phase** means *final* KfW *inspecting* (i.e., checks if a population does accept the offered services), *ex-post evaluating* performed by the independent KfW administrative departments and finally *transparently informing* via KfW's transparency portal,[26] including informing about the origin, impact and use of provided funds.

KfW generally searches intergovernmental agreements for projects. It is checked by KfW if projects proposed are both realisable and developmentally sound (for criteria see the annex of 45). Specialised consulting firms work jointly with partners and feasibility studies are drawn up, thus providing answers to all key questions in a project, such as developmental impacts, economic efficiency,[27] and possible risks.

KfW developmental projects were evaluated to have been successful to a level higher than 80%.[28]

THE WORLD BANK (WB)

As an IFI, the World Bank (WB) is providing loans to the world's countries for capital programs. WB contains two institutions: IBRD, the "International Bank for Reconstruction and Development", and IDA, the "International Development Association", and itself is a component of WBG, the World Bank Group.

WB officially states its aim to be **poverty reduction** and **promotion of shared prosperity**. WB's Article I of Agreement defines as one of its aims (a) encouraging to develop productive resources and facilities in less developed countries; (b) providing own capital or promoting foreign investment and (c) promoting international trade's growth balanced in the long run of.

Countries' Strategic Documents

WBG's "**Country Partnership Framework**" (CPF) targets making WB's country-oriented model ever better systematically selective, based on evidence, and focused on the WB's double aims: increasing shared prosperity in a **sustainable** manner and ending extreme **poverty**. CPF is replacing the earlier Country Assistance Strategies (CAS), and jointly used with WB's Systematic Country Diagnostics (SCD), the CPF directs WBG's support to member countries.

Each new CPF is informed by a **Systematic Country Diagnostic** (SCD). A target of the SCD is identifying the most relevant opportunities and challenges faced by a country in advancing towards the twin goals. A thorough analysis provided this, and consultations inform a wide range of stakeholders.

WB's Project Criteria

The **Sustainable Development Goals (SDGs)** and the eight Millennium Development Goals (MDG) targets are valid for 2000–2015 (MDGs, see the list below) or 2016–2030 (SDGs). To realise MDG goals, **six criteria** must be met: more effort in **health and education**, stronger and **growing more inclusively** in fragile states, more as well as **better aid**, integration of the **development and environment** agendas, improvements in trade negotiations, plus more **focused** and stronger support from multilateral institutions such as WB.

1. Eradicating Hunger and Extreme Poverty.
2. Ensuring Environmental Sustainability.
3. Promoting Gender Equality.
4. Achieving Universal Primary Education.
5. Child Mortality Reduction.
6. Maternal Health Improvements.
7. Combatting AIDS/HIV, Malaria, or Other Diseases.
8. Developing a Global Developmental Partnership.

To ensure that WB-financed operations would not counteract these aims but rather add on to realising them, a so-called **Environmental and Social Framework** (**ESF**) was defined in 2016.

The WB and climate change: WB doubled its support on CC adaptation amounting to 2,300 M$ in 2011 to 4,600 M$ in 2012 plus a **Climate Change Action Plan** was produced. As we know, our planet now is more than +0.8 °C warmer as compared to the pre-industrial epoch; and its warming could reach +2 °C within 2 to 3 decades.

The World Bank project cycle: how does it function?

Given that there is no unequivocal vocabulary and definition, the 6 key phases in any WB project cycle comprise to: *identify; prepare; appraise; negotiate & present to the board; implement & supervise; evaluate* (*Fig. 8*). While many project suggestions do not even pass an early identification phase, others undergo

[26] KfW-T (2018), KfW's transparency portal. URL: http://transparenz.kfw-entwicklungsbank.de (accessed on 21.03.2020).

[27] KfW (2019), Kreditanstalt für Wiederaufbau. URL: https://www.kfw-entwicklungsbank.de/International-financing/KfW-Development-Bank/Tasks-and-goals/Unsere-Arbeitsweise/ (accessed on 21.03.2020).

[28] KfW (2020), Kreditanstalt für Wiederaufbau. URL: https://www.kfw.de/microsites/Microsite/transparenz.kfw.de/en/wirkungen/ (accessed on 21.03.2020).

Fig. 8. **The WB's project cycle**

Source: WB (2017), The World Bank. URL: http://treasury.worldbank.org/cmd/htm/GreenProjectCycle.html (accessed on 21.03.2020).

improvements during preparing or appraising phases which makes them look very differently as compared to original design. Over 200 projects are approved by WB in the course of a typical year.[29]

1. **Identification**: To identify and propose a project for WB financing is a task for governments borrowing. During this early phase, questions are answered by planners: Who is intended to benefit from this project? Could the same objective be achieved by other options? Will the project's benefits be greater than the costs? A project must also successfully pass a test against WB priorities.

2. **Preparation**: Even if the WB might help often, a borrowing country always carries the responsibility to examine all aspects of their project: technical, social, environmental, and economic ones. It has to define and analyse existing and available options to this project, all their degrees of feasibility including their benefits and costs.

3. **Appraising**: A dedicated assessment of the project, now independently undertaken by WB, is named appraisal. Over 150 appraisal missions on-site, each during 3–4 weeks, are performed annually performed by consultants and WB staff envisaging technical, economic, financial or institutional questions.

4. **Negotiating and Presenting to Board**: A WB appraisal report summarises recommendations on how the loan's conditions form a basis to negotiate with the borrower. Negotiations involve the borrower and WB staff in for an agreement on necessary measures for the final success of the project. At this point in time, the WB Board of Directors is presented with the project.

5. **Implementing and Supervising**: Around 10 WB weeks of staff annually will be used to supervise each

[29] WB (2016), The World Bank. Taking Kazakhstan as example for an achieved iterative process. URL: http://documents.worldbank.org/curated/en/576651477533678239/Kazakhstan-Performance-and-learning-review-of-the-country-partnership-strategy-for-the-period-FY 12–17.

single project; also visiting the project site identifies problems and supports finding solutions.

6. **Evaluating**: OED, the Operations Evaluation Department within the World Bank, carries responsibility as an independent department for the ultimate assessment of project results in an impartial manner.

ADB, THE ASIAN DEVELOPMENT BANK

The Asian Development Bank ADB is an FI and in 1966 established as a regional development bank, having headquarters in Mandaluyong, Metro Manila, Philippines, more precisely located in the Ortigas Centre. Around the world, ADB additionally maintained over 30 field offices for promotion of economic and social development within the Asia and the Pacific regions. In spite of the many successes in this region, a large share of the world's poor lives there: over 300 million still dispose of less than $ 1.90 daily and an astonishing 1.2 billion earn less than $ 3.10 daily.

ADB's Focus Areas

These include:

- Infrastructure at large, including energy, water supply, water sanitation, transport, urban development, communications.
- CC, Environment, DRM (Disaster Risk Management). For 2008–2020, ADB's long-term strategic framework defines environmental sustainability as a prerequisite to poverty reduction and economic growth in the Pacific and Asia.
- Regional Integration and Cooperation (RCI): by this process, economies and states turn more regionally interconnected, poverty-reduced, and with less economic disparity, accelerate economic growth, strengthen institutions in Asia, and raise productivity and employment. With the Wecoop2 [46] project's regional approach and encouragement [14], RCI matches strategically well.
- Developing the Finance Sector. This means that a finance system is an economic lifeline to a country.
- Lending to the private sector.

ADB's Co-financing

ADB's private sector operations (considered apart from its own funds) generated also a record-high of 5,840 M$ of co-financing — thus increasing by 1,200 M$ from 2015 — also including 238 M$ of co-financing to officially support operations by non-sovereign actors.

The CPS (country partnership strategy) represents the primary ADB platform used when designing operations for delivering developmental results on a country level. ADB works to map out a developmental strategy (medium-term) plus a 3-year business plan for country operations (COBP) for its implementation in each developing member country.

The ADB project cycle: How does it work?

Financing is provided for such projects that effectively will contribute to further social and economic development in the given country and will have a highly strong poverty alleviation impact while conforming to the ADB and country strategies. *Fig. 9* shows ADB's project cycle.

1. **Countries' Partnership Strategies**: For each member country developing, ADB works by defining a development strategy (medium-term) and an operating program named CPS (country partnership strategy), aligned with this country's poverty reduction goals and development plan, and prepared coherently with a DMC planning cycle.
2. **Projects' Preparation and Identification**: Often, ADB provided a grant entitled project or program preparatory TA technical assistance (technical assistance) to help for identification and preparation by government of a feasible project, which could include initial social & poverty analysis or a TA report. While examining the project, ADB examines project feasibility in a fact-finding mission.
3. **Approving**: consists of the sub-phases: (i) **Loan Negotiation**: submission of draft loan agreements or project proposals; (ii) **Board's Approval**: approval by ADB's Directors' Board through the Recommendation and Report of the President; (iii) **Signing the Loan**: signing by cabinets of the borrowing countries' Governments and ADB President; (iv) **Loan Effectiveness**: After conditions (cross-effectiveness of co-financing, legal requirements, and other agreements) are met, the loan takes effect.
4. **Implementation**: Implementation by an executive agency (usually 2–5 years), then recruitment of project consultants to assist the Government, as needed.
5. **Evaluation after Completion**: When the TA activities and project facilities are completed, ADB

Fig. 9. **The ADB project cycle**

Source: ADB (2017), Asian Development Bank. URL: https://www.adb.org/site/disclosure/public-communications-policy/cycle; https://www.adb.org/sites/default/files/page/82563/project-cycle.pdf (accessed on 21.03.2020).

prepares a project completion report to document the overall experience.

AIIB, THE ASIAN INFRASTRUCTURE INVESTMENT BANK

As a new multilateral FI, AIIB was founded with the declared intention of bringing countries together across Asia for addressing daunting infrastructure necessities. By enhancing economic development and interconnectivity in this region through advancements within infrastructural or other productive sectors, the Asian Infrastructure Investment Bank seeks to improve access to basic services and to help stimulate growth.

AIIB sets out to offer (non-)sovereign finance for sustainable and sound projects in power and energy, rural infrastructure and agriculture development, transportation and telecommunications, environmental protection, water supply and water sanitation, and urban development & logistics.

AIIB started to operate on 25 December 2015 the foundational agreement entered into force, having its headquarters in China's capital Beijing. AIIB was proposed as China's governmental initiative and has 56 member states as of 2017 (*Fig. 10*), plus another 24 prospective members. Its capital has a value of 100,000 M$, thus equivalent to two thirds of ADB's capital and about half that of WB.

Following AIIB's AOA (Articles of Agreement), it will "provide or facilitate financing for any member, agency, instrumentality or political subdivision thereof, or any entity or enterprise operating in the territory of a member, as well as to international or regional agencies or entities concerned with the economic development of the Asia region".[30]

Goals and Priorities

The creation of the AIIB shows the greater economic level of Emerging Markets in China and in general — AIIB might act as a game-changer.

Priority Themes

In its 1st operating year, both stakeholder engagements and client demand were validating AIIB's original rationale of creation, emphasising 3 particularly relevant

[30] AIIB (2017), Asian Infrastructure Investment Bank. URL: https://www.aiib.org/en/projects/process/index.html.

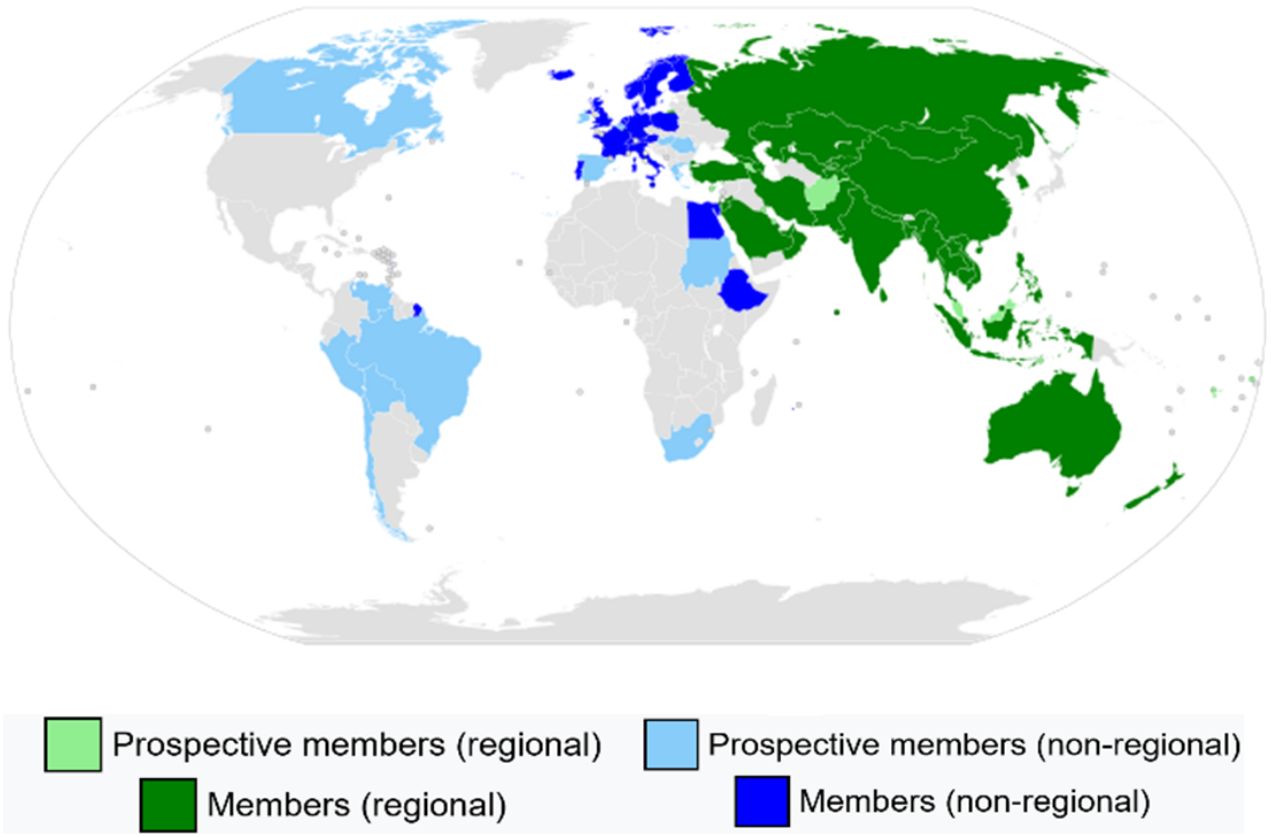

Fig. 10. **Member states of AIIB**

Source: AIIB (2017), Asian Infrastructure Investment Bank. URL: https://www.aiib.org/en/projects/process/index.html (accessed on 21.03.2020).

areas, now evolving into AIIB's thematically emerging priorities:

- Infrastructure Sustainability: to support countries in meeting their developmental and environmental goals as well as promoting green infrastructure.
- Cross-country Connectivity: across Central Asia, prioritising transnational infrastructure, namely energy pipelines and telecoms, roads and rail, ports, and reopening marine routes in South and South East Asia, the Middle East and beyond.
- Mobilising Private Capital: with other MDBs in partnership, private financers, governments, and other partners devise innovative solutions that catalyse private capital.

Sector Strategies

AIIB's Asia Strategy for Sustainable Energy establishes a new framework for energy projects investments that will increase access for safe, reliable and clean electric energy to millions across Asia. For such strategy implementation, AIIB supports members when they perform their obligations as defined in the Paris Agreement, namely "holding an increasing average global temperature to well below 2 °C (beyond pre-industrial levels) and pursuing efforts for limiting this increasing temperature to 1.5 °C". AIIB plans to achieve such aim and aligns support with national energy investment plans of their members, and also their NDCs (Nationally Determined Contributions).

Project cycle

This bank's project process (*Fig. 11*) is guided by AIIB's thematic priorities and strategic goals: sustainable infrastructure, private capital mobilization and cross-country connectivity. First, AIIB analyses ideas for projects and proposals from its partners, clients and other stakeholders, and then seeks to attain appropriately balancing between sectors, borrowers and (non-) sovereign projects. Subsequently, those projects meeting all preliminary screening criteria will be included in a rolling investment program.

Fig. 11. **AIIB's principal project cycle**

Source: AIIB (2017), Asian Infrastructure Investment Bank. URL: https://www.aiib.org/en/projects/process/index.html (accessed on 21.03.2020).

RECOMMENDATIONS AND CONCLUSIONS

This article's target is twofold: (1) it shows in which way international financial institutions (IFIs) can contribute to climate protection projects and (2) how the method for application and implementation (= the so-called project cycle) works for the most relevant IFIs. Moreover, EU's IFCA (Investment Facility for Central Asia) was laid out as a case study for the generally used "blending" tool.

All mentioned IFIs, namely the entirety of

- GCF (Green Climate Fund),
- EIB (European Investment Bank),
- EBRD (European Bank for Reconstruction and Development),
- AFD (French Development Agency),
- KfW (German Development Bank),
- WB (World Bank),
- ADB (Asian Development Bank), and
- AIIB (Asian Infrastructure Investment Bank)

established social and environmental project criteria by which efficiency and suitability of submitted projects are evaluated.

Thus, this article provides introductory practical guidance on how to cooperate with IFIs for responsible climate protection projects.

Moreover, this article answers the question posed in the title, namely *how IFIs' procedures can contribute to climate protection*:

1. Already at present, IFIs require a dense set of environmental and social project criteria.

2. Driven by the increasing need for blended financing, however, these environmental and social project criteria should be harmonised among IFIs in order to (i) facilitate proposal submission for involving several IFIs and (ii) establish a planet-wide and consistent regulatory body of interlinked criteria.

3. By redirecting their financial volumes into climate-compatible projects (as discussed on these pages), IFIs re-shape the framework of action among the industry of infrastructure projects: success means to obey criteria of climate compatibility.

4. The effect of such redirection of global project financing towards climate protection will support recently declared EU policy supporting the needed "Green Deal", as proclaimed by the new Presidency of the European Commission.[31]

Therefore, this article spans from IFIs' rationales to the rational of climate protection, while keeping a viewpoint of *societal learning*. Thus, the question formulated in the title is answered.

[31] EU (2019), Innovative Financial Instruments (blending). Brochure and information. URL: https://ec.europa.eu/europeaid/policies/innovative-financial-instruments-blending_en.

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Financing the Implementation of National and Regional Projects: Problems and Sustainable Development Directions

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ABSTRACT

Regional projects and programs are intended to become the main mechanism for achieving national development goals in territorial entities. The **aim** of the article is to analyze the problems of project implementation and program approaches at the level of the constituent entities of the Russian Federation, as well as to develop proposals for their development. The **methodological basis** of the study is the regulatory legal acts of the federal and regional levels, scientific (foreign and domestic) literature in the field of economics and public finance, official statistical information, empirical data regarding the results and progress of the implementation of regional projects and state programs of the constituent entities of the Russian Federation. The author uses the method of system analysis. The article analyzes the conceptual foundations of project management in the public sector, foreign and domestic research on this issue, examples of program implementation abroad, establishes the role of regional projects and state programs in the budget system of the Russian Federation, their relationship, identifies the main problems of their financing, considers examples of direct implementation of projects and programs, and suggests directions for their development. In the course of the study, the distortion of the initially inherent meanings of the implementation of the project approach is proved, first of all, in determining the goal setting, providing sufficient mechanisms for its achievement and financing. It is established that the state programs at present actually represent documents of planning of budget appropriations in implicit interrelation with the main directions of activity of authorities. It is **concluded** that it is necessary to clarify the current project and program methodology, which will allow the regions not only to engage in the implementation of federal projects but also to initiate them according to the priorities of socio-economic policy and the characteristics of the region. The author also proposes to develop regional projects as financial institutions. For this, it is necessary to clarify the budget legislation to ensure the possibility of actual planning of expenditure obligations within the framework of the design of projects. The prospects for further research are to develop a model for evaluating the effectiveness of the design and implementation of regional projects and state programs, and its further testing on specific programs of the constituent entities of the Russian Federation.

Keywords: national projects; regional projects; state programs; finance; financing

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INTRODUCTION

At present, national projects occupy a central position among the priorities of the state's social and economic policy. As part of an expanded meeting of the Presidium of the State Council on September 28, 2020, Russian President V.V. Putin noted,[1] that the successful achievement of national goals, improving the quality of life of people is a key benchmark for assessing the effectiveness of both the Russian government and regional management teams. The national development goals for the period up to 2030 are defined by Decree No. 474,[2] according to which, annually, when drafting the federal budget, allocations are made on a priority basis for the implementation of national projects. At the same time, the main instrument of financial and budgetary

[1] Expanded meeting of the Presidium of the State Council of the Russian Federation on September 28, 2020. URL: http://kremlin.ru (accessed on 23.03.2021).

[2] Decree of the President of the Russian Federation of July 21, 2020, No. 474 "On the national development goals of the Russian Federation for the period up to 2030."

policy is the state programs of the Russian Federation and the constituent entities of the Russian Federation, designed to ensure the relationship between the priority goals of social and economic development and budgetary funds expenditures.

Currently, federal projects are being finalized in accordance with the national goals, updated in 2020, after which regional projects will be clarified that ensure the achievement of national goals in the constituent entities of the Russian Federation. It is at the regional level that the activities of national projects are directly implemented, tangible for citizens and the business community.

Studies on this topic are not widely represented in the scientific literature: some studies either do not fully cover the financial aspect, or do not take into account regional experience, or were prepared long before the start of the implementation of national projects in their modern form, or focused on the sectoral aspect of the implementation of a particular program (project) without considering the methodology of the program and project management as a whole.

In this regard, the analysis of the experience of implementing and financing regional projects and national programs accumulated in Russia in 2018–2020 is a relevant and timely area of scientific research. The purpose of this article is to analyze the problems of applying the project approach to the implementation and financing of priority areas of social and economic development at the level of the constituent entities of the Russian Federation, as well as to develop proposals for its development. Research objectives on the way to achieving this goal are:

1) considering the conceptual framework of the project approach in public administration, considering specific features of the latter;

2) defining the role of regional projects and programs in the modern system of strategic planning and the financial system of the Russian Federation;

3) establishing the relationship between regional projects and state programs of the constituent entities of the Russian Federation, which are similar in nature and goals to financial organizations;

4) analyzing the main problems of financing regional projects and state programs;

5) developing proposals for the development of design and program approaches in the socio-economic and budgetary policy of the regions.

The target of research is regional projects and programs. The subject of the research is methodological approaches to financing projects and programs at the regional level. The sources of the research data were regulatory legal acts of the federal and regional levels, scientific (foreign and domestic) literature in the field of economics and public finance on the research topic, official statistical information, empirical data on the results and progress of the implementation of regional projects and state programs of the constituent entities of the Russian Federation.

CONCEPTUAL FRAMEWORK FOR PUBLIC GOVERNANCE PROJECTS

The design approach, consistently developing as a scientific method, in the twentieth century was already widely used in construction, the military-industrial complex, space exploration, and other fields and, finally, attracted the attention of economists. Gerd Diethelm [1, p. 18] defines the following features of projects: they are new, have a complex structure, are specifically result-oriented, limited in time, depending on the availability of resources, action-oriented, characterized by responsibility for the quality, for the most part, are free of hierarchical structures, have creative and innovative features. The author defines a project as a task that has a specific implementation start and end date and requires the use of resources in each separate but interdependent activity that must be performed to achieve the goal

(for which the project was initiated). We note here that a project cannot be defined as a task, since it itself can often provide for the solution of a number of tasks aimed at achieving the ultimate goal for which it was formed and implemented.

Clifford F. Gray and Eric W. Larson [2, p. 17] highlight the characteristics of a project: the goal, participants diversity, the implementation of something new, special requirements in terms of time, cost, and quality. According to the named authors, a project is defined as a non-routine, one-time effort limited in time, budget, resources, and performance specification designed to meet customer needs. The above definition of a project as an effort seems to us also rather narrow since projects, as a rule, include a set of activities.

According to V.M. An'shin, A. Aleshin and K.A. Bagrationi [3, p. 49], when evaluating the success of project management, the concept of "project management triangle" is used, i.e. triple constraint "quality (the content of the project work) — terms — costs". Accordingly, the project is considered successful if the requirements for time, cost, and quality are met. These authors define a project as a purposeful, pre-developed, and planned set of actions (creation or modernization of physical objects, technological processes, technical and organizational documentation for them, material, financial, labor, and other resources), as well as management decisions. and measures for their implementation. It seems to us that the goals of the project may be the creation (modernization) of a much more diverse list of objects (processes) than those listed by the above authors in the definition, which, at the same time, does not fully disclose other structural elements of the project and the nature of their interaction.

D. V. Makhnev [4, p. 9] believes that the application of the concept of project management, regardless of whether it is a profit-oriented corporation, a non-profit organization, or a government agency. The author understands project management as a way of organizing, planning, managing, coordinating labor, financial and material, and technical resources, in which the set goals of the administration are achieved mainly through the implementation of projects.

It is difficult to agree with such a general position. A team of authors consisting of S. Abramkina, L. Vladykin, and A. Lukin [5, p. 40] rightly note the specific features of project management in public (as opposed to private) structures: the strict legal regulation of activities; strict reporting lines, involving systematic reporting; spending mainly budgetary funds; openness of activities and public control; focus on achieving priority goals for society; preference for social impact over profitability. According to the authors, a project is a time-limited set of activities implemented by a special team, the ultimate goal of which is to obtain a unique result.

There are two fundamentally different types of activity in government bodies: the process (clearly prevails) and the project one. The above features and definitions of the project of research economists clarify the fundamental difference between the project type of activity and the process one. Process activities are cyclical: authorities, as a rule, are created specifically for the implementation of certain processes. In this case, the process can be called a regularly repeated sequence of actions in which resources are spent and a certain result is achieved.

In this regard, within the framework of this study, we will define a regional project as a set of activities implemented by the authorities (or development institutions) of the constituent entity of the Russian Federation, aimed at achieving a unique result by a certain point in time that is significant from the point of view of the priorities of the social and economic development of the region, due to a complex of measures sufficient to achieve the project goal, formed taking into account weighed up risks and provided with the necessary budgetary funds. The definition of

the "perfect" project, based on the results of the analysis of the theoretical and conceptual framework of project management, will help us in the subsequent stages of this study in considering the actual state of ongoing regional projects by comparing them with a certain standard.

FOREIGN EXPERIENCE IN IMPLEMENTING REGIONAL PROJECTS AND PROGRAMS

The implementation of state-targeted programs and projects is widespread in foreign countries, primarily in developed ones. The study of the results and effectiveness of project and program documents are also widely represented by studies of foreign research economists, including, the aspect of the implementation of programs and projects at the regional and local levels. This method of budget management is used by such leading countries as Australia, Canada, the Netherlands, New Zealand, the USA, and Sweden.

I.H. Kantsur, L. Ye. Hats, T.B. Kharchenko, O.V. Smahlo, and L.V. Prokopets [6] highlight the features of the program-target method of budget management, which, in their opinion, provides: a high level of control over results in the context of the use of budget funds; public availability of information on budget expenditures; transparency of the process of spending funds; the ability to identify duplicate budget projects.

A team of authors, consisting of M. Brachert, E. Dettmann, M. Titze, analyze the implementation in the regions of Germany of a program for providing investment grants to commercial organizations in municipalities, aimed at stimulating their development and reducing spatial inequality [7, p. 12]. The authors conclude that the goal of the program — to create jobs in economically weak regions — has not been achieved, and investment grants are faced with the problem of a trade-off between productivity and employment growth.

A. Frenda, E. Sepe, S. Scippacercola in their scientific study [8, p. 12] analyze the effectiveness of public spending in the framework of regional programs and projects for the development of social protection of the population. The paper examines institutional factors that are not considered in budget planning, but gradually push decision-makers to pay more attention to the effectiveness and efficiency of programs.

M. Callanan [9, p. 210] notes that programs and projects implemented by the Irish government over the past several decades reflect a strong desire to transfer government authority to regions and municipalities. However, the actual trend, on the contrary, is a steady drift of service responsibilities away from local government to the national bodies. The cumulative effect of this functional drift is to reduce the involvement of local governments in their traditional role of infrastructure provision and towards a greater emphasis on the role of local authorities in supporting the social and economic development of their area.

G. Gallo, analyzing the results of the implementation of poverty reduction programs in Italy, believes that regional programs expand the circle of potential beneficiaries and the level of coverage of national programs, while somewhat reducing poverty at the national level [10, p. 149]. This indicates the importance and complementarity of programs, as well as multi-level (considering regional) participation of the authorities in national politics.

An article by E. Einio and H.G. Overman [11] assesses the consequences of the implementation of state programs of large-scale zonal intervention aimed at improving employment and entrepreneurial activity in the most disadvantaged regions of the UK by providing targeted support to enterprises in the local commercial sector.

A.G. Eldar [12] notes that analysis of Azerbaijan's experience in financial and investment support for the social and

economic development of the region shows that each state program, along with budgetary funds, provides for the use of extrabudgetary sources as financial resources: foreign investment, resources of foreign enterprises, international organizations, and foreign states. emphasizes that, unfortunately, the existing real measures are at a very low level. It is not enough yet to actively attract foreign investments to the regions and organize joint activities of foreign investors. In this regard, measures to increase the interest of the region's subjects in active participation in international financial and investment cooperation should be organized purposefully, comprehensively, and systematically.

Economists T. Morin and M. Partridge [13, p. 37] analyze the experience of implementing regional programs to increase the employment and incomes of the population in poor areas of the United States. The authors ask the question: Do small, locally-oriented programs have any measurable results, or do they represent a semblance of program activity? This study concludes that a small local program can bring all relevant federal and local state governments and stakeholders together to collaborate. At the same time, such a program benefits one of the poorest regions in the country at a very low cost.

M. Wagner, S. Schaltegger, E. G. Hansen, K. Fichter [14] investigate how university support programs in Germany contribute to the development of entrepreneurial ecosystems and what impact these programs have on sustainable regional development. The authors conclude that these programs have a positive impact on knowledge dissemination. The University facilitates the transfer of knowledge to the entrepreneurial ecosystem through systemic functions of search, learning, resource mobilization, and networking.

NATIONAL PROJECT AS A FINANCIAL CATEGORY

Modern national projects in 2006–2010 were preceded by the implementation of four national projects in Russia:

- "Health";
- "Affordable and Comfortable Housing — for Russian Citizens";
- "Education";
- "Development of the agro-industrial complex (AIC)".

Having analyzed the implementation of one of them, O. I. Barkova [15, p. 13] notes that national projects represent a financial category, since they are implemented in the field of monetary distribution and redistribution of funds.

It is difficult to disagree with this position: from an institutional point of view, a national project is a financial institution. National projects do not have their own income, financial resources come in the order of redistribution of incomes of other subjects of the economic system. Financing of national projects is a two-way movement of cash flows in the formation of sources and their use in the framework of the implementation of project activities.

Along with the institutional approach, when studying the financing of national projects, it is advisable to use the system analysis methodology, highlighting the structural elements, internal and external relations (affecting the results), the goals of each of the elements, based on the general purpose of the object. In this regard, the financing of regional projects should also be considered systematically: on the one hand, as a set of interrelated elements, on the other hand, as a process of movement of financial resources: the receipt — the direction of expenditures, the processing — the implementation of activities, the output — the achievement of target values and expected results.

V. V. Kovalev [16, p. 412] in the analysis of the project approach uses the concept of "financial plan", which he defines as a way to achieve financial goals and link income and expenses, which is based on strategic and production plans. At the same time, the strategic plan implies the setting of goals,

objectives, scale, and scope of activities. Production plans are drawn up based on a strategic plan and provide for the definition of production, marketing, research, and investment policies. Applying this approach to regional projects of the public sphere, we note that they also provide for a strategic plan (goals, objectives, results of a federal project established for a constituent entity of the Russian Federation), a production plan (a set of measures to achieve the goals of the strategic plan) and a financial plan. Unlike the commercial sphere, a feature of the financial plans of public sector projects is the presence of only the expenditure side. The revenue part in this case replaces the public good created by the project.

FEATURES OF STATE PROJECTS AT THE REGIONAL LEVEL

M.H. Yakimova [17, p. 19] notes the inconsistency of a number of project management elements with the traditional elements of management of a bureaucratic organization, which deforms the essence of the project in the public sphere, the factors of which, according to the named author, are: an inflexible organizational structure; lack of professional competencies; lack of objective indicators of project efficiency; lack of sufficient funding and other.

These factors do exist. At the same time, in the above list, certain factors influence the success of project management to various degrees. Thus, the following should be recognized as "pivotal" and system-wide: a rigid organizational structure, formalization of "current" activities in the form of projects, insufficient financial support, and complex compatibility with the "management on-demand" model. Other factors clearly have a less pronounced degree of influence or are the result of other factors.

A team of authors S. Abramkina, L. Vladykina, and A. Lukin [5, p. 42] also notes that in public administration there is a contradiction between project and functional management mechanisms, since, on the one hand, a transition to project management is proclaimed, and on the other, these projects are implemented using a conservative set of approaches and mechanisms. These authors analyze the ratio of projects at different levels. In their opinion, the successful immersion of regional priority projects in national and federal ones presupposes the fulfillment of a number of conditions:

- increasing personal responsibility;
- prioritizing real results;
- monitoring of project implementation;
- objective target indicators, their monitoring;
- the possibility of flexible redistribution of funding;
- identification of possible risks during the project formation.

The named authors also identify the challenges faced by the authorities in project management. It is especially noted that projects often do not involve linking targets and the selected mechanisms for achieving them. Indeed, these issues are often the result of a lack of understanding of project management in the field. At the same time, it seems to us that the failure of the project approach is not limited to the low level of qualifications of regional project teams. The problem is more complex and multifaceted: in the modern project methodology, regional teams have practically no opportunity to form a set of mechanisms corresponding to the scale of goal-setting determined from the outside (at the federal level). This conclusion will be confirmed and illustrated by a specific example of the implementation of regional projects in one of the sections of this article.

REGIONAL PROJECTS IN THE STRATEGIC AND FINANCIAL SYSTEMS OF RUSSIA

Decree No. 474 establishes indicators of national goals for the country as a whole, decomposes their target values both for the responsible federal authorities (sectoral profile) and for the constituent entities of

the Russian Federation (territorial profile). Specific indicators of achievement in the regions are established within the framework of agreements between the heads of federal projects with the constituent entities of the Russian Federation.

According to the Government Resolution of the Russian Federation No. 1288[3] the regional project ensures the achievement of the goals, indicators, and results of the federal project, the activities of which are related to the legally established powers of the constituent entity of Russia. The preparation of federal projects is carried out taking into account the principle of substantiating the effectiveness, sufficiency, and necessity of results, as well as their contribution to the achievement of goals and indicators, the implementation of the tasks set. At the same time, federal and regional projects are reflected in the classification of budget expenditures established by the Ministry of Finance of Russia.

The head of the federal project and the authorized person of the constituent entity of the Russian Federation agree on the implementation of a regional project on its territory. The conclusion of this agreement is carried out in accordance with the Methodological instructions in the standard form.[4] In accordance with the agreement, the head of the federal project provides monitoring (achievement of the values of indicators, the performance of tasks, achievement of the results of the federal project in the constituent entity of the Russian Federation, as well as the implementation of the action plan); conclusion of an agreement on the provision of an inter-budgetary transfer from the federal budget to the budget of the subject (only if available). The regional project manager ensures: approval of the state program of the constituent entity of the Russian Federation, in which the project is singled out as a separate structural element; formation of a project passport; achievement of values of indicators, fulfillment of tasks, results of a federal project for a constituent entity of the Russian Federation, as well as the implementation of an action plan; reporting and compliance with performance discipline.

According to the established methodology[5] the preparation of a regional project is carried out as per a standard structure, considering the following principles:

- setting goals and indicators of the regional project aimed at achieving the goals and indicators of the federal project;
- inclusion in the passport of the regional project of the indicators of the federal project for the constituent entity of the Russian Federation, approved in the passport of the federal project;
- substantiation of the effectiveness, sufficiency, and necessity of measures, their contribution to the achievement of the results of the regional project.

In the current methodology for the formation of regional projects under study, attention is drawn to the requirement for its goal — it is assigned to the constituent entity of the Russian Federation at the federal level, i.e. from the outside. In this regard, specific goals for a particular region, determined by the characteristics of priorities and factors of social and economic development, cannot be set and achieved within the framework of regional projects.

REGIONAL PROJECTS AND STATE PROGRAMS

State programs, based on materials by M. A. Ekaterinovskaya, O. V. Orusova, N.V. Tshadadze, K.V. Haustova [20, p. 1602],

[3] Resolution of the Government of the Russian Federation of October 31, 2018, No. 1288 "On the organization of project activities in the Government of the Russian Federation".

[4] Methodological instructions on the procedure and standard form for concluding an agreement between the head of the federal project and the head of the regional project on the implementation of the regional project on the territory of the constituent entity of the Russian Federation (approved by the minutes of the meeting of the Presidium of the Council under the President of the Russian Federation on strategic development and national projects No. 15 of December 17, 2018).

[5] Methodical recommendations for the preparation of regional projects. URL: https://www.mintrans.ru (accessed on 23.03.2021).

become, on the one hand, a tool (designer) to achieve a strategic goal, and on the other hand, in the monitoring process, they can assess the level of approach to the goal, identifying the reasons for deviation due to various risks. This approach allows not only to record the achieved results and the level of costs but also to demonstrate a structural analysis of the processes and proportions of the economy, to become the basis for improving the quality of state social and economic policy by compiling a toolkit of one program loop is more complicated.

A separate modern research problem is the ratio of national (federal and regional) projects and state programs at the level of the Russian Federation and the constituent entity of the Russian Federation. According to Russian legislation, regional state programs are developed in accordance with the priorities of social and economic development. The first source of these priorities is the national development goals, which are binding on the territory of all constituent entities of the Russian Federation.

According to the Concept for increasing the efficiency of spending budget funds for 2019–2024,[6] one of the main directions of public finance reform is the formation of the budgetary policy considering the target indicators of state programs of the Russian Federation, and when improving the system of state programs, the integration of national projects should be considered.

In accordance with clause 4.4. The main directions of budgetary, tax, and customs-tariff policy for 2021 and the planning period of 2022 and 2023,[7] not only national projects are aimed at achieving national development goals, but also mechanisms of state programs. At the same time, a full-scale inventory of the activities of state programs is being carried out on their contribution to achieving national development goals within the framework of the Unified Plan for Achieving the National Development Goals for the period up to 2024 and planning for the period up to 2030, which is currently being developed.

Some researchers, including O.V. Veremeeva [18, p. 26], confirm the need to integrate projects and programs. After all, it is within the framework of state programs that the main share of the expenditures of the federal budget and the budgets of the constituent entities of the Russian Federation is planned. Project management principles, O. Safonova, E.A. Anchikhrov [19, p. 60], do not contradict the target budget planning, but only strengthen it. Project management methods can be effective in the implementation of government programs since they allow for an accentuated allocation of funds.

At the same time, the Budget Code[8] does not contain provisions on the financing of national and regional projects, and Federal Law No. 172-FZ[9] does not classify projects like strategic planning documents. Activities of federal and regional projects are implemented and financed within the framework of state programs of the Russian Federation and the constituent entities of the Russian Federation. The inclusion of federal projects in state programs is provided for by Resolution No. 588,[10] according to which federal projects and their individual activities are classified as structural elements of state programs of the Russian Federation. Similar to the program methodology of the federal level, the procedure for the formation and implementation of state programs of the constituent entities of the Russian Federation determines the place and

[6] Order of the Government of the Russian Federation of January 31, 2019, No. 117-r "On approval of the Concept for increasing the efficiency of spending budget funds for 2019–2024".

[7] The main directions of budgetary, tax, and customs-tariff policy for 2021 and the planning period of 2022 and 2023 (approved by the Ministry of Finance of Russia).

[8] Budget Code of the Russian Federation of July 31, 1998, No. 145-FZ (as amended on December 22, 2020).

[9] Federal Law of June 28, 2014, No. 172-FZ "On Strategic Planning in the Russian Federation".

[10] Resolution of the Government of the Russian Federation dated 02.08.2010 No. 588 "On approval of the Procedure for the development, implementation, and evaluation of the effectiveness of state programs of the Russian Federation".

financial support of regional projects (regional parts of federal projects) in the state budget system of the region as a structural element of state programs.

Thus, the expenditure obligations of the budgets are planned within the framework of state programs of the constituent entities of Russia, and within the framework of regional projects, they are "reflected" in a certain sample, or rather from the analytical point of view. In this regard, the goal-setting of projects at present cannot be completely sovereign, since decisions on financing and, accordingly, the formation of a set of measures sufficient to achieve the set goals, projects are not adopted at meetings of design institutes (project committees), but within the framework of the established conservative program methodology in strict accordance with budgetary legislation.

State programs are now in fact documents of planning budgetary allocations in an implicit and partly formal connection with the main activity of the authorities. The implementation of the main role of the state program as a financial institution necessary to meet the requirements of budgetary legislation. At the same time, the high level of quality of the program as a financial mechanism that ensures the relationship of budget funds and the expected results of their use has not been reached.

The scale of the problem is massive due to the fact that, as a rule, state programs (sectoral, service, program for the development of the social sphere) are implemented by a regional executive authority endowed with appropriate powers. Accordingly, the set of regional programs is an exhaustive long-term plan for the activities of regional authorities, and the amount of funding for state programs actually represents the entire budget of a constituent entity of the Russian Federation. This also indicates an incomplete transition to program financing of public expenditures from a conservative budgeting model, in the format of which individual state programs are implemented.

It is necessary to focus on the following: within the framework of this study, the quality of the activities of the authorities and its results are not evaluated. Current activities and "manual" management have always been and will take place in public administration, they are often effective. At the same time, program activities by their nature are aimed at creating a new quality and a unique result, the achievement of which is ensured by the necessary set of mechanisms, sufficient funding and is a chronologically coordinated action plan. The substitution of concepts, when the actual traditional budgeting of current activities is called a program, is dangerous in its consequences.

The most balanced solution in the context of the identified problems is the division of state programs of the constituent entities of the Russian Federation into departmental and targeted. Departmental programs were previously used at the regional level, and it is often their characteristics that are inherent in modern state programs. Within the framework of targeted state programs, it is advisable to implement the program-targeted approach in the strictest sense.

PROBLEMS OF IMPLEMENTATION AND FINANCING OF REGIONAL PROJECTS

At the stage of their formation and discussion, a number of problems in the implementation and financing of regional projects were identified. In the materials of the round table held in the Federation Council of the Russian Federation on December 24, 2018, on the issue of financial support for national projects,[11] a number of the following problems were noted.

The first of them is the low share of national project activities related to the powers of the constituent entities of the Russian Federation (no more than 60%). In practice, the discrepancy between the approach to the formation of regional projects and federal projects is revealed.

[11] Round table on the topic "Financial support for the implementation of national projects." URL: http://council.gov.ru/activity/activities/roundtables/100340/ (accessed on 23.03.2021).

This contradiction is caused by a fundamental reason: the powers of the federal and regional levels at the legislative level are different, and the "blind" transfer of the goals and objectives of federal projects to the regional level could not initially be justified, since this is not provided for by the powers of the constituent entities of Russia.

The second problem within the framework of the round table was that the interaction between the responsible federal authorities and the constituent entities of the Russian Federation was supposed to be carried out by concluding agreements with the establishment of targets for the regions and financial assistance from the federal budget. In practice, these agreements often included only the obligations of the regions to achieve target indicators, and the set of target values of all regions constituted the goal of the federal project. Co-financing from the federal budget to achieve general federal and regional project goals was not envisaged for a significant part of the projects. Obviously, this approach "erodes" the responsibility of federal curators and widens the gap between the stated goals and the actual mechanisms for achieving them within the framework of regional projects, primarily due to the apparent lack of funding for the latter.

The third main problem of the implementation of national projects in the constituent entities of the Russian Federation, the roundtable participants identified the methodology for the decomposition of indicators of federal projects by region. This was often done by a simple calculation: 1) the contribution of each of the regions to the value of a particular general indicator in the "base" year was calculated, and 2) this value for the region was multiplied by the growth corresponding to the target annual dynamics of the national indicator. Accordingly, this approach did not consider either regional specifics or the impossibility of multiple increases in the baseline indicators in regions with a "high base". At the same time, the constituent entities of the Russian Federation practically did not have the opportunity to challenge the target values of regional projects proposed under the agreements.

The existing system of financial support for the implementation of regional projects drew criticism from representatives of the constituent entities of the Russian Federation. On the issue of the implementation of national projects at the regional level on April 2, 2019,[12] a seminar meeting was held in the Federation Council of the Russian Federation, during which the lack of federal co-financing for the regions to achieve the targets of the federal project "Industrial Export" of the national project "International Cooperation and Export" was noted. The participants noted that the constituent entities of the Russian Federation do not have significant levers of influence on this indicator, therefore it is very problematic to achieve the target indicators in this area. To overcome this problem, it was proposed to refine the target indicators of the regional level, taking into account the capabilities of the constituent entities of the Russian Federation: economic, financial, climate, and others.

PRACTICE OF IMPLEMENTATION AND DIRECTIONS OF DEVELOPMENT OF REGIONAL PROJECTS

It is advisable to illustrate the problems discussed above and the conclusions drawn with a specific example. Thus, the Federal Project "Export of Services"[13] (implemented in 2018–2019) envisaged the achievement of a volume of export of services in the amount of USD 100 billion by 2024. This task is in accordance with the passport of the federal project, was solved by achieving the following results:

1) a plan for the visa liberalization was approved;

2) a set of measures to minimize currency control requirements;

[12] Analytical Bulletin of the Analytical Department of the Office of the Federation Council of the Federal Assembly of the Russian Federation No. 14 (728) edited by V.D. Krivova, 2019.

[13] Federal project "Export of services" (approved by the minutes of the meeting of the project commission of the national project "International Cooperation and Export" dated November 26, 2018 No. 4).

3) a set of measures for certification and adaptation of services;

4) the "Strategy for the development of export of services for the period up to 2025" was approved;

5) monitoring of barriers to the export of services was carried out;

6) acts on simplification of the visa requirements were adopted;

7) the entry of foreign nationals with electronic visas was simplified;

8) visa service processing time was reduced to 3 working days for various types of visas;

9) a set of measures was developed to increase the export of services by category.

The indicated areas of implementation of measures are within the exclusive competence of federal executive bodies and do not relate to the established powers of a constituent entity of the Russian Federation. At the same time, the agreements on the implementation of relevant regional projects directed to the regions for signing contained the obligations of the constituent entities of the Russian Federation to increase the volume of export of services in certain areas without including mechanisms for solving the assigned tasks. in agreements. In addition, the draft agreements were formed without the participation of the regions, the target values in the regional context were calculated by the method of a simple extrapolation of the preliminary results of 2018, based on the contribution of each region to the volume of certain types of export of services to the Russian Federation.

According to the methodology of the Central Bank of the Russian Federation, the export of services is understood as a transaction between residents (receiving funds) and non-residents of the country (spending funds) in the following categories: transport services; business trips; informational; construction industry; associated with the use of industrial goods; financial and insurance; services in the field of culture and recreation. For example, the share of export of transport services in the total export of regional services averages 85%. At the same time, it is obvious that the constituent entities of the Russian Federation do not have real levers to increase the demand for the services of airlines, carriers by rail, and road, especially among non-residents.

The example of the formation and implementation of a regional project in 2018–2019 contradicting the essence of project management and the initial meanings of its implementation, confirms the problems of the project approach in the public sector discussed above and the quality of interaction between the heads of federal projects with the constituent entities of the Russian Federation. Note that in 2020, the Ministry of Economic Development of the Russian Federation decided to terminate the implementation of the federal project "Export of Services": its activities were transferred to other federal projects in this area, and the indicators for the regions in terms of the export of services were canceled. At the same time, lessons from this past practice should be drawn in the future when developing project management at the regional level.

Regional projects should begin to play a more prominent role in the implementation of social and economic policy. Currently, funding for projects in most regions does not exceed 10% of the budgets of the constituent entities of the Russian Federation, while more than 95% of the budgets are directed to the implementation of regional state programs. A significant part of the tasks of implementing the project approach was solved in the established methodology. In this respect, the actual application of the methodological guidelines is of decisive importance, rather than their formal presence. The solution can be a reference model of the structure of regional projects with highlighted mandatory requirements for its elements and their interconnections.

Mandatory requirements for the structure of a regional project should emphasize the required level of quality of the relationship of its structural elements: the goal set by tasks; indicators that accurately reflect the progress

of problem-solving; a set of measures (subject to the necessary funding), sufficient to solve problems and achieve the ultimate goal of the project. Regional projects that do not meet the requirements of this model are doomed to be declarative.

CONCLUSIONS

Regional projects and state programs are designed to become a conduit for achieving national development goals "on the ground". At the same time, projects and programs, as theoretically substantiated and recognized by the world scientific community as effective technologies, contain enormous potential in achieving the priority goals of the social and economic development of the regions. The experience of implementing projects and programs is widespread abroad.

At the same time, a number of factors affect the management of projects in the public sector, such as a rigid organizational structure, the formalization of "day-to-day" activities of departments in the form of projects, insufficient funding, and inconsistency of the project. approach with a conservative order management model. The article discusses the problems of the actual implementation of national projects at the regional level in 2018–2019, which indicate a significant distortion of the originally laid down meanings of the implementation of the project approach and contradictions in the established practice of interaction between the heads of federal projects and the constituent entities of the Russian Federation in achieving national goals, appropriate goal-setting, as well as providing it with sufficient mechanisms and funding.

State programs are now in fact documents of planning budgetary allocations in an implicit connection with the main activity of the authorities. This is the implementation of the main role of state programs as a financial institution, which is necessary to meet the requirements of budgetary legislation.

In this regard, it is necessary to clarify the current design and program methodology in terms of granting the regions the right to form and implement projects not only according to the results and goals of federal projects but also according to the goals and objectives initiated by the constituent entity of the Russian Federation, corresponding to the priorities of social and economic policy and the characteristics of the region. Blind copying of the provisions of federal projects at the regional level, leading to the declarative nature of project management, should become a thing of the past, and a new quality should be given to the relations between the heads of federal projects with the constituent entities of Russia. It is also advisable to develop a regional project as a financial institution. To do this, it is necessary to clarify the budgetary legislation to ensure the possibility of actual planning of expenditure obligations as part of the formation of projects. Prospects for further research should focus on the development of a model for assessing the effectiveness of the formation and implementation of regional projects and state programs, its further testing on specific programs of the constituent entities of the Russian Federation.

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System Balance Index as an Indicator of the Russian Gas Industry's Sustainable Growth

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ABSTRACT

The paper examines an approach to developing a strategy for the Russian gas industry's sustainable growth based on the system economic theory's methodology. The **aim** of the study is to evaluate the current state of the industry by calculating sustainable growth indices. Grey Relational Analysis (*GRA*) reveals a deep relationship between sustainable growth indices and Return on equity (ROE), Lambert Energy Index (LEI), Return on environmental investments (ROE_{env}), and Return on social investments (ROE_{sr}). The system balance index (SBI) is calculated, which expresses the intensity of links between the financial, energy, environmental and social subsystems of the gas industry. The results show that the Russian gas industry companies are characterized by a low level of ROE_{env} or ROE_{sr} , negatively affecting the SBI value. The authors **conclude** the importance of environmental protection and social responsibility for achieving sustainable industry growth should not be underestimated. This circumstance should be taken into account when setting strategic goals for companies in the gas industry. According to the authors, applying system economic theory to achieve sustainable growth goals has huge potential to overcome economic phenomena and improve company management practices.

Keywords: Russian gas industry; sustainable growth; system economic theory; Sustainable Balance Index (SBI); systems thinking; system methodology; system balance; system paradigm

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INTRODUCTION

The paper addresses the theory of sustainable growth under the system paradigm. In the research, sustainable growth is treated as a system, where the result concerns the interconnection among energy, environmental, economic and social subsystems [1]. During the 1980s, researchers began a fundamental reappraisal of thinking on economic growth. Nowadays, we observe contradictions of the sustainable financial growth traditional organization model as "alone" functional focused on the finance aspects only [2]. The most crucial problem is the theoretical and empirical study of the interconnections among energy, environmental, economic and social systems.

Considering sustainable growth approach under the system paradigm has enormous potential for developing a sustainable economy. The system paradigm was introduced into scientific practice by J. Kornai in 1998 and was complemented with other well-known economic paradigms, such as the neoclassical, institutional, evolutionary, etc. [3–5]. In the papers of G. Kleiner [6–8], the concept of system paradigm in economics was developed and created a model of a tetrad — a stable complex of four basic types of systems (object, environment, process and project). As Eric Pappas said, "the systems theory approach to sustainability in five contexts (social/cultural, economic, environmental, technical, and individual) is a realistic and useful approach to sustainability" [9]. The systems approach in dealing with complex problems is the best way to develop methods for achieving sustainability [10]. System thinkers, such as Senge [11], Wheatley, Bertalanffy [12], Wilber

and Meadows [13], claimed that everything has interconnections and need to develop complex methods for evaluation processes [14]. Ludwig Von Bertalanffy (1968) emphasized that all things could be considered as a system [13, 15]. Flood and Jackson (1991) describe a system as a difficult and highly interlinked network [16]. Further, Checkland defines a system as a model of a whole society, which may apply to human activity [8]. Accordingly, the actual problem of the modern economic theory is finding such a paradigm that could reflect economic processes taking place in the objective reality with a high degree of reliability [17]. Long before the Santa Fe Institute was opened, Belgian Nobel laureate Ilya Prigogine was making research on questions about the sources of the order and structure in the world. Waldrop (1992) indicates that systems can organize themselves spontaneously into complex structures [18].

The authors consider sustainable growth as a system between financial, energy, social, and environmental subsystems. Each subsystem represents by itself a group of factors influencing sustainable growth. In this paper, the authors calculating System Balance Index (further — *SBI*) as an indicator for the Russian gas industry's sustainable growth. Schematic views on the components of sustainable system growth and its interactions based on the Hester and Adams model [13] are shown in *Fig. 1*.

Society needs to change the old way of measuring financial sustainability to the new one [19, 20]. The dynamics of ecosystems and human systems need to be examined in the context of post-normal science based on complex systems thinking [21]. Nowadays, the complexity of subsystems for achieving green growth is the necessary method for developing [22].

Indeed, the development of the economy in developing countries is expected to contribute most to the growth of world energy consumption, thus coupling sustainable growth with energy consumption is the primary foresight method for future economic development [23, 24]. One of the characteristics of scientific and technical development is the influence on the ecological state [25, 26]. Uneconomic growth is a term used in Environmental Economics to define a kind of economic growth that does not lead to an increase in the welfare of society [27–29]. Indeed, Charles A.S. Hall emphasized that society could transform links between natural science and financial processes [30–33]. It is essential to have found methods for the evaluation of energy efficiency and environmental protection for increasing sustainability [25, 34, 35].

According to the Russian Federation Energy Strategy up to 2030, Russia has appointed an innovative way of growing the oil and gas industry to strengthen leading line items [36]. Since the Russian gas industry provides about 10% of national gross domestic product, which translates to 25% of the country's income in the government budget, the energy companies' sustainable growth plays a significant role in Russia's growth as a whole. Thus, the research is about sustainable growth providing set and balance of the social and economic points concerning gas industry growth in Russia. Over the last few years, sustainable growth has become increasingly crucial in the Russian Federation; thus, there were many circumstances for a transition from fast growth to sustainable growth in Russia. This is evident from the ongoing reform in government, taxes, and financial legislation.

The structure of the paper is as follows. Section 2 reviews the relevant literature. Chapter 3 elaborates on the employed research method, while Section 4 analyses and discusses the findings. The final parts offer some concluding remarks.

METHODOLOGY

Sample and software

Take into consideration Russian oil and gas industry data between the 1996 and 2019 period. Data was used from the three biggest Russian gas companies' annual reports. Gazprom, Rosneft, Novatek together have about 90% of the Russian gas market production share, therefore, by these three companies, we can judge the state of sustainable growth for the industry as a whole. Data was classified according to the sustainable areas regarding finance, environmental, energy

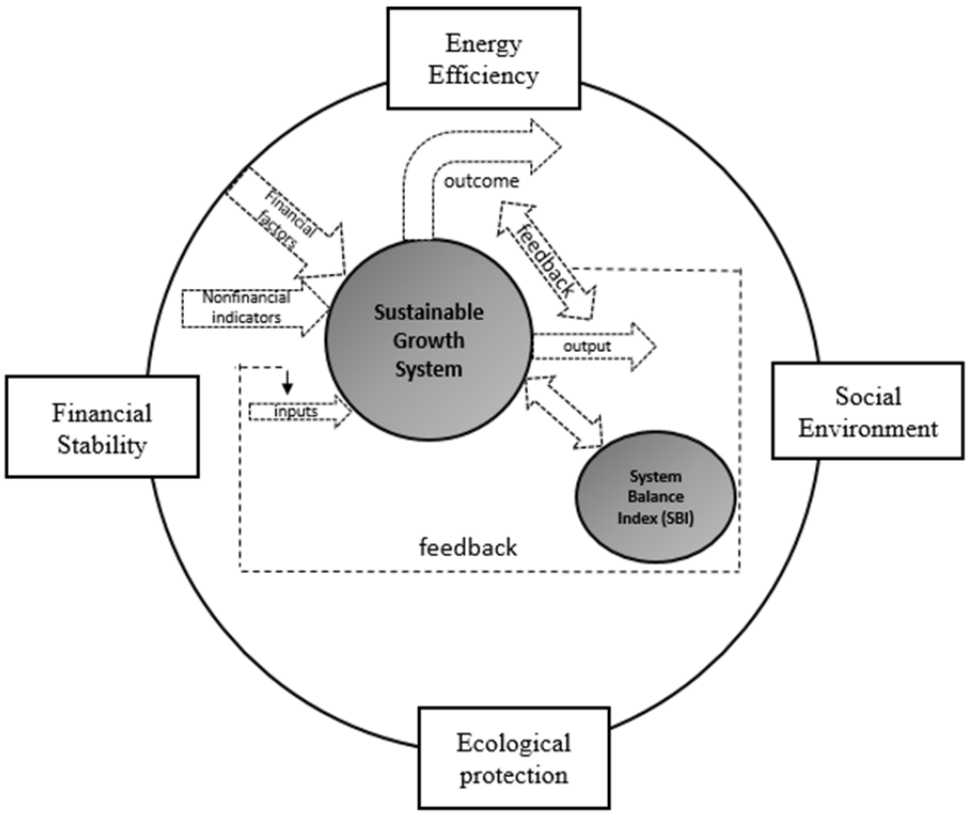

Fig. 1. **Schematic view on the components of sustainable growth system**

Source: the authors' understanding of sustainable growth system.

and social factors. The set of indices has been chosen according to sustainable growth functions assessment. Also, the Environmental Ratings of the Russian gas companies were used in the paper.

The authors have done the following steps:

1) Data collection;
2) Data classification;
3) Sustainable growth indices calculations;
4) Testing how financial and non-financial factors influence sustainable growth indices;
5) SBI calculation

Calculations were done with the help of the R language programme [37].

Grey correlation analysis methodology

The authors used grey relation analysis (GRA) to analyse the degree of proximity between system' parent factors and sub-factors [38, 39]. The authors have chosen GRA because it is a method to measure the degree of correlation among factors according to the degree of similarity or dissimilarity of the development trend among factors. The authors tested four indices as the sustainable growth primary indicators:

Higgins sustainable growth rate (SGR) [40, 41], Ivashkovskaya sustainable growth index (SGI_{iv}), Varaya' sustainable growth index (SGI_{ROE-r_e}), Ivashkovskaya index modifications SGI_{WACC}. The higher the ratio l/k, the more reliable it is (more substantial number of periods the company generates a positive economic profit) [42]. SGI_{ROE-r_e} means that profit and capital growth can occur, if the rate of return on equity ROE is higher than the cost of equity r_e. *Table 1* shows a detailed formula description.

Firstly, the authors collected financial, social energy and social indicators from the three biggest Russian gas companies:

- Finance indicators: $EBIT$ (Earnings before interest and taxes), ROA (Return on assets), ROS (Return on sales), ROE (Return on equity), $NWCT$ (Net working capital turnover), CR (Current Ratio), NPG (Net profit growth), NAG (Net assets growth), FL (Financial leverage), DOL (Operation leverage degree), CL (Combine

Table 1

Detailed formula

Sustainable Growth Indices	Proxy	Calculation method	Meaning
Higgins Sustainable Growth Rate	SGR_H	$g = f(P, R, A, T)$	Where, g – it is the index of sustainable growth, expressed in percent; P – profit after taxes; R – rate of reinvestment; A – turnover of assets; T – the ratio of assets to equity or leverage.
Ivashkovskaya Sustainalbe Growth Index	SGI_{Iv}	$SGI_{Iv} = (1+g_s) \times X_k^1 - X \sum_{i=1}^{k} max\left[(0, (ROCE_i - WACC_i)\right]$	Where (1+g_s) – the average growth rate of sales; k – the number of years of observations; l – the number of years during which there was a positive spread of return on invested capital; $ROCE_i$ – return on capital employed per year; $WACC_i$ – weighted average cost of capital per year.
Varaya Sustainable Growth Index	SGI_{ROE-r_e}	$SGI_{ROE-r_e} = G_{sales}^{aver} \times X_k^1 - X \sum max\left[(0, (ROE - r_e)\right]$	Where, ROE – return on equity; r_e – the cost of equity.
Ivashkovskaya Modif. Sustainalbe Growth Index	SGI_{wacc}	$SGI_{ce} = G_{sales}^{aver} \times X_k^1 - X \sum max\left[(0, (ROCE_i - WACC_i)\right] X \sum max\left[(0, (G_{ce} - aver)\right]$	Where, G-aver – average growth tempo; $ROCE_i$ – return on invested capital per year; $WACC_i$ – the weighted average cost of capital in year; G_wacc – growth rate of invested capital for the period; G_aver – average growth rate of invested capital.

Source: [2, 40, 41].

leverage), *DER* (Debt equity ratio), *WACC* (Weighted average cost of capital).

- Energy indicators: *EROI* (Energy Return on Investment), *ES* (Energy savings).
- Social indicators: ROE_{sr} (Return on social expenses), *RER* (Revenue per employee ratio).
- Ecological indicators: ROE_{env} (return on costs concerning environmental protection), *ER* (environmental ratings).

Then by using grey relation analysis *GRA*, the authors chose financial and non-financial indicators, that have the biggest influence on the sustainable growth indices.

System equilibrium' methodology

In the research analysis the authors use the primary principles of the system balance concept according to the system economic theory [7, 42]. In the tetrad system analysis, a, b, c, d factors characterized the interaction of existing systems intention [4]. Kleiner suggested a system balance index reflecting disparities in the development of four tetrad subsystems. Kleiner' system index [43] is in *Eq. 1*

$$I = \frac{1}{\left(\frac{a}{b}+\frac{b}{a}+\frac{a}{c}+\frac{c}{a}+\frac{a}{d}+\frac{d}{a}+\frac{b}{c}+\frac{c}{b}+\frac{b}{d}+\frac{d}{b}+\frac{c}{d}+\frac{d}{c}-11\right)} \quad (1)$$

According to Kleiner's system index methodology, the next stage that is required is a representation of the system as a 100×100 square located in the Cartesian reference system with vertices (0.0). (0.100). (0.100). (100.0). On the

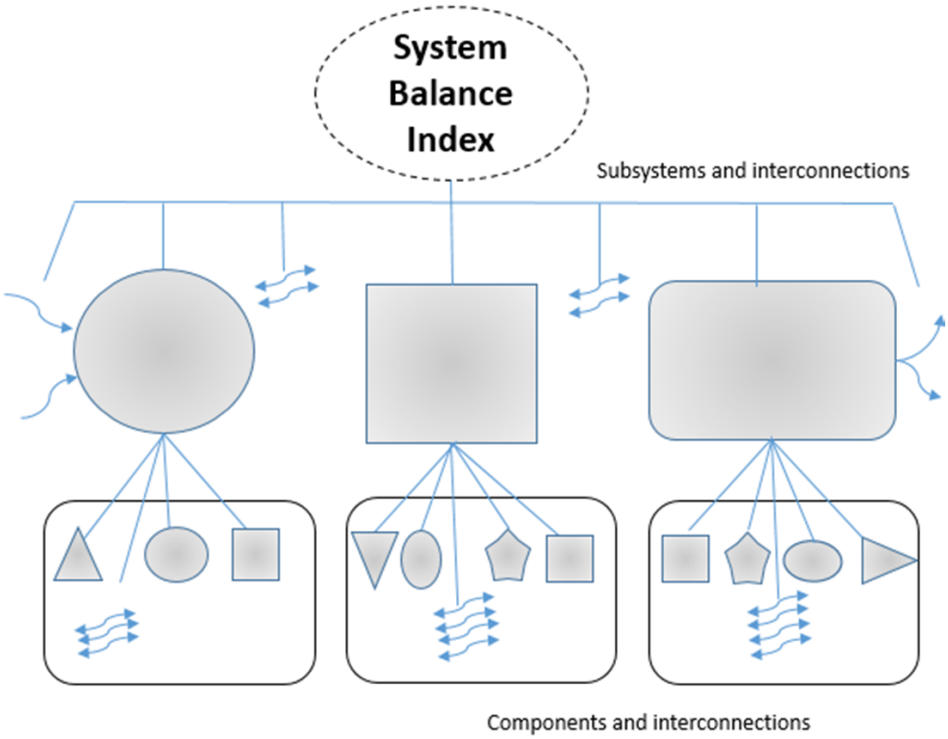

Fig. 2. **System, subsystems and components form a structural hierarchy**

Source: the authors' system balance index subsystems and components understanding.

square sides we need to plot the points reflecting the obtained relations between the subsystems [6].

SBI is the universal instrument for everyone who can try another variety of factors to create a financial sustainable index for industry and companies. SBI could be interpreted by the following way: $0 \le SBI \le 0.2$ — fragile balanced connection, the $0.2 \le SBI \le 0.5$ — delicate balance, $0.5 \le SBI \le 0.7$ — average balance, the $0.7 \le SBI \le 0.9$ — strong balance, $0.9 \le SBI \le 1$ — solid balance. SBI shows the balance between the components. In the strategic plan (ideal case) the weight of the components in the index and the attention to them in the economic policy plan should be the same. A balanced system provides more opportunities for management (it clearly shows how much this or that criterion deviates from the balance, this allows to justify the direction of development in this or that direction). The authors modified system balance index subsystems and components to form a structural hierarchy that is shown in *Fig. 2*.

Fig. 2 shows the system balance index subsystems and components. Thus, any subsystems could be linked together. In the research, the authors analyse the sustainable growth system with subsystems like energy, finance, ecology and social subsystem. The authors' approach to consider sustainable growth from a position of the system economics theory opens new opportunities for the development of sustainable economic analysis.

RESULTS

GRA results

The authors have tested more than twenty energy, environmental and social indicators that influence four types of sustainable growth coefficients. The most influential nonfinancial indicators were chosen as the parts of *SBI*. As we see the results in *Table 2*.

LEI, ROE_{env}, ROE_{sr} are the nonfinancial factors that have the biggest influence on SGR. Indices show the quite similar results for four coefficients: SGR_H, SGI_{iv}, SGI_{ROE} and SGI_{WACC}. The biggest influence on sustainable growth coefficients is $ROA, ROE, FL, RG, WACC, NWCT$.

The logic of the study is the following. There are three gas companies that cover almost the entire gas market of the Russian Federation. Every

Table 2

Grey correlation method' results

No.	SGR (H)		SGI (I)		SGI (ROE)		SGI (WACC)	
1	*ROEsr*	0.999631755	*WACC*	0.997044625	*ROEsr*	0.999631755	*ROEsr*	0.992635548
2	ROE	0.996857084	*NWCT*	0.996882854	*ROE*	0.996857084	*ROEenv*	0.989161429
3	*NWCT*	0.996731913	*LEI*	0.996859862	*NWCT*	0.996731913	*ROE*	0.989160053
4	*LEI*	0.996461302	*FL*	0.996771869	*LEI*	0.996461302	*ROA*	0.989154941
5	*RG*	0.996430353	*RG*	0.996653973	*RG*	0.996430353	*FL*	0.98915173
6	*WACC*	0.996317117	*ROE*	0.995680909	*WACC*	0.996317117	*RG*	0.989147647
7	*FL*	0.996256888	*ROA*	0.995580778	*FL*	0.996256888	*LEI*	0.989147298
8	*ROA*	0.995392176	*ROEenv*	0.995326027	*ROA*	0.995392176	*WACC*	0.98914482
9	*ROEenv*	0.995260265	*ROEsr*	0.994625289	*ROEenv*	0.995260265	*NWCT*	0.989144626
10	*ROCE*	0.994025443	*ROCE*	0.994299553	*ROCE*	0.994025443	*DER*	0.98914204
11	*DER*	0.993286149	*EBIT*	0.99325541	*DER*	0.993286149	*EBIT*	0.989050387
12	*EBIT*	0.992391333	*DER*	0.992578558	*EBIT*	0.992391333	*ROCE*	0.989030059
13	*RER*	0.992005782	*RER*	0.991805588	*RER*	0.992005782	*RER*	0.988747758
14	*ROS*	0.991997208	*ROEs*	0.99118176	*ROS*	0.991997208	*ROEs*	0.988689877
15	*NWC*	0.991591822	*NWC*	0.991164141	*NWC*	0.991591822	*NWC*	0.988547244
16	*ROEs*	0.991253955	*ROS*	0.990507554	*ROEs*	0.991253955	*ROS*	0.988256609
17	*ROFA*	0.979212675	*ROFA*	0.975124238	*ROFA*	0.979212675	*ROFA*	0.985550664
18	*CL*	0.946137523	*NAG*	0.945970554	*CL*	0.946137523	*CL*	0.947088786
19	*DOL*	0.945171051	*CL*	0.945887173	*DOL*	0.945171051	*DOL*	0.946125041
20	*NAG*	0.944745681	*DOL*	0.944918486	*NAG*	0.944745681	*NAG*	0.943378757
21	*NPG*	0.933981343	*NPG*	0.933920898	*NPG*	0.933981343	*NPG*	0.93407283
22	ER	0.398638304	*ER*	0.398919673	*ER*	0.398638304	*ER*	0.398393491

Source: the authors calculations.

company has its own financial performance. To organize these companies' sustainable growth evaluation as well as the entire gas industry in Russia, the authors believe that equal emphasis should be placed concerning four areas — economy, society, ecology and energy. How to understand by what indicators to evaluate these four areas and their relationship with sustainable growth indicators? In order to understand this, the authors perform grey relation analysis (GRA) to account for the impact of indicators on sustainable growth indices. From the obtained table (see *Table 2*) we select one indicator from every group (economy, society, ecology and energy) that has the greatest impact on the sustainable growth indices. The authors focus research on the necessity of the equivalence between economic, social, ecological and energy indicators in the long-term perspective. The current SBI value was calculated, which should tend to the ideal. As a result, the most influential factors on sustainable growth indices in the economy were chosen — ROE, energy — LEI, ecology — ROE_{env} and social — ROE_{sr}. All of these four indicators should be expressed equally for achieving the sustainability of growth.

SBI calculations results

The authors determine a ratio between types of intra-corporate subsystems by pairs, having designated their interaction through four independent parameters: a (pair "$ROE - LEI$"); b (pair "$LEI - ROE_{env}$"); c (pair "$ROE_{env} - ROE_{sr}$"); d (pair "$ROE_{env} - ROE$") (*Fig. 3*).

SBI expresses smoothly tend. Results have shown that Lambert Energy Index (LEI) is the primary factor for supporting balance in the system. The actual SBI in 1996 was 0.11, in 2015 was 0.15 and in 2019 was 0.23. Results show that if ROE_{env} and ROE_{sr} is suffering in the industry, SBI would suffer too. This fact could help to determine the importance of an ecological protection factor in the sustainable growth system as a whole (see *Table 3*).

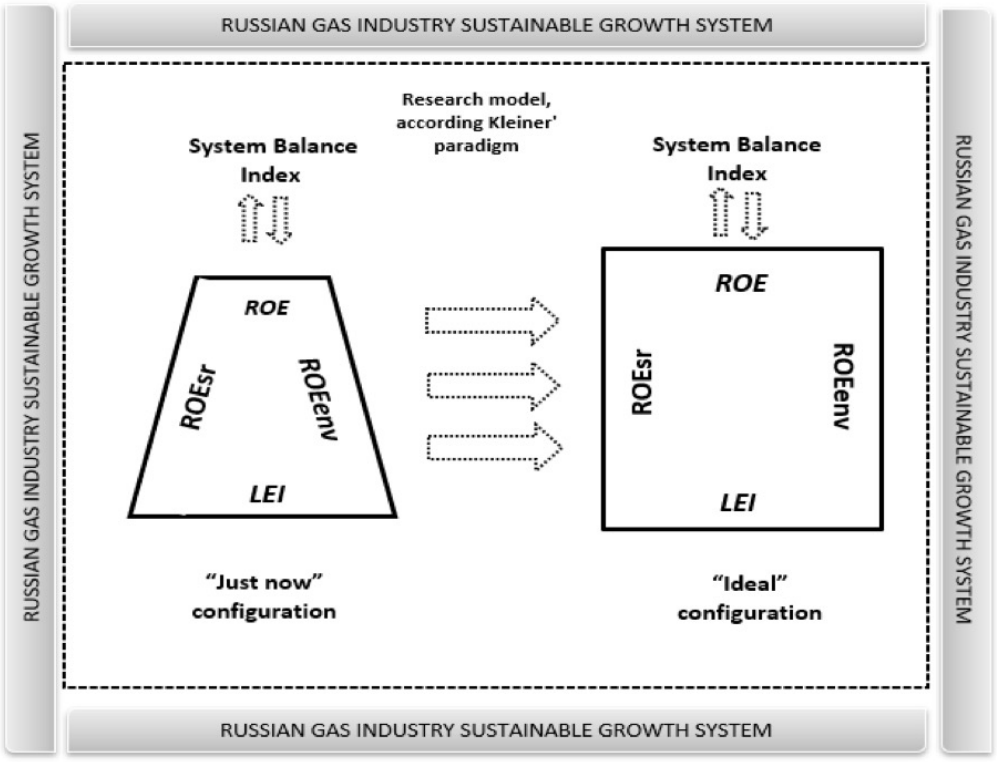

Fig. 3. **Russian gas industry sustainable system**

Source: the authors' methodology.

In the strategic perspective, none of the components (factors) included in the model should prevail over others, i.e., the closer to 1 index results, the more balanced the situation is considered at the moment. With the proposed approach sustainable financial growth would have a completely different quality, more significant social and environmental responsibility and focus on the future of human well-being. Most likely the balance model (when the contribution of all four factors is equal) would not be optimal from the standpoint of profitability but focused on sustainability because the task is not only to make a profit but also to get an environmentally-oriented and socially responsible industry or company. The authors build a system index interconnections link, using the observations of the interaction flowing process between 1996 and 2019. The strongest links can be observed between LEI with ROE_{env} and ROE_{sr} as well as we confirmed the close intensity of links between parts of SBI, with high intensity of links between internal four sustainable parameters.

The SBI dynamics from 1996 to 2019 is shown in *Fig. 4*.

Table 3

SBI and its subsystems results

	1996	2015	2019
ROE	0.22	0.28	0.38
LEI	0.41	0.54	0.58
ROE_{sr}	0.02	0.04	0.05
ROE_{env}	0.02	0.02	0.02
SBI	0.11	0.15	0.23

Source: the authors' calculations.

In gas companies, it is necessary to set strategic goals based on the system balance index. Thus, for example, if we look at the SBI structure in 1996, LEI reached the highest level — 0.41. Thus, the LEI indicators should be planning for the next year not lower than the current one. For the remaining indicators, the same increment values should be set so that the SBI can reach an ideal (close to ideal 1) state.

CONCLUSIONS AND POLICY IMPLICATIONS

The Russian gas industry also could be considered as the source of sustainability, the

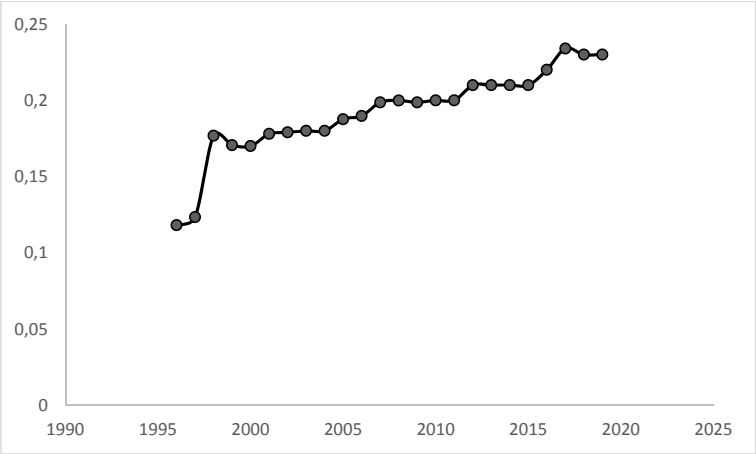

Fig. 4. **SBI dynamics from 1996 to 2019**

Source: the authors' calculations.

source of social responsibility, energy efficiency and environmental protection measures in progress. Sustainable analysis in energy companies could be built on the basis of system methodology [44]. The authors argue that energy, environment and social responsibility are much more critical factors for the sustainability of growth and development than Russian gas companies' management suppose. Indeed, according to nowadays reality, the meaning of sustainable growth should be reconsidered in the context of environmental protection, energy efficiency, and social responsibility.

The authors suggested that it is expedient to use the complex estimated indicator characterizing sustainable growth for a better understanding of companies' sustainability growth system. The choice of indicators and extent of factors that influence interaction inside the Russian gas industry's system is determined. If necessary, the company's management could revise the indicators every year, based on its own sustainable growth goals and methodology. Intrinsic high-quality influence of non-financial factors (energy, social, environmental) on the Russian gas industry's sustainable growth indices was revealed.

Nowadays, the authors have a heated discussion on what is better — financial sustainable growth should be balanced (all parts of the model are equal at the end) or this model is not useful in our society, because it expresses only "ideal" balanced World. The authors firmly intended to research an all-level-equilibrium system index concerning various sets of subsystems and factors. The authors intended to continue research under the system paradigm.

The authors have used System Balance Index (SBI) formula to ensure the Russian gas industry's sustainable growth. As the main Research conclusion, the links between financial sustainability and sustainable factors, such as LEI, ROE_{env}, ROE_{sr} were obtained. Russian gas companies' financial policy results should also depend on sustainable factors. As we know, SGR_H is related to $ROE, FL, RG, WACC, NWCT$ to contribute to financial sustainability, that is why companies should pay more attention to these financial coefficients that have a great influence on financial sustainable growth rate. But SGR_H is also related to nonfinancial factors to contribute to financial sustainability. That is why the authors decided to include nonfinancial factors in the System Balance Index (SBI). SBI expressed the intensity of links between model' factors components, trends equilibrium. The way from "just now" non-balanced Russian gas industry configuration to future "ideal" balanced (sustainable) configuration was found. Results show that if ROE_{env} and ROE_{sr} are suffering in the company, SBI would suffer too. This fact could help to determine the importance of environmental protection and social responsibility factors in the sustainable growth system as a whole. It has been shown that on the assumption of the nature of their spatial and temporal boundaries, the sustainable

system can be influenced not only financial factors, but also by non-financial factors, like energy saving, environmental protection and social responsibility factors.

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ORIGINAL PAPER

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Impact of the Value of Intangible Assets on the Capitalization of Food Retailers for their Sustainable Growth

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ABSTRACT

The **objective of the research** in the article is the food retail companies that occupy leading positions in the Russian and foreign markets. The **subject of the study** is financial and economic relations in the field of the use of intangible assets (IA) as a significant factor in increasing the capitalization of food retailers and their sustainable development. The **relevance** of the problem is due, on the one hand, to the significant contribution of trade to the country's GDP, on the other hand, to the need to find new drivers for the sustainable development of food retailers in the context of overcoming the negative consequences of the pandemic and the digital economy. The **purpose** of the study is to assess the impact of the value of intangible assets on the capitalization of food retailers. The authors applied the **methods** of comparative analysis, calculation of financial and economic indicators, correlation, and regression analysis of statistical data processing. The authors used Student's t-test and Fisher's f-test to confirm the quality of the constructed model. The study shows that Russian food retailers, as compared to foreign ones, occupy a smaller market share in the domestic economy and have a smaller share of intangible assets in the non-current assets of companies (except for X5 Retail Group). On the Russian food market, a trend has been revealed towards an increase in the production of goods under private labels and a decrease in the presence of foreign retailers, as well as an increase in the share of online trading that requires the use of intellectual property, including digital intangible assets, and leads to an increase in cash flows. Based on multivariate correlation analysis, it was found that the capitalization of trading companies in the food sector is most affected by the value of intangible assets and return on them. The constructed model of linear two-factor regression allows the authors to **conclude** that with an increase in the value of intangible assets by 1%, the market capitalization of a company increases by 10% with a constant return on assets. The article provides recommendations for Russian food retailers on the formation and use of a portfolio of intangible assets for value-based business management, which will contribute to their sustainable development.

Keywords: the value of intangible assets; return on assets; capitalization of food retailers; digital economy; sustainable development

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INTRODUCTION

The relevance of the research on the impact of intangible assets on the capitalization of food retailers is due to a number of currently existing socio-economic trends and factors.

Firstly, it should be noted that the share of retail and wholesale trade in Russia's GDP, according to Rosstat, has remained significant over the past three years and amounts to about 11–12%,[1] trade in the structure of domestic GDP ranks 8th, which indicates the importance of this industry for the country's economy.

In 2012–2019 the largest contribution (up to 48%) to the total volume of retail trade was made by food and grocery retailers (*Fig. 1*).

Secondly, in the structure of sales of food and grocery retailers, a special place is occupied by the so-called private label products. These products are manufactured either under the brand of a retail chain or under another brand that is sold exclusively in that retail chain. Due to the lower advertising and marketing costs, private label products have a lower cost compared to well-known brands. In addition to control over pricing, retailers also gain control over product quality, which is an important aspect of a retail chain's appeal.[2]

Fig. 2 shows that Russian retailers have been actively expanding the range of their own brands: for the period 2011–2018 the share of such products increased from 2% to 8%. Thus, the importance of intangible assets, including the goodwill of food and grocery retailers, is increasing as a factor influencing the investment attractiveness and, as a consequence, the capitalization of trading companies.

This is also evidenced by another trend that has emerged in connection with the digitalization of the economy, and more recently the difficult epidemiological situation caused by the coronavirus disease — the growth of online sales of fast-moving consumer goods (FMCG), including food and grocery retail trade (*Fig. 3*).

At the end of 2019, the turnover of the online food sales market showed a rapid growth of 67% and amounted to 45 billion rubles.[3] Consumers are changing their habits: actively ordering products online, comparing prices in an online store before buying, using smartphones to analyze special offers, and using social media as a feedback form for retailers. Online sales of FMCG are expected to reach 2.2 trillion rubles (7.0% of the retail market) by 2029.[4]

Table 1 shows the largest online food and grocery stores according to the InfoLine rating for May 2020, that is, during the first wave of coronavirus in Russia (*Table 1*).

According to the table, X5 Retail Group is in the lead, but the recently launched Sbermarket is actively promoting its online services.

Today, large retailers not only show interest in the online format, but also actively open online supermarkets, for example, perekrestok.ru, auchan.ru, av.ru, shop.lenta.com, okeydostavka.ru, vkusvill.ru, delivery.metro-cc.ru.[5] The online trading format requires the registration of their own domain names, the development of websites, special software applications, and digital content, which, in turn, also increases the share of digital intangible assets of trading companies.

Thus, it is due to intangible assets that companies can create a unique product that is in high demand not only due to its quality but also to the positive reputation of the brand, as well as the information and digital

[1] Russia in numbers, 2020. URL: https://gks.ru/bgd/regl/b20_11/Main.htm (accessed on 11.03.2021).

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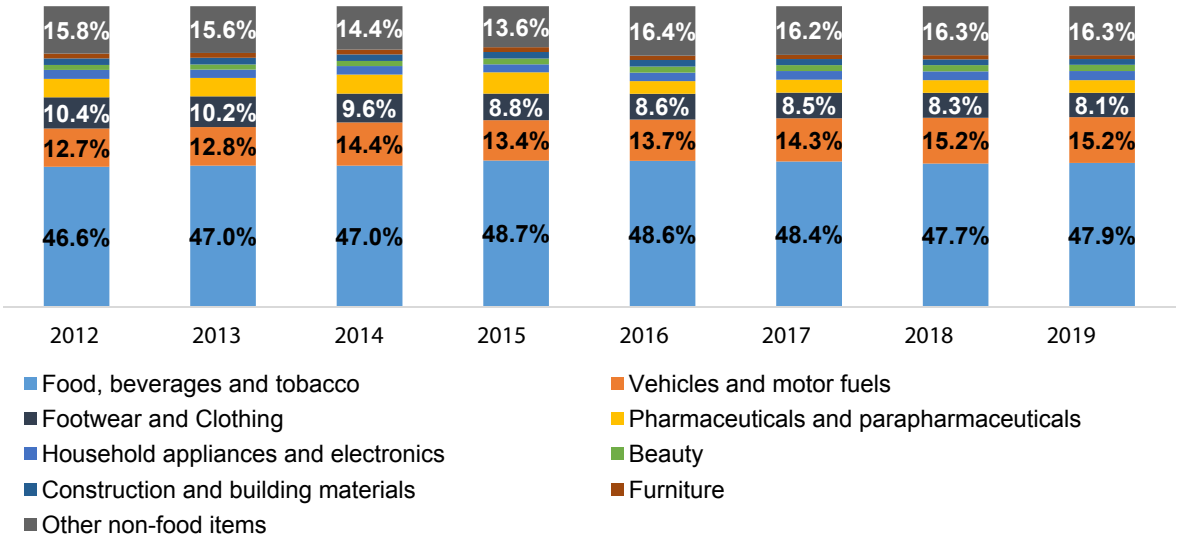

Fig. 1. **Structure of retail sales in Russia, 2012–2019, %**

Source: Rosstat data, gks.ru.

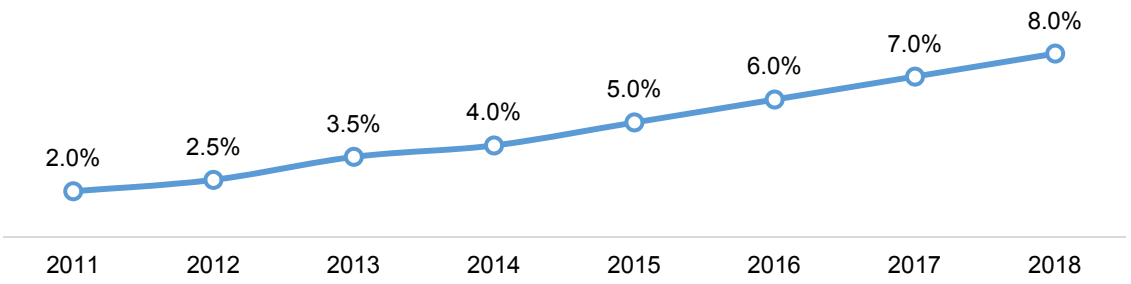

Fig. 2. **Share of sales of private label products in the retail market of Russia, 2011–2018, %**

Source: compiled by the authors based on materials from the InfoLine information agency. URL: http://infoline.spb.ru (accessed on 11.03.2021).

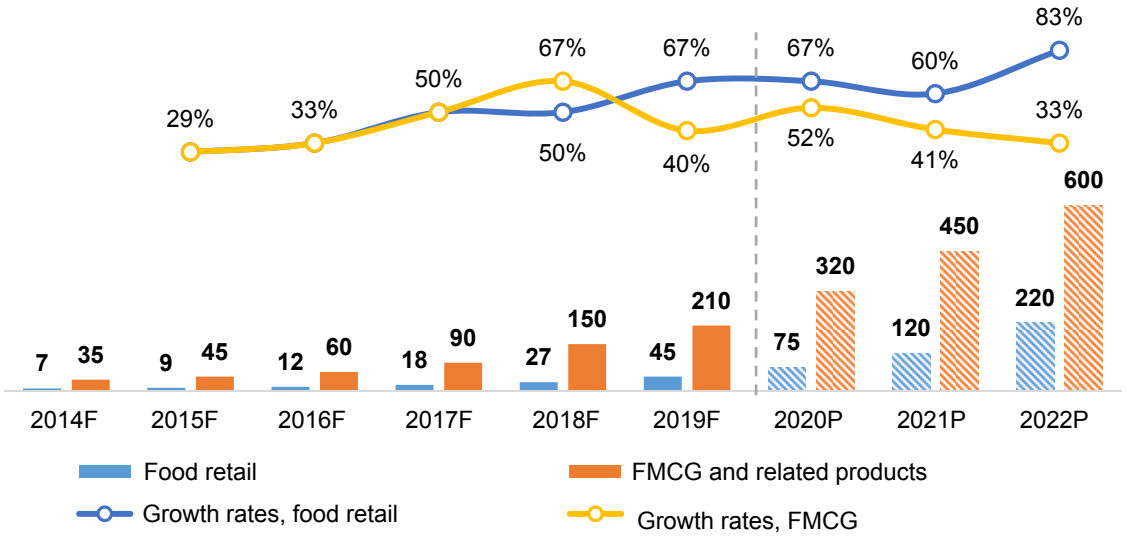

Fig. 3. **Dynamics of the online FMCG retail market, 2014–2022, RUB billion**

Source: compiled by the authors based on materials from the InfoLine information agency. URL: http://infoline.spb.ru (accessed on 11.03.2021).

Table 1

TOP online grocery retailers in Russia

Retailers	Turnover, RUB billion (VAT incl.)	Orders, thousand	Average purchase value, RUB (VAT incl.)
X5 Retail Group: Perekrestok.ru	2.37 1.7 0.673	714 350 364	3319 4813 1849
SberMarket	2.028	505	4015
Utkonos	1.9	295	6450
Ozon.ru	1.6	1400	1140
Vkusvill	1.25	604	2070
Yandex.Lavka	1.2	1200	1000
iGoods	1.1	241	4565
Wildberries	0.997	-	-
Samokat	0.95	1400	680

Source:Forbes magazine website. URL: https://www.forbes.ru/biznes/404047-situaciya-vse-bolshe-pohodit-na-gonku-vooruzheniy-kak-servisy-x5-i-sberbanka?photo=3 (accessed on 11.03.2021).

innovations used in the process of selling food products. Therefore, every food and grocery retailer striving to grow in the market and increase its capitalization should focus on these assets.

The study aims to substantiate the importance of intangible assets as a factor in the growth of food retailers' business based on assessing the impact of intangible assets on their capitalization.

To achieve this aim, we set the following tasks:

- to analyze the macroeconomic indicators affecting the turnover of retail companies;
- to conduct a comparative statistical analysis of domestic and foreign food retailers in terms of structure, share of intangible assets in non-current assets;
- to conduct a correlation and regression analysis of the impact of intangible assets on the capitalization of the studied food retailers of the Russian and foreign markets;
- to give recommendations to Russian food and grocery retailers on intangible asset management in order to increase the capitalization of companies in the digital economy.

MATERIALS AND RESEARCH METHODS

The information base of the study was the work of domestic and foreign scientists engaged in the development of the concept of company value management, the valuation of intangible assets, regulatory documents and standards in the field of valuation, official statistics, and official websites of food retailers[6] and information and analytical database Bloomberg.[7]

[6] "Dixie Group" official website. URL: https://dixy.ru/ (accessed on 25.03.2020). "Magnit" official website. URL: https://magnit-info.ru/ (accessed on 25.03.2020). "Okey Group" official website. URL: https://www.okmarket.ru/ (accessed on 25.03.2020). "Lenta Ltd" official website. URL: https://lenta.com/ (accessed on 25.03.2020). "Walmart Inc" official website. URL: https://www.walmart.com/home (accessed on 25.03.2020). "X5 Retail Group" official website. URL: https://www.x5.ru/ (accessed on 25.03.2020).

[7] Bloomberg information and analytical system. URL: http://www.bloomberg.com (accessed on 20.03.2020).

The theoretical basis of the study was the value-oriented management models [1], in which intangible assets play a significant role, in particular: G. Ahonen's "intangible value chain" [2] for the company to receive additional income from the use of intangible assets and, as a result, positive market value added (MVA); "value creation mix" by R. Normann and R. Ramirez [3], where intangible assets, as well as intangible competencies and hidden abilities to create innovations, are considered as strategic assets of the company [4]; models of the impact of off-balance sheet intangible assets (customer loyalty [5], company image [6], research results [7]) on the efficiency of commercial activities, etc. Particular attention was paid to the work of researchers on the composition of intangible assets [8] and the search for growth drivers for retail companies [9, 10].

Since the market capitalization is used as an indicator characterizing the value of a company, which is largely influenced by external factors, the methods of macroeconomic [11, 12] and statistical analysis [13, 14] were used. To study the influence of internal factors associated with the activities of the companies themselves, the methods of analysis of economic indicators [15–17], obtained from the data of financial and management reporting, were used.

Finally, the study of the relationship between intangible assets and the capitalization of grocery retailers was carried out using multivariate correlation-regression analysis [18, 19], which makes it possible to measure the tightness of the relationship between variables and determine which of the factors has the greatest influence on the effective indicator, as well as to establish the form of dependence and build a model regression to predict the capitalization of companies for given values of factor variables [20].

RESEARCH RESULTS

Analysis of macroeconomic factors affecting the turnover of Russian food retailers

The consumer price index (CPI) should be considered as macroeconomic factors that directly affect the financial performance of food retailers.

The consumer price index for food products characterizes the average change in prices for a certain period for products included in the consumer basket. *Fig. 4* shows the dynamics of this index for the period 2010–2019.

The graph shows a downward trend in the index during relatively prosperous periods of economic development and spikes in values during crisis events (after the economic crisis of 2008, in 2014–2015 due to the introduction of anti-Russian sanctions, in 2018 due to the strengthening of macroeconomic instability in the world). In December 2020, the CPI value for food was 104.21% compared to December 2019, which is associated with another unfavorable factor — the downturn of the Russian economy due to the pandemic.

In addition to product inflation, the volume of sales in this segment can also be affected by the level of real household incomes. For the analysis, the indicator of real disposable household income was selected, which characterizes income adjusted for the rate of inflation, excluding mandatory payments. *Fig. 5* shows the dynamics of real disposable cash income in Russia for the period 2014–2019, expressed in terms of growth rates compared to the previous year.

The graph shows a downward trend in real disposable household incomes after the emergence of crisis phenomena in the economy, in connection with which one should expect a decrease in this indicator in 2020 compared to the previous year against the background of negative economic consequences during the pandemic.

The relationship between the indicators of food inflation, the rate of change in real disposable household income, and the

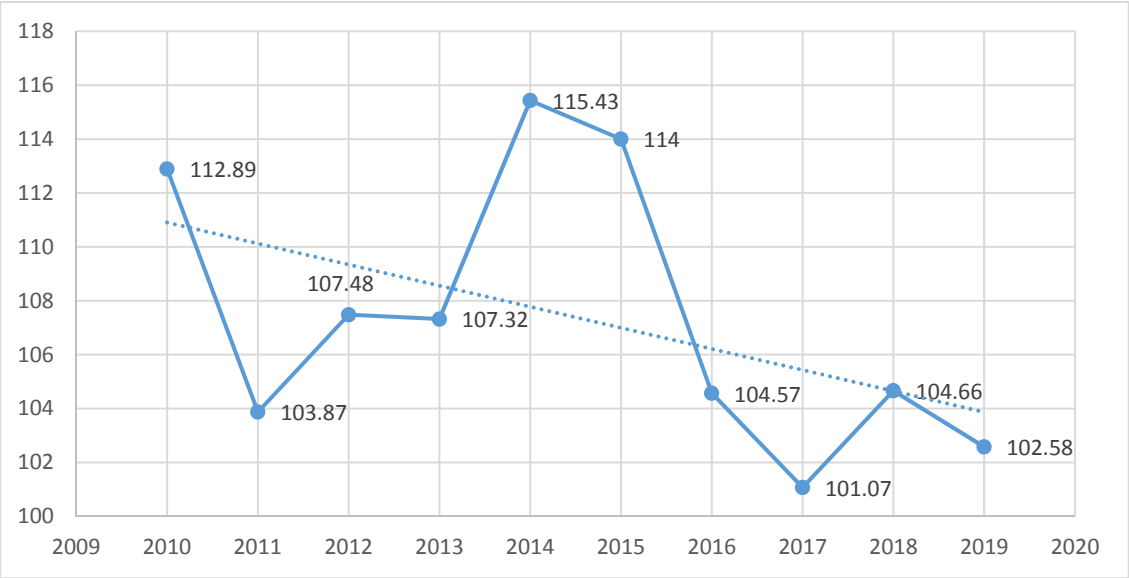

Fig. 4. **CPI for food products in 2010–2019**

Source: compiled by the authors based on the Rosstat data. URL: https://www.gks.ru/folder/13397?print=1 (accessed on 04.05.2021).

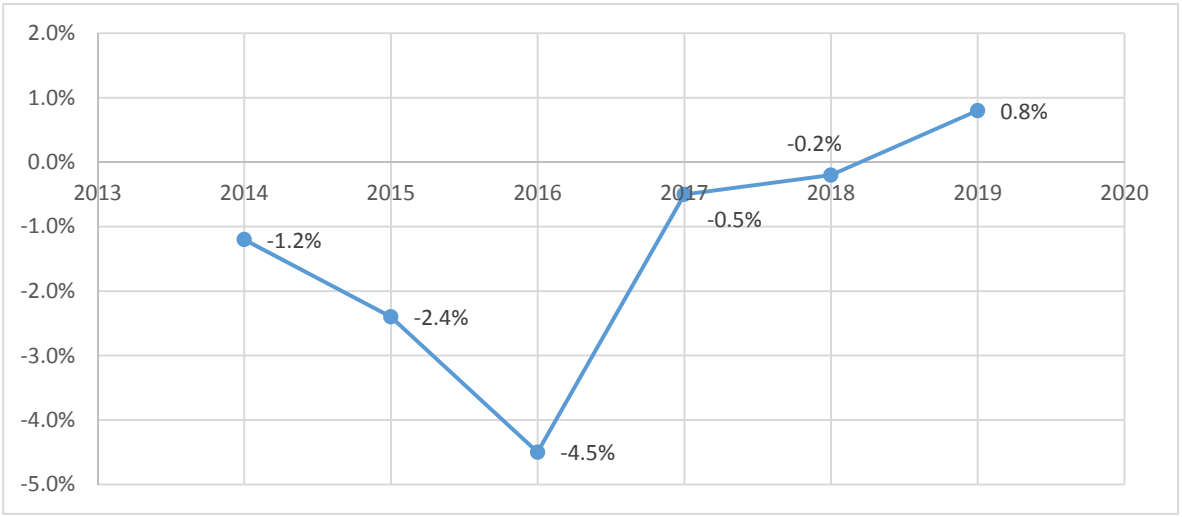

Fig. 5. **Dynamics of the growth rate of real disposable income in Russia compared to the previous year**

Source: compiled by the authors based on the Rosstat data.

turnover of food retail trade is shown in the graph (*Fig. 6*).

Based on the graphs presented, it can be concluded that the change in the growth rates of food retail turnover and the growth rates of real disposable income (RDI) practically coincide. The dependence of trade turnover and the consumer price index is observed in the period up to 2017, then a decrease in food inflation does not lead to the same slowdown in the growth rate of retail trade.

Based on the results of the analysis of macroeconomic factors, we can conclude that the volume of the retail food market is closely related to the level of real disposable income of households, but, regardless of the economic situation, the food market does not so clearly "fall" due to the social significance of the goods provided. In this regard, the capitalization of food retailers will largely be influenced by internal factors that determine the competitiveness of companies in modern

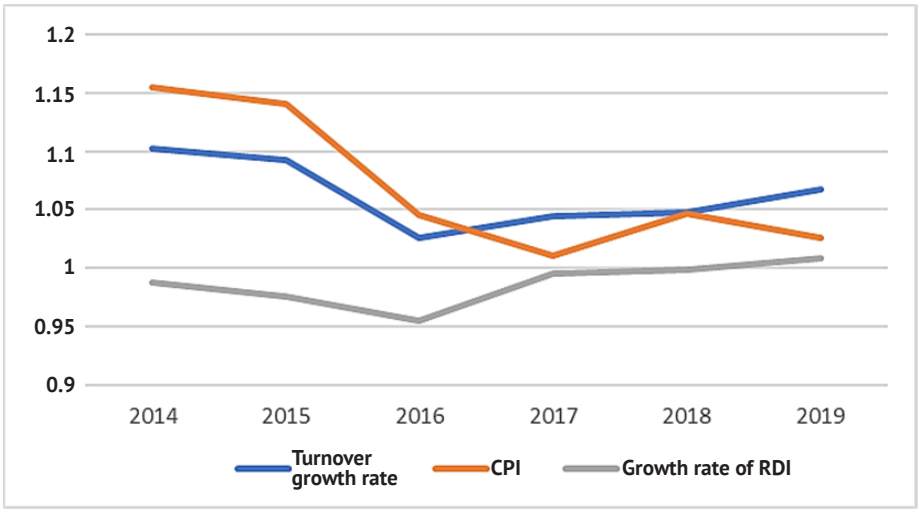

Fig. 6. **Growth rates of the main macroeconomic indicators in the food retail market**

Source: compiled by the authors based on the Rosstat data.

economic realities, primarily intangible assets and financial indicators.

Comparative analysis of domestic and foreign food retailers by structure and share of intangible assets in their non-current assets

Initially, we will identify the largest Russian and foreign food retailers as key players in the food market. According to Deloitte, among the 250 TOP retailers in the Global Powers of Retailing rating[8] at the end of 2019, Russian retail chains such as X5 Retail Group ranked 42nd with revenue of $ 24.4 billion, Magnit — 51st with revenue of $ 19.4 billion, Lenta Ltd — on the 159th place with revenue of $ 6.6 billion, Dixy Group — on the 215th place with $ 4.7 billion. The Russian food retailer O'Key Group, which was not included in the rating of Deloitte, but occupies a significant position in the domestic food market, was also selected for the analysis.

The listed companies are among the five leaders of the Russian food market. They account for 28.8% of the entire food market in Russia. In some foreign countries, the indicator characterizing the market share of the largest retailers is much higher, for example, in the USA — 46%, in France — 54%, in Poland — 56%, in the UK — 61%, in the Czech Republic — 71%, in Germany — 74%.

Foreign food retailers holding leading positions in the aforementioned revenue ranking include Target (USA) — 11th; Aeon (Japan) — 13th place; Tesco (Great Britain) — 1st place; Carrefour (France) — 7th place; Kroger Co. (USA) — 5th place, Walmart (USA) — 1st place.

In the selected retail chains for the purpose of comparative analysis, the study considered the absolute value of intangible assets reflected on the balance sheet of the organization; the share of intangible assets in non-current assets (*Tables 2, 3*); composition and structure of intangible assets.

As of 2019, the absolute value of intangible assets prevails among the industry leader X5 Retail Group and amounts to more than 126 billion rubles, which is more than 2.5 times the sum of all intangible assets of other represented Russian retailers. It should be noted that the value of intangible assets for many domestic companies is growing, but the share of intangible assets in non-current assets of almost all retailers, except for X5 Retail Group, remains quite stable. At the same time, Dixy is the leader with a 31% share of intangible assets, which significantly

[8] Global Powers of Retailing. Deloitte. 2020. URL: https://www2.deloitte.com/uk/en/pages/consumer-business/articles/global-powers-of-retailing.html (accessed on 05.05.2020).

Table 2

Analysis of the size and share of IA in non-current assets of the largest Russian food retailers

Absolute value of intangible assets (RUB million)							
	2013	2014	2015	2016	2017	2018	2019
X5	78878.7	80302.0	90414.0	96749.0	108718.0	112574.0	126265.0
Magnit	2118.4	2352.5	2765.7	2791.1	3635.5	28556.5	30794.0
Lenta	623.2	870.5	1092.3	1890.2	1816.7	1905.9	2271.0
Dixy	20543.1	20553.5	21273.4	21441.2	14907.5	15024.1	16321.3
O'key	550.0	539.4	1293.7	893.1	961.1	1294.2	1105.8
Share of intangible assets in non-current assets, %							
	2013	2014	2015	2016	2017	2018	2019
X5	35	33	31	28	27	14	14
Magnit	1	1	1	1	1	4	4
Lenta	1	1	1	1	1	1	1
Dixy	36	35	33	33	28	31	20
O'key	1	1	2	1	2	2	2

Source: compiled by the authors based on the Bloomberg information and analytical database.

Table 3

Analysis of the size and share of IA in the non-current assets of the largest foreign retail companies

Absolute value of intangible assets (RUB million)							
	2013	2014	2015	2016	2017	2018	2019
Target	11388	21163	20988	15522	39977	45755	43778
Aeon	67957	80934	155880	200391	153961	155485	178104
Tesco	202362	224324	359881	303830	197748	209573	534880
Carrefour	410219	672626	753496	639643	646497	750079	656819
Kroger Co	99716	214503	285145	250751	226950	284413	264327
Walmart Inc	685745	1268500	1260400	1024100	1026700	2043900	1983000
Share of intangible assets in non-current assets, %							
	2013	2014	2015	2016	2017	2018	2019
Target	1.0	1.1	1.1	1.0	2.6	2.4	2.3
Aeon	7.3	7.2	8.3	8.0	7.7	7.4	7.4
Tesco	11.6	10.2	11.6	9.8	8.9	8.5	17.2
Carrefour	36	34	34	33	37	33	30
Kroger Co	13.9	14.2	15.7	16.0	15.4	15.9	12.1
Walmart Inc	13.6	12.9	12.0	12.1	12.6	19.8	17.8

Source: compiled by the authors based on the Bloomberg information and analytical database.

exceeds the share of intangible assets even among foreign food retailers. Apparently, Magnit, Lenta, and O'Key companies do not pay enough attention to the development of their intangible assets.

Particular attention should be paid to the composition and structure of intangible assets of the companies under study in order to analyze which intangible assets prevail on the balance sheet of Russian food retailers.

The structure of Lenta's intangible assets is not shown in *Fig. 7*, since in 2019 only software is present in the company's intangible assets.

In terms of the variety of intangible assets, Magnit leads with such intangible assets as goodwill (91%), software (4.94%), lease rights (2.85%), licenses (0.5%), trademarks (0.1%). It should be noted that goodwill is reflected in the balance sheets of only three companies under study — X5 Retail Group, Magnit and Dixy Group, while it accounts for more than 80% of all available intangible assets of the companies. It is also worth paying attention to the availability of software, which is becoming more important in the era of digitalization. According to this indicator, X5 Retail Group is in the lead, with software accounting for 92% of all intangible assets.

Among foreign retailers, the undisputed leader in the absolute value of intangible assets throughout the entire study period is the American company Walmart, which also ranks first in the Global Powers of Retailing 2020 report. In 2019, the value of the intangible assets of this grocery retailer is approximately 1,983 billion rubles, which is more than 157 times higher than the indicator of the main player in the Russian food retail market — X5 Retail Group. This difference is explained both by the greater amount of goodwill and by the fact that foreign companies, unlike Russian ones, try to reflect all intangible assets on their balance sheets, which increases their investment attractiveness and capitalization.

At the same time, the share of intangible assets in non-current assets of foreign retailers generally exceeds this indicator for Russian companies (with the exception of Target). Only the shares of intangible assets in non-current assets of X5 Retail Group and Dixy Group are comparable to them.

Based on the comparative analysis of food retailers in the domestic and foreign markets in terms of intangible assets, we can conclude that the largest Russian retailers, with the exception of X5 Retail Group, are inferior to foreign ones in absolute value, intangible assets are recorded on the balance sheets of organizations. Also, the share of intangible assets in the structure of assets of domestic companies is on average lower than that of foreign companies.

Correlation-regression analysis of the impact of intangible assets on the capitalization of the studied food retailers of the Russian and foreign markets

The analysis was carried out in several stages:

1) determining the linear correlation coefficient between capitalization and the book value of intangible assets for the studied Russian and foreign food retailers;

2) conducting a comparative analysis of the financial and economic indicators of Russian and foreign food retailers to form a general homogeneous sample for correlation and regression analysis;

3) carrying out a multivariate correlation analysis to collect, in addition to intangible assets, other most significant factors affecting the change in the effective indicator;

4) building a multivariate regression model and assessing its quality.

Stage 1. Determination of the linear correlation coefficient between capitalization and the book value of intangible assets.

The values of the linear correlation coefficient between the book value of intangible assets and the capitalization of Russian and foreign food retailers are shown in *Fig. 7*.

Based on the results obtained, the relationship between the capitalization

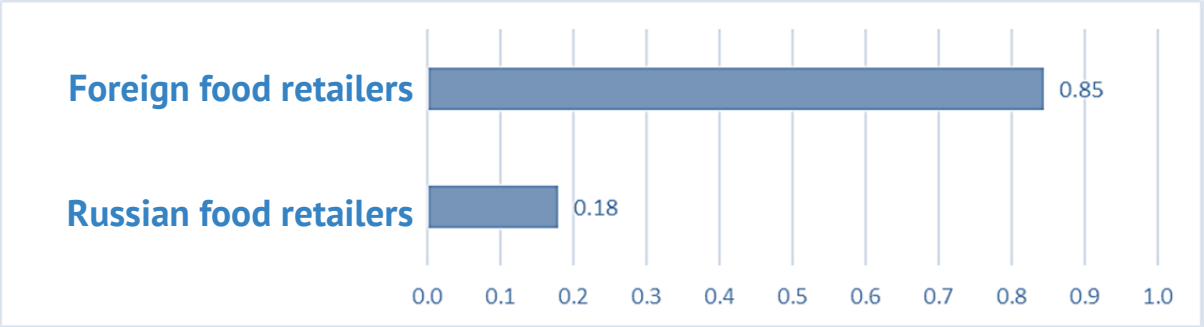

Fig. 7. **Correlation coefficients between the value of IA and the capitalization of companies**

Source: compiled by the authors on the basis of calculations using the MS Excel Data Analysis.

Table 4

Financial and economic indicators of Russian food retailers, 2019

Indicator	X5 Retail Group	Magnit	Lenta	Dixy	Okey	Average value
Capitalization growth rate, %	125	96	85	109	87	100.4
Share of intangible assets, %	12	3	1	20	2	7.3
Asset turnover	1.67	1.49	1.38	3.78	1.83	2.03
Return on assets,%	9	5	6	6	4	6
Leverage	8.67	4.57	3.75	8.29	3.78	5.81
Tobin's Q	1.43	1.15	1.03	1.21	1.03	1.17
Current liquidity	0.49	2.32	0.95	0.47	0.91	1.03

Source: compiled by the authors based on the Bloomberg information and analytical database.

indicator and intangible assets for Russian companies can be called weak, since the correlation coefficient is less than 0.3. For foreign companies, on the contrary, the relationship between these indicators is close, since the correlation coefficient ranges from 0.7 to 0.9. In this regard, we can conclude that intangible assets do not have such a strong impact on capitalization in the Russian food retail market as in the external market. This can be explained by factors such as high volatility of the stock market in the food retail sector, underestimation of Russian companies in general, incomplete reflection in the balance sheet of intangible assets of companies, and also by the fact that the strategic benchmark of the companies under study is aimed more at increasing revenue than maximizing market value.

Stage 2. Conducting a comparative analysis of the financial and economic indicators of Russian and foreign food retailers (*Tables 4, 5*), which may also affect the change in their capitalization.

Comparing the average values of the two tables, we can conclude that the greatest differences relate to two characteristics: the growth rate of capitalization and the share of intangible assets in foreign companies is

Table 5

Financial and economic indicators of foreign food retailers, 2019

Indicator	Target	Aeon	Tesco	Carrefour	Kroger Co	Walmart Inc	Average value
Capitalization growth rate, %	148	146	141	90	92	114	122
Share of intangible assets, %	1.6	3.0	12.8	19	9	13	10
Asset turnover	1.9	0.8	1.4	1.5	3.2	2.3	1.8
Return on assets, %	11	2	4	4	6	9	6
Leverage	3.6	8.7	3.7	5.1	5.1	3.1	4.9
Tobin's Q	2.0	1.1	1.1	1.0	1.4	2.1	1.5
Current liquidity	0.89	0.99	0.61	0.82	0.76	0.80	0.81

Source: compiled by the authors based on the Bloomberg information and analytical database. URL: http://www.bloomberg.com (accessed on 20.03.2021).

Table 6

Values of the correlation coefficient (*R*) based on the results of multivariate correlation analysis

	Market capitalization	IA	ROA	Assets turnover	ROE	Leverage
Market capitalization	1.00					
Intangible assets value	0.88	1.00				
Return on assets	0.50	0.31	1.00			
Asset turnover	0.25	0.18	0.79	1.00		
Return on equity	0.12	–0.02	0.60	0.76	1.00	
Leverage	–0.37	–0.24	–0.25	–0.06	–0.08	1.00
Current liquidity	0.22	0.18	–0.29	–0.23	–0.25	–0.14

Source: compiled by the authors using the MS Excel Data Analysis.

significantly higher than similar indicators for Russian companies.

In addition, Russian companies have significant volatility in their indicators relative to the average. Thus, the values of indicators of X5 Retail Group are close to or exceed the average values (excluding current liquidity). At the same time, the rate of capitalization growth for this retailer is the highest. For the rest of the companies, most of the indicators take values below average or there are some "outliers", in particular, the share of intangible assets in Dixy Group significantly exceeds the average values, as does the current liquidity of Magnit.

Standard Error	2.5443477					
Observations	42					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	2	1174.973922	587.4869612	90.74972392	2.13459E–15	
Residual	39	252.4745035	6.473705218			
Total	41	1427.448426				
–	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	–3.440875938	0.864611698	–3.979677752	0.000290999	–5.18971817	–1.692033707
HMA	10.01635645	0.871083993	11.49872634	4.24709E–14	8.25442277	11.77829013
return on assets	38.29922012	12.44661832	3.077078379	0.003813248	13.12355826	63.47488198

Fig. 8. **Regression analysis data of the relationship between the value of IA, return on assets, and capitalization of the companies under study**

Source: compiled by the authors using the MS Excel Data Analysis.

Table 7

Evaluation of the quality of the constructed regression model

Parameters	*t*-test	*t*-tab.	Comparison	Significance of coef.	*P*-value	α	Comparison	Significance of coef.
b0	–3.980	2.708	–3.980|> t tab.	Significant	0.0003	0.05	0.0003 < α	Significant
b1 (IA)	11.499	2.708	11.499 > t tab	Significant	4.25E – 14	0.05	4.25E – 14 < α	Significant
b4 (ROA)	3.077	2.708	3.077 > t tab.	Significant	0.0038	0.05	0.0038 < α	Significant
Parameter	F-test	F tab.	Comparison	Equation significance	Significance F	α	Comparison	Equation significance
Regression equation	90.750	5.194	90.75 > t tab.	Significant	2.13E – 15	0.05	2.13E – 15 < α	Significant

Source: compiled by the authors based on regression analysis data.

Most foreign companies do not show strong volatility of their indicators relative to the average. The only exception is Target, which has the largest negative deviation of the share of intangible assets from the average, so it is advisable to exclude its data from further analysis. The leader is Walmart Inc, whose performance is either above or close to the average (excluding leverage). Thus, the sample for correlation-regression analysis includes five foreign companies (except for Target) and one Russian company — X5 Retail Group, which is on a par with foreign companies in many competitiveness indicators, including the absolute value of intangible assets, their share in non-current assets, return on assets, Tobin's Q ratio. In addition, having calculated for a given company separately the correlation coefficient between the indicators of the company's market capitalization and the value of intangible assets, we obtained a value of 0.86 (86%), which indicates a close relationship between these indicators.

Stage 3. Conducting multivariate correlation analysis.

This analysis allows us to select from the set of considered financial and economic internal factors those that have the greatest

impact on market capitalization. *Table 6* shows the results of the analysis.

Based on the results obtained, it can be concluded that of all the factors studied, the closest relationship with the effective indicator (market capitalization) is for intangible assets (R = 0.88), and there is also a noticeable relationship with the return on assets ratio (R = 0.5). The relationship between capitalization and other factors is weak or moderate (R < 0.5), therefore, these factors can be excluded from further consideration.

Stage 4. Building a multivariate regression model.

A linear model was chosen for the analysis. Considering the value of intangible assets and the return on assets selected at the stage of multivariate correlation analysis, we will construct a two-factor model of their influence on changes in market capitalization.

The results of the regression analysis are shown in *Fig. 11*.

Thus, the resulting model will be:

$$f(x) = -3,44 + 10,02x_1 + 38,30x_2, \qquad (1)$$

where $f(x)$ — market capitalization of the company;

x_1 — value of intangible assets;

x_2 — return on assest.

The coefficient of determination for the two-factor model is about 82%, which indicates the high quality of the model and the fact that changes in the effective indicator by 82% are due to changes in the factors of the model (the value of intangible assets and return on assets).

To assess the quality of the model, we will run the Fisher F-test and the Student's t-test for each of the coefficients at the 5% significance level and for the model itself (*Table 7*).

Based on *Table 7*, we can conclude that all found regression coefficients are significant, and the equation itself is applicable not only for the sample but also for the general population of retailers. Consequently, the constructed regression model is adequate.

CONCLUSIONS

Overcoming the consequences of the pandemic for the Russian economy involves the implementation of measures aimed, inter alia, at maintaining the quality of life of the population. In this regard, providing citizens with vital food products at reasonable prices requires the uninterrupted and efficient operation of food retailers, with GDP contribution of 12–14%. At the same time, for the companies themselves, the achievement of efficiency in conditions of an objective increase in prices is associated with the search for internal development drivers, which should certainly include the development of a new format of online trading and other digital marketing tools, which requires an increase in the share of intangible assets in non-current assets and improving the quality of their management.

As for the food retail sector in Russia, it is also worth noting that the market share of the leaders of this sector in aggregate is less than the share of the largest retail chains in foreign developed countries. At the same time, the market share of the largest Russian retailers is growing every year due to a decrease in sales through traditional distribution channels, as well as a decrease in the market share of foreign retailers in Russia with a simultaneous increase in the recognition of domestic trademarks and brands. This indicates future prospects for the development of Russian retail chains and the need to search for additional competitive advantages, which, based on the experience of world leaders, can become intangible assets.

The influence of intangible assets, as well as the return on assets, on the capitalization of food retailers and, as a consequence, on their investment attractiveness, is justified by the use of multivariate correlation-regression analysis based on data mainly related to foreign retail chains. The sample included

data from only one Russian company — X5 Retail Group, comparable to foreign peers in terms of key competitiveness indicators, including the size and share of intangible assets in non-current assets. The resulting model (*Fig. 1*) allows us to conclude that with an increase in the value of intangible assets by 1%, the market capitalization of a company can grow by 10% with constant profitability, and with an increase in the profitability of assets, including intangible assets, by 1% the market capitalization can grow by 38% at a constant value of intangible assets. The quality of the constructed model is confirmed using Student's *t*-statistics and Fisher's F-test.

For most Russian food retailers, a close correlation between market capitalization and intangible assets is not obvious. However, the previous conclusions provide a basis for the development of generalized recommendations for Russian food and grocery retailers to manage their intangible assets to increase capitalization and investment attractiveness. In particular, companies should:

1) adopt the concept of value-based management aimed at increasing the market value of a business and increasing its capitalization as a basic development strategy;

2) consider intangible assets as the main factor in increasing market capitalization;

3) in the absence of intangible assets on the company's balance sheet, take measures to identify them and reflect them in the accounting records;

4) introduce new digital technologies and innovations, including those related to e-commerce, in the main areas of the retailer's activities;

4) evaluate the existing intangible assets of the company for obsolescence and impairment, as well as analyze the effectiveness of their use and the possibility of commercialization;

5) form a portfolio of intangible assets based on the needs of the company, consumers and the food retail market as a whole;

6) determine the volume of investments in potential intangible assets, prioritize the most effective of them, contributing to an increase in the innovative and technological development of the retailer;

7) make a forecast of potential economic benefits, ensuring the growth of the value and capitalization of the company when using the created portfolio of intangible assets, make the necessary adjustments to it;

8) evaluate the effectiveness of the resulting portfolio of intangible assets.

Compliance with these recommendations by Russian food retail representatives, based on the experience of world leaders and the findings of the study, will help to increase the market capitalization and investment attractiveness of Russian food retailers, as well as their sustainable development.

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Formation and Assessment of the Investment and Reputation Capital of the Enterprise

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ABSTRACT

The article assesses the influence of factors that form the reputation of an enterprise in the real sector of the economy, on the ability to attract investments and form investment capital. The study **aims** to identify the most important components of reputation capital that stimulate the inflow of investments for the implementation of projects that are significant for the development of the region. The author applies **methods** of multidimensional weighted scoring assessment of business reputation, construction of factor models, and identification of regression relationships between investment capital and factors that form business reputation, methods of pair correlations, and modelling. This study assesses the impact of factors on the level of investment capital and business reputation of 38 regionally significant organizations included in the list of residents of the Territory of Advanced Social and Economic Development (TASED) of the Far East and receiving tax incentives and administrative benefits. The scientific hypothesis that the investment capital of an enterprise as a key element of the territorial economic system is formed under the influence of a complex of factors of business reputation is subject to verification. The types of business reputation are identified for enterprises of regional significance. The author makes a **conclusion** that the inflow of investments and the accumulation of capital is facilitated by information transparency, participation of the enterprise in socio-cultural, educational events in the region, support of ethical and corporate principles. The research results can be used by the management companies of the territories of advanced development and the management of enterprises implementing national projects for the development of the regional economy.

Keywords: territorial economic system; business reputation; compliance risks; territory of advanced development; capital of an enterprise; investments

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INTRODUCTION

The regional economic policy of the Russian Far East is aimed at the formation of territorial economic systems with a favorable investment climate and a special regime that stimulates entrepreneurial activity in the domestic and foreign markets. A business unit, namely an enterprise, becomes a strategic element of the territorial economic system, and the level of socio-economic development of the municipality and the region depends on its effective activity. Strategically significant enterprises in priority sectors of the national economy use the natural resource potential of the region, transport and logistics networks, accumulate significant amounts of capital, and provide employment for the population. In modern conditions of the implementation of the economic policy for the development of the depressed Far Eastern regions of Russia, territories of advanced development have been formed, which create an opportunity for favorable development and sustainable growth for enterprises included in the list of residents. The business activity of the enterprise is determined by the successful implementation of investment projects of a regional scale, the construction of industrial production, social and transport infrastructure.

To develop the economic potential of enterprises as elements of territorial economic systems, certain incentives are needed, which should include motivation of investors, support from regional authorities and management, budget co-financing of projects. Investors and the state invest in projects aimed at the local market, in the presence of highly effective demand of the population of the territory, low competition, and a high reputation of the enterprise in the market. Investments contribute to the modernization of industrial complexes, the introduction of resource-saving technologies, the expansion of sales markets, and the promotion of products for sale to foreign markets. Thus, a regionally significant enterprise with a certain economic potential should strive to activate the factors of successful long-term functioning, increase investments and form a positive business reputation in a competitive environment.

This study is based on the main provisions of the theory of capital (V. V. Kovalev [1], O.V. Efimova [2]), the assessment of the business reputation of the enterprise (I. S. Vazhenina [3], A. Veh [4], M. Menuet [5], E. D. Schetinina, E. A. Shchetinina [6]), the approach of stakeholders (V. G. Kogdenko, M. V. Mel'nik [7]), the concept of integrated reporting (N.V. Malinovskaya [8]). Scientific publications describe the economic role of capital for the development of corporate structures that accumulate financial investments, systematize the factors and components of business reputation. At the same time, the literature does not sufficiently study the priority factors of the formation of the business reputation of enterprises implementing significant investment projects for the development of the region and attracting real investments. In this regard, the aim of the study is to identify the most important components of reputation capital that stimulate the inflow of investments for the implementation of projects significant for the development of the region.

INVESTMENT AND REPUTATION CAPITAL OF THE ENTERPRISE AND FACTORS OF ITS FORMATION

Investment and reputation capital is an important structural element of an enterprise's capital, which ensures the economic growth of the territorial economic system. On the one hand, investment and reputational capital have a financial nature, which consists of the accumulation of invested funds at the expense of owners' investments, increasing profits, and attracting loans and credits. Capital is a form of investment value increment in the process of a relatively independent inflow of finance, ensuring the process of reproduction of the financial and economic activities of an enterprise. A financial concept developed before the

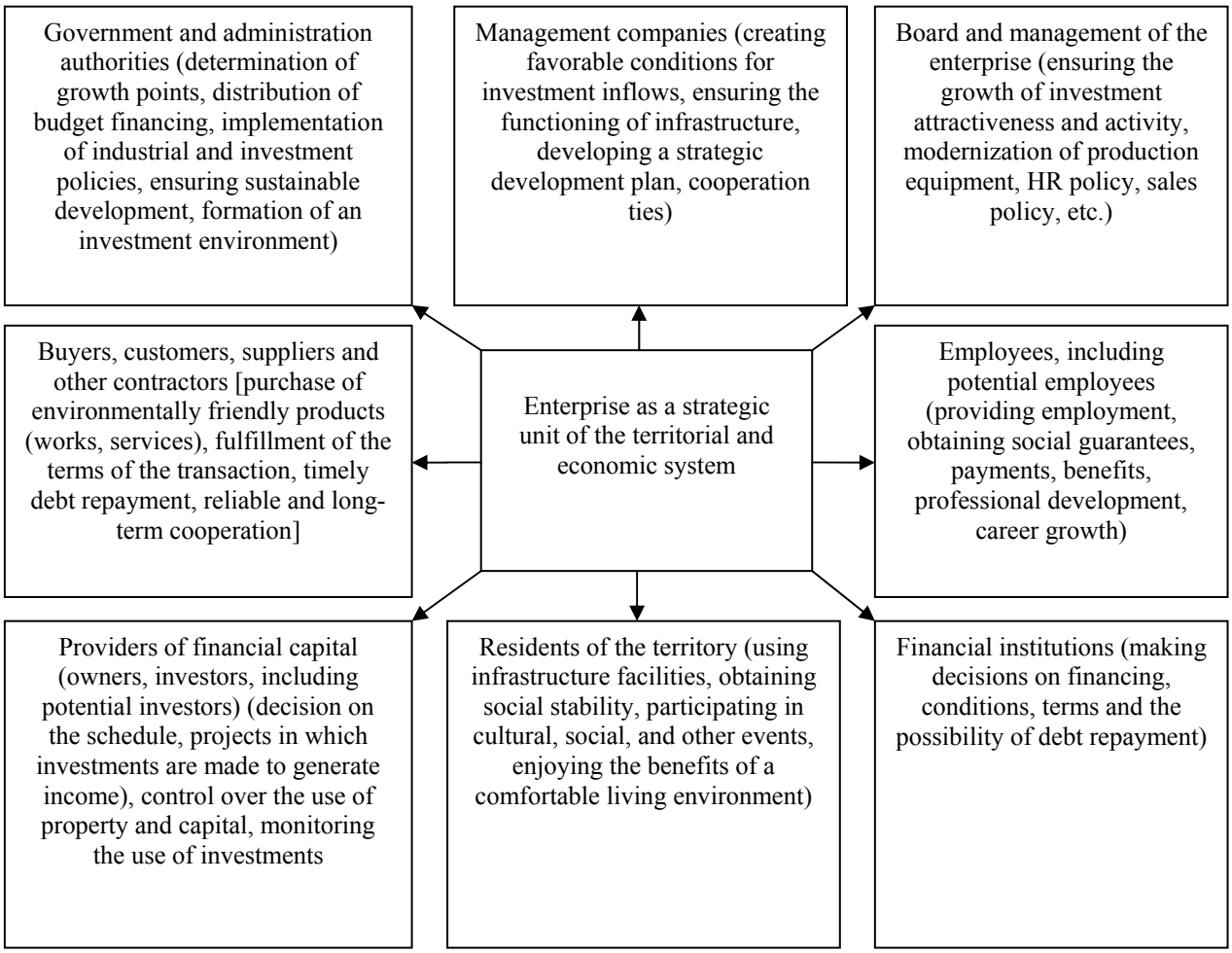

Fig. 1. **Stakeholders of enterprises of territorial economic systems**

Source: compiled by the author.

beginning of the 20th century. (A. Smith, J. Hicks, J. Sweeney, P. Samuelson) consider "investment capital", "net assets" and "own advanced capital" to be identical concepts. Based on this concept, the investment capital of an enterprise is calculated as the difference between assets and accounts payable [9]. O. V. Efimova [2] defined investment capital as the main source of financing for an enterprise. V. V. Kovalev notes that the enterprise performs an investment function, purposefully investing its own and borrowed funds in a particular project [1]. The larger the investment capital, the lower the risk of losing financial stability and protecting investors from the loss of invested capital. The financial concept makes it possible to reliably assess the amount of capital, the effectiveness of invested funds, and the value of the company using accounting methods and factor analysis techniques. However, the financial concept of capital does not describe the whole complex of exogenous and endogenous factors that contribute to the inflow of investments into the activities of enterprises of regional significance.

The most popular is the concept of integrated reporting, in which a combination of social and reputational, industrial, human, network, intellectual financial, natural capital plays a special role. The combination of all types of capital forms the market value of the company and supports sustainable economic growth. From the point of view of the concept of integrated reporting, investments are considered "economic resources that

contain the potential for obtaining economic benefits that are part of the capital" [8]. The variety of types of capital is associated with the approach of the stakeholder to the category of "enterprise", which implements the strategy of economic development and capital accumulation in interaction with the state in the framework of participation in government programs, suppliers of financial capital, suppliers and lenders, employees, customers, and the community. Interaction with stakeholder groups is schematically shown in *Fig. 1*.

When interacting with groups of stakeholders, the business reputation of the enterprise, network relations, and connections with the external environment are formed. The enterprise becomes the center of the territorial and economic system, in which the exchange of resources and information, the distribution of capital, and the formation of a value chain take place.

From the point of view of stakeholder theory, the goal of enterprise development is to meet the needs of a wide range of stakeholders by creating public goods, increasing the assets and resources of the territory, creating connections and competitive advantages. A successful enterprise that implements investment projects important for the socio-economic development of the region becomes a tool for popularizing and shaping the image of the territory. At the same time, as the business reputation of the enterprise and the project grows, interest in the region grows from the economically active population, domestic and foreign investors. For most stakeholders, an important criterion for assessing the success and effectiveness of work is not only the cost of investment capital but also quality parameters or the attitude of stakeholders. In this understanding, business reputation becomes an important component of investment and reputation capital.

Economists associate the category of "business reputation" with similar scientific categories "image and fame", "social responsibility" [10], "reliability" and "investment attractiveness" [11]. The relationship between these categories is manifested in the fact that most often reputation factors are integral components of qualitative and quantitative methods for assessing investment attractiveness, reliability, etc. The above concepts are quite subjective since they depend on the opinions of various stakeholder groups ("a set of beliefs or rational opinions") [3].

M.D. Akat'eva [11] associates reputation with competitiveness, which increases financial stability and returns on investment. Investment attractiveness is considered as a type of business reputation formed by one group of stakeholders (investors).

S.G. Vazhenin and I.S. Vazhenina rightly notes that reputation forms trust as an integral part of "economic relations, which characterizes the expectations of the participants regarding their compliance with the established rules of interaction and their obligations" [12]. At the same time, scientists note that a decrease in confidence in an economic entity affects the imbalance of all socio-economic processes in regions and municipalities, leads to financial difficulties, a drop in interest and support of investors and authorities. An enterprise's reputation is an important component of economic security, protecting the organization and its stakeholders from internal and external threats.

Summarizing the existing approaches, it is necessary to highlight the distinctive features of investment and reputation capital:

- multidimensional nature of formation under the influence of many endogenous and exogenous factors (investment climate of the region, management and financial system of the enterprise);
- relations with human, intellectual, natural, financial and other types of capital;
- long-term nature of education and the possibility of a loss of value with a sharp deterioration of risk factors;

• the formation under the influence of the subjective opinion of stakeholders, their emotions, perception and expectations.

Investment and reputation capital is formed under the influence of a complex of factors that can be both stimulating and constraining. The latter include reputational risks, which become threats of loss of investment and termination of the project. Reputational risk is considered as the threat of loss of reputation as a result of the negative perception of the organization by its customers, counterparties, and other stakeholders, which affects the organization's business relations, maintenance, and establishment [11]. The emergence and strengthening of reputational risk threaten to increase the cost of borrowed capital due to decreased confidence in the organization on the part of investors and lenders, limited public support and access to administrative resources, decreased customer loyalty, and the organization's solvency. Reputation characterizes the position of an enterprise in the economic environment, the ability and capability to cope with financial, regional, social risks, and other factors of instability.

To assess the level of business reputation, there is a fairly wide range of indicators, which, as a rule, are subdivided into groups: corporate, informational, image, ethical and behavioral, organizational-functional, institutional, etc. Analysis and grouping of factors of business reputation by frequency of mention in the literature are presented in *Table 1*.

In the methods of assessing business reputation, financial indicators are dominant, and in weighted scoring financial indicators are assigned a higher weight value. Reputation is assessed using indicators of financial stability, which contributes to the formation of a high level of trust and guarantees the implementation of investment projects. Most of the stakeholders are guided by financial indicators and credit ratings, investment activity.

Reputation and compliance risks arising as a result of ineffective management or opportunism of an economic agent (negligence, evasion, use of official powers for personal purposes), violations of business conduct in the implementation of economic transactions, destabilize the territorial economic system. Assessment of non-financial components and risks of the level of business reputation of an enterprise is popular in foreign literature [15]. According to A. Veh [4], the stable and sustainable development of an enterprise is ensured not only by fame, but also by honest behavior in the markets, a low level of risk of litigation, and high ratings of products that are provided for quality and environmental safety. Financial fraud, bribery, tax evasion, labor discrimination, non-compliance with the principles of environmental safety of production, antitrust laws can damage the business reputation of an enterprise [13].

Economic crimes, corruption links and misappropriation of assets seriously damage the business reputation of an enterprise and also become factors that hinder the inflow and effective use of investments. Compliance risks destroy the territorial economic system since they give rise to chain bankruptcies, especially the involvement of strategically important organizations in this process. Compliance risks destabilize the conditions for the development of residents at the micro-level, hinder the implementation of the socio-economic interests of investors, society, and the state [14].

The negative impact of compliance risks on the company's business reputation is manifested in the fact that lawsuits arise, negative information is disclosed in the media, trust from key business partners and investors decreases, and financial and non-financial information about the company is hidden. Enterprises with a low level of reliability and an ineffective internal control system are always given increased attention by regulatory and supervisory authorities, which, in the case

Table 1

Analysis and ranking of factors that form the business reputation of an enterprise

Factor	Number of mentions	V.G. Kogdenko [7]	E.E. Petrakova, M.S. Zolotova [16]	T.S. Lisitskaya [17]	I.S. Vazhenina [3]	E.D. Shchetinina, E.A. Shchetinina [6]	M.G. Grigoryan, N.A. Loginova [18]	M.D. Akat'eva [11]	I.V., Yakhneeva, R.I. Khansevyarov R.I., Strel'tsov A.A. [10]
Corporate governance factors	16								
Corporate governance, availability and compliance with the corporate governance code	2			+	+				
Management efficiency	1				+				
Accumulated business experience, age of the organization	2			+				+	
Reputation of the head of the organization, top managers, owners, professionalism	4	+	+		+			+	
Labor disputes	1				+				
Management's perspective on ethics, corporate culture, social responsibility of business	1				+				
Long-term management perspectives	1				+				
History, mission and elaborated development strategy	1						+		
Staff turnover, HR policy	2		+					+	
Compliance with the company's policy with the expectations of employees, shareholders	1	+							
Competitive advantages	13								
Quality of products, goods, works, services, services	6	+		+	+	+	+	+	
An advantageous economic and geographical position	1							+	
A visual image of the organization, corporate identity	2	+		+					
Emotional attraction	1				+				
Brand awareness and its identity (feature), fame	2			+	+				
Innovativeness	1			+					
Information technology factors	12								
Information activities of the company	1				+				
Openness, accessibility and transparency of business, effective information system for goods and services	3	+		+	+				
Positive media coverage, customer reviews, advertising, business success, product safety	6	+		+	+	+		+	+
Assessment of the reliability of financial statements	1							+	
Ensuring data protection from theft, failures, unauthorized access	1				+				
Compliance factors	10								
Business image (conscientiousness in fulfilling the assumed obligations)	2				+				+
Absence of unscrupulous counterparties	1							+	
Complaints from the controlling and supervisory authorities of the Russian Federation, clients, court or convictions	1				+				
Financial losses and fraud, theft, participation in illegal schemes	2	+			+				

Table 1 (continued)

Factor	Number of mentions	V.G. Kogdenko [7]	E.E. Petrakova, M.S Zolotova [16]	T.S. Lisitskaya [17]	I.S. Vazhenina [3]	E.D. Shchetinina, E.A. Shchetinina [6]	M.G. Grigoryan, N.A. Loginova [18]	M.D. Akat'eva [11]	I.V., Yakhneeva, R.I. Khansevyarov R.I., Strel'tsov A.A. [10]
Industrial accidents and safety violations	1	+							
Compliance with legislation, norms, principles of business ethics	2	+							+
ICS and disclosure of the effectiveness of its work, prevention of conflicts of interest	1								+
Financial factors	9								
Credit rating and other ratings, good reputation of the borrower	4	+		+			+	+	
Financial condition, financial stability, financial indicators and their dynamics, profit	4			+	+		+		+
Tax incentives and loans, the amount of state aid, investment grants	1	+							
Ethical and behavioral factors	8								
Corporate culture, level of labor discipline (transparency, democratic leadership style, fairness, responsibility)	4		+	+		+	+		
Ethics in relations with internal and external partners, compliance with norms	3	+			+		+		
The level of relationship of the organization's staff with customers	1	+							
Market factors	5								
Reputation appreciated by the company's consumers	1	+							
Market position, competitive behavior of the company in the market	2				+	+			
Well-established system of sales of goods, services, response to customer requests, considering their needs	2	+						+	
Social responsibility factors	5								
Social reputation (social goals, roles in the social and cultural life of society, charity)	3			+		+	+		
Social investment, innovation, social responsibility	2			+	+				
Institutional factors	4								
The presence of an administrative resource and interaction with the authorities, the presence of large reputable partners	2	+			+				
Participation in government programs, government purchases, government contracts	1	+							
Participation in associations and unions	1				+				
Environmental factors	2								
Environmental responsibility	1				+				
Responsible attitude to the environment	1				+				

Source: compiled by the author based on the analysis of scientific publications [3, 6, 7, 10, 11, 16, 17].

of opportunistic behavior, leads to financial losses in the form of fines and penalties on overdue obligations. In turn, this leads to a decrease in solvency and profit, as a result of which investment capital decreases.

The ability to assess the risks of violation of legislation has increased in the context of information transparency of the parameters for assessing the reliability of an enterprise as a counterparty. Failure to fulfill contractual obligations, overdue accounts payable, labor disputes, late payment of wages, tax evasion negatively affect the business reputation of a supplier or a conscientious taxpayer. The transparency of information in the media contributed not only to ensuring transparency of information for making investment decisions but also to the negative manifestation of information risks caused by possible information leakage, unauthorized access, and sabotage.

In connection with the possible negative manifestations of the enterprise in society, the concept of corporate social responsibility (CSR) was developed [19]. Factors contributing to the socially oriented, ethical behavior of the company have become important factors of the business reputation growth and investment attractiveness. According to foreign researchers, investments are directed to projects that ensure the creation of a favorable living environment on the territory, improve the well-being of the population, the implementation of socially significant projects, energy conservation and resource conservation programs, and environmental protection. Non-transparency of information about projects, observance of CSR in the activities of enterprises are considered as investment barriers [20]. Due to the importance of CSR, investment scores of enterprises, industries, regions include environmental, social, ethical, and cultural areas (human resources, environment, safety, relations between stakeholders, management ethics). Thus, complex factors of business reputation and their division into groups make it possible to develop a methodology for assessing investment and reputation capital with quantitative and qualitative assessment indicators.

COMPONENT-FACTOR APPROACH TO ESTIMATE THE INVESTMENT AND REPUTATION CAPITAL OF THE ENTERPRISE

The methodology for assessing the investment and reputation capital of enterprises that attract real investments for the implementation of strategically significant projects is implemented at the following stages:

1. Identification of factors that stimulate and restrain the growth of investment and reputation capital. The choice of the list of factors is based on the availability of information for assessment, complexity, and consistency, considering their relationship and interdependence.

2. A scoring assessment of the components of reputation capital. The reduction to a single measurement scale is caused by the need to evaluate both qualitative and quantitative indicators.

3. Ranking observations on a scale, assessing the relationship between the value and the assessment of investment capital.

4. Modeling and identifying the relationship between the factors that form business reputation, their extended groups, and the level of investment capital.

5. Determination of the type of enterprise by the level of accumulated investment and reputation capital.

6. Development of measures aimed at reducing the impact of reputational and compliance risks.

The indicative approach involves the development of a system of indicators, interrelated and subordinate, allowing one to assess the level of investment and reputation capital of enterprises in the real sector of the economy. Within the framework of the assessment methodology, indicators

Table 2

Indicators proposed for assessing the investment and reputation capital of an enterprise

Effective/factor attribute name	Indicator	Designation
Performance indicators		
Investment Capital	Investment capital	IC
Factor features		
Compliance Factors (KF)		
Business image (conscientiousness in fulfilling the assumed obligations)	The number of violations revealed as a result of the conducted inspections The ratio of inspections that revealed violations to the total number of inspections carried out Number of claims (participation of an enterprise as a defendant) The degree of reliability (according to the data of the sites Contour-focus, etc.)	X1 X2 X3 X4
Financial losses and fraud, theft, participation in illegal schemes	The number of claims against the organization	X5
Compliance with legislation, norms, principles of business ethics	The amount of tax and other obligatory debt	X6
Corporate Governance Factors (YF)		
The reputation of the head of the organization, top managers, owners, professionalism	Public opinion about the leader, experience and length of service, business partnership, absence of bankruptcy in previously operating organizations Change in HR management over the past 3 years The presence of the owner in the register of mass founders	X7 X8 X9
Labor disputes	Participation of the organization in labor disputes, availability of information on delays in the payment of wages	X10
Information Technology Factors (IF)		
Openness, accessibility and transparency of business, effective information system, including for products, services	Posting information about the financial and non-financial activities of the organization on websites and investment portals	X11
Positive media coverage, customer reviews, advertising, business success, product safety	Citation of the company's website, availability of product quality reviews	X12
Financial Factors (FF)		
Financial performance indicators	Return on sales Autonomy coefficient Current liquidity ratio Net profit growth rate Dependence on borrowe Dependence on creditors	X13 X14 X15 X16 X17 X18

Table 2 (continued)

Effective/factor attribute name	Indicator	Designation
Market Factors (RF)		
Market position, competitive behavior of the company in the market	Sales growth rate Number of market competitors Age of the company	X19 X20 X21
Ethical and Behavioral Factors (EF)		
Business culture (transparency, democratic leadership style, fairness, responsibility)	The presence on the organization's websites of a code of conduct, anti-corruption rules, and standards, etc.	X22
Institutional Factors (InF)		
The presence of an administrative resource and interaction with the authorities, the presence of large reputable partners	Participation in government purchases, government contracts, international exhibitions, etc.	X23
Social Responsibility Factors (SF)		
Social investment, innovation, social responsibility	Participation in the implementation of social projects, socio-economic life of the region, participation in exhibitions and conferences, implementation of environmental protection measures. Investments in social infrastructure facilities	X24 X25

Source: compiled by the author.

are proposed, the essence of which is expressed in the possibility of assessing the level of accumulated capital for sustainable functioning and increasing the return on investment. The grouped indicators are presented in *Table 2*.

The most acceptable range of the level of factor features in scores $r \in [0; 5]\%$. For a scoring assessment of factors, it is proposed to use formula (1) when assessing the direct relationship and formula (2), if there is an inverse relationship between the factors and the result:

$$r = r_{\min} + \frac{I_{\max} - I_i}{I_{\max} - I_{\min}}(r_{\max} - r_{\min}), \quad (1)$$

where I — indicator; r — factor value in scores.

$$r = r_{\max} - \frac{I_{\max} - I_i}{I_{\max} - I_{\min}} r_{\max}. \quad (2)$$

The study uses a sample of regionally significant organizations included in the list of residents of the TASED of the Far East of Russia and receiving tax incentives and administrative preferences. The study sample includes:

1) enterprises with the largest volume of investment in projects (over 1 billion rubles) and a large amount of accumulated investment capital;

2) functioning for more than two years from the date of creation.

The sample under study covers 38 enterprises of regional importance. TASED

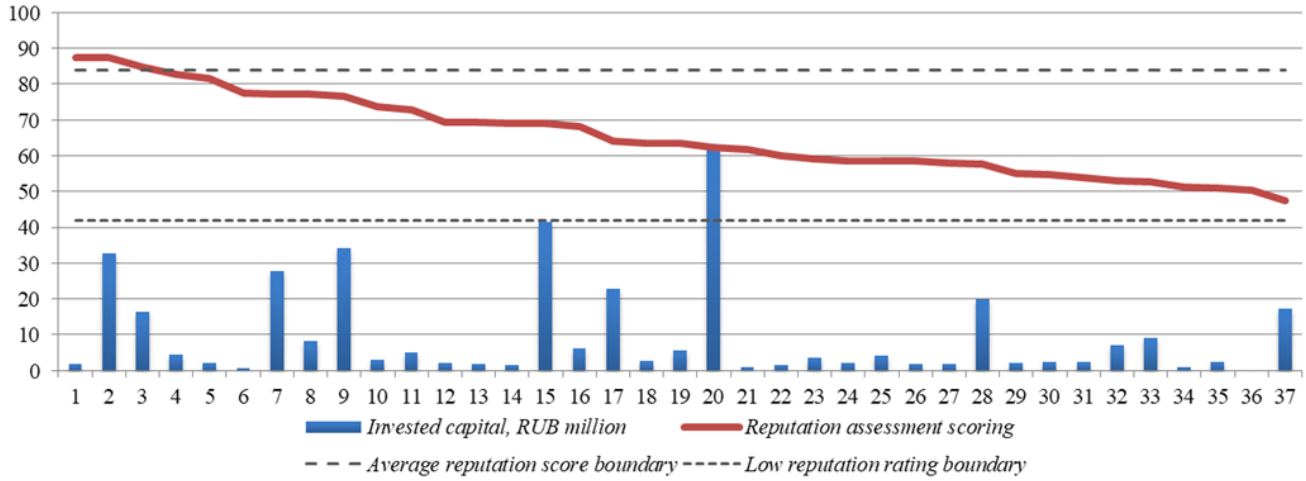

Fig. 2. **Scoring assessment of the business reputation of residents of the TASED of the Far Eastern Federal District (using the example of 38 enterprises with an investment estimate of more than 1 billion rubles per project)**

Note: the estimate of the Amur GZP is excluded due to the large deviation.

Source: compiled by the author based on the data of the investment card of JSC "KRDV" and financial statements, other information of state bodies about organizations-residents of territories of advanced development (information system "Kontur Focus" and service Rusprofile). URL: http://https://www.rusprofile.ru/; http://https://focus.kontur.ru/ (accessed on 20.02.2021).

residents invest in the reproduction of fixed assets and an increase in production capacity, the modernization of industrial complexes, the construction of new profitable facilities that are significant for the development of the industrial and export potential of the region.

To assess the influence of factors on the level of investment capital, the methods of pairwise correlations and modeling were used. Factor models were built based on stepwise selection in the SPSS program; to assess the hypothesis of the absence of autocorrelation of residuals, multicollinearity testing, and the Durbin-Watson test were carried out. The advantage of stepwise selection in the program is to obtain the best multiple regression model corresponding to the statistical parameters of adequacy and reliability.

The general multiple regression model, including groups of factor features, is as follows:

$$IC = b + \alpha_1 KF + \alpha_2 YF + \alpha_3 IF + \alpha_4 FF + \\ + \alpha_5 RF + \alpha_6 EF + \alpha_7 InF + \alpha_8 SF, \quad (3)$$

where $\alpha_1 ... \alpha_n$ — regression coefficients.

The model for assessing the influence of factors on investment capital is determined as follows:

$$IC = b + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + ... + \alpha_{25} X_{25}. \quad (4)$$

The models are designed to identify factors of a stimulating and restraining nature and to determine the possibility of an enterprise accumulating investment capital.

ASSESSMENT OF THE INFLUENCE OF FACTORS ON THE FORMATION OF INVESTMENT AND REPUTATION CAPITAL

Fig. 2 shows the results of scoring of the business reputation of residents of the TASED and the cost of investment capital. The estimates obtained show that the amount of invested capital and the level of business reputation do not have a general trend. This indicates that investors do not always invest in reliable enterprises, but are guided by the prospects of projects, future output and profitability, investment plans and project passports.

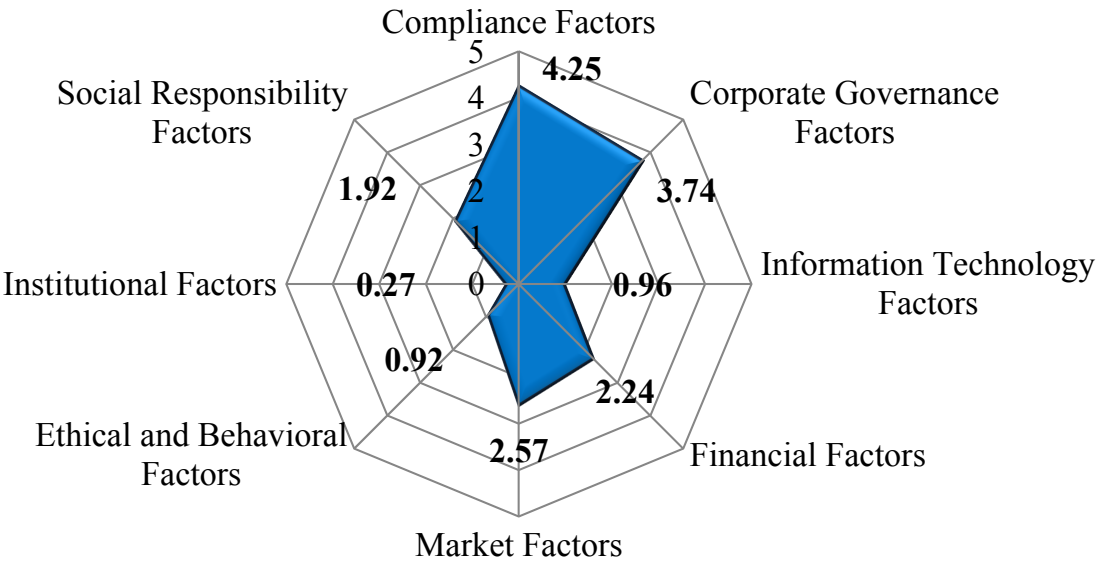

Fig. 3. **Comprehensive assessment of factors affecting the business reputation of regionally significant enterprises**

Source: compiled by the author based on financial statements, information from state bodies, websites of organizations-residents of territories of advanced development (information system "Kontur Focus" and service Rusprofile). URL: http://https://www.rusprofile.ru/; http://https://focus.kontur.ru/ (accessed on 20.02.2021).

The graph shows that a favorable trend is that enterprises with a high amount of investment capital fall within the border of high and medium levels of goodwill. According to the complex of the assessed parameters, only 3 enterprises have a high business reputation, which is 8% of the studied sample. The rest of the surveyed objects were classified as medium business reputation. If the level of goodwill characterizes the market value of the capital of an enterprise, then the difference between the booked investment capital and its market value characterizes the degree of capital accumulation or the "consumption" of capital. Thus, for all assessed objects, the level of reputation is higher than investment capital, which indicates favorable business conditions for doing business and a large volume of investment inflows into projects. The only example of inefficient use of capital can be Zvezda Shipbuilding Complex LLC (*Fig. 2*, object 20) due to labor disputes, claims of regulatory authorities, long-term participation in courts, unprofitable activities.

Fig. 3 shows a multi-axis diagram that reflects the level of influence of a group of factors according to the list of indicators in *Table 2*.

Enterprises that attract investments for the implementation of significant regional projects have low compliance and corporate governance risks, as evidenced by a high score of factors (4.25 and 3.74 in the maximum border of 5). Indeed, with an unfavorable compliance environment and violations of the law, the sample included only 5 enterprises, which were subject to penalties for violating tax laws, violations were identified during inspections for compliance with the law, and 2 organizations are at the stage of bankruptcy and stripped of their resident status of TASED in 2020, which jeopardized the implementation of investment projects. Institutional factors are less important due to a lack of participation in public procurement and little activity at international exhibitions. This factor can be assessed relatively, as it depends on the stage

Table 3

Pairwise correlations of the invested capital and enlarged groups of factors that form the business reputation of regionally significant enterprises

Indicator	IC	KF	YF	IF	FF	RF	EF	InF	SF
Invested Capital (IC)	1	–0.42**	0.17	0.65**	0.03	–0.03	0.68**	0.73**	–0.11
Compliance Factors (KF)	–0.42**	1	–0.27	–0.22	0.35*	–0.08	–0.37*	–0.46**	0.29
Corporate Governance Factors (YF)	0.17	–0.27	1	0.45**	–0.01	0.32	0.25	0.03	0.1
Information Technology Factors (IF)	0.65**	–0.22	0.45**	1	0.12	0.01	0.74**	0.42**	0.25
Financial Factors (FF)	0.03	0.35*	–0.01	0.12	1	0.26	–0.02	–0.16	0.11
Market Factors (RF)	–0.03	–0.08	0.32	0.01	0.26	1	0.13	–0.17	–0.23
Ethical and Behavioral Factors (EF)	0.68**	–0.37*	0.25	0.74**	–0.02	0.13	1	0.5**	–0.13
Institutional Factors (InF)	0.73**	–0.46**	0.03	0.42**	–0.16	–0.17	0.5**	1	–0.1
Social Responsibility Factors (SF)	–0.11	0.29	0.1	0.25	0.11	–0.23	–0.13	–0.1	1

** Correlation is significant at 0.01 (2-sided).

* Correlation is significant at 0.05 (2-sided).

Source: compiled by the author based on the data of the investment card of JSC "KRDV" and financial statements, other information of state bodies about organizations-residents of territories of advanced development (information system "Kontur Focus" and service Rusprofile). URL: http:// https://www.rusprofile.ru/; http://https://focus.kontur.ru/ (accessed on 20.02.2021).

of the project life cycle and the type of activity of the organization. A negative fact is the low indicators of the information technology component of business reputation, assessed by the site citation index, accessibility, and openness of information on the company's website. Indeed, in this sample, only a small number of organizations have their own websites and disclose full financial and non-financial information. *Table 3* presents the results of a correlation analysis of the cost of investment capital and factors affecting the level of business reputation. To carry out the correlation-regression analysis, the cost of investment capital was converted into the scoring estimate.

The analysis showed that investment capital correlates with a group of ethical and behavioral, information technological, and institutional factors. Moreover, the correlation with compliance factors arises due to the fact that large and medium-sized enterprises with high investment capital are more susceptible to the risks of violations of the law, inspections by various regulatory and supervisory authorities. Moreover, the size of the sanctions imposed on these entities is also higher.

There is no high correlation between all groups of factors in assessing business reputation. There is a high closeness of the relationship between information

Table 4

Pairwise correlations of invested capital and factors that form business reputation

	IC	X23	X5	X3	X20	X22	X12	X8	X7	X10	X11
IC	1	0.7**	−0.147	−0.033	−0.008	0.52**	0.136	0.297	0.44**	−0.5**	0.44**
X23	0.7**	1	−0.64**	0	0.034	0.497**	0.62**	−0.138	0.37*	−0.28	0.2
X5	−0.147	−0.64**	1	0.54**	−0.066	−0.48**	−0.67**	−0.1	−0.38*	−0.08	−0.07
X3	−0.033	0	0.54**	1	0.319	−0.26	−0.06	−0.1	−0.42**	−0.08	−0.24
X20	−0.008	0.034	−0.066	0.319	1	0.18	0.14	0.18	−0.22	−0.05	−0.22
X22	0.52**	0.5**	−0.48**	−0.26	0.18	1	0.53**	−0.06	0.56**	−0.11	0.63**
X12	0.136	0.62**	−0.67**	−0.06	0.14	0.5**	1	0.162	0.359*	0.09	0.21
X8	0.297	−0.138	−0.1	−0.1	0.18	−0.06	0.162	1	0.042	0.53**	−0.07
X7	0.44**	0.37*	−0.38*	−0.42**	−0.215	0.561**	0.359*	0.04	1	0.02	0.72**
X10	−0.5**	−0.28	−0.08	−0.08	−0.05	−0.11	0.09	0.53**	0.02	1	−0.02
X11	0.44**	0.2	−0.07	−0.24	−0.22	0.63**	0.21	−0.07	0.72**	−0.02	1

** Correlation is significant at 0.01 (2-sided).

* Correlation is significant at 0.05 (2-sided).

Source: compiled by the author based on the data of the investment card of JSC "KRDV" and financial statements, other information of state bodies about organizations-residents of territories of advanced development (information system "Kontur Focus" and service Rusprofile). URL: http:// https://www.rusprofile.ru/; http:// https://focus.kontur.ru/ (accessed on 20.02.2021).

technology and ethical and behavioral factors since the latter was assessed by the presence of ethical standards on the site, which indicates the interdependence of the parameters. A moderate positive relationship was found between information technology and institutional factors, between ethical and behavioral and institutional factors, which indicates that these groups of factors form the reliability of an organization as a business partner. A multiple regression model was generated using stepwise regression analysis:

$$IC = -1.191 + 0.739InF + 0.459IF\,. \qquad (5)$$

The resulting model is significant at 68% (R^2), insignificant and correlated factors were excluded by the stepwise selection method. This model describes the importance of institutional and information technology factors. This can be explained by the fact that enterprises participating in public procurement already have a confirmed level of reliability, which, from the point of view of stakeholders and investors who make decisions in conditions of limited information, is an important indicator of business reputation valuation. The factor of information transparency and openness confirms the value of creating a

Table 5

Typology of regionally significant enterprises by the level of investment and reputation capital

	Type 1	Type 2	Type 3
	High level of investment and reputation capital	**Average level of investment and reputation capital and average level of risks**	**Low level of investment and reputation capital and low level of risks**
Type characteristic	The company accumulates investments through participation in the implementation of socially significant projects; finances environmental initiatives; has stable business relationships, reliable partners, effective management; no negative reviews; has a stable dynamics of financial indicators; no overdue debt; no layoffs of employees and labor conflicts; transparency and reliability of the information on the site; high level of trust on the part of the authorities; good image among the population	The company has reliable business connections, but does not participate or rarely takes part in social projects and in the life of the region; no negative reviews; in connection with minor violations of contractual obligations, periodically participates in court proceedings as a defendant; there is a decrease in capital by no more than 5%; there are one-time and irregular delays in mandatory payments; unforeseen losses occur; on the official website there is no information about the activities of the enterprise	The company has unscrupulous business partners; does not participate in socially significant events; has negative customer reviews; numerous facts of unethical behavior of employees were noted; increased layoffs of employees; the reduction and «consumption» of capital; regular delays in payments; growth in the volume of overdue debt; high level of unexpected losses; repeated violations of contractual obligations; information opacity; low level of trust on the part of the authorities and administration
Number of observations	3	27	9
Examples of enterprises	JSC Khabarovsk International Airport; LLC "Baikal Mining Company"; POLYMETAL International PLC	LLC Shipbuilding Complex Zvezda; OOO Gazprom pererabotka Blagoveshchensk; Ostrovnoy Rybokombinat LLC; JSC "RK "Novy Mir""; JSC "Eastern Petrochemical Company" LLC "TechnoNIKOL Far East", etc.	LLC "Organization multidisciplinary service-BK"; LLC "S Technology"; LLC "RFP Wood Pellets"; LLC Service-Integrator YAKUTIA, etc.

Source: compiled by the author.

positive image in the Internet environment. At the same time, it is equally important to control the reliability and completeness of published financial and non-financial information, which is guided by investors. *Table 4* shows the results of the correlation analysis.

Considering the influence of each indicator of business reputation on the amount of invested capital, it is necessary to highlight the positive relationship between the participation of an enterprise in public procurement, the image of the head, the placement of financial statements on the website, the implementation of environmental measures, the participation of the organization in the life of society. Based on the assessment of the relationship between investment capital and factors, a model was built:

$$IC = -0.306 + 1.114X_{23} + 0.825X_5 - 0.648X_3 + \\ + 0.142X_{20} + 0.138X_{22} - 0.208X_{12} + 0.133X_6 \quad (6)$$

(16.97;0) (9.29;0) (–7.79;0) (4.19;0) (5.06;0)
(–3.31;0.002) (2.61;0.014)

Note: the values of t-statistics are indicated in brackets, the degree of significance.

The multiple regression model has a statistical significance of $R^2 = 0.945$. In this model, in addition to the factors listed above, compliance factors were also significant, namely: the number of claims against enterprises. The absence of lawsuits and tax arrears guarantees a positive business reputation.

Based on the analysis, the types of business reputation for enterprises of regional importance were formed.

According to the level of reputation, enterprises are divided into three groups, most of them have an average level at which there are low values of indicators for several factor features.

CONCLUSIONS

Thus, enterprises participating in the development of the territorial economic system should strive to form a positive image and constantly participate in the life of the region's society. A positive factor that increases sustainability is adherence to the concept of social responsibility, posting information about environmental, innovative activities on Internet sites, which attracts investors, buyers, employees, and other stakeholders. Adherence to cultural and ethical values contributes to the understanding by stakeholders of the interest of the company's management in stability and long-term development. Corporate social responsibility is aimed at observance of moral standards, combating corruption and inequality of the population. To avoid opportunistic behavior, it is necessary to adopt standards based on norms of behavior and ethical principles. Socially responsible behavior of an enterprise that demonstrates sustainable development in the long term presupposes participation in socially significant projects, transparency, and business activity. Maintaining social well-being and ensuring comfortable living of the population on the territory, safety, and environmental friendliness are becoming the main strategic objectives of the enterprise as an object of regional relations "business-government-population".

Formed reputation and investment capital allow attracting investors, partners, consumers, accelerates implementation processes, creates opportunities for increasing debt financing, makes available resource and capital markets, foreign sales markets and sources of financing. The low level of business reputation indicates the need to develop a risk management system based on the criteria of the importance and significance of the consequences, a financial compliance control mechanism.

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The Impact of ESG Factors on Asset Returns: Empirical Research

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ABSTRACT

The subject of the research is the assessment of Investment decision-making efficiency considering the sustainable development requirements. The article **aims** to identify the relationship between environmental, social and governance (ESG) performance and market returns for investors and the reasons for it. The relevance of the paper is determined by the need to develop research in the field of ESG integration and evaluation of the portfolio investment effectiveness in the context of responsible investment practices popularity. **Scientific novelty**: the study develops the theory of ESG integration and allows the authors to conclude that ESG commitment is a driver of market profitability for investors. The authors apply **methods** such as theoretical analysis of scientific publications (analysis, synthesis, generalisation) and quantitative methods, including statistical data analysis, regression analysis, financial modelling. The research base is scientific works of domestic and foreign authors, analytical reports of rating agencies, ESG funds, historical stock market data on companies analysed in the course of this study. All the information used in this study is publicly available or provided by the Bloomberg database. In the course of the study, authors form model portfolios of ESG-oriented and ESG-neutral companies shares and perform a comparative analysis of their fundamental indicators and financial returns. The authors **conclude** that the portfolio of ESG-oriented companies demonstrates profitability no lower than the portfolio of ESG-neutral companies, considering the risks. At the same time, the values of the fundamental indicators of ESG-oriented companies are inferior to the values of ESG-neutral companies. The relationship between the degree of a company's ESG compliance and its investment attractiveness is due, among other things, to non-financial value drivers. The authors recommend integrating ESG into the analysis of investment portfolios, significant for the development of investment strategies.

Keywords: sustainable development; responsible investment; ESG integration; portfolio analysis; return on investment; value drivers; ESG financial impact

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INTRODUCTION

As the importance of non-financial factors related to sustainable development requirements grows, there is a need for comprehensive and reliable methods of assessing how various factors of environmental, social and corporate governance (ESG) risks and opportunities affect the effectiveness of investment strategies and value creation.

The most significant ESG issues for investors are:

- environmental issues — climate change, carbon emissions, air and water pollution;
- social factors and risks — health and safety, human rights, labor practices, employee engagement;
- issues of corporate governance — the digital transformation of business, executive compensation, board diversity, anti-corruption [1, 2].

In recent decades, a large number of frameworks have appeared presenting possible solutions for the formation, structuring, and disclosure of non-financial information that is important for investment decisions [3].

Significant progress in this matter has been achieved as a result of the active development of non-financial reporting standards, including the GRI (Global Reporting Initiative) sustainability reporting standards and the IR (Integrating Reporting) conceptual framework for integrated reporting, as well as the SASB (Sustainability Accounting Standards Board or SASB Standards), which regulate the disclosure requirements for companies listed on the American Stock Exchange. The focus on the standardization of non-financial information represents significant progress in terms of content and presentation of information that is important to investors and other stakeholders.

The development of industry standards should be viewed as a positive trend, since they allow considering specific industry risks and value drivers that are significant for investors. In addition, a system of thematic disclosures is actively developing, for example, related to climate, epidemiological risks, in particular COVID-19, and their financial implications [4].

We have concluded that the disclosure of non-financial information to key users of financial statements, primarily investors, is becoming a steady trend. However, this raises certain problems that significantly impede progress in meeting the information needs of investors [5, 6]:

- despite the common fundamental foundations, the use of different standards for non-financial reporting leads to incomparability of information disclosed in companies' reports;
- there is no clear and obvious relationship between financial reporting data and non-financial information disclosed to interested users;
- the system of internal and external control over the disclosure of non-financial information is in its infancy, the disclosed non-financial information does not yet provide the necessary level of investor confidence;
- rating agencies, individual institutional investors use their own systems for evaluating non-financial data, which leads to different results and recommendations, which also reduces the confidence of data users [7].

Despite all the difficulties, financial institutions and issuers provide a real impetus to improve the system of financial and non-financial information necessary for making investment decisions [1].

An analysis of the theoretical views and concepts that contributed to the formation and development of ESG investment decisions makes it possible to better understand the spread of initiatives that have taken place since the second half of the twentieth century, and to determine the directions of their further development.

We highlight the most significant concepts for the development of the principles of responsible investment. These traditionally include the concept of sustainable development, the theory of stakeholders, the concept of corporate social responsibility of business. We believe that no less significant and historically earlier is *the concept of externalities*, consistently

developed in the works of Henry Sidgwick (1880), Alfred Marshall (1890), Arthur Cecil Pigou (1920) and emphasizing the importance of non-market interdependencies of economic agents and the need to consider the influence of external factors and effects on their activities. Thus, the concept of externalities underlies the understanding of corporate social and environmental issues, as well as corporate social responsibility.

ESG investment creates asymmetric benefits and provides an "insurance effect", that is, protection against negative consequences, especially during a social or economic crisis.

The concept of sustainable development emerged in the early 1970s. This theory challenged the unlimited potential for increased production and consumption due to limited natural resources and increased environmental damage. The famous by Brutland report (1987), defines the concept of sustainable development as "development that meets the needs of the present, without compromising the ability of future generations to meet their own needs" [8]. This definition draws attention to the possibility of growth of economic agents in conditions of objectively existing restrictions and risks, which creates the basis for an extended approach to their financial analysis.

The definition of sustainable development, proposed by T. Van Holt, T. Whelan [9], considers the following fundamental aspects of the concept: "at minimum do not harm people or the planet and at best create value for stakeholders, and focus on improving sustainability performance in areas in which the company or brand has a material environmental or social impact (such as in their operations, value chain, or customers, etc.)".

The stakeholder theory proved to be crucial in the development of the concept of corporate governance and the importance of stakeholders in the process of creating value. In 1984, Freeman proposed a rethinking of the Friedman doctrine (1970),[1] according to which the company's only social responsibility is to increase profit for its shareholders. He argued that since the company's profits are the result of its activities and interactions with stakeholders (employees, customers, suppliers, government agencies, society, the environment, etc.), its goal is to satisfy the needs of the latter, which will enable it to receive profit [10].

Later, in 1997, J. Elkington substantiated the famous concept of The Triple Bottom Line [11], which went beyond standard measurements of profit and assumed the need to integrate economic, social, and environmental factors. It also has the thesis that organizations should inform stakeholders about their activities. The Global Reporting Initiative (GRI) has adopted this concept as the basis for the development of a corporate reporting system.

Influenced by these trends, the concept of "sustainable finance" has become widespread, which is directly related to considering ESG information when making investment decisions in the financial sector. The paper by D. Schoenmaker, W. Schramade [12] highlights the development stages of the concept of sustainable financing and its practical implementation. According to this concept, in the world and in society over time, there is a gradual shift from the shareholder value to the stakeholder value. As the principles of sustainable financing develop, economic, or rather financial, criteria for investment decisions will recede into the background compared to environmental and social criteria [12].

The development of these concepts has become a study of the relationship between financial performance or corporate financial performance (CFP) and ESG [13–15]. Can we expect more competitive companies and better financial performance from more resilient

[1] URL: https://www.nytimes.com/1970/09/13/archives/a-friedman-doctrine-the-social-responsibility-of-business-is-to.html (accessed on 07.07.2021).

companies? Or is it fair to say that investing in sustainable development reduces free cash flow and therefore negatively affects business value, at least in the short term? These alternative positions on the problem are actively discussed in the academic community [16, 17].

Another theory postulated that the direction of the relationship between ESG and CFP is reversed: strong financial performance allows companies to invest in sustainable strategies and practices [18]. This theory provides a strong argument against the simple correlation between ESG and CFP. Without a thoughtful research, it is impossible to determine the causal direction of the relationship (even if there is one).

Considering the above, the purpose of the research was to test the validity of the claim that ESG compliance is a driver of market returns for investors.

LITERATURE REVIEW

The most heated discussions in the area under study are devoted to the following topics:

- the concept and methods of ESG-integration [19–22];
- the relationship between financial and ESG performance [23–26];
- the degree of investor satisfaction with the ESG information disclosure, including new challenges associated primarily with the COVID-19 pandemic [27–29].

According to a meta-review [26], the following main types of ESG research in the financial sector can be distinguished.

The research that analyze the relationship between ESG scores and financial performance of companies. These studies typically use a group of public companies and environmental/social performance indicators to determine how sustainable development initiatives affect financial results [25, 27, 30].

The studies that investigate the effectiveness of the formation of investment portfolios based on ESG criteria. Most investment research examine the relationship between ESG performance and financial performance of asset portfolio using risk-adjusted returns. Later studies also consider the issues of the effectiveness of investment strategies [26, 30, 31]. The growing interest of the investment community in integrating ESG information into decision-making is reflected in recent research [26, 28]. They concluded that, instead of absolute ESG metrics, the best evidence of future investment benefits is positive dynamics, while the company's ESG scores may be average but improving. The study by NN Investment Partners[2] found that companies with average ESG scores that performed positively contributed the most to Sharpe ratios.

Research on specific topics such as climate change or social risks and their impact on investment decisions, which are increasingly important during the ongoing COVID-19 pandemic [4, 27].

In the academic literature, the question "Is it worth it to be sustainable?" has been a topic of discussion over the past decades. Researchers investigate the dependance of a large number of financial performance indicators on ESG factors [14, 23].

The most common indicators are: return on assets, return on equity. Market indicators that most often act as a dependent variable include the cost of debt and equity capital, Tobin's q and Sharpe ratio [14, 23]. At the same time, some scholars argue that the choice of the ESG metric can predetermine the outcome of assessing the ESG-CFP relationship [5].

Most of the studies analyzed show a positive ESG-CFP relationship [13, 14]. The study [26] shows that the identified financial advantages as a result of meeting the requirements of sustainable development prevail in corporate-type works (60% ± 7.2 pp).

For research on investment portfolios, a less significant result was noted (35% ± 7.8 pp). However, the cumulative evidence of positive, neutral, and mixed conclusions about the impact of ESG performance on financial

[2] NN Investment Partners. 2017. The materiality of ESG factors for emerging markets equity investment decisions: academic evidence. URL: https://www.nnip.com/CH_en/corporate/Press/News-Commentary/view/ (accessed on 07.07.2021).

performance was comparable (93% corporate versus 86% portfolio). This confirms the notion that ESG return on investment is on average no different from traditional investments.

There is evidence that corporate managers see sustainability investment as a driver of corporate financial results, while the return on investment in ESG, averaged over many portfolio management strategies, is indistinguishable from the conventional one. A possible explanation for this is the fact that the criteria for evaluating the performance of company managers and investors are different: managers can expect higher expected cash flows, while investors expect to receive the required market return. However, if the growth of corporate financial performance (CFP) correlates with the ESG resilience, why is investing in the same companies not accompanied by additional returns for investors? Conversely, if the relationship between CPF–ESG companies is insignificant, what drives investors to include these shares in their portfolios?

Most investors want returns on their ESG investments that are in line with normal returns. In other words, they do not expect the returns on ESG strategies to outperform traditional strategies. Therefore, a positive result can be considered in studies in which neutral effectiveness was found [26]. Assuming that corporations can achieve better long-term financial performance through sustainability strategies, this relationship can be expected to be reflected in investor strategies.

ESG integration is not a one-size-fits-all strategy. Analysts typically choose best-in-class companies. However, some researchers have found that it is very effective to select the companies that are increasing their ESG rating the fastest (impulse strategy). Since the impulse effect is stronger for firms with initially low ESG ratings, investors may be able to benefit from their selection. The research [30] suggests that changes in the characteristics of ESG companies can be a useful financial indicator for generating alpha.

A review of the literature identified limitations and challenges with regard to methods for analyzing and evaluating investments in ESG. One of the most common criticisms of investing in sustainable development is that it is difficult for investors to correctly identify and properly weigh the various ESG factors when choosing an investment [31].

P. Hawken [32] raised the question of too broad selection criteria. In a review of ESG-focused mutual funds, P. Hawken found that the investment strategies used by most funds allow virtually any publicly traded company to be registered with an ESG fund. This practice has resulted in little difference between the portfolios of many ESGs and conventional funds. Many ESG-focused funds and portfolios still include stocks of companies with controversial ESG practices in certain areas, such as McDonald's and Coca-Cola. Finally, focusing on best-in-class companies based on specific ESG factors can at the same time lead to the inclusion of companies in the portfolio that do not meet other sustainability requirements.

Almost all large companies, regardless of their ESG orientation, can be included in one or more ESG funds. ESG investment funds and ETFs often invest in companies that can be considered "bad players" in one or more ESG parameters. The criteria used to select factors and specific ESG metrics are too subjective and may reflect narrow, conflicting, including ideological or political positions and demands.

Some researchers criticize the selection criteria and note a significant heterogeneity in the approaches of investors, consultants, and managers to investing in ESG in terms of terminology, strategy, and practice [32]. In [33], based on an analysis of the ratings of the six leading ESG rating agencies, it was concluded that they sometimes use conflicting metrics to measure and evaluate ESG.

Some works present a global analysis of institutional investors, which led to the conclusion that "the biggest obstacle for investors is the lack of quality data on the

performance of companies in terms of ESG factors that are significant for them" [1, 3, 6]. Combined with the fact that many studies have used a sample of data from years back to 2010 when ESG's reporting was just being generated, investors may have judged the resilience of companies with big assumptions.

Another challenge is the focus on short-term returns for investors and financial analysts, which can lead to the exclusion of highly ESG-rated companies that are focused on long-term results.

Researchers disagree on whether investing in ESG is effective. There is a lot of empirical research on this topic in the academic literature. Based on the analysis of individual ESG funds, indices, portfolios, or company stocks, some researchers [5, 21] found that the inclusion of ESG factors in investments, as a rule, gave results at the same level or not worse than from investments not related to sustainable development. For example, R. G. Eccles and M.D. Kastrapeli [21], when comparing companies with high and low resilience ratings, found that high-ranked companies significantly outperform in the stock market over the long term. However, many individual and institutional investors still believe that investing in ESG entails a decrease in investment performance. However, academic literature indicates that when appropriately compared (e.g. ESG strategy, investment time horizon, performance metrics), ESG investments deliver performance at least comparable to non-ESG investments [26].

MATERIALS AND METHODS

The research methodology is based on comparing the individual characteristics of two samples of stocks (hereinafter referred to as "model portfolio"), formed based on the compliance of certain stocks with the ESG policy.

This study was carried out in the form of hypothesis testing based on a literature review.

As part of the study, the following main hypothesis was put forward and tested:

H0: the relationship between the degree of ESG compliance of a company with the investment attractiveness of a company's shares is due to factors that are not exclusively related to the fundamental drivers of value.

Thus, the assumption is being tested, among other things, whether the non-financial value of a company's compliance with ESG practices is significant enough to investors that there is an additional source of equity returns for investors. If the return on stocks of companies focused on ESG is higher or identical to the return on peers (considering the risk), and at the same time, such a return will not be correlated in any way with the fundamental indicators of business activity that determine the amount of cash flows and the required rate of return (business value drivers), this will confirm the main hypothesis.

To test the main hypothesis, additional hypotheses were put forward related to the analysis of the ratio of portfolio returns (group of hypotheses H.1) and hypotheses related to the analysis of the ratio of fundamental indicators of portfolios (group of hypotheses H.2):

H1.1: stocks of ESG-oriented companies perform worse than stocks of ESG-neutral companies;

H1.2: ESG-oriented stocks perform similarly to ESG-neutral stocks;

H1.3: stocks of ESG-oriented companies perform better than stocks of ESG-neutral companies;

H2.1: the values of fundamental indicators of value drivers of ESG-oriented companies are worse than the values of similar indicators of ESG-neutral companies;

H2.2: the values of the fundamental indicators of value drivers of ESG-oriented companies are identical to those of ESG-neutral companies;

H2.3: the values of fundamental indicators of value drivers of ESG-oriented companies are better than values of similar indicators of ESG-neutral companies.

Depending on the confirmation of additional hypotheses, the main hypothesis can be

confirmed or disproved in accordance with a given matrix (*Table 1*).

Thus, the main hypothesis of the study will be confirmed if the return on the ESG portfolio is similar to or higher than the return on the ESG neutral portfolio with worse fundamental indicators of the ESG portfolio compared to the fundamental indicators of a portfolio that is ESG-neutral.

In accordance with the hypotheses put forward, this work takes the form of analytical research and uses quantitative methods such as statistical data analysis, regression analysis, modelling, retrospective analysis of indicators.

The Information base of the research include:

1. Scientific works of domestic and foreign authors, analytical reports of rating agencies, ESG funds — to identify existing ESG investment issues.
2. Historical data of the stock market for the companies under study, with the aim of forming model ESG-oriented and ESG-neutral portfolios and their subsequent assessment.
3. Financial and non-financial reporting of the analyzed companies — to consider the fundamental indicators of model portfolios.

All information required to conduct this study is publicly available or provided by the Bloomberg database.

The research stages are:

1. Formation of hypotheses.
2. Compilation of a model portfolio of ESG-oriented companies and a model portfolio of ESG-neutral companies. At this stage, it is important to track industry and geographic aspects and consider the size of the companies to form a comparable portfolio (ESG-neutral companies).
3. Comparative analysis of the profitability of model portfolios. Testing additional hypotheses H1.1, H.1.2, H.1.3.
4. Comparative analysis of fundamental indicators of model portfolios. Additional hypothesis testing H2.1, H.2.2, H.2.3.
5. Interpretation of the results.

It should be noted that the study revealed a number of limitations that significantly influenced the research methodology and the choice of individual analysis tools:

1. Currently, there is no clear criterion for classifying companies as ESG-oriented. The overwhelming majority of public companies disclose information about ESG activities, which allows various rating agencies to form integral indicators in this area. These indicators, together with the expert judgment of portfolio managers, determine the choice of certain stocks for inclusion in the portfolios of ESG funds (whose investment policy is aimed at forming a portfolio of companies focused on ESG).
2. There are no ESG-neutrals among the large market capitalization. This is confirmed by the inclusion of the vast majority of large-capitalization companies in the portfolios of the most popular ESG funds. The inclusion of such stocks in the portfolio can also be explained by the relatively low volatility of the returns on these stocks, which allows stabilizing the portfolio returns within the framework of the fund's investment policy. It should also be noted that the level of ESG information disclosure is significantly higher among large companies, which, due to rather vague selection criteria, gives reason to consider almost any large company as ESG-oriented.
3. Stocks of small and mid-cap companies are included in a limited number of portfolios of ESG funds, which can be explained by the volatility of their returns and lower liquidity compared to stocks of larger companies.
4. It is technically impossible to control the inclusion of certain stocks in any of the ESG funds, which makes it impossible to unambiguously classify any companies as ESG-neutral.
5. The number of comparable companies for small-cap companies is limited, resulting in a relatively small sample size for compiling model portfolios.

To compile a model portfolio of ESG-oriented companies, a number of companies were selected from the most popular ESG-focused funds, according to Morningstar. Many funds

Table 1

Supplemental research hypothesis system for main hypothesis testing

		Fundamental indicators of ESG-oriented and ESG-neutral portfolio comparison		
		Lower (H.2.1)	**Neutral (H.2.2)**	**Higher (H.2.3)**
Total return of ESG-oriented and ESG-neutral portfolio comparison	Lower (H.1.1)	Not confirmed	Not confirmed	Not confirmed
	Neutral (H.1.2)	Confirmed	Not confirmed	Not confirmed
	Higher (H.1.3)	Confirmed	Confirmed	Not confirmed

Source: authors' calculations.

have been limited to those whose investment strategies are to invest exclusively in small and mid-cap companies. Also, an additional positive screening filter was applied to the respective funds in accordance with the Morningstar analyst rating for funds and sustainability rating. The Hartford Global Impact R 6 HGXVX portfolio as of 06/27/2021 was selected from a variety of funds for the purposes of this study, as it has the highest performance in the ratings above.

For the purposes of this study, considering the presence of various financial instruments in the portfolio and the availability of information about individual companies, 10 stocks of companies with the largest share in the fund's portfolio were selected. The model portfolio of these stocks was formed by creating an equal-weighted index.

To compile a model portfolio of ESG-neutral companies for each company from the model portfolio of ESG-oriented companies, comparable companies were selected based on the following criteria:

- Industry according to the Global Industry Classification Standard (GICS);
- the main region of presence;
- enterprise value.

The model portfolio of ESG-neutral companies was also formed through the creation of an equal-weighted index.

The profitability of the model portfolios was calculated retrospectively for the period from 2011 to 2021, the frequency of observations was quarterly. To determine the profitability, the indicator of total return (TR) was used, to assess the level of risk — the indicator of total risk, calculated for each instrument by the Bloomberg terminal system. To test hypotheses H1.1-H.1.3, a pairwise regression tool was used, in which the profitability of the model portfolio of ESG-neutral companies was used as the independent variable, and the profitability of the model portfolio was used as the dependent variable of ESG-oriented companies. The test was carried out by testing the hypothesis that the regression coefficient is not statistically equal to one. Otherwise, portfolio returns are not statistically different. The MS Excel software environment and the S&P Capital IQ information and analytical system were used as a technical analysis environment.

To compare the fundamental indicators of model portfolios (group of hypotheses H.2), the following indicators were used:

- Price/Book Value (P/BV);
- Price/Earnings (P/E);
- Enterprise Value / EBITDA;
- Enterprise Value / Unlevered Free Cash Flow;
- EBITDA margin;
- Return on assets;
- Return on invested capital;
- Asset turnover;
- Debt/EBITDA.

We used quarterly observations from the 1st quarter of 2013 to the 2nd quarter of 2021 (a total of 34 observations for each indicator for 20 companies). The fundamental value of the portfolio was determined in proportion to the weight of the stocks in the portfolio. Hypotheses H.2.1-H.2.3 were tested using a pairwise regression method similar to hypothesis testing H1.1-H.1.3. The technical environment for the analysis was also the MS Excel software environment.

RESULTS AND DISCUSSION

For the purposes of the study, model portfolios were formed, which included the stocks of the following companies:

ESG-oriented portfolio (10 companies with a fixed stock weight in the portfolio — 10%):

- Agilent Technologies Inc;
- Danaher Corp;
- Schneider Electric SE;
- Signify NV;
- Koninklijke Philips NV;
- Koninklijke DSM NV;
- Nuance Communications Inc;
- Trane Technologies PLC;
- Nomad Foods Ltd;
- Boston Scientific Corp.

ESG-neutral portfolio (10 companies with a fixed stock weight in the portfolio — 10%):

- Iqvia Holdings Inc;
- Abbott Laboratories;
- Legrand SA;
- IMCD NV;
- Siemens Healthineers AG;
- AKZO NOBEL N.V.;
- PTC Inc;
- Experian plc;
- Tate & Lyle plc;
- Edwards Lifesciences corp.

The composition of the formed portfolios and the industry affiliation of the companies in the portfolios are shown in *Fig. 1*.

The Bloomberg database was used for the formation of portfolios modeled as of 06/01/2011 to obtain historical data on the profitability and risks of portfolios.

Analyzing the profitability of portfolios over a 10-year horizon (from 2011 to 2021) (*Fig. 2*), it can be noted that the profitability of an ESG-neutral portfolio is slightly higher than that of an ESG-oriented portfolio.

However, the study also found that the ESG-oriented portfolio performed better than the ESG-neutral portfolio during the COVID-19 pandemic crisis (*Fig. 3*).

This observation confirms the results of the study by M. S. Fernandez, A. Abu-Alkheil, G. M. Khartabiel [34], who found that during the financial crisis (2007–2009) German green mutual funds achieved higher adjusted returns than conventional funds. Similar results tend to hold true for economic downturns.

Thus, ESG investment creates asymmetric benefits and provides an "insurance effect", that is, protection against negative consequences, especially during a social or economic crisis. Under these conditions, firms with low ESG scores will have to offer a risk premium, which can be even more noticeable in volatile capital markets.

To test hypotheses H1.1-H.1.3, it is necessary to separately test the differences in the total returns of the model portfolios using pairwise regression. The results of constructing a regression equation for the return of two portfolios are presented in *Table 2*.

The coefficient on the independent variable is statistically significant. In this case, the *t*-statistic when testing the hypothesis that the coefficient is not equal to 1 is equal to:

$$t = \frac{(1 - 0.879)}{0.049} = 2.46.$$

Fig. 1. **The composition of the formed portfolios (Portfolio — ESG-oriented portfolio, Benchmark — ESG-neutral portfolio)**

Source: author's modelling in the Bloomberg database.

Fig. 2. **Total return of ESG-oriented and ESG-neutral portfolios (2011–2021)**

Source: author's modelling in the Bloomberg database.

Fig. 3. **Profitability of ESG-oriented and ESG-neutral portfolios during the COVID-19 pandemic**

Source: author's modelling in the Bloomberg database.

Table 2

Regression statistics for total return comparison

Regression statistics					
Multiple R	0.947988				
R2	0.898682				
Norm. R2	0.870904				
St. error	8.15071				
Observations	37				
	Coefficients	***St. error***	***t-stat***	***p-value***	
X0	0	N/A	N/A	N/A	
X1	0.878644	0.04917	17.86943	1.76E-19	

Source: authors' calculations.

Table 3

Regression statistics for total risk comparison

Regression statistics					
Multiple R	0.957873				
R2	0.917521				
Norm. R2	0.886271				
St. error	0.781736				
Observations	33				
	Coefficients	***St. error***	***t-stat***	***p-value***	
X0	0	N/A	N/A	N/A	
X1	1.005828	0.053311	18.86731	6.68E-19	

Source: authors' calculations.

The *t*-critical value at d*f* = 36, *p* = 0.01 is 2.719. Given that the observed *t*-statistic is less than the *t*-critical, the hypothesis that the portfolio returns are not equal is rejected.

Thus, it was concluded that the return on the model portfolio of ESG-oriented companies does not differ from the return on the portfolio of ESG-neutral companies.

Considering the risk profile of portfolios (*Fig. 4*) presented in the Bloomberg database, we conclude that the level of risk is approximately the same (the total risk level of

Fig. 4. **Comparative risk profile of ESG-oriented and ESG-neutral portfolios**

Source: author's modelling in the Bloomberg database.

Table 4

Regression statistics for fundamental metrics comparison

	EBITDA Margin, %	ROA, %	ROC, %	Total Asset Turnover	Total Debt/ EBITDA	P/BV	P/LTM EPS	TEV/LTM EBITDA	TEV/LTM Unlevered FCF
Regression coefficient (slope)	0.88	0.63	0.62	0.77	1.03	0.59	0.67	0.76	0.78
Stand. Error	0.02	0.05	0.05	0.02	0.08	0.01	0.06	0.03	0.03
T-statistics (for coefficient =1 hypothesis)	6.10	7.99	7.10	9.24	–0.38	34.44	5.41	7.83	6.49
t-critical (p=0,01)	3.25					2.73			
Hypothesis verification	+	+	+	+	-	+	+	+	+
R2	1.00	0.95	0.94	0.99	0.94	0.99	0.78	0.95	0.94

Source: authors' calculations.

an ESG-oriented portfolio is 18,13 compared to the total risk level for an ESG-neutral portfolio — 18,43). Moreover, country-specific characteristics contribute most to the risk assessment.

To test hypotheses H1.1-H.1.3, it is necessary to separately test the differences in the total risk level of the model portfolios using pairwise regression.

The results of constructing the regression of the risk level between the two portfolios are presented in *Table 3*.

Similar to the rate of return, the risk of both portfolios is significantly correlated, which proves the comparability of the companies in the portfolio. The *t*-statistic when testing the hypothesis that the coefficient is not equal to 1 is equal to:

$$t = \frac{(1-1.006)}{0.053} = 0.11.$$

The *t*-critical value at d*f* = 33, *p* = 0.01 is 2.73. Accordingly, it was concluded that the risk level of both portfolios was similar.

Based on the test results, it was concluded that the risk and profitability of both portfolios were identical. Thus, hypothesis H.1.2 is confirmed; hypotheses H.1.1 and H.1.3 are rejected.

According to the "classical school", the return on assets in a portfolio is determined by the values of fundamental indicators. Therefore, it is necessary to conduct a comparative analysis of the values of the fundamental indicators of the companies included in the ESG-oriented and ESG-neutral portfolios to identify the internal drivers of profitability of the portfolios under consideration.

Table 4 shows the results of paired regressions of various fundamental indicators built for two portfolios.

Considering the high R^2 values and statistically significant regression coefficients, we can conclude that the fundamental indicators of the model portfolio of ESG-neutral companies are higher than those of ESG-oriented companies. It should be noted that not all ratios are equal to one (except for the indicator characterizing the level of debt burden), which allows us to conclude that the fundamental indicators for ESG-oriented companies are lower.

Note that not only the profitability indicators but also the price multiples of ESG-neutral companies exceed the values of the ESG-oriented companies. One of the possible explanations for such observations may be the fact that among small and medium-sized companies there are dynamically growing companies that invest more actively in their growth and development than in ESG. As companies mature and maintain their growth rates, they tend to reorient their investments towards ESG.

Thus, hypothesis H2.1 was confirmed, hypotheses H.2.2 and H.2.3 were rejected. In contrast to ESG-neutral peers, the portfolio of ESG-oriented companies showed relatively lower values of fundamental indicators directly related to the formation of value for shareholders. At the same time, the fact that the profitability of both portfolios turned out to be comparable allows us to conclude that the behavioral aspects of decision-making are significant for investors, which determined the research results. However, when interpreting these results, the premises and limitations of this study related to the comparability of company data should be considered.

CONCLUSIONS

The aim of the present study was to verify the validity of the statement that ESG commitment is a driver of market returns for investors.

As part of the study, the hypothesis was put forward and tested: the relationship between the degree of ESG compliance of a company and the investment attractiveness of the stocks of a given company is due to factors that are not exclusively related to the fundamental factors of value. To test the main hypothesis, additional hypotheses were put forward related to the analysis of the ratio of portfolio returns, and hypotheses related to the analysis of the ratio of fundamental portfolio indicators.

In the course of the study, model portfolios of ESG-oriented and ESG-neutral companies were formed; a comparative analysis of the profitability and fundamental indicators of model portfolios was carried out.

The result of the study was the conclusion that the portfolio of ESG-oriented companies shows returns no lower than the portfolio of ESG-neutral companies in terms of risk. At the same time, the values of the fundamental indicators of ESG-oriented companies (the level of business activity, return on equity, price multiples) are inferior to the values of ESG-neutral companies (considering the similar level of debt burden). This confirms the main hypothesis that the relationship between a

company's ESG compliance and the investment attractiveness of stocks is due not only to factors related to fundamental (financial) value drivers.

Based on the results, the authors recommend considering the following factors that are significant for the analysis and assessment of investment decisions:

1. Investors who decide to invest in ESG companies and funds are guided not only by the results of fundamental analysis but also by personal beliefs about the importance of ESG.

2. There is a relationship between ESG factors and non-financial risks that are not considered in the market-based valuation of companies (and, as a result, are not translated into higher price multiples).

3. Currently, different segments of the investment community use different investment strategies in the field of ESG, which is manifested in different methods of selecting investments in ESG.

4. Most investors are willing to receive returns on ESG investing that are consistent with normal returns. In other words, they do not expect the returns on ESG strategies to outperform traditional strategies.

5. ESG investing provides asymmetric benefits during social and economic crises. The results of this study support this thesis.

This study develops the theory of ESG integration and contributes to the conclusion that adherence to ESG factors is a driver of market returns for investors.

The authors see the prospects for further research in the study of the relationship between ESG indicators and the characteristics of the investment attractiveness of assets.

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Research of the Synergetic Effects of the Impact of Innovative and Related Macroeconomic Factors on Economic Growth

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ABSTRACT

This article examines the main mechanisms and tools for implementing innovation policy in countries with fast-growing economies such as China and India. The study **aims** to explore the causal relationship between innovation, key macroeconomic variables and economic growth. The author applies the entropy **method** and adapts the Gray model to build a system of indices for assessing the coordination of the interaction of technological innovation, financial development and economic growth. The **results** show that the degree of integration of the financial system into innovation processes has a significant positive impact on the success of innovation, which is measured by patent activity. Our research proves that innovation indirectly affects economic growth through quality of life, infrastructure efficiency, employment, and trade openness. The findings of the research reveal that both economic growth and innovation tend to depend on a number of conjugate variables in the long run: capital, labor, etc. The author **concludes** that a comprehensive analysis of technological innovation, financial development and economic growth shows that the three-factor relationship has great potential for coordinated development, as a result of which, according to the calculated forecasts, economic growth in fast-growing economies will significantly accelerate its pace in the next five years. The subject of further research may be an analysis of whether the degree of conjugation of connectivity and coordination between the three systems will maintain stable growth at high values and whether they will be able to reach the stage of transformation.

Keywords: economic growth; macroeconomic factors; technological innovation; R&D; financial system; national innovation system

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INTRODUCTION

In recent years, as the study of innovation policy has advanced, most researchers have concluded that an extensive system of financing innovation is required to implement strategies for disruptive technological innovation since such a system allows the economy to quickly respond to new technological innovation challenges [1, 2]. Thus, technological innovation and financial development are integral parts of the same chain of economic growth. However, as noted by a number of researchers who conducted a comparative analysis of the national innovation systems of different countries [3], at present, the uneven development of regional economies can not only cause innovation dissonance and social instability but also impede long-term economic development.

Coordinated regional economic development will help reduce these regional differences. Banks foster technological innovation and provide finance to companies that stand a chance of success. Technological innovation contributes to financial development by expanding market demand, increasing profits and reducing transaction costs. Therefore, when studying the impact of financial development on economic growth, it is necessary to consider the impact of technological innovation on both of these factors. It should be noted that most of the existing research usually considers financial development and technological innovation as exogenous factors. However, from the point

of view of our study, these factors mutually influence each other and should be considered as endogenous variables. This article attempts to combine these variables into a single system of interrelationships and comprehensively analyze the characteristics of coordinated development. At the same time, we will try to adapt our model for individual countries to identify cross-country differences in the relationship between these variables, which will contribute to the balanced development of the economy.

The main contribution of our research consists of the following results. First, we built a system of indices for assessing the coordinated interaction of technological innovation, financial development and economic growth. To do this, we used the entropy weight method combined with expert advice to determine the weight of the score index. Second, we used a relationship degree model to assess the relationship and coordination of our factors. Third, we have adapted gray model to forecast the dynamics of the relationship and coordination of our factors. Finally, based on empirical analysis, we put forward a number of assumptions and proposals to strengthen the interconnection of our factors and ensure sustainable economic growth.

REVIEW AND CRITICAL ANALYSIS OF THE MAIN THEORETICAL AND METHODOLOGICAL APPROACHES

First of all, we note that K. E. Maskus, R. Neumann, T. Seide [4] found that increasing the level of financial development can reduce the differences between technologically backward and developed countries, reduce financing costs, increase the efficiency of financing, and thus facilitate the introduction of innovations. At the same time, their research has shown that there are various methods of activating domestic financial markets, which at the same time have a positive effect on the intensity of industrial R&D. However, among the indicators of the financial market, only foreign direct investment has a positive effect on the intensity of R&D. In turn, R.H. Chowdhurya, M. Maung [5], using the example of the Indian economy, found that financial markets remove the problem of information asymmetry in R&D financing, which can significantly facilitate investment in R&D.

QX. Zhang and L. Feng [6] used empirical data from the listed companies to analyze the influence of financial impact on firms' technological innovation. They viewed financial development and technological innovation as two subsystems and studied the spatial characteristics of communication and coordination, as well as the temporal differentiation between them. QX. Zhang and L. Feng found that the degree of coordination and interrelation of these factors in countries differs significantly. In other words, the technological innovation potential of individual countries lags behind the level of financial development. They used a systemic communication model to empirically analyze the evolution of convergence and coordinated development between technological innovation, industrial sectoral structure and financial development and concluded that, in general, the level of convergence of the three systems is steadily increasing, and the level of development tends to be optimized.

C. Bravo-Ortega and A.G. Marin [7] found that with a 0.1% increase in R&D, labor productivity grows by 1.6%.

F.R. Lichtenberg [8] indicated that the private sector's contribution to R&D to increase productivity growth is 7 times higher than investment in fixed assets.

P. Howitt and D. Mayer-Foulkes [9] put forward the theory of vertical technological innovation, believing that an increase in enterprise investment in R&D can increase opportunities for successful technological innovation and contribute to further economic development.

A.B. Atkinson and J.E. Stiglitz [10] presented the concept of a learning-by-doing model and believed that with its help countries would disseminate the accumulated experience of technological innovation through trade, thereby contributing to economic development between

regions. Later, they conducted an empirical study of the impact of technological innovation on the quality of economic growth and found that, in general, technological innovation can significantly improve the quality of all-around economic growth and significantly increase efficiency, optimize the sectoral structure of the industry. In doing so, however, they found that technological innovation exacerbated income inequality.

Nevertheless, in his studies, J. Xiao [11] argues that technological innovation can be developed to form a pole of economic growth and contribute to regional economic development. Technological innovation can create new resources or production methods and contribute to the modernization of the sectoral structure of the industry, and the interactive promotion of technological and institutional innovations can stimulate new knowledge and technologies. Innovation and transformation of factors of production make the status of knowledge elements more visible.

L. L. Li and L. B. Zhou [12] conducted a factor analysis of the Chinese economy in 2017, reducing 23 estimates to three factors. They found a positive relationship between economic growth and the complex potential of technological innovation, consisting of three main factors, namely: the effectiveness of the contribution of talent, the basic potential of regional innovation development and regional economic growth.

F. Y. Wang and J. Zheng [13] used data from the 40 largest steel companies in China from 2011 to 2018 to find a positive relationship between the integrated potential of technological innovation and economic growth, and found an increase in the degree of relationship in two of them.

P.L. Rousseau and P. Wachtel [14], using the methods of dynamic panel data, showed that the activity of the stock market and the banking sector has a positive effect on the development of the economy.

A. Ilyina and R. Samaniego [15] selected 28 manufacturing industries in the United States and used their data to study the impact of financial development on economic development from 1970 to 1999. Research has shown that developed financial markets directly stimulate industrial growth through R&D.

Also R. G. Rajan and L. Zingales [16], N. Cetorelli and M. Gambera [17] conducted similar studies and found the relationship between financial development and industrial development in India.

In turn, F. Y. Wang and J. Zheng [13], based on data from 1999 to 2016, found that the real economy has a positive side effect, and there is a positive impact of technological innovation on the local real economy, but a negative impact on neighboring provinces and cities in China.

S. Yang and T.T. Huang [18], using differential regression methods such as the generalized method of moments (GMM) and least squares dummy variable (LSDVC), based on the theory of least squares (OLS), investigated the relationship between financial development and economic growth, and found a lagging non-linear effect between the two, which means lagging inverted U-shaped relashinship.

Meanwhile, in his studies, X.B. He [19] found that there is a long-term, stable equilibrium relationship between financial development, technological innovation and economic growth. He stresses that financial development is the direct cause of economic growth.

In turn, L. L. Li and L. B. Zhou [12] also found that economic growth promotes financial development and technological innovation. For example, in China, financial development and technological innovation contribute to economic growth more than in India. In their research L. L. Li and L. B. Zhou [12] proposed a three-sector dynamic game model, and the results of this model show that financial innovation itself inhibits economic growth, while co-financing of technological innovation has a significant impact on economic growth.

In general, summing up the results of the theoretical and methodological analysis, it can be noted that the existing research creates a

reliable prerequisite for further research, but still have a number of shortcomings.

First, previous studies have mainly looked at current nodal problems, or have focused on analyzing the relationship between two or three factors, but in pairwise correlation.

Second, these studies did not reveal long-term dynamic effects, especially those that have not yet been observed. There are studies analyzing the possible interdependence of these three factors, and to identify the relationship, the structure of the analysis in these studies is based on an ideal research platform and methodology, more precisely, on the application of a systemic communication approach built on the "three-module vector" model and analysis of their interaction.

Based on this methodology, in our study, we use the degree of convergence and coordination of the three systems, as well as the gray model to forecast their future dynamics.

IMPROVEMENT OF FUNCTIONALITY AND ADAPTATION OF NEW TOOLS IN RESEARCH METHODOLOGY

One of the methods that has generated wide interest in the research environment in recent years is the entropy method. It is based on the distance between a finite number of valuable objects and positive and negative ideal solutions to determine the relative pros and cons of each evaluated object and is widely used in systems engineering. The distance principle is a popular mathematical model for solving multipurpose decision analysis problems that use the entropy weight method to determine the weighting index. For assigning weights to indices, the method of entropy weights is more often used, since it allows you to overcome subjective factors and more objectively, comprehensively and accurately reflect the information and laws inherent in the data of the index. The entropy weight method can significantly improve the contrast and spacing between index data and effectively avoid a number of errors due to too small a difference in the index data. This method is distinguished by high objectivity, high accuracy and scientific validity. It can comprehensively and systematically reflect the usefulness of the indicative information.

The entropy method is an objective way to determine the weight of an index. This is mainly determined by the size of the observation value information. If there are m system and n indices, then the data matrix can be expressed as $X = \left(x_{ij}\right)_{m*n}$. If the difference between the values of the X_{ij} index is greater, then the effect of complex assessment is better. If the index values are the same, then the complex assessment is invalid.

When determining the weight of an index, the data must first be standardized. This reduces bias in the results due to subjective factors.

The data standardization process includes two stages. At the first stage, the entropy method can ignore the standardization process without any impact on the dimension. The principle is to find the proportion of a certain indicator in different schemes of the same indicator. The data must be non-negative for processing. It also makes sense to translate the data to ensure that the entropy logarithm makes sense for the following structural elements:

For large indicators:

$$X'_{ij} = \frac{X_{ij} - \min\left(X_{1j}, X_{2j}, \ldots X_{nj}\right)}{\max\left(X_{1j}, X_{2j}, \ldots X_{nj}\right) - \min\left(X_{1j}, X_{2j}, \ldots X_{nj}\right)}, i = 1, 2, \ldots, n; j = 1, 2, \ldots m. \quad (1)$$

For small indicators:

$$X'_{ij} = \frac{max\left(X_{1j}, X_{2j}, \ldots X_{nj}\right) - X_{ij}}{\max\left(X_{1j}, X_{2j}, \ldots X_{nj}\right) - \min\left(X_{1j}, X_{2j}, \ldots X_{nj}\right)} + 1, i = 1, 2, \ldots, n; j = 1, 2, \ldots m. \quad (2)$$

At the second stage, the weight indicator is determined. This stage is intended for quantitative assessment and complex processing of all information about the evaluated object. Weighing each factor avoids the complexity of the assessment process. The entropy method is used to determine the weights of the indices. First, based on the selected estimates, our $n \times m$ input matrix can be obtained as follows:

$$X=\begin{bmatrix} x_{11} & x_{12}\ldots. & x_{1n} \\ x_{21} & x_{22}\ldots & x_{2n} \\ x_{n1} & x_{n2}\cdots & x_{nm} \end{bmatrix}_{n\times m}, \quad (3)$$

where the system number is expressed in terms of n, and the index score is expressed in terms of m.

Second, the same trend is used to process the target index and a positive matrix is obtained. After evaluating, for all indicators to be of good quality, the low-quality indicator should be processed in reverse order, as the above indicators have their advantages and disadvantages. We get the corresponding matrix:

$$Y=\begin{bmatrix} y_{11} & y_{12}\ldots. & y_{1n} \\ y_{21} & y_{22}\ldots & y_{2n} \\ y_{n1} & y_{n2}\cdots & y_{nm} \end{bmatrix}_{n\times m}. \quad (4)$$

Now that we have a normal matrix, we can get the following calculation formula:

$$z_{ij}=\frac{y_{ij}}{\sum_{i=1}^{n} Y_{ij}},\left(j=1,2,\ldots,m\right), \quad (5)$$

where z_{ij} — an element in a normal matrix.

When we get an estimate of the weight index, the calculation formula will be as follows:

$$H\left(x_j\right)=-k\sum_{i=1}^{n} z_{ij} lnz_{ij}, j=1,2,\ldots,m. \quad (6)$$

Here k — the correcting factor, and z_{ij} — j-th index of the -th estimated index.

Then the entropy value of the estimated index will be converted into a weight value as follows:

$$d_j=\frac{1-H\left(x_j\right)}{m-\sum_{j-1}^{m} H\left(x_j\right)}, j=1,2,\ldots m, \quad (7)$$

where $0\le d_j\le 1, \sum_{j=1}^{m} d_j=1$.

Systems of technological innovation, financial development, and economic growth are particularly complex and involve technical, social, and economic factors. Economic growth needs financial support. In addition, technological innovation requires sufficient financial support and must be supported by economic growth. Together they form a system of interaction. The degree of connection chosen in our work represents the degree of correlation and influence between different indicators in the three systems. It is defined as the degree of coordinated development of the three subsystems. In particular, to understand the degree of coordination, the degree of influence, and the level of these three factors, a system of assessment indicators should be built that determines the degree of connection and coordination of these three factors.

The next method is the gray forecasting model GM (1.1), which is a time series forecasting model that includes a group of differential equations adapted to parameter variance as well as a first-order differential equation.

These three systems are quite large and very complex. They are linked dynamically and in stages, the entire link trend cannot be predicted using conventional linear or nonlinear models and is highly uncertain. Gray model is a method of forecasting the development of the characteristic value of the behavior of a system containing both known and uncertain information, i.e. predicting changes in a certain range.

We take a look at the data processing methodology. First, the time series being processed is called the generated column. Suppose that $X^{(0)}=\left\{X^{0}(1),X^{(0)}(2),X^{(0)}(3),\ldots,X^{(0)}(n)\right\}$ — initial data of the indicator that we need to predict. This can be done by calculating the ratio of the levels of the series $\lambda(t)=\frac{X^{(0)}(t-1)}{X^{(0)}(t)}, t=1,2,3,\ldots,n.$

Gray forecasting model is valid when most levels are added to the interval $\left(\frac{-2}{e^{n+1}},\frac{2}{e^{n+2}}\right)$. Otherwise, it is needed to reprocess

the data to make it logarithmic and smoothed. The preprocessed data is smoothed to three-point smoothing as follows:

$$X^{(0)}(t)=\left[X^{(0)}(t-1)+2X^{(0)}(t)+X^{(0)}(t+1)\right]/4, \quad (8)$$

$$X^{(0)}(1)=\left[3X^{(0)}(1)+X^{(0)}(2)\right]/4, \quad (9)$$

$$X^{(0)}(n)=\left[X^{(0)}(n-1)+3X^{(0)}(n)\right]/4. \quad (10)$$

The final preprocessing step also accumulates the generated processing data. The secondary data is then continuously looped to get the fully generated column.

Using the expression $X^{(1)}(k)=\sum_{n=1}^{k}X^{(0)}(n)$, we can get the following series:

$$X^{(1)}=\left\{X^{(1)}(1),X^{(1)}(2),X^{(1)}(3),\ldots,X^{(1)}(n)\right\}. \quad (11)$$

The degree of randomness weakens, and stationarity increases significantly, which can be described by the following series:

$$\frac{dX^{(1)}}{dt}+aX^{(1)}=u. \quad (12)$$

Finally, the index system consists of a number of indexes that reflect the relationship between them (*Table 1* and *2*). *Table 1* and *2* show the generalized values of the estimates of the indicators of the system of economies of India and China.

The choice of indices should clarify the logical correlation, scientific validity and representativeness of the indices, and reflect the correlation of different systems. Our research is based on the above principles. The indicators in the tables are divided into three main systems: technological innovation, financial development, and economic growth.

The system of technological innovation includes a system of R&D costs and the results of implemented innovations, and the system of financial development is subdivided into financial depth, financial range and a system of financial efficiency. The economic growth system includes systems of quality and quantity of economic growth. To prevent the influence of subjective factors on the results of the weighting coefficients of the indices and to ensure the reliability of the assessment, the weighting coefficients of all indices are considered.

In general, the results of the calculations show that the degree of convergence of the three key systems in these countries does not differ much, except that India as a whole is in a position to "catch up" with the Chinese innovation system and gradually increase in R&D spending.

Meanwhile, returning to our methodology, it can be noted that over the past two decades, technological innovation, financial development, and economic growth in India and China have demonstrated different values of the degree of mutual coordination throughout the entire cycle (*Tables 3* and *4*).

According to the above classification of the degrees of coordination, we see that during 2006–2018 the degree of coordination of the three systems of the Chinese economy is gradually increasing, but at the same time, we observe that the level of coordination is below the average level (0.4204) in general for 2006–2010.

The degree of conjugacy increased from 0.2478 to 0.4817, i.e. indicators were relatively stable, and in general, the situation tended to grow. From 2006 to 2008, it was at a low level, mainly due to a slowdown in economic growth. Lagging economic growth lacked funds to invest in technological innovation, so financial development was relatively slow, resulting in a low degree of conjugacy coordination. In addition, the structure of the economy has been relatively unified over the years, and the structure of the industry has been somewhat backward. 2009–2018 saw strong economic growth, a negative phase, and the overall degree of conjugacy was still relatively low but had a long-term uptrend. The conjugacy level in 2018 was 0.4817, which is close to the transformation stage.

We consider similar indicators of India (*Table. 4*).

Table 1

Index system for assessing the relationship between technological innovation, financial development and economic growth in India

System	Subsystem	Rating index	Type of relationship	Index weights
Technological innovation	Innovation costs	R&D spending (per Rs 1 billion)	+	0.0717
	Innovation system launch	R&D investment intensity, %	+	0.0564
		Number of permits for the issuance of patent applications, ea.	+	0.0943
		Patent applications, ea.	+	0.0751
Financial development	Depth of financial involvement	Cumulative assets of financial institutions/ GDP, %	+	0.0653
		The total output of shares in the stock market (per Rs 1 billion)	+	0.0337
	Range of financial involvement	Premium income/GDP, %	+	0.0516
		Per capita insurance (Rs/person)	+	0.0527
	Financial involvement efficiency	The volume of cumulative trade bonds (per Rs 1 billion)	+	0.0315
		The number of retail offices offering financial services (per 10 thousand people)	+	0.00998
		The number of retail offices offering financial services per 100 square meters	+	0.0112
		Number of personnel working in retail offices (thousand people)	+	0.0311
		Value added of the financial industry/total population of the region (Rs/person)	+	0.0531
		General balance sheet/ deposits of financial institutions, %	+	0.0593
		Investments in financial assets (Rs million)	+	0.0157
Economic growth	Quality of economic growth	Aggregate retail consumer goods (per Rs 1 billion)	+	0.0108
	Economic growth rate	Consumer price index, %	–	0.0378
		Average monthly wages of employees (per 100 thousand rupees)	+	0.0542
		Per capita consumption expenditure (Rs)	+	0.0237
		Number of participants serving personnel insurance (people)	+	0.0082
		GDP per capita (Rs 100 thousand/person)	+	0.0116
		City population density (people/sq. km)	+	0.0385
		Urbanization rate, %	+	0.0395

Source: Handbook of Statistics on Indian Economy. URL: https://www.india.gov.in/handbook-statistics-indian-economy; IMF Statistics — International Financial Statistics. URL: https://data.imf.org/?sk=388dfa60–1d26–4ade-b505-a05a558d9a42 (accessed on 21.06.2021); author's calculations.

India's conjugacy coordination increased from 0.2355 in 2006 to 0.5106 in 2018 — more than doubled. The overall level of coordination has improved, but there is still a large gap with China.

We have divided the research into two phases. The first phase was from 2006 to 2008, when the degree of alignment of the pairing was low, and economic growth during this period lagged behind. This was due to the long-term formation of a resource-dependent model of economic growth in both countries, which could not effectively respond to the urgent need to adjust the development regime; therefore, the coordinated development of the system

Table 2

Index system for assessing the relationship between technological innovation, financial development and economic growth in China

System	Subsystem	Rating index	Type of relationship	Index weights
Technological innovation	Innovation costs	R&D spending (per Rs 1 billion)	+	0.0621
	Innovation system launch	R&D investment intensity, %	+	0.0453
		Number of permits for the issuance of patent applications, ea.	+	0.0921
		Patent applications, ea.	+	0.0744
Financial development	Depth of financial involvement	Cumulative assets of financial institutions/ GDP,%	+	0.0632
		The total output of shares in the stock market (per Rs 1 billion)	+	0.0225
	Range of financial involvement	Premium income/GDP, %	+	0.0421
		Per capita insurance (Rs/person)	+	0.0431
	Financial involvement efficiency	The volume of cumulative trade bonds (per Rs 1 billion)	+	0.0262
		The number of retail offices offering financial services (per 10 thousand people)	+	0.0111
		The number of retail offices offering financial services per 100 square meters	+	0.0233
		Number of personnel working in retail offices (thousand people)	+	0.0411
		Value added of the financial industry/total population of the region (Rs/person)	+	0.0652
		General balance sheet/ deposits of financial institutions, %	+	0.0681
		Investments in financial assets (Rs million)	+	0.0215
Economic growth	Quality of economic growth	Aggregate retail consumer goods (per Rs 1 billion)	+	0.0209
	Economic growth rate	Consumer price index, %	–	0.0477
		Average monthly wages of employees (per 100 thousand rupees)	+	0.0655
		Per capita consumption expenditure (Rs)	+	0.0352
		Number of participants serving personnel insurance (people)	+	0.0200
		GDP per capita (Rs 100 thousand /person)	+	0.0127
		City population density (people/sq. km)	+	0.0491
		Urbanization rate, %	+	0.0477

Source: National Bureau of Statistics of China. URL: http://www.stats.gov.cn/english/; IMF Statistics — International Financial Statistics. URL: https://data.imf.org/?sk=388dfa60–1d26–4ade-b505-a05a558d9a42 (accessed on 21.06.2021); author's calculations.

was severely limited. The second phase was characterized by moderate coordination of interaction from 2008 to 2018. At this phase, countries continued to pursue a policy of openness, and financial development proceeded at a rapid pace. The first years showed a lag in economic growth and financial development, and in subsequent years — in technological innovation. The lag in technological innovation results in an inability to effectively stimulate economic growth, and the overall degree of connectivity and coordination is low.

Table 3

The value and degree of conjugacy coordination of the three systems (technological, financial and economic growth) of China in 2006–2018

Год	Index of financial development, I_1	Index of technological development, I_2	Index of economic growth, I_3	Complex coordination index, K	Degree of conjugacy, F	Degree of conjugacy coordination, φ	Level of conjugacy	Level of conjugacy coordination	A system that is lagging in conjugacy coordination
2006	0.1821	0.1912	0.1647	0.1797	0.2478	0.2421	Low	Low	Economic growth
2007	0.1842	0.2033	0.1749	0.1886	0.2476	0.2566	Low	Low	Economic growth
2008	0.1923	0.2112	0.3192	0.2443	0.3133	0.3199	Negative	Moderate	Financial development
2009	0.2032	0.2132	0.2722	0.2314	0.3279	0.3494	Negative	Moderate	Financial development
2010	0.2109	0.2234	0.2601	0.2331	0.3744	0.4112	Negative	Moderate	Financial development
2011	0.2117	0.2242	0.3036	0.2489	0.4626	0.4346	Negative	Moderate	Financial development
2012	0.2284	0.2372	0.2993	0.2567	0.4897	0.4438	Negative	Moderate	Financial development
2013	0.2331	0.2387	0.3581	0.2791	0.4997	0.4722	Negative	Moderate	Financial development
2014	0.2423	0.2503	0.3686	0.2897	0.4998	0.4728	Negative	Moderate	Financial development
2015	0.2679	0.2512	0.3769	0.2994	0.4939	0.5008	Negative	Moderate	Technological innovations
2016	0.2701	0.2526	0.3885	0.3045	0.4840	0.5023	Negative	Moderate	Technological innovation
2017	0.2923	0.2555	0.4166	0.3211	0.4814	0.5080	Negative	Moderate	Technological innovation
2018	0.2956	0.2634	0.2953	0.2826	0.4817	0.5193	Negative	Moderate	Technological innovation
Average value	0.2369	0.2350	0.3002	0.2583	0.4204	0.4266	Negative	Moderate	Technological innovation

Source: National Bureau of Statistics of China. URL: http://www.stats.gov.cn/english/; IMF Statistics – International Financial Statistics. URL: https://data.imf.org/?sk=388dfa60-1d26-4ade-b505-a05a558d9a42 (accessed on 21.06.2021); author's calculations.

Thus, the degree of conjugacy and coordination of these three systems as a whole demonstrates an upward trend, which to some extent correlates with their economic policies. The question of whether the degree of conjugacy and coordination between them will support stable growth at the level of high values and whether they will be able to reach the stage of transformation is the subject of a separate study.

Finally, we will try to adapt gray model to forecast the conjugacy and conjugacy coordination of the three systems over the next

Table 4

The value and degree of conjugacy coordination of the three systems (technological, financial and economic growth) of India in 2006–2018

Год	Index of financial development, I_1	Index of technological development, I_2	Index of economic growth, I_3	Complex coordination index, K	Degree of conjugacy, F	Degree of conjugacy coordination, φ	Level of conjugacy	Level of conjugacy coordination	A system that is lagging in conjugacy coordination
2006	0.1821	0.1912	0.1647	0.1797	0.2478	0.2421	Low	Low	Economic growth
2007	0.1842	0.2033	0.1749	0.1886	0.2476	0.2566	Low	Low	Economic growth
2008	0.1923	0.2112	0.3192	0.2443	0.3133	0.3199	Negative	Moderate	Financial development
2009	0.2032	0.2132	0.2722	0.2314	0.3279	0.3494	Negative	Moderate	Financial development
2010	0.2109	0.2234	0.2601	0.2331	0.3744	0.4112	Negative	Moderate	Financial development
2011	0.2117	0.2242	0.3036	0.2489	0.4626	0.4346	Negative	Moderate	Financial development
2012	0.2284	0.2372	0.2993	0.2567	0.4897	0.4438	Negative	Moderate	Financial development
2013	0.2331	0.2387	0.3581	0.2791	0.4997	0.4722	Negative	Moderate	Financial development
2014	0.2423	0.2503	0.3686	0.2897	0.4998	0.4728	Negative	Moderate	Financial development
2015	0.2679	0.2512	0.3769	0.2994	0.4939	0.5008	Negative	Moderate	Technological innovations
2016	0.2701	0.2526	0.3885	0.3045	0.4840	0.5023	Negative	Moderate	Technological innovation
2017	0.2923	0.2555	0.4166	0.3211	0.4814	0.5080	Negative	Moderate	Technological innovation
2018	0.2956	0.2634	0.2953	0.2826	0.4817	0.5193	Negative	Moderate	Technological innovation
Average value	0.2369	0.2350	0.3002	0.2583	0.4204	0.4266	Negative	Moderate	Technological innovation

Source: Handbook of Statistics on Indian Economy. URL: https://www.india.gov.in/handbook-statistics-indian-economy; IMF Statistics — International Financial Statistics. URL: https://data.imf.org/?sk=388dfa60–1d26–4ade-b505-a05a558d9a42 (accessed on 21.06.2021); author's calculations.

five years, and to provide a theoretical basis for policy implementation.

After passing the model verification, the correspondence of the degree of conjugacy was C = 0.2561, P = 0.9677, and the correspondence of the conjugacy coordination was C = 0.1521, P = 0.9876. According to the likelihood rank of this model, P ⩾ 0.95 and C ⩾ 0.35, which can be used for forecasting. That is, the degree of coordination of the three systems can be predicted during 2019–2024. Overall, we found that the degree of conjugacy increases steadily

from 2020 to 2024 and enters the transformation phase of the degree of conjugacy in 2021, and the growth rate increases significantly. In addition, the predicted value of the degree of conjugacy coordination is also greatly improved. The final coordination phase will begin in 2023 and the synergies from the development of the three systems will improve significantly. As a result, the degree of conjugacy coordination in the interaction of technological innovation, financial development, and economic growth tends to increase in the next five years, but from the tables above, we see that the degree of conjugacy coordination is not synchronized and their evolution is not the same. Coordination of technological innovation, financial development and economic growth still takes time, and proactive economic policies are needed to promote coordinated development.

CONCLUSIONS

On the basis of the idea of system communication in this paper, a model of a "three-vector module" was built [20]. On the basis of a cross-country comparative analysis of the mechanisms of interaction of these three systems, an analysis of the conjugacy degree was carried out. In general, our conclusions are as follows.

First, from a comprehensive analysis of technological innovation, financial development and economic growth, we see that they are all on the rise. The technological innovation index has the greatest increase indicating that it has relatively great potential to facilitate coordinated development in the future. The financial development index shows an accelerated growth trend, which means that the financial reform has reached good initial results and additionally contributes to a combination of three systems.

Second, from the point of view of the change in the degree of conjugacy in China, more precisely, an increase from 0.2478 to 0.4817, the leading advantage of this country becomes more and more evident. This is due to the significant improvement in technological innovation in China and the improvement in the financial climate, which is setting a good example for other countries.

Third, the degree of coordination of conjugacy in China is growing, albeit slowly, although it showed a lag in terms of financial development. From 2013 to 2018, China entered a state of high conjugate coordination. In 2018, the degree of conjugacy coordination reached an extreme value.

Fourth, the forecast results show that the degree of conjugacy will grow steadily from 2020 to 2024 and enter the transformation stage in 2022, and the growth rate will increase significantly. In addition, the predicted value of the degree of conjugacy coordination will also be significantly improved. The highest value of the degree of coordination will be achieved in 2024, and the synergistic effect of development will improve. However, the growth of the degree of conjugacy during the transformation period is expected to be significantly lower than the degree of conjugacy coordination. Their coordination will still take a long time, therefore, to promote coordinated development, it is necessary to pursue an active economic policy.

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Optimization of the Activities of Institutions Promoting Investment in the Sustainable Economic Growth of Russia

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ABSTRACT

The article examines and assesses the problem of the investment deficit in the Russian economy, which has acquired particular relevance due to the coronavirus crisis caused by the pandemic. The study **aims** to develop practical recommendations for Russian state bodies to stimulate the investment process in the Russian economy and improve the efficiency of measures taken by the state to ensure the country's socio-economic development. The **objectives** of this paper are to analyze the directions of optimization and prioritization of investment of resources during the economic recession caused by the coronavirus crisis using investment lending and project financing instruments, as well as to analyze and assess the ongoing reform of development institutions based on the state corporation "VEB.RF". The research **methodology** includes an analysis of the regulatory legal framework, statistical information, official reports of state bodies, development institutions, scientific monographs and publications of Russian scientists, periodicals. The authors analyzed the trends and problems of the investment process in the Russian economy, including in the field of attracting foreign direct investment. Attention is paid to the ongoing reform of development institutions aimed at enhancing the role of the state development corporation "VEB.RF" in stimulating investment. The authors **conclude** that it is necessary to take a set of functional, instrumental, and institutional measures aimed at stimulating investment and ensuring sustainable socio-economic development of Russia. In particular, in the context of a shortage of domestic sources of financing for long-term investments, it is important to provide regulatory macroeconomic support for the inflow of foreign direct investment into the Russian economy. In this regard, the authors propose to change the monetary policy strategy to increase the stimulating role of refinancing of credit institutions and the projected exchange rate in attracting domestic and foreign long-term investments and ensuring sustainable development of the Russian economy. The authors also propose to increase the role of foreign exchange regulation and foreign exchange control in stimulating investment and ensuring sustainable socio-economic development of Russia.

Keywords: investments; coronavirus crisis; investment financing instruments; sustainable economic development; reform of development institutions; state development corporation "VEB.RF"; National Wealth Fund; monetary policy strategy

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INTRODUCTION

Recently, the COVID-19 pandemic has significantly affected the problem of the shortage of long-term domestic and foreign investments in the Russian economy. A wide range of representatives of the scientific expert community (A. G. Aganbegyan, S. Yu. Glazyev, O. D. Govtvan', M. V. Ershov, A. N. Klepach, I. V. Kosorukova, Ye. B. Lenchuk, B. N. Porfiriev, D. E. Sorokin, M. N. Uzyakov, A. A. Shirov, etc.) in their studies focused on a comprehensive analysis of the factors and characteristics of the investment process and the development on its basis of proposals for stimulating investments to overcome recession and ensuring sustainable growth of the Russian economy. New, tougher than before, conditions for the functioning of the Russian economy with a smaller amount of budgetary resources require its restructuring and intensification of investments in the development of technologies and human capital to solve the key tasks of increasing the level and quality of life of the population [1]. The low share of high-tech products produced and exported by Russia as the main resultant indicator of the innovative development of the economic system objectively requires optimization of the structure and increasing the efficiency of state financing of innovations [2]. In the new realities, it is also necessary to effectively regulate the flows and directions of foreign direct investment, which are the driving force behind modern innovative technologies and increasing the country's competitiveness on a global level [3].

An important place in solving the problems of rational use of investment resources for sustainable economic development is occupied by the scientific works of scientists of the Financial University under the Government of the Russian Federation, devoted to the study of new development trends of the financial sector in Russia. [4], institutional problems of regulation of investment risks [5], construction of an updated architecture of Russian finance in the new global context [6].

RELEVANCE AND STRATEGIC IMPORTANCE OF THE INVESTMENT PROBLEM FOR THE RUSSIAN ECONOMY

Enhancing the role of investments in ensuring sustainable development of the Russian economy is a nationwide mid-term objective. In the Decree of the President of Russia V. V. Putin dated July 21, 2020, No. 474 "On the national development goals of the Russian Federation for the period up to 2030" set the task to ensure "real growth of investments in fixed assets of at least 70% compared with the indicator for 2020".[1] The relevance and the difficulty of achieving this goal is due to unfavorable external and internal conditions.

The world economy, including the Russian one, is negatively affected by:

- the weakening of global investment and consumer demand and, accordingly, the freezing and abandonment of investment projects in the context of the coronavirus crisis;
- GDP decline;
- aggravation of the problem of protectionism and trade wars in international relations;
- increasing imbalances and growing risks of the global financial crisis.

According to the United Nations Conference on Trade and Development (UNCTAD), in the first half of 2020, the decrease in foreign direct investment (FDI) in the world was 49% compared to the same period in 2019, including in industrialized countries, FDI decreased by 75% — up to USD 98 billion.[2]

[1] Decree of the President of the Russian Federation of July 21, 2020, No. 474 "On the national development goals of the Russian Federation for the period up to 2030". URL: http://kremlin.ru/events/president/news/63728 (accessed on 05.01.2021).

[2] The UN predicts a decrease in foreign investment in the world in 2020 by 30–40%. 27.10.2020. URL: https://tass.ru/ekonomika/9825013/ (accessed on 05.01.2021).

Table 1

Indicators of the inflow of foreign direct investment in Russia in 2010–2020

Indicator	2010	2015	2016	2017	2018	2019	2020 (January–June)
FDI inflows to Russia, USD billion	43.2	6.9	32.5	28.6	8.8	32.0	2.3
FDI inflows to Russia, % of GDP	2.8	0.5	2.6	1.8	0.5	1.9	0.3

Source: Bank of Russia; URL: https://cbr.ru/statistics; Росстат / Rosstat; URL: https://rosstat.gov.ru/compendium (accessed on 21.01.2021)

In response to the coronavirus crisis, there was a noticeable drop in the volume of foreign investment in the Russian economy. According to the Bank of Russia, in July–September 2020, non-residents invested USD 3.1 billion in the real sector of the Russian economy — three times less than in the same period a year ago. By the cumulative total for 9 months of 2020, the inflow of foreign investment into Russian business decreased 5 times — to USD 4.7 billion against USD 24.2 billion a year ago.

The low share of high-tech products produced and exported by Russia as the main resultant indicator of the innovative development of the economic system objectively requires optimization of the structure and increasing the efficiency of state financing of innovations.

In general, during 2010–2020 the inflow of foreign direct investment into the Russian economy is very volatile over the years and, on the whole, has a small share in the volume of GDP (*Table 1*).

The problem of a deficit in investment in the real sector of the Russian economy is of a structural nature and, under the influence of the coronavirus crisis, its aggravation is observed (*Table 2*).

The volume of investments in fixed assets in relation to the volume of GDP decreased from 21.5% of GDP in 2017 to 17.6% in 2019 and 15.6% in 9 months of 2020. In the 2020 quarter, investment in fixed assets from all sources of financing decreased by 11.7% compared to the previous quarter.[3] According to the calculations of HSE specialists, in comparison with the period 1999–2010, when the average annual growth of investments was 9.7% (even considering the failure of 13.5% in 2009), in 2011–2019 it fell to 1.9% over the year.[4]

PROMOTING INVESTMENT IN SUSTAINABLE GROWTH OF THE RUSSIAN ECONOMY

The most urgent task in the current conditions is the substantiation and implementation of systemically significant solutions to the problem of stimulating investment growth in priority sectors of the economy. According to B.N. Porfiryev, a considerable reserve of economic growth lies in investments in radical

[3] Foreign investment in Russia has collapsed 5 times. 13.10.2020. URL: https://www.finanz.ru/novosti/valyuty/inostrannye-investicii-v-rossiyu-rukhnuli-v-5-raz-1029675947/ (accessed on 05.01.2021).

[4] A new investment crisis is forecasted in Russia. 16.09.2020. URL: https://www.vedomosti.ru/economics/articles/2020/09/15/840059-rossii-predskazali/ (accessed on 05.01.2021).

Table 2

Fixed capital investment in Russia in 2010–2020, RUB billion and % of GDP

Indicator	2010	2015	2016	2017	2018	2019	2020 (January-September)
Investment in fixed assets, RUB billion	9152.1	13897.2	14748.8	16027.3	17595.0	19319.0	11920.6
Investment in fixed assets, % of GDP	20.7	20.0	21.2	21.5	20.7	17.6	15.6

Source: Rosstat. URL: http://rosstat.gov.ru/compendium (accessed on 21.01.2021).

technological re-equipment of production: firstly, in the modernization of manufacturing industries and, secondly, in the modernization of the fuel and energy complex [7].

Focus on priority areas of investment activity suggests diversification of sources of its financing. Traditionally, the main resources for long-term investments in the Russian economy are the own funds (profit and depreciation charges) of enterprises with a share of 60% of GDP and borrowed funds in the form of investment bank loans with a share of up to 10%. In the context of the economic downturn under the influence of the coronavirus crisis, the possibilities of using the profits of enterprises in financing long-term investments are limited by the general reduction in their size and the need to ensure working capital. Bank profits are accumulated mainly in short-term financial assets and are poorly used for long-term lending to the economy. Market-based investment financing instruments (stocks, bonds) traditionally play an insignificant role in the investment process, and the access of Russian enterprises to the international financial market is limited, including due to the sanctions.

According to Russian economists A.G. Aganbegyan and M.V. Ershov, given the extremely low share of investment in GDP at 17%, accelerated economic growth for Russia is possible if investment growth is 10–15% annually. For the transition to the sustainable long-term economic growth of 3–4% per year, the share of investments in GDP must be raised to 25% of GDP. In their opinion, additional investments in fixed assets and the implementation of infrastructure projects, including at the budget expense, should be provided mainly on repayable terms through the development of investment lending, which currently takes only 8–10% compared to 30–50% in developed countries and 20–30% in China.[5]

O.D. Govtvan' focuses on bank loans as a key mechanism for reallocating financial resources in the real sector of the economy, reorienting banks' credit selection towards rent redistribution, budget injections and rehabilitation loans to create new income through long-term investments in economic growth. A special role in this redistribution mechanism is assigned to project financing, which can improve the efficiency of the selection of projects and borrowers. A certain shift in the preferences of the banking sector, according to O.D. Govtvan', through selective measures of monetary policy. The

[5] Aganbegyan A.G., Ershov M.V. No long money — no growth. Vedomosti. 09.09.2020. URL: https://www.vedomosti.ru/economics/articles/2020/09/08/839227-dlinnih-deneg/ (accessed on 5.01.2021).

role of specialized development institutions is also positively assessed as a very important and useful organizational form for the organization and correct orientation of financial and redistribution processes, subject to high-quality examination of investment projects [8].

Studies of economic growth in leading countries confirm the key role of innovation and technological development in ensuring sustainable socio-economic development [9–11]. In addition, a number of studies confirm that financing, creation, and implementation of innovations make it possible to ensure the competitiveness of economic entities, allowing them to form unique competitive advantages [12–14].

According to D. E. Sorokin: "Russia's economic strategy should not set the goal of achieving comprehensive technological leadership — such a statement would mean a waste of resources. It is necessary to focus on those areas of innovative and technological development that are crucial for guaranteed national security" [11]. Such areas, according to Ye. Lenchuk [10], currently include:

- internet of things;
- big data analytics;
- artificial intelligence;
- neural network technologies;
- technologies of nano- and micro-satellites;
- nanomaterials;
- additive manufacturing;
- advanced energy storage technologies;
- synthetic biology;
- blockchain.

To effectively finance innovation and technological development, as well as neutralize Western sanctions and ensure the security of the monetary and financial system of Russia, according to S. Yu. Glazyev, it is necessary to "switch" from external to internal sources of credit in the Russian economy. In this regard, an integrated approach to the formation of the money supply is required in conjunction with the goals of economic development and relying on internal sources of money emission [15]. The most important of them is the mechanism of refinancing of credit institutions, which is closed on lending to the manufacturing sector of the economy and investments in priority areas of development, which can be ensured by using well-known and tested in developed countries indirect (refinancing against the security of the state's government programs, the provision of state guarantees, funding of development institutions) methods of monetary emission [15]..

INCREASING THE ROLE OF DEVELOPMENT INSTITUTIONS IN INVESTING IN THE REAL SECTOR OF THE ECONOMY

In conditions of weak investment and consumer demand under the influence of the coronavirus crisis, enterprises in the real sector can rely mainly on an increase in the volume and increase in the efficiency of state financial support for the development of their production activities. However, the possibilities for mobilizing budgetary resources to finance investments are limited by the negative consequences of the coronavirus crisis and the growing budget deficit, including at the regional level. According to preliminary information from the Federal Treasury, by the end of 2020, the total budget deficit of 58 out of 85 Russian regions at the end of 2020 reached 762.2 billion rubles, which is 5% of the total volume of their budget revenues.[6] In general, the budget of the Russian Federation in 2020 was, according to the Minister of Finance A. G. Siluanov, 3.8% of GDP, or 4.1 trillion rubles.[7]

In these conditions, a special place in the system of measures taken by the government is taken by the optimization and reduction

[6] The pandemic has led to budget deficits in almost 70% of Russian regions. 20.01.2021. РБК. URL: https://www.rbc.ru/economics/20/01/2021/6006aeb99a794714a76005c9 (accessed on21.01.2021).

[7] The federal budget in 2020 was executed with a deficit of 3.8% of GDP. 21.01.2021. URL: https://www.kommersant.ru/doc/4654761 (accessed on 22.01.2021).

of the number of numerous development institutions created in recent years to increase the efficiency of their activities in promoting investment. As per the Unified Plan developed by the government at the end of October 2020 to achieve the national development goals of the Russian Federation for the period up to 2024 and for the planning period until 2030, a reform of development institutions and the creation of unified mechanisms for managing the investment process is currently underway.[8] The activities of development institutions are integrated into the national agenda, their inventory is carried out, the goals, objectives, and indicators of the investment efficiency of these institutions are specified.

In the period from the beginning of the 1990s to the present time, 40 development institutions have been created in 10 areas, including industry, export, agriculture, social sphere, and other sectors. In this cumbersome institutional structure, formed in a mode of targeted response to challenges in the socio-economic sphere that arose in different periods, the functions of many institutions are duplicated by public authorities without long-term systemic goals of national development.[9] After the completion of the reform in 2021, a single investment block of the Unified Development Institute will be created based on VEB.RF, 5 enlarged, and 12 specialized institutions. It is assumed that all of them will not overlap with each other in terms of functions and tasks. Their activities will be subordinated to the goals of national development set out in the Presidential Decree and the Unified Government Plan. The plan is structured around five national goals and 25 indicators of their achievement. At the same time, target values for the next five years have been determined for each indicator, as well as the final result for 2030. In particular, in accordance with the Action Plan to accelerate the growth rates of investments in fixed assets, an increase in the physical volume of investments in fixed assets in the period from 2021 to 2030 at the level of 5.1–5.6% per year and an increase in the physical volume of investments in fixed capital in the period from 2021 to 2030 at the level of 5.1–5.6% per year and increasing their share in GDP up to 25%.[10]

In the process of forming a single investment block on the basis of VEB.RF, the SME Corporation, the Russian Export Center, EXIAR, Rusnano and four funds — Skolkovo, the Fund for Assistance to Small Innovative Enterprises in Science and Technology, the Fund for Infrastructure and Educational Programs and the Industrial Development Fund. Eight development institutions are being liquidated, some of their functions are being redistributed between VEB.RF and federal executive bodies. Some institutions are being consolidated: in particular, the State Transport Leasing Company and VEB-Leasing are being transformed into a Unified Leasing Company, and a Universal Bank is being created based on SME Bank and DOM.RF Bank. The Russian venture capital company is taken over by the Russian Direct Investment Fund. The new structure retains strategically important organizations: Rosatom, Roscosmos, Rostec, Rosavtodor, Rosagroleasing, Rosselkhozbank, the Deposit Insurance Agency and a number of other proven structures.

[8] A unified plan to achieve the national development goals of the Russian Federation for the period up to 2024 and for the planning period until 2030. Government of the Russian Federation. Project for 20.08.2020. URL: http://project.orb.ru/wp-content/uploads/2020/09 (accessed on 5.01.2021).

[9] According to Ruslan Abramov, Head of the Department of Public and Municipal Administration of the PRUE, the intersection of the functions of management institutions and government bodies reaches up to 30% of the functional. "The goal of the Mishustin's reform of development institutions has been named." MK. 23.11.2020. URL: https://www.mk.ru/economics/2020/11/23/nazvana-cel-mishustinskoy-reformy-institutov-razvitiya.html (accessed on 05.01.2021).

[10] A unified plan to achieve the national development goals of the Russian Federation for the period up to 2024 and for the planning period until 2030. Government of the Russian Federation. Project for. URL: http://project.orb.ru/wp-content/uploads/2020/09 (accessed on 05.01.2021).

The goals defined in the Unified Plan are broken down both by ministries and departments and by development institutions. The implementation of national goals is closely linked to budgetary policy. Annual expenses for the implementation of the Unified Plan will amount to more than 12 trillion rubles or more than half of the planned budget for 2021.[11]

Adjustments in the monetary policy strategy should be supplemented by measures of effective currency regulation using the instruments at the disposal of the monetary authorities to limit the outflow/inflow of speculative capital in combination with ensuring effective currency control over the implementation of the established norms and requirements by the subjects of foreign economic activity.

The reform of development institutions is aimed at optimizing the functionality in managing investment decisions, saving budget funds for an expanded bureaucratic apparatus, improving the investment climate and accelerating the implementation of long-term business projects.

The strengthening of VEB's position and its importance as a powerful investment bank in the new institutional development management model is viewed as a key instrument of state economic policy. There is also scarce optimism regarding the reform of development institutions. According to the leading expert of the Institute of Contemporary Development N. Maslennikov, the question arises about the effectiveness of the new management system, since "...it is not enough for VEB to simply "home" the institutions. We need to amend the legislation, change financial and investment schemes".[12]

Over the period from September 2019 to September 2020, the share of project financing in VEB's loan portfolio decreased from 66.1% to 39.6%.[13] Along with the optimization of investment activities throughout the multi-level system of management institutions under the guidance of VEB.RF, it is important, first of all, to modernize, diversify and increase the efficiency of VEB itself, taking into account the contribution made by the Russian Federation in May 2020 to the Bank's authorized capital in the amount of 350 billion rubles and bring its total volume to 372.1 billion rubles. Changes to the legislation governing VEB's activities and its interaction with other institutions in the new format must be fully adapted to the revised financial and investment schemes in accordance with the ambitious tasks assigned to it. It is also necessary to diversify the client base of VEB.RF, in which now 32% of the volume of loans falls on the 3 largest borrowers.[14] An important area of increasing the efficiency of VEB's activities in the new development management model should be an increase in the share of project financing in the structure of the loan portfolio as the main instrument for long-term financing of investment projects. At the end of September 2020, the share of VEB.RF loans with a maturity of more than 5 years were less than one quarter — 23,6%.[15]

The effect of the reform of development institutions, calculated for the medium term, can manifest itself more fully, provided that

[11] The government has finalized a unified plan for achieving national goals. 28.10.2020. URL: https://www.interfax.ru/russia/734570 (accessed on 05.01.2021).

[12] The goal of the Mishustin's reform of development institutions has been named. MK. 23.11.2020. URL: https://www.mk.ru/economics/2020/11/23/nazvana-cel-mishustinskoy-reformy-institutov-razvitiya.html (accessed on 05.01.2021).

[13] Results of the VEB.RF Group's activities for 9 months of 2020 according to IFRS. November 2020, p.5. URL: https://veb.ru/files/?file=53311fe2304a911093b7d896868635c5.pdf (accessed on 5.01.2021).

[14] Ibid., p. 6.

[15] Ibid., p. 5.

the measures taken are supplemented by an increase in the role of the National Welfare Fund (NWF) in promoting investment in the real sector of the economy, as well as by adapting the monetary policy strategy to new tasks by enhancing the role of the interest rate and exchange rate in stimulating investment and economic growth.

Considering the decrease in budget revenues in January-September 2020 by 12% compared to the same period in 2019, more active and rational use of the NWF resources to attract investments becomes relevant. As of December 1, 2020, the volume of the fund increased to 13.46 trillion rubles compared to 7.77 trillion rubles at the beginning of the year. In these conditions, it is reasonable to reduce the established threshold for the volume of NWF resources allocated by the Ministry of Finance of Russia for investing in the economy from 7 to 5% of GDP, provided that the allocated funds are carefully monitored.[16] This will make it possible to fill the shortage of investment resources, exacerbated by the impact of the coronavirus crisis.

Given the lack of domestic sources of financing for long-term investments, it is important to provide regulatory macroeconomic support for the inflow of foreign direct investment into the Russian economy, including by maintaining predictable and relatively stable dynamics of the ruble exchange rate [16–21]. In the context of falling budget revenues due to falling prices for oil and other raw materials and the growing global crisis under the influence of COVID-19, the rational use of foreign exchange instruments to stimulate the inflow of foreign investment is becoming especially relevant. In 2020, under the influence of COVID-19, uncertainty increased in the foreign exchange market. If in 2019 the ruble remained relatively stable with a tendency to strengthen it over the year, then in the first months of last year its volatility increased. In the period from the beginning of January to the end of March 2020, there was a sharp drop in the dynamics of the Ruble/US dollar exchange rate from 60–61 to 80–81, or 30%. Later, the situation returned to normal, and by the end of 2020, the ruble exchange rate strengthened to the level of 73–75 Ruble/US dollar.

In the new conditions, to increase the predictability of monetary and financial conditions for attracting long-term foreign investment, it seems advisable to switch to a regime of a softly regulated ruble exchange rate within the range determined by both fundamental factors of the state of the economy and the goals of attracting foreign investment into the Russian economy. In a number of scientific works by scholars of the Financial University, devoted to the study of monetary, and financial conditions for ensuring sustainable growth of the Russian economy, it is noted that a reasonable choice and maintenance of the forecasted range of the ruble exchange rate will allow the monetary authorities to more evenly distribute responsibility for maintaining macroeconomic stability between two flexibly adjustable exchange rate and monetary policy and more actively pursue a policy of lowering the key interest rate to expand investment lending and stimulate economic growth. In addition, adjustments in the monetary policy strategy should be supplemented by measures of effective currency regulation using the instruments at the disposal of the monetary authorities to limit the outflow/inflow of speculative capital in combination with ensuring effective currency control over the implementation of the established norms and requirements by the subjects of foreign economic activity [16–21].[17]

[16] The size of the National Wealth Fund. Ministry of Finance of Russia. URL: https://minfin.gov.ru (accessed on 05.01.2021).

[17] In line with its policy of stimulating economic growth and supporting exports in 2019, the Reserve Bank of India cut its key rate by 135 basis points (to 5.15%), the Central Bank of Brazil by 200 basis points (to 4.5%), and the Central Bank of Turkey — by 1200 basis points (up to 12%) (Annual report of the

CONCLUSIONS

The resource potential of the Russian economy, including banking sector profits, NWF resources, and international foreign exchange reserves, remains very significant, despite the negative consequences of the COVID-19 pandemic. It is important to rationally use it in the face of a continuing acute shortage of investment in the real sector of the Russian economy. To solve this problem, a systematic approach is required, based on a set of measures of a functional, instrumental and institutional nature. Since financial instruments have successfully proven themselves in international banking practice, it is necessary to significantly expand the use of investment loans and project financing in priority industries. The ongoing reform of development institutions is aimed at enhancing the role of the VEB.RF group in stimulating investment. An important organizational condition for the success of the reform is the modernization of the activities of VEB itself, the creation of rational and cost-effective schemes for long-term project financing within the framework of a single investment block created for the sustainable development of the country in the real sector of the economy. The effect of the activities of the reformed development institutions largely depends on the stable resource base used in the implementation of investment projects and the projected monetary and financial conditions for attracting foreign direct investment. Theory and practice confirm the key role of innovation and technological development in ensuring sustainable socio-economic development of countries. To finance innovation and technological development in Russia, as well as neutralize Western sanctions and ensure the security of its monetary and financial system, it is necessary to "switch" from external to internal sources of credit in the Russian economy. To do this, it is necessary to expand the NWF's ability to finance investments and adjust the monetary policy strategy to increase the stimulating role of refinancing of credit institutions and the projected exchange rate in attracting domestic and foreign long-term investments and ensuring sustainable development of the Russian economy.

The proposed set of measures will have a stimulating effect on the inflow of investments into the real sector of the Russian economy and will increase their role in sustainable economic growth.

Bank of Russia for 2019). URL: https://www.cbr.ru/Collection/Collection/File/27873/ar_2019.pdf (accessed on 05.01.2021).

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Zvonova E. A. — stated the problem, developed the conceptual framework of the article, performed a critical literature review.
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Sustainable Development Assessment of Commercial Banks Based on the Analytic Hierarchy Process

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ABSTRACT

In the present context, the issues of sustainable development of commercial banks are becoming particularly relevant, since they largely determine the state of the country's economy as a whole. At the same time, commercial banks operate under the influence of various factors of the internal and external environment, digital transformation and the transition to the fourth industrial revolution, which significantly changes the conditions of their functioning. The time lag in which a credit institution can be in a relatively static, stable state is reduced. In this regard, there is a need to develop a methodology for assessing the sustainable development of commercial banks. This paper **aims** to develop theoretical provisions and methods for assessing the sustainable development of commercial banks using the **analytic hierarchy process**. As a result of the research, theoretical approaches to the disclosure of the economic content of the sustainable development of commercial banks, as well as existing A methodological approach to assessing the sustainability of the bank's development is justified, considering five components: economic, social, environmental, institutional and technological. Within the framework of this approach, criteria for their assessment are proposed for each of the components of the sustainability of the development of commercial banks, a scale of their relative importance is constructed and vectors are determined based on expert assessments. The authors make a **conclusion** that it is necessary to distinguish four types of stability of the bank's development: absolute stability, normal stability, unstable state, crisis state. This approach can be used by commercial banks when developing a strategy for the sustainable development of financial and credit organizations. **Prospects** for further research may be associated with the development of alternative methods for assessing the sustainable development of commercial banks.

Keywords: commercial bank; sustainable development; sustainability assessment; analytic hierarchy process; modeling

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INTRODUCTION

The state of the banking system is the most important indicator of the economic security of any country, region, and the banking sector is a factor in ensuring sustainable development and decarbonization of the economy [1, 2]. At the same time, many factors of the internal and external environment have a significant impact on the state of the banking sector (including commercial banks): macroeconomic policy; market conditions for goods and services; changes in the financial system; uneven economic development of certain regions; the growth of social tension; changing customer preferences; resource base; customer confidence; bank reputation and others [3–5].

According to the calculations of foreign scientists who assessed the impact of endogenous and exogenous factors on the stability of Latvian banks in 2003–2016, credit risk and the level of efficiency negatively affect the stability of banks, while the size of the bank, liquidity, profitability, inflation, and GDP growth have a positive impact [6].

N. Karim, S. M. Al-Habshi, M. Abduh, conducting a comparative analysis of the impact of macroeconomic indicators (GDP, interest rate, inflation) on the activities of Islamic banks and the banking sector in Indonesia for the period 1999–2013, concluded that these factors have a significant influence on the banking sector in Indonesia, but not on Islamic banks [7].

In the modern world, banks perform many functions: attracting temporarily free funds from legal entities and individuals and their placement on terms of payment, urgency, repayment, intermediation in payments, operations in the stock and foreign exchange markets, settlement and cash services, acquiring, online service, notional cash pooling, etc. Banks do not just accumulate financial resources, carrying out the internal accumulation of funds, they ensure their continuous movement for sustainable economic development, solving environmental and social problems [8, 9].

In particular, foreign scientists S.C. Obiora, O. Bamisile, E. Opoku-Mensah, A.N.K. Frimpong, examining the banking and financial systems of 45 countries, conclude that an increase in lending contributes to an increase in emissions of harmful substances by business entities into the atmosphere, as well as to an increase in interest rates on loans and deposits leads to a decrease in these emissions [10].

Performing the function of redistributing savings into investments, commercial banks face various risks that can lead to bankruptcy and loss of stability. In this regard, the problems of assessing and ensuring the sustainable development of commercial banks are very relevant.

CONTENT OF THE DEFINITION "SUSTAINABLE DEVELOPMENT OF A BANK"

During the period of the second industrial revolution, an objective need arose to expand the range of research on the problem of stability and sustainable development. This was due to the fact that along with rapid economic growth, the introduction of innovations and new technologies, the growth of industrial production, an increase in the standard of living of the population, there was a high degree of exploitation of natural resources and an increase in social inequality. Environmentalists have begun to pay attention to the limits of world population growth and the depletion of natural resources [11, 12].

In particular, following the report "Our Common Future" prepared in 1987 by the International Commission on Environment and Development, the term "sustainable development" became widespread. This has been interpreted as "such development that satisfies the needs of the present, but does not compromise the ability of future

generations to meet their own needs".[1] In 2015, the UN adopted the document "Transforming Our World: The 2030 Agenda for Sustainable Development", which reflects the Sustainable Development Goals (SDGs) and the main indicators, the achievement of which will save the planet's resources and ensure decent living conditions for all. This document takes into account three pillars of sustainable development: economic growth, social inclusion, and environmental protection.

Currently, the three-pillar concept of sustainable development, along with the economic, social, and environmental components, are supplemented by a number of scientists with a fourth subsystem — the institutional one [13, 14]. The inclusion of the institutional subsystem in the concept of sustainable development is due to the need to create a regulatory framework, a modern information system, and other institutions whose activities are aimed at ensuring the sustainable development of countries, regions, organizations.

As for the banking sector, we note that today categories such as "sustainability", "stability", "reliability" of a bank are widely used.

Note that the first mention of sustainability in banking was found in the World Bank's Sustainable Banking with the Poor: A Worldwide Inventory of Microfinance Institutions. This report notes that microfinance institutions represent a new socially oriented business model for organizing financial activities.[2] This finding is based on an analysis of basic social services provided by financial institutions to low-income populations. In the monograph "Sustainable Banking: Greening Finance", J. J. Bauma, M. Jauken, LJ Klinkers note that banks have a role to play in ensuring environmental sustainability [15].

The study of scientific views on the sustainability of a commercial bank made it possible to identify three main approaches to this problem. The first approach followed by L. P. Belykh and O. B. Nesterenko is based on considering the sustainability of a commercial bank from the point of view of the state of equilibrium [16, 17]. At the same time, there are three types of equilibrium: stable, unstable and indifferent. A stable equilibrium is characterized by the ability of an object to return to a state of equilibrium, determined by various factors, while an unstable equilibrium is the inability of an object to return to its original state. Indifferent equilibrium is a state in which any point of the system is a point of equilibrium, and the deviation of the system from the initial point of rest does not change anything in the alignment of forces within it.

According to Yu. N. Bulanov, the main characteristics of the bank's sustainable development are balance, stability and development [18].

The most popular in the scientific community is the second approach to considering the sustainability of a bank, which is followed by G. G. Fetisov, O. I. Lavrushin,[3] A. O. Shenaev [19, 20]. It is based on the definition of a bank as an object that performs its inherent functions, and stability is viewed as the bank's ability to continuously perform these functions in a changing environment. This approach to the functioning of a bank is often identified with the concept of "reliability" since it is "reliability" that is characterized as the ability of an object to perform certain functions. So, A. V. Buzdalin characterizes the bank's

[1] Our Common Future. New York: UN, 1987. URL: https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf (accessed on 12.07.2021).

[2] The World Bank. Sustainable Banking with the Poor: A Worldwide Inventory of Microfinance Institutions. Washington, DC, 1997. URL: http://wwwwds.worldbank.org/servlet/WDSContentServer/IW3P/IB/2006/04/12/000160016_20060412172642/Rendered/PDF/354680paper.pdf. (accessed on 12.07.2021).

[3] Lavrushin O.I., ed. Banking in the modern economy. Textbook. Moscow: KNORUS; 2016. 671 p.

reliability as the ability to fulfill obligations within a certain period of time [21].

The third approach to considering the concept of "sustainability of a commercial bank" is based on the idea of goal-oriented development. So, Yu. S. Maslenchenkov examines the economic stability of the bank from the point of view of the sustainability of its activities in the medium and long term. "Stability is the state of a commercial bank in a changing market environment, which ensures the purposefulness of its movement now and in the foreseeable future" [22].

It should be noted that today the term "bank stability" is often used in the context of its financial stability. At the same time, the financial stability of the bank is determined by the state and structure of assets, efficiency of activities, and capital adequacy [23, 24].

The generalization of the existing approaches to disclosing the content of the bank's sustainability made it possible to formulate the following definition of the considered category. Sustainability is a qualitative characteristic of the state of the bank throughout the entire interval of its development, which allows it to remain in an equilibrium state and continuously perform its functions when the factors of the external and internal environment change. Moreover, the sustainable development of the bank should be balanced, considering the economic, social, institutional and technological components.

METHODOLOGY FOR ASSESSING THE SUSTAINABLE DEVELOPMENT OF A COMMERCIAL BANK

In world practice, there are a significant number of methods for assessing the financial position and sustainability of a commercial bank. These methods can be divided into two groups: 1) methods used by central banks, supervisory authorities; 2) bank ratings used by independent news agencies.

Table 1 presents a comparative analysis of existing methods for assessing the sustainability of a commercial bank.

It should be emphasized that each of these methods is based on the analysis of quantitative indicators, while qualitative ones are not present in all, which reduces the quality of a full assessment of the bank's overall condition. All considered methods, as a rule, are based on the analysis of capital, liquidity, quality of liabilities and assets, profitability. Each method has both advantages and disadvantages. The main disadvantage of the considered methods is that almost all of them are based on information that is not publicly available, which significantly narrows the circle of their users. Only supervisory authorities can use these methods.

The study aims to develop a methodological approach to assessing the sustainability of a commercial bank based on the method of analytic hierarchy process (AHP). The main argument in favor of using this method is its versatility, which allows it to be used for solving a variety of problems.[4] This method involves the collection, processing, and interpretation of large amounts of data based on expert judgment [25].

Implementation of AHP is based on expert assessments and includes the following stages:

1. Target analysis:

- tree-like detailing of approaches (local criteria) P_i (i = 1, 2, ..., n) and alternatives for achieving the goal R_j (j = 1, 2, ..., m);
- identification of ranges (confidence intervals) of possible values for quantitative indicators of target components of the management system by the method of expert assessments;

[4] The World Bank. Sustainable Banking with the Poor: A Worldwide Inventory of Microfinance Institutions. Washington, DC, 1997. URL: http://wwwwds.worldbank.org/servlet/ WDS Content Server/IW3P/IB/2006/04/12/000160016_20060412172642/Rendered/PDF/354680paper.pdf. (accessed on 12.07.2021).

Table 1

Comparative analysis of methods for determining the stability of a commercial bank

Method	Quantitative indicators	Qualitative indicators	Expert assessment	Integral result indicator	Standard (recommended) values	Ranking of banks by group	An analysis rating
Russian methods							
Methodology of the Central Bank of the Russian Federation, assessing the financial condition of a bank	+	–	+	+	+	+	–
Methodology of the Central Bank of the Russian Federation for the inclusion of a bank in the deposit insurance system	+	+	+	+	–	–	–
Expert RA methodology	+	–	–	+	–	+	–
Methodology "Kommersant"	+	–	–	+	–	–	+
Foreign methods							
CAMELS (USA)	+	+	+	+	–	+	–
BAKIS (Germany)	+	–	–	–	+	+	–
PATROL (Italy)	+	–	–	–	+	+	–

Source: compiled by the authors.

• construction of algorithms for the relationship of individual target indicators.

2. Comparative analysis: construction of a set of matrices of pairwise comparisons for each of the lower levels of the hierarchy according to the principle: "one matrix for each controlled element (adjacent to the top level)", while the elements of any level are compared with each other with respect to their impact on controlled elements.

3. Hierarchical synthesis for weighing your own weights.

4. Assessment of the consistency of the entire hierarchy (acceptable consistency ratio — up to 10%).

As noted above, the assessment of the sustainable development of a commercial bank provides, in our opinion, the allocation of five components (local criteria):

- economic sustainability (P_1);
- social sustainability (P_2);
- environmental sustainability (P_3);
- institutional sustainability (P_4);
- technological sustainability (P_5).

As part of the study, a survey was conducted of several dozen experts — professionals in the field of banking. The experts were asked to evaluate the criteria (K_1-K_{40}) and the above-presented main components of the bank's sustainability

Table 2

Rating of fundamental components designed to assess the sustainable development of a commercial bank

Components of sustainable development of a commercial bank	Rank
Economic sustainability (P_1)	10
Social sustainability (P_2)	7
Environmental sustainability (P_3)	3
Institutional sustainability (P_4)	7
Technological sustainability (P_5)	8

Source: compiled by the authors.

on a 10-point scale. Further, the obtained results were processed using the methods of mathematical statistics.

The rating of the components of the sustainable development of a commercial bank, considering expert assessments, is presented in *Table 2*.

For each of the proposed components of the sustainable development of a commercial bank, by constructing a scale of their relative importance and determining the priority vector based on expert assessments, they are established on a 10-point scale of importance weight criteria for each component. *Table 3* presents the criteria for the economic, environmental, social, institutional and technological components of the sustainable development of a commercial bank.

Assessment of the level of digitalization of the bank and its internal divisions includes, inter alia, an analysis of the development of business process automation; self-service channels (services and functions available in digital channels); the speed of operations (offline, online, in real-time); development of data management systems, including machine learning; availability of services 24/7; rate of change, time to market.

Analysis of the security level of a bank and banking operations includes an assessment of the security of the main structural elements (owners, top managers, social relations, physical communications, personnel, equipment, facilities).

Analysis of the level of development of the bank's offline infrastructure implies an analysis of the presence or absence of a "single window" system, electronic queue, call-center, equipment of waiting rooms, etc.

Assessment of the level of development of the bank's online infrastructure includes an analysis of the official website, mobile applications for individuals and legal entities and individual entrepreneurs, Internet banking, Internet trading, etc.

Assessment of the level of information security of a bank involves an analysis of the sufficiency, relevance and speed of information updating.

Analysis of the degree of development of the infrastructure of the banking sector in the region involves the analysis of the presence/absence and development of audit and consulting companies, credit bureaus, insurance companies, appraisal organizations, collection agencies, credit brokers, IT companies, law firms, etc.

Assessment of the fairness of tariffs for banking services, dividends, wages, bonuses involves an analysis of the presence/absence of hidden commissions in banking products, a significant gap in the wages of staff and top managers, the formation of dividends on ordinary and preferred shares.

Table 3

Criteria for the components of sustainable development of a commercial bank

Designation	Criteria	Rank
Economic sustainability		
K_1	Return on equity (ROE)	8
K_2	Return on assets (ROA)	9
K_3	Capital adequacy level	10
K_4	Capital adequacy ratio	8
K_5	Capital quality assessment	8
K_6	Current liquidity ratio	9
K_7	Earning assets level	8
K_8	Net interest margin ratio	8
K_9	Resource base stability coefficient	8
K_{10}	Share of overdue loans	8
K_{11}	Maximum exposure to one borrower or a group of related borrowers (N 6)	8
K_{12}	Customer base ratio	8
K_{13}	Consumer loyalty index	8
K_{14}	Share of the regional deposit market	6
K_{15}	Market share of loans to non-financial organizations	6
K_{16}	Market share of loans to individuals	6
K_{17}	Gross regional product per capita	7
K_{18}	Inflation rate in the region	6
K_{19}	Business cycle stage	7
Social sustainability		
K_{20}	Share of the bank's investments in social projects	6
K_{21}	Fair formation of tariffs for banking services, dividends, wages, bonuses	8
K_{22}	Salary level of bank employees	6
K_{23}	Employee satisfaction with working conditions and wages	7
K_{24}	The level of the bank's expenses for staff development	7
K_{25}	Bank transparency level	7
K_{26}	Charity spending level	5
K_{27}	The level of per capita household income of the region	6
Environmental sustainability		
K_{28}	Share of expenditures on natural resources, including energy, in the expenditures associated with supporting the activities of a credit institution	5
K_{29}	Share of investments in projects related to environmental protection, rational use of natural resources	4
Institutional sustainability		
K_{30}	The level of information security of a bank	8
K_{31}	The level of regulation of the internal processes of a bank	8
K_{32}	Branch network development level	7
K_{33}	The level of cooperation and integration of a bank with partners	7
K_{34}	The degree of development of the infrastructure of the banking sector in the region	8
K_{35}	Banking legislation level	9
Technological sustainability		
K_{36}	The level of digitalization of the bank and its internal divisions	9
K_{37}	The share of modern technologies in the organization and management of the bank	8
K_{38}	Bank and banking security level	10
K_{39}	The level of development of the bank's offline infrastructure	8
K_{40}	The level of development of the bank's online infrastructure	8

Source: compiled by the authors.

Table 4

Determination of the vector of priorities (weights) of criteria for assessing the economic stability of a bank

Indicator	K_1	K_2	K_3	K_4	K_5	K_6	K_7	K_8	K_9	K_{10}	K_{11}	K_{12}	K_{13}	K_{14}	K_{15}	K_{16}	K_{17}	K_{18}	K_{19}	Weight
K_1	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_2	1.13	1.00	0.90	1.13	1.13	1.00	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.50	1.50	1.50	1.29	1.50	1.29	**22.482**
K_3	1.25	1.11	1.00	1.25	1.25	1.11	1.25	1.25	1.25	1.25	1.25	1.25	1.25	1.67	1.67	1.67	1.43	1.67	1.43	**24.980**
K_4	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_5	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_6	1.13	1.00	0.90	1.13	1.13	1.00	1.13	1.13	1.13	1.13	1.13	1.13	1.13	1.50	1.50	1.50	1.29	1.50	1.29	**22.482**
K_7	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_8	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_9	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_{10}	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_{11}	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_{12}	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_{13}	1.00	0.89	0.80	1.00	1.00	0.89	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.33	1.33	1.33	1.14	1.33	1.14	**19.984**
K_{14}	0.75	0.67	0.60	0.75	0.75	0.67	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	0.86	1.00	0.86	**14.988**
K_{15}	0.75	0.67	0.60	0.75	0.75	0.67	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	0.86	1.00	0.86	**14.988**
K_{16}	0.75	0.67	0.60	0.75	0.75	0.67	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	0.86	1.00	0.86	**14.988**
K_{17}	0.88	0.78	0.70	0.88	0.88	0.78	0.88	0.88	0.88	0.88	0.88	0.88	0.88	1.17	1.17	1.17	1.00	1.17	1.00	**17.486**
K_{18}	0.75	0.67	0.60	0.75	0.75	0.67	0.75	0.75	0.75	0.75	0.75	0.75	0.75	1.00	1.00	1.00	0.86	1.00	0.86	**14.988**
K_{19}	0.88	0.78	0.70	0.88	0.88	0.78	0.88	0.88	0.88	0.88	0.88	0.88	0.88	1.17	1.17	1.17	1.00	1.17	1.00	**17.486**

Source: compiled by the authors.

Table 5

Determination of the vector of priorities (weights) of criteria for assessing the social stability of a bank

Indicator	K_{20}	K_{21}	K_{22}	K_{23}	K_{24}	K_{25}	K_{26}	K_{27}	Weight
K_{20}	1.00	0.75	1.00	0.86	0.86	0.86	1.20	1.00	**7.452**
K_{21}	1.33	1.00	1.33	1.14	1.14	1.14	1.60	1.33	**9.936**
K_{22}	1.00	0.75	1.00	0.86	0.86	0.86	1.20	1.00	**7.452**
K_{23}	1.17	0.88	1.17	1.00	1.00	1.00	1.40	1.17	**8.694**
K_{24}	1.17	0.88	1.17	1.00	1.00	1.00	1.40	1.17	**8.694**
K_{25}	1.17	0.88	1.17	1.00	1.00	1.00	1.40	1.17	**8.694**
K_{26}	0.83	0.63	0.83	0.71	0.71	0.71	1.00	0.83	**6.210**
K_{27}	1.00	0.75	1.00	0.86	0.86	0.86	1.20	1.00	**7.452**

Source: compiled by the authors.

Таблица 6 / Table 6

Determination of the vector of priorities (weights) of criteria for assessing the environmental sustainability of a bank

Indicator	K_{28}	K_{29}	Weight
K_{28}	1.00	1.25	**2.236**
K_{29}	0.80	1.00	**1.789**

Source: compiled by the authors.

Table 7

Determination of the vector of priorities (weights) of criteria for assessing the institutional stability of a bank

Indicator	K_{30}	K_{31}	K_{32}	K_{33}	K_{34}	K_{35}	Weight
K_{30}	1.00	1.00	1.14	1.14	1.00	0.89	**6.151**
K_{31}	1.00	1.00	1.14	1.14	1.00	0.89	**6.151**
K_{32}	0.88	0.88	1.00	1.00	0.88	0.78	**5.382**
K_{33}	0.88	0.88	1.00	1.00	0.88	0.78	**5.382**
K_{34}	1.00	1.00	1.14	1.14	1.00	0.89	**6.151**
K_{35}	1.13	1.13	1.29	1.29	1.13	1.00	**6.920**

Source: compiled by the authors.

Table 8

Determination of the vector of priorities (weights) of criteria for assessing the technological stability of a bank

Indicator	K_{36}	K_{37}	K_{38}	K_{39}	K_{40}	Weight
K_{36}	1.00	1.13	0.90	1.13	1.13	**5.254**
K_{37}	0.89	1.00	0.80	1.00	1.00	**4.670**
K_{38}	1.11	1.25	1.00	1.25	1.25	**5.838**
K_{39}	0.89	1.00	0.80	1.00	1.00	**4.670**
K_{40}	0.89	1.00	0.80	1.00	1.00	**4.670**

Source: compiled by the authors.

Table 9

Intervals of changes and expert assessments of criteria for the degree of sustainable development of a commercial bank

	Indicator	Evaluation of criteria		
		0	1	2
Economic sustainability				
K_1	Return on equity (ROE)	Below 4	4–10	Above 10
K_2	Return on assets (ROA)	Below 0.5	0.5–1.5	Above 1.5
K_3	Capital adequacy level	Below 8	13 and higher	8–13
K_4	Capital adequacy ratio	Below 10	10–15	Above 15
K_5	Capital quality assessment	Above 80	30–80	Below 30
K_6	Current liquidity ratio	Below 50	50–70	Above 70
K_7	Net interest margin ratio	Below 5	5–8	Above 8
K_8	Earning assets level	Below 50	50–85	Above 85
K_9	Resource base stability coefficient	Below 50	50–70	Above 70
K_{10}	Share of overdue loans	Above 4	2–4	Below 2
K_{11}	Maximum exposure to one borrower	Above 25	25–20	Below 20
K_{12}	Customer base ratio	Below 70	70–80	80–100
K_{13}	Consumer loyalty index	Below 30	30–50	Above 50
K_{14}	Share of the regional deposit market	Below 5	5–15	Above 15
K_{15}	Market share of loans to non-financial organizations	Below 5	5–15	Above 15
K_{16}	Market share of loans to individuals	Below 5	5–15	Above 15
K_{17}	Gross regional product per capita	Below the all-Russian level	At the all-Russian level	Above the all-Russian level
K_{18}	Inflation rate in the region	Above the all-Russian level	At the all-Russian level	Below the all-Russian level
K_{19}	Business cycle stage	Bottom, decline	Rise	Peak
Social sustainability				
K_{20}	Share of the bank's investments in social projects	Below 2%	2–5%	Above 5%
K_{21}	Fair formation of tariffs for banking services, dividends, wages, bonuses	0–3%	4–6%	7–10%
K_{22}	Salary level of bank employees	At the level	Exceeds 1.2–1.5 times	Exceeds more than 1.5 times
K_{23}	Employee satisfaction with working conditions and wages	Below 30%	30–70%	Above 70%

Table 9 (continued)

	Indicator	Evaluation of criteria		
		0	1	2
K_{24}	The level of the bank's expenses (share of the wage fund) for staff development	Below 0.5%	0.5–5.0%	Above 5.0%
K_{25}	Charity spending level	No costs	Irregular costs	Fixed costs
K_{26}	The level of per capita income of households in the region in comparison with the average per capita money income of the population in the country as a whole	Below the national average per capita income of households	At the level of the national average per capita income of households	Above the all-Russian level of average per capita income of households
K_{27}	Share of the bank's investments in social projects	Below 2%	2–5%	Above 5%
	Environmental sustainability			
K_{28}	Share of expenditures on natural resources, including energy, in the expenditures associated with supporting the activities of a credit institution	Above 4%	2–4%	Below 2%
K_{29}	Share of investments in projects related to environmental protection, rational use of natural resources	Below 0.1%	0.1–1.0%	More than 1.0% of investments
	Institutional sustainability			
K_{30}	The level of information security of a bank	Low	Medium	High
K_{31}	The level of regulation of the internal processes of the bank	No	Partial	All internal processes are regulated
K_{32}	The level of development of the branch network (availability in the administrative centers of the region)	In one	In several	In most
K_{33}	The level of cooperation and integration of the bank with partners	Lack of cooperation	The presence of several projects in cooperation with partners	Developed level of cooperation with the bank's partners
K_{34}	The degree of development of the infrastructure of the banking sector in the region	Low	Medium	High
K_{35}	Banking legislation level	Low	Medium	High
	Technological sustainability			
K_{36}	The level of digitalization of the bank and its internal divisions	0–2	3–6	7–10
K_{37}	The share of modern technologies in the organization and management of the bank	Below 0.1	0.1–1	Above 1
K_{38}	Bank and banking security level	0–2	3–6	7–10
K_{39}	The level of development of the bank's offline infrastructure	0–1	2	3–4
K_{40}	The level of development of the bank's online infrastructure	0–2	3–4	Above 4

Source: compiled by the authors.

Table 10

Types of sustainable development of commercial banks

Type	Value I_{sus}	Characteristics of a bank
Absolute stability	201–350	The Bank is characterized by a high level of profitability and capital adequacy, return on assets, liquidity of capital, availability of a sufficient resource base and flexible management system, and the use of modern banking digital technologies. The Bank has a fairly effective security system and developed infrastructure, has stable cooperative and integration partnerships, is distinguished by an open system for setting tariffs for banking services, dividends, and a fair system for assessing employees' work. The Bank participates in green financing and social projects
Normal stability	101–200	The Bank successfully develops, implements its strategy, and meets the expectations of business entities concerning the future profitability (return) of its capital while maintaining an acceptable level of risks for it. The Bank is characterized by the adequacy of its equity capital and a good ratio of the growth rates of the resource and client base, the ability, by regulating the growth rates of equity capital, liabilities and assets, to ensure a given return on equity with an acceptable level of risk and sufficient liquidity of operations. The Bank participates in social projects and/or projects aimed at reducing the environmental pollution
Unstable state	51–100	There are no violations of stability standards, but their values do not ensure the efficient operation of the bank. The average degree of development of the banking infrastructure, the irregularity of social projects and charitable activities, and the average level of profitability are characteristic
Crisis state	0–50	Regulatory violations are possible. The main indicators of the bank's activity are showing negative dynamics. The financial result of the credit institution is negative. The bank has a poor quality of capital and loan portfolio. Signs of legal and/or economic affiliation. The Bank does not participate in social and charitable projects

Source: compiled by the authors.

Thus, we have built a matrix of pairwise comparisons of five components (economic, social, environmental, institutional, and technological) to assess the sustainability of the development of a financial and credit institution (1):

$$\begin{pmatrix} & P_1 & P_2 & P_3 & P_4 & P_5 \\ P_1 & 1.00 & 1.43 & 3.33 & 1.43 & 1.25 \\ P_2 & 0.70 & 1.00 & 2.33 & 1.00 & 0.88 \\ P_3 & 0.30 & 0.43 & 1.00 & 0.43 & 0.38 \\ P_4 & 0.70 & 1.00 & 2.33 & 1.00 & 0,88 \\ P_5 & 0.80 & 1.14 & 2.67 & 1.14 & 1.00 \end{pmatrix}. \quad (1)$$

We also constructed matrices of pairwise comparisons and vectors of priorities (weights) of individual criteria for each component (*Tables 4–8*).

Based on the matrices of pairwise comparisons, we obtain estimates of local priorities for each considered component of the bank's sustainable development (P_1, P_2, P_3, P_4, P_5) using the convolution of each matrix into a vector and its normalization (2)—(7).

$$\begin{aligned} P_1 = {} & 19.984 \cdot K_1 + 22.482 \cdot K_2 + 24.980 \cdot K_3 + \\ & + 19.984 \cdot K_4 + 19.984 \cdot K_5 + 22.482 \cdot K_6 + 19.984 \cdot K_7 + \\ & + 19.984 \cdot K_8 + 19.984 \cdot K_9 + 19.984 \cdot K_{10} + + 19.984 \cdot K_{11} + \\ & + 19.984 \cdot K_{12} + 19.984 \cdot K_{13} + 14.988 \cdot K_{14} + 14.988 \cdot K_{15} + \\ & + 14.988 \cdot K_{16} + 17.486 \cdot K_{17} + 14.988 \cdot K_{18} + 17.486 \cdot K_{19}. \end{aligned} \quad (2)$$

$$P_2 = 7.452 \cdot K_{20} + 9.936 \cdot K_{21} + 7.452 \cdot K_{22} + \\ + 8.694 \cdot K_{23} + 8.694 \cdot K_{24} + \\ + 8.694 \cdot K_{25} + 6.210 \cdot K_{26} + 7.452 \cdot K_{27}. \quad (3)$$

$$P_3 = 2.236 \cdot K_{28} + 1.789 \cdot K_{29}. \quad (4)$$

$$P_4 = 6.151 \cdot K_{30} + 6.151 \cdot K_{31} + 5.382 \cdot K_{32} + \\ + 5.382 \cdot K_{33} + 6.151 \cdot K_{34} + + 6.920 \cdot K_{35}. \quad (5)$$

$$P_5 = 5.254 \cdot K_{36} + 4.670 \cdot K_{37} + \\ + 5.838 \cdot K_{38} + 4.670 \cdot K_{39} + 4.670 \cdot K_{40}. \quad (6)$$

The integral indicator for assessing the sustainable development of a regional commercial bank (I_{sus}), calculated on the scale of relative importance (*Table 1*) of each individual local criterion, has the form (11):

$$I_{sus} = 0.370 \cdot P_1 + 0.259 \cdot P_2 + 0.111 \cdot P_3 + \\ + 0.259 \cdot P_4 + 0.296 \cdot P_5. \quad (7)$$

For each component (local criterion), intervals of changes and corresponding assessments of the criteria for the degree of sustainable development of a commercial bank were constructed (*Table 9*).

We believe that based on the calculation of the integral indicator (7), four types of sustainable development of commercial banks can be distinguished: absolute stability, normal stability, unstable state, crisis state (*Table 10*).

CONCLUSIONS

The research allows us to draw the following conclusions. Currently, the definition of "sustainable development of commercial banks" is considered from the standpoint of three approaches: 1) as a state of equilibrium; 2) the ability to continuously perform functions under the influence of various factors; 3) the stability of its activities in the medium and long term. In our opinion, stability is a qualitative characteristic of the state of a bank throughout the entire interval of its development, allowing it to remain in an equilibrium state and continuously perform its functions when the external and internal factors change. The bank's sustainable development should be balanced, considering the economic, social, institutional and technological components.

As a result of the study, a method was developed for assessing the sustainability of a commercial bank's development, based on the use of the method of analytic hierarchy process. The methodology proposed by the authors provides for the calculation of an integral indicator considering five components: economic, social, environmental, institutional, and technological. This approach can be used by commercial banks when developing a strategy for the sustainable development of a financial and credit institution. The proposed methodology can be used by banks with both universal and basic licenses.

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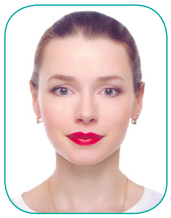

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Authors' declared contributions:
Semenova N.N. — defined the problem, developed a conceptual framework of the article, developed a methodological approach to assessing sustainable development of banks, described the results and wrote the conclusions of the study.
Ivanova I.A. — designed tabular and graphical representations of the results, constructed an economic and statistical model.
Vasil'kina A.A. — collected research material, performed a critical literature analysis.

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Financial Fear Index in the Digital Financial Assets Market

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ABSTRACT

The **relevance** of the research topic is due to the increasing role of non-traditional financial instruments that contribute to financial instability. Therefore, various indicators are required to reflect the situation in the digital financial assets market, the volatility quotes, and the level of investor confidence. The **aim** of the study is to develop and test on empirical data a generalized indicator of financial instability (financial fear index) in the digital financial assets market. The **novelty** of the research lies in the adaptation of the classic model of building the volatility index to the cryptocurrency market. The authors use statistical **methods** for collecting and processing data, analyzing time series, weighing, designing economic indicators. The paper summarizes the results of modern research on the correlation between digitalization and financial instability. The authors **conclude** that at certain short periods of 2020 the ruble-dollar volatility was comparable or even higher than the ruble-bitcoin one. In addition, there is much less fear and uncertainty in the cryptocurrency market today than there was at the end of 2018. The main **result** of the study is the financial fear index model based on the method of calculating the weighted average option price of the underlying asset and hedging of price risks. The model has been tested using data on the bid and ask prices of cryptocurrencies at a specific point in time. Estimates have been obtained indicating the growing instability in the digital financial asset market. The authors offer **recommendations** regarding the index threshold values, which indicate the level of investors' fear.

Keywords: fear index; digital financial assets; cryptocurrency market; volatility; financial instability; option contracts

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INTRODUCTION

The current stage of economic development is characterized by a global change in the proportions of development of the real and virtual sectors of the economy, structural changes in the financial sector, and, in general, a qualitative change in the financial component of the economy as an integral link between the processes of production and consumption. New technologies are being actively introduced to financial markets: big data [1, 2], quantum computing [3], the blockchain of financial transactions [4, 5], etc.

Business digitalization, on the one hand, can significantly improve the quality of life by increasing labor productivity, the quality and efficiency of decisions made, increasing the transparency of information processes, financial and business operations in various fields of activity. In [6] it is proved that considering the components of the digital potential of the city (information and communication infrastructure, digital government and e-business) makes it possible to more accurately assess its investment attractiveness. On the other hand, digitalization inevitably leads to the emergence of specific conditions for the implementation of financial and economic activities and qualitatively new scenarios for the development of the economy, the emergence of additional risks and threats. The paper presents the most complete list of risks and opportunities of the digital economy concerning the current stage of development of the Russian Federation [7].

It should be noted that the new course towards digitalization of the economy is taking place against the background of negative processes in the economy [8] and politics [9] associated with the impact of COVID-19. In an era of global instability, the most acute problem is the preservation and diversification of investment portfolios to avoid negative effective rates of return. In these conditions, the instruments of the modern digital economy look like an interesting alternative to traditional instruments, but not as a full-fledged replacement, but as a hedging instrument, an important addition to the risky part of any investment portfolio. At the same time, considering the social risks of investment, the main emphasis should be placed not on the highest profitability, but on maintaining the expected profitability.

This paper aims to present existing approaches to the construction of generalized indicators of financial market volatility and show their capabilities in relation to the digital financial asset market. Based on this, it is planned to develop and test on the example of the cryptocurrency market a universal indicator of financial instability (financial fear index), which is necessary for timely making adequate decisions, hedging investment risk in the absence of an exhaustive volume of statistical data on the situation on world markets. To build the indicator, a special adaptation of the existing stress meters of traditional financial assets to the specifics of the virtual market is required.

It is quite obvious that in the context of declining investor confidence in a number of traditional financial assets, the markets for modern digital financial instruments are very active. There are currently over 2,000 cryptocurrencies actively traded on unregulated or registered exchanges. In January 2016, the total capitalization of the cryptocurrency market was about $ 7.5 billion, and two years later it reached its maximum value — more than $ 750 billion (as of May 2020, the capitalization was about $ 250 billion) [10]. The daily trading volume of cryptocurrencies exceeds billions of dollars. According to the Skew analytical service, by June 2020, the value of open positions in bitcoin options on the Deribit exchange reached $ 1.1 billion, in contracts on Ethereum — $ 150 million.[1]

[1] $ 1 Billion Bitcoin & Ethereum Options To Be Exercised On Deribit. URL: https://forklog.com/na-deribit-ispolnyatsya-optsiony-na-bitkoin-i-ethereum-stoimostyu-v-1-mlrd/ (accessed on 07.02.2021).

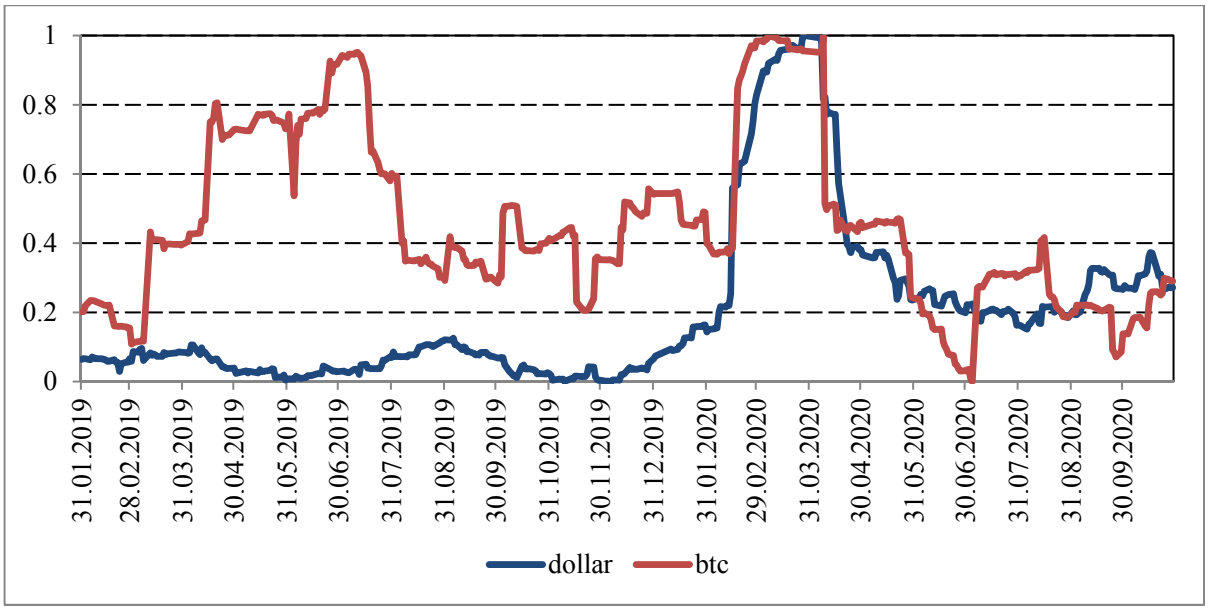

Fig. 1. **Volatility of the ruble against the dollar and bitcoin**

Source: calculated by the authors on the data of the ruble exchange rate to the dollar and bitcoin.

This suggests that the majority of players are betting on the further growth of the cryptocurrency market. At the same time, opinions are expressed about extremely high risks associated with the significant volatility of digital financial instruments as an inevitable attribute of the process of the formation of new markets [11]. There are even studies that compare cryptocurrencies to speculative bubbles similar to those found in traditional financial markets [12–14]. Indeed, in the cryptocurrency markets, at the moment of expiration of the nearest options, as a rule, there is increased volatility, especially when the expiration affects a large number of open positions (although most investors postpone open positions for a new period). However, we believe that the threat of serious consequences associated with the high volatility of digital assets is greatly exaggerated. This can be illustrated by a simple statistical example in relation to the Russian foreign exchange market, especially in light of the processes that took place in 2020, when the state allowed a significant depreciation of its own national currency. As the simplest indicator of volatility, the standard deviation of the ruble against the dollar and bitcoin can be used. To do this, we take a daily sample of quotes for the period from January 2019 to November 2020 and for each date, we calculate the spread of growth rates by 30 points (15 values before this date and 15 values after). To bring the indicators to a single scale (from 0 to 1), we will normalize and, as a result, we will get a graph of moving standard deviations (*Fig. 1*), by the peaks of which we can judge the high volatility of the ruble against the dollar and bitcoin. The figure shows that in 2019 the exchange rate of the ruble against bitcoin was more volatile than against the dollar. In 2020, the situation has changed. The behavior of the curves is largely similar, the volatility of the ruble against the dollar was even higher in certain periods (April, June, September–October). Overall, these dynamics are much less subject to fluctuations. For the cryptocurrency market, the beginning of the volatility compression phase is noticeable, which subsequently led to rapid growth in quotations by almost 200% at the beginning of 2021.

We also note that the thesis of a decrease in cryptocurrency volatility is confirmed by a

number of studies. For example, in [15], using numerical methods for analyzing time series, it is shown that the cryptocurrency market has entered a new stage of development despite the presence of risks that have a long-term positive relationship with the level of financial stability. After 2018, there is still a decrease in the volatility of all liquid cryptocurrencies. This circumstance, according to the author, allows even partial use of digital currency in the monetary policy of the Central Bank of the Russian Federation.

The fundamental reasons for the instability of the Russian economy include not only the volatility of digital financial assets (in a certain way, private and insignificant instruments on a macroeconomic scale) but also the underdevelopment of market institutions and low management efficiency. Fluctuations in the global environment, in particular in world oil prices, also contribute to instability in Russia. However, in modern conditions it is difficult to assess this influence — the relationship between energy prices and the Russian ruble exchange rate, stock indices, and interest rates is contradictory. Correlation often changes from tight to weak, from direct to reverse, due to the actions of speculators, investor expectations, and, ultimately, market sentiment, which is constantly changing, resulting in new trends.

BRIEF LITERATURE REVIEW

At present, quantitative methods for analyzing financial instability have been developed and are actively used. We refer to traditional and alternative estimates of the variation of the observed parameters of socio-economic development: macroeconomic indicators, industrial production, stock indices, exchange rates, etc. In particular, there is extensive experience in the development of various options for the index of financial instability. In Russian studies (for example, [16, 17]) this index was constructed by aggregating such indicators of financial and related markets as the volatility of stock indices and oil prices, exchange rate dynamics, yield spreads on government bonds, etc. In fact, in these and many other works, the financial instability index is the domestic alternative of the financial conditions index (FCI) or financial stress, widely known in foreign studies. Among the recent studies carried out by Russian scientists, one should highlight the work [18], which implements a number of alternative methods for constructing the index. In addition, we note the article [19], which also presents several specifications of the FCI of Russia. One of the results was the conclusion about the good predictive properties of this index concerning the 2014–2015 recession — the signal from it came two quarters before the start of a sharp drop in GDP.

As predictors of global economic crises, various FCI types began to be developed back in the 1990s. (a detailed review of the world practice of their use is presented in [20]) and are still actively used. For example, in [21], using the FCI, a simulation of the distribution of future real growth of US GDP by quantiles was carried out depending on the current financial and economic conditions. The regression model showed asymmetry in quantiles, that is, the lower quantiles of the distribution show strong variations, while the upper ones are stable over time. Based on this methodology, South Korean researchers obtained similar results [22] — first, they proved the asymmetric influence of financial conditions on the future growth of the country's GDP using quantile regressions with only internal variables included in the index. They then extended their model to include variables that reflect fluctuations in the US financial markets. It is concluded that the deteriorating financial condition of the US economy makes further growth of Korean GDP more volatile (and this effect, according to the authors, began to be observed only after South Korea opened its financial market in 1998).

In general, indices of the FCI class use a "portfolio" approach in the sense that such indices are obtained by aggregating private or group variables using weighting methods, principal components, or dynamic factors. At the same time, quite often the volatility index (VIX), also called the "fear index", is included in the FCI as one of the variables. For example, this was done back in 2009 when developing the KCFSI — the Kansas City Financial Stress Index [23]. However, the VIX is also used as an independent market indicator, which is calculated based on the volatility of the actual option prices on a particular stock index. Thus, the classic VIX, developed by the Chicago Board Options Exchange, is based on data on the prices of options on the S&P500 index with different expiration dates.[2] The Russian analogue (RVI) uses option prices on the RTS Index with a period of more than 30 days before expiration.[3] Note that the dynamics of the VIX and RVI indices reflect the influence of the American economy on the Russian markets. True, cross-border volatility indices are present with a certain time lag due to the rules of trading on exchanges. At the same time, the anonymity of bitcoin[4] is not a critical factor, which, in our opinion, significantly affects the volatility of quotes.

There are also many other indices (VIXY, VXEEM, VXGOG, etc.) — all of them are considered reliable market predictors and are used by market participants as an analytical tool before making investment decisions. In addition, VIX information is used in some models to improve the pricing of the options [24].

Numerous studies support the predictive power of the VIX. It is interesting to note that in [25] the high efficiency of this index was proved during the period of COVID-19. Using empirical data on 19 stock indices from different countries, the authors built and compared three models to predict financial market volatility during the pandemic. Various tests and evaluations have led us to conclude that the VIX model (more precisely, the HAR-RV–VIX model, which is a specification of the realized volatility autoregressive model) is better suited for most markets. However, there are works that criticize this index. In [26], it is argued that the correlation between the imputed (expected) volatility (which allows us to estimate the VIX, built in accordance with the Black-Scholes model) and the real (realized) market volatility is very weak.

In [27], it is concluded that, depending on the expectations of investors regarding the growth or decline in market returns, the VIX can give different estimates. In the case of positively biased expectations, the VIX usually overestimates market volatility, otherwise, it underestimates. Moreover, the higher the negative expectations of investors, the more the VIX underestimates volatility.

Volatility assessment using quantitative methods is also carried out in relation to the digital financial asset market. First of all, it should be noted the growing interest of researchers both in information technologies and in the economic aspects of the problem. Statistical and econometric methods are actively used to analyze cryptocurrency markets. Thus, in [28], bitcoin price drivers were analyzed using wavelet analysis methods, in [29], the advantages of cryptocurrency diversification in portfolios of various asset classes were assessed, in [30], evidence was found using VAR models, that the higher transactional activity of Bitcoin temporarily leads to its higher profitability.

[2] The Cboe Volatility Index. URL: https://www.cboe.com/indices/ (accessed on 07.02.2021).

[3] Russian volatility index. URL: https://www.moex.com/ru/index/RVI (accessed on 07.02.2021).

[4] The anonymity of cryptocurrencies is a controversial issue. Many consider anonymity to be a myth, since any transactions with cryptocurrency leave digital traces, which can be easily tracked by their participants via social networks, IP addresses, crypto wallets, etc. This opens the way for the transfer of data about market participants, see, for example, "One of the largest crypto exchanges will release customer data to the US authorities". URL: https://ria.ru/20180225/1515243837.html (accessed on 28.02.2021).

In the literature, a significant amount of research on the digital financial assets market is devoted to their consideration as investment instruments. In this context, methods for assessing the profitability and volatility of cryptocurrencies are of great importance [31, 32]. However, considering the objectives of our work, index methods of assessment are of certain interest. Among them, one should highlight CRIX (CRyptocurrency IndeX) — one of the first indices proposed in [33]. It is based on the Laspeyres method, well-known in economic statistics, which makes it possible to assess the price dynamics of a portfolio of digital assets with fixed weights. This index became the basis for building a more advanced VCRIX (Volatility CRyptocurrency IndeX) — an index that uses the VIX methodology for imputed volatility and allows to predict the average annual volatility of cryptocurrencies for the next 30 days on a daily basis.

In [34] VCRIX is tested on empirical data for 2015–2019 — the index recorded all significant jumps in volatility associated with shocks in the cryptocurrency markets. For example, the authors managed to find significant amplitudes and high frequency of the index in 2017 — VCRIX showed values that were interpreted as expected daily volatility of 140%. This is due to major changes in cryptocurrency legislation in China, Korea, Japan, and the United States, as well as the debate over the adoption of Segregated Witness (SegWit), a protocol update designed to improve blockchain efficiency.

It should be noted that blockchain flaws affect volatility, but known vulnerabilities and types of attacks allow timely development and implementation of protection measures. In particular, it is a well-known fact that during a bitcoin transaction, after verification, a new block is formed in the chain, which contains information about this transaction. But verification requires computing power and some time. And only after that, the financial transaction is performed.

The essence of the vast majority of cryptocurrency attacks boils down to the following. An attacker with a relatively large amount of computational resources can create his own version of the chain without sending it for verification. Blockchain is an unauthorized fork into a real malicious chain that is not broadcast to the main network. The attacker performs some legal operation on the real chain without including information about it in a malicious fork that grows and outstrips the real blockchain in length. There is a kind of double payout, while the original amount of funds does not change.

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Note that the problem of vulnerability of all financial transactions is somewhat broader and concerns the necessary security measures when working with the blockchain. Similar risks are borne by the widespread introduction of neural network technologies into the work of the classical stock market. At the same time, the active use of blockchain and appropriate information protection measures will smooth out possible negative consequences and, accordingly, the contribution of this factor to fluctuations in cryptocurrency quotes.

In this context, assessments of the state's attempts to control the world cryptocurrency market are important. The necessary

[5] How to hack Bitcoin, attack 51. URL: https://altcoinlog.com/attack-cryptocurrency-51-procent/ (accessed on 28.02.2021).

Fig. 2. **Dynamics of the financial fear index in the digital financial assets market**

Source: compiled by the authors.

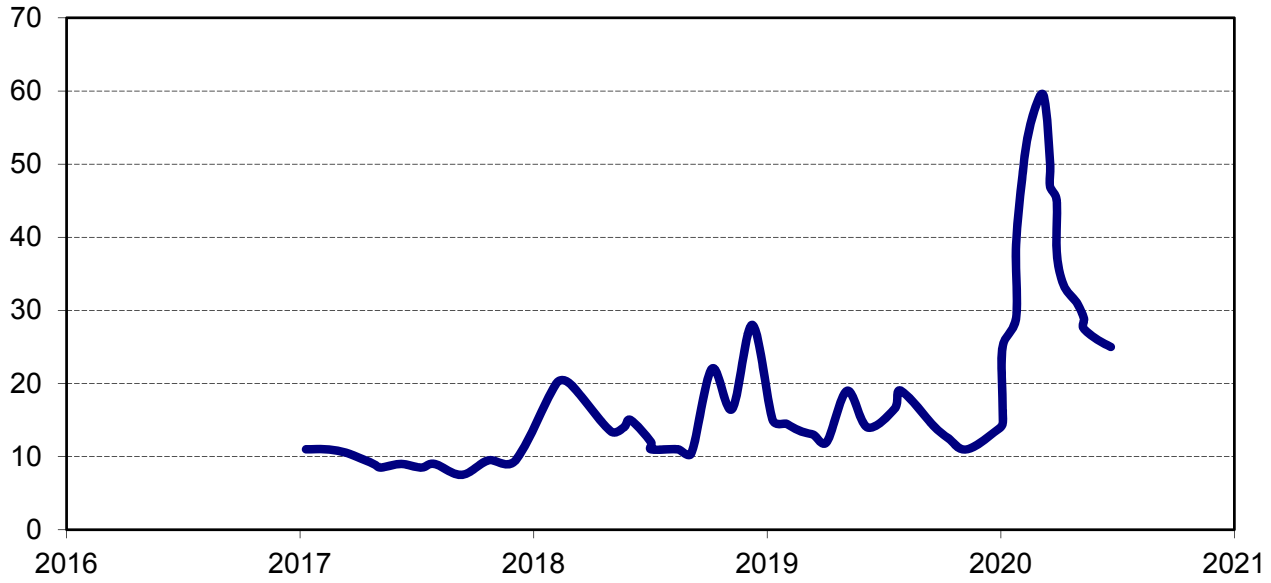

Fig. 3. **VIX dynamics**

Source: compiled by the authors based on data https://ru.tradingview.com/chart/?symbol=CBOE: VIX (accessed on 21.01.2021).

regulatory measures in this area are contained in the FATF standards and recommendations,[6] as well as in a number of works on this issue (for example, in [35]). In particular, they highlight the need to introduce licensing mechanisms for services in the cryptocurrency industry, change legislation, establish thresholds for transactions, etc. In our opinion, the current regulatory policy in the digital asset market is a desire for a state monopoly on the emission of all means of payment, i.e. in fact, this is the way to the digitalization of national currencies in a non-cash form. In this situation, the blockchain is likely to become a link between national and global cryptocurrencies, as well as a

[6] FATF (2012–2020). International Standards on Combating Money Laundering and the Financing of Terrorism & Proliferation. FATF, Paris, France. URL: www.fatf-gafi.org/recommendations.html (accessed on 28.02.2021).

technological base for the functioning of not only the digital but also the real economy.

FINANCIAL INSURANCE INDEX AS A GENERAL INDICATOR OF FINANCIAL INSTABILITY IN THE DIGITALIZATION OF FINANCIAL OPERATIONS

Preliminary statistical analysis

Using the statistical data of the quotes of the underlying asset (bitcoin) and its derivative (bitcoin futures), we can approximately simulate the dynamics of our own indicator (index) of financial fear in the digital financial asset market — hereinafter we will use the abbreviation IFFD. This index model is constructed as the inverse of the derivative of the underlying asset, normalized to the standard deviation.

Fig. 2 shows the dynamics of IFFD, where any point on the graph does not represent a discrete value, but a certain spread of numerical values that reach their maximum or minimum at the moment. It can be noted that the index in 2019 decreased to 30–40 points, which is approximately two times higher than the volatility indicators in the stock markets (*Fig. 3*). However, the cryptocurrency market has much less fear and uncertainty than there was at the end of 2018.

The level of financial instability of real and virtual financial assets is characterized by a negative correlation between indicators of price dynamics and the relative magnitude of volatility, especially during the crisis of 2014–2016, and the following crisis of 2020, which determines the level of investor confidence in real and digital financial assets. At the same time, the growth of the index of distrust in the financial sector differs significantly in the segments of digital and non-digital financial assets. There is a lag in the development of average rates of dynamics with a certain time lag.

This allows us to recommend the corresponding index as the most important leading indicator of financial instability and an effective tool for diversifying an investment portfolio to hedge risks.

If we compare the dynamics of IFFD and VIX, we can see that the crisis in 2019 affected investor confidence in the cryptocurrency market, while the crisis hit the stock market only a year later. In addition to quantitative assessments of levels, the nature of the risk of the virtual and real economies differs. This is due to the specifics of the manifestation of different types of interconnected crisis phenomena in the financial environment, the inertia of the corresponding processes in digital and traditional financial markets.

Theoretical basis

To develop early warning systems for financial instability, an urgent indicator of financial instability is urgently needed, which quickly reflects the situation in the financial market, the degree of investor confidence, the level, dynamics, and relative magnitude of the volatility of the main quotes. Considering the above, we start developing our own indicator — the financial fear index. When calculating it, it is necessary to consider investors' demand for digital financial assets.

Anticipating our development, we note the discrepancies in understanding the essence of the term "volatility" and "fear of investors". Periods of turbulence in financial markets are usually preceded by a phase of declining short-term volatility. The uncertainty of the current state and the direction of further development of the economy raises concerns about the financial condition, volumes, structure of investments in financial assets, and the adoption of financial obligations. This fear gives impulses, shakes up and expands the sphere of volatility, causes an increase in the amplitude of price fluctuations, which, in turn, further intensifies investor fears and generates panic. Any slightest fluctuation in the market situation, sometimes for subjective but systemically significant reasons, can cause a snowball effect, become a turning point in a trend. There is a massive closure of the

positions of market participants, a new trend is forming. Ultimately, everything is decided by expectations, moods, often associated with random factors indirectly related to the economy: speculative play, the interests of the political and business elites, the opposition of political forces, the influence of the international situation, local conflicts, natural disasters, man-made impacts and, finally, the spread of diseases. The latter directly affects the real sector of the economy, causing corresponding financial problems.

The financial fear index is a display of quantitative estimates of investors' forecasts regarding the volatility of the price of an underlying asset for a certain period. We take the VIX as a basis to develop our indicator, the underlying asset of which, as mentioned earlier, is an option on the US S&P500 index, which covers a large number of securities of various companies. A statistical regularity has been established, according to which the S&P500 indices and the VIX calculated on its basis have an inverse correlation, which is associated with financial fears of market participants caused by significant changes in quotations on the financial market. When volatility returns to normal, the market becomes more predictable, which leads to higher prices for financial instruments.

For the digital segment of the financial market, it is possible to use similar indicators, assessing the expected volatility similarly to the VIX indicator. We write about this in the review section. However, the presence of several indicators used for various segments of the financial market does not allow making operational financial decisions related to the diversification of an investment portfolio consisting of both traditional and digital financial assets.

Methods

If we analyze in detail a sample of option contracts on the Deribit cryptocurrency exchange at certain points in time with expiration dates in the near future, then we can more accurately model the IFFD dynamics using the method of calculating the weighted average price of an option on the underlying asset and hedging the price risks. This approach is fully consistent with the classical methodology by analogy with the VIX.

Using the classic Black and Scholes model, we will quantify investor positions in digital financial assets. The value of the proposed IFFD will be determined as a weighted average forecast of the variance based on the prices of all options that investors are willing to pay for the right to buy or sell the underlying asset at a specified price, hedging the risks of sharp price fluctuations in the market.

The IFFD model will be as follows:

$$I = 100 \cdot \sqrt{\frac{2}{T}\sum \frac{\Delta p_{ex}}{p_{ex.i}^{2}} \cdot \overline{p}_{opt.i} - \frac{1}{T}\left(\frac{p_a + p_{opt}}{p_{ex.0}} - 1\right)^2},$$

where T — the time in fractions from the calendar year until the exercise of a certain series of the option; $p_{ex.i}$ — the specific exercise price of the option from the aggregate; Δp_{ex} — the average absolute change in the option strike price, calculated as the arithmetic average of the absolute change in the next and previous strike price; $p_{ex.0}$ — the closest exercise price of the option to the expected one at the time of exercise, which at each particular moment is considered relative to the set of exercise prices set in the current contracts; p_a — the actual current price of the underlying asset on the market; $\overline{p}_{opt.i}$ — the average value between the purchase and sell prices of a particular option (option price).

As for the price of each option (p_{opt}), it depends solely on the expected probability of the price movement of the underlying asset, starting from the current price level relative to the option strike price during the next calendar month remaining until the expiration date. For example, the price of a call option would be determined as the difference between the current price and the

Table 1

Data for options with various expiration dates (June 27, 2020) as of June 26, 2020

Buy option (call option)			Strike price, dollar	Option to sell (put option)		
Bid price, dollar		Volume of bids, btc.		Bid price, dollar		Volume of bids, btc.
purchase	sale			purchase	sale	
677.85	1005.25	0	8375	0	13.83	22
553.35	885.36	0	8500	9.22	13.83	44088
433.46	765.47	0	8625	9.22	18.44	43832
313.57	645.58	0.1	8750	13.84	23.07	44102
355.26	382.94	43831	8875	23.07	32.3	43866
230.67	267.57	43866	9000	32.3	41.53	43886
143.08	166.16	43840	9125	64.57	73.8	31
78.41	87.64	43851	9250	106.12	124.58	56.1
27.69	41.53	52	9375	156.91	295.36	43933
18.45	23.07	118	9500	276.88	406.09	43831
13.83	18.45	90	9625	396.93	498.47	0.1
4.61	18.45	9	9750	498.02	0	0
0	13.83	43985	9875	0	0	0
0	18.45	35.4	10000	0	0	0
0	13.83	43895	10125	0	0	0

Source: compiled by the authors based on data https://www.deribit.com/main#/futures (accessed on 21.01.2021).

risk-weighted discounted strike price, that is, as follows:

$$p_{opt} = p_a \cdot p(EO) - p_{ex} \cdot p^{-r_f \cdot T} \cdot p(NO),$$

where $p(EO)$ — the probability of exceeding the spot price of the underlying asset (distributed approximately according to the normal law with zero mean and standard deviation equal to one) of the strike price, that is, the probability of the call option being exercised; $p(NO)$ — the probability that the spot price of the underlying asset will not be exceeded by the strike price, that is, the probability that the call option will not be exercised (risk hedging ratio); r_f — risk-free interest rate (taken equal to 4.5% per annum); T — the time until the option is exercised in years (taken equal to 1/12).

The numerical values of risk factors, that is, the odds of exercising an option and not exercising an option, are calculated as follows:

$$EO = \frac{\ln\left(\frac{p_a}{p_{ex}}\right) + r_f \cdot T + \frac{\sigma^2 \cdot T}{2}}{\sigma^2 \cdot \sqrt{T}},$$

$$NO = EO - \sigma \cdot \sqrt{T},$$

where σ — the theoretical standard deviation (in fractions of a unit) in annual terms (taken as 0.4, based on data on option prices).

The price of a put option is determined using a similar formula with the opposite

sign, adjusting the risk factors multipliers, respectively, by $1-p(EO)$ and $1-p(NO)$.

To obtain a generalized indicator, it is necessary to weigh the numerical values of the indicator according to the number of days before the expiration of each of the series in annual terms. For this purpose, we will determine the 30-day weighted average (I_T) using the formula:

$$I_T = \sqrt{\frac{T_{365}}{T_{30}}\left(T_1 I_1^2\left(\frac{T_2 - T_{30}}{T_2 - T_1}\right) + T_2 I_2^2\left(\frac{T_{30} - T_1}{T_2 - T_1}\right)\right)},$$

where T_{365}, T_{30} — time in fractions of the calendar year; T_1, T_2 — time until the date of execution of the next and subsequent series of option contracts for shares of a calendar year; I_1, I_2 — IFFD volatility assessment of the next and subsequent series of option contracts.

Data and results

We used the prices of options contracts as the initial statistics. The bid prices for the purchase and sale of cryptocurrency at the time of calculation were taken as a basis, i.e. as of June 26, 2020 — a total of 15 bid positions of the assets being valued. We will show the formation of the price of a specific option using the example of a buy option. We will proceed from the investor's average market assessment of the development of the market situation, which is expressed in the distribution of bid prices for purchase and sale.

Thus, the current price of the underlying asset was $ 9230. Taking the approximate strike price of the option in July 2020 to buy at $ 9410, we first determine the arguments of the factor function:

$$EO = \frac{\ln\left(\frac{9230}{9410}\right) + 0.045 \cdot 1/12 + \frac{0.4^2 \cdot 1/12}{2}}{0.4^2 \cdot \sqrt{1/12}} = -0.077,$$

$$NO = EO - 0.4 \cdot \sqrt{1/12} = -0.192.$$

To determine probabilities $p(EO)$ and $p(NO)$ we use the standard spreadsheet function NORM.ST.DIST(x), which returns the standard normal cumulative distribution, has a mean of zero and a standard deviation of one:

$$p(EO) = 0.469 \text{ and } p(NO) = 0.424.$$

Thus,

$$p_{opt} = 9230 \cdot 0.469 - 9410 \cdot e^{-0.045 \cdot (1/12)} \cdot 0.424 = 358.6 \ US\ dollars$$

The index was calculated based on the two closest series of call options and put options with different expiration dates, June 27 and July 31, respectively, in USD as of June 26, 2020, at the current price of the underlying asset of $ 9230.

The use of sample data at the moment is associated with the objective lack of historical information about the dynamics of all parameters of options transactions. The calculations use sample data provided by the trading system under study. However, they correlate quite well with data from other trading systems, since it is a well-known fact that there are arbitrage transactions that quickly equalize prices between different markets and maintain their equilibrium. It should be noted that despite the possibility of using the information on the real quotes of the underlying asset, a feature of our study is the use of a data array at the time of calculation (as of June 26, 2020) due to the lack of up-to-date historical information on the distribution of order prices, order volumes regarding execution prices. This is due to the desire of the authors to focus not on real transactions reflecting the results of the operation of market pricing mechanisms, but on the expectations of investors hidden behind these figures. Initial data is continuously generated by traders in real-time based on their own views on the development of the situation, forecasts, expectations, beliefs, sentiments, fear, greed, etc., cannot be calculated.

We also note that any investor acts in the absence of comprehensive information about

Table 2

Results of calculations of components of the financial fear index

$p_{ex.i}$	$p^2_{ex.i}$	$p_{opt.i}$ (call)	$p_{opt.i}$ (put)	$\Delta p_{ex} \times p_{opt.i} / p^2_{ex.i}$ (call)	$\Delta p_{ex} \times p_{opt.i} / p^2_{ex.i}$ (put)
8375	70 140 625	841.55	6.915		0.000012323
8500	72 250 000	719.355	11.525		0.000019939
8625	74 390 625	599.465	13.83		0.000023239
8750	76 562 500	479.575	18.455		0.000030131
8875	78 765 625	369.1	27.685		0.000043936
9000	81 000 000	249.12	36.915		0.000056968
9125	83 265 625	154.62	69.185		0.000103862
9250	**85 562 500**	**83.025**	**115.35**		0.000168517
9375	87 890 625	34.61	226.135	0.000049223	
9500	90 250 000	20.76	341.485	0.000028753	
9625	92 640 625	16.14	447.7	0.000021778	
9750	95 062 500	11.53	249.01	0.000015161	
9875	97 515 625	6.915	0	0	
10000	100 000 000	9.225	0	0	
10125	102 515 625	6.915	0	0	
Total				0.000114915	0.000446591

Source: authors' calculations.

all transactions made on various trading floors, relying only on certain indicators (moving averages, indices of relative strength, divergence, and convergence, etc.), selected data on the situation on the exchange markets. Investment decisions in such conditions are made impulsively. However, in general, such sample data and estimates obtained in the course of calculations are unbiased (for example, the average prices of options contracts) and with a certain degree of a probability represent the entire population. Thus, there is no systematic error in our calculations, which allows us to consider the accepted accuracy of calculations as satisfactory.

As an example, we will give the initial data (*Table 1*) and show the calculation in relation to only one date — June 27.

For settlements on options with an exercise date of June 27, we will use *Table 2*. We select for settlements contracts concentrated around the base execution price, i.e. closest to the one expected at the time of execution. In our case, it is equal to $ 9250. As a rule, it corresponds to the minimum absolute difference between the prices of options to purchase and sell. Next, we discard the non-monetary call and put contracts, respectively, below and above the base execution price. We also discard contracts with zero bid prices, purchase and sell volumes.

The formula is used to calculate the first series options expiring after 1 day as of June 26, 2020:

$$I_1 = 100 \times \sqrt{\frac{2}{1/365}(0.000114915+0.000446591) - \frac{1}{1/365}\left(\frac{9230+\frac{83.025+115.35}{2}}{9250}-1\right)^2} = 61.899.$$

We performed similar calculations for a series of options with a strike date of July 31, which is 35 days later than June 26, 2020. As a result, we get I_2 = 68.826.

We weigh the obtained numerical values of the indicator by the number of days before the expiration of each of the series in annual terms and obtain a 30-day weighted average:

$$I_T = \sqrt{\frac{365}{30}\left(\begin{array}{l}\frac{1}{365}\cdot 61.899^2\cdot\left(\frac{35-30}{35-1}\right)+\\ +\frac{35}{365}\cdot 68.826^2\cdot\left(\frac{30-1}{35-1}\right)\end{array}\right)} = 68.788.$$

Discussion

The proposed indicator quantifies the spread of option prices on the underlying asset and is interpreted as follows. The IFFD is measured as a percentage of the expected change in the price of the underlying asset during the next calendar year. For our calculation, it is expected that the quotes of the underlying asset will change in the direction of a decrease or increase by 68.8%. Then, with a probability of 0.954, it can be argued that the expected level of quotes during the next calendar month will be within the confidence interval from the current level within two standard deviations, i.e. plus or minus $2\times\frac{0.68788}{\sqrt{12}} = 0.39714$ or 39.7%. However, it is known that the Student's *t*-test for a small sample imposes more stringent restrictions on variation, given the nature of the distribution. This is because sample variance is a biased quantification of the total variance. Therefore, it is necessary to additionally consider such a distribution parameter as the number of degrees of freedom of the sample variance. Then, with a probability of 0.954, it can be argued that the expected level of quotes during the next calendar month will be within the confidence interval from the current level within 2.145 standard deviations, i.e. plus or minus 0.428, or 42.8%.

We offer the following recommendations on the threshold values of the index in relation to the digital financial asset market:

1. Below 30% — low volatility indicates good investor sentiment, however, the lower this value, the greater the likelihood of a trend reversal.
2. 30–50% — average value, normal state, but this value does not allow giving specific signals to open or close positions.
3. 50–70% — a serious increase in the degree of volatility, signaling the emerging crisis phenomena and the corresponding fluctuations in exchange quotations.
4. Above 70% — panic begins in the market, which leads to a collapse of stock prices.

The obtained assessment of our indicator at the level of 68.8% exceeded the value of the criterion of 50%, which indicates the growing instability in the segment of digital financial assets. Note that very often phases of turbulence, characterized by multiple growths of quotations, are preceded by a certain period of decrease in volatility when the corresponding assets are distributed or accumulated. We have identified such periods in 2020 — the volatility of bitcoin was comparable to the volatility of the ruble (*Fig. 1*). However, such periods are inevitably followed by a surge in volatility — our forecast based on data on prices for options contracts in June 2020 turned out to be correct, since at the beginning of 2021 the cryptocurrency market showed very high volatility.

The proposed indicator of investor confidence in financial assets can be successfully used in various spheres of economic activity that have embarked on the path of digitalization, and serve as a leading indicator of negative impulses and imbalances in development.

In the future, this model can be improved both by clarifying the nature of the relationship between the components of the financial market and by expert assessments. The generalized financial fear index can be formed from the corresponding

financial fear indices for segments of the financial market. The construction of such a model will make it possible to draw even more accurate conclusions regarding the dynamics of the main parameters of economic development.

CONCLUSIONS

The conducted research allows us to formulate several conclusions. The digital transformation of the economy is taking place in an environment of financial instability. In this situation, modern digital economy instruments as a hedging method can act as an alternative to traditional instruments.

Today, we are seeing increased investor interest in digital financial assets — with a total market capitalization of hundreds of billions of dollars. At the same time, one of the results of our research was the confirmation of the hypothesis about the presence of phases with relatively low risks of volatility in the cryptocurrency market. Using the methods of statistical analysis, it was shown that in certain short periods of 2020, the volatility of the ruble to the dollar is comparable or even higher than to bitcoin. However, the volatility reduction is always followed by a surge in volatility, which was especially clearly demonstrated by the bitcoin quotes in 2021.

Analysis of modern scientific publications allows us to conclude that there are a large number of developments that quantitatively assess financial instability. A special place here is occupied by indices of financial condition (financial stress) obtained by aggregating private or group variables and serving as good predictors of instability and crises. These indicators are being actively used in the digital financial asset market — they allow to record surges in volatility associated with shocks in the cryptocurrency markets. The generalization of these indicators made it possible to model the dynamics of the own index, obtained as the reciprocal of the underlying asset and normalized to the standard deviation.

The main result of the study was the model of the financial fear index in the digital financial asset market. This model is based on the method of calculating the weighted average price of the underlying asset option and hedging the risks of sharp price fluctuations in the market. This approach is fully consistent with the "classic" Black and Scholes model used to develop the famous VIX volatility indicator.

The IFFD model was tested on statistical data on the prices of option contracts. We considered the bid prices for purchasing, selling cryptocurrency not in dynamics, but on a certain date — this is due to the lack of up-to-date historical information on the distribution of bid prices and volumes concerning execution prices. The result was the calculation of the index and its interpretation. Threshold values of the index are proposed, which can be used to determine the level of fear of investors in the digital financial asset market. The estimates obtained (calculations were made based on data as of June 2020) gave a signal of increasing market volatility, which was confirmed by a sharp increase in price volatility in early 2021.

The developed model can be used in real financial transactions in order to make the right investment decision in a timely manner in conditions of uncertainty, lack of comprehensive information, insider information, etc. The practical value of the index is explained by its ability to signal the overheating of the digital segment of the financial market, which requires the immediate closure of long positions, the possible opening of short positions. This allows us to recommend the index as a leading indicator of financial instability in order to reduce investment risks.

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Key Trends and Prospects for Sustainable Development of the Urban Settlement System in the Russian Federation

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ABSTRACT

The subject of the study is the problem of the spatial distribution of the population in Russia and its regions. **The relevance** of research is determined by the key trends in the processes of distribution and movement of human capital in the context of cities. The paper **aims** to analyze the key trends and prospects for the development of the Russian settlement system at the federal, regional, and local levels. The research **methods** include a critical analysis of approaches to territorial settlement optimization, the modern system of urban settlement in Russia and its regions based on the use of statistical data of the Federal State Statistics Service for 2011–2019. The authors carried out a comparative analysis of the studied processes by countries using the Zipf method, as well as by Russian regions using the the Lorenz coefficient. It has been determined that the group of regions with an increase in the level of differentiation of urban settlement is characterized by a high level of depopulation of small and medium-sized cities with a contraction and concentration of the population in the largest city of the region, which creates additional risks for the sustainable development of the territory. A decrease in the level of differentiation of urban settlement is observed in regions where the share of the population of both small and medium-sized cities (but at a slower pace) and large ones is decreasing. **The scientific novelty** of the study lies in the development of an approach to improving the settlement system in Russia based on the application of the Lorenz coefficient and modelling methods. The authors **conclude** that an uneven system of settlement has developed in Russia, creating prerequisites for the emergence of new imbalances and threats to the complex sustainable development of the country's territory. In this regard, it is advisable to develop an appropriate document in the field of state policy at the federal level or clarify similar issues within the framework of existing documents, as well as to increase the scientific validity of the measures taken using formalized methods of forecasting and planning. A promising direction in this area is the development of an agent-based model that allows increasing the efficiency of the distribution of financial resources for the development of social infrastructure. **The results** of the study justify the expediency of reallocating financial resources of the budget to ensure state policy in the field of development of the settlement system in the country.
Keywords: settlement system; Russian regions; social infrastructure financing; Zipf curve; Lorenz coefficient

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INTRODUCTION

One of the urgent problems both for the world community and for individual countries is the spatial population distribution and the influence of demographic processes on the sustainability of the development of territories. The implementation of measures aimed at managing these processes requires significant financial resources from the state and private companies. In the Russian Federation, in the context of increasing urbanization, the main demographic trends are the concentration of human capital in the most developed and large settlements, which are the economic and financial centers of the country, the uncontrolled growth of agglomerations, the deterioration of the socio-economic situation of medium and small-sized cities, a significant migration outflow from most territorial formations, rural degradation, etc. All this creates risks of loss of sustainability in the development of both individual settlements and entire regions of the country. At the same time, we are talking not only about territories that are losing human capital, but also about the largest cities of the country, the load on the social infrastructure of which is increasing every year. In this regard, the optimization of resettlement, the achievement of sustainable, uniform socio-economic development of territories of different levels due to the rational distribution of human capital, including by adjusting the structure of expenditures of budgets of all levels, are becoming important development issues of state policy of Russia in the field of spatial development.

The aim of this study is to analyze the key trends and prospects for the development of the settlement system in Russia both at the federal and regional levels. In order to achieve this goal, it is necessary to analyze the system of urban settlement in Russia and its regions, the priorities of state management of spatial development, scientific approaches to optimizing territorial settlement, the peculiarities of financing the social infrastructure of territories as a key factor in their demographic development, as well as ensuring the stability of the settlement system as a whole [1]. Based on the results of the analysis, it is planned to identify the main trends and directions of the development of the settlement system in Russia.

METHODOLOGICAL APPROACHES TO REGULATION OF THE SETTLEMENT SYSTEM DEVELOPMENT

In the scientific community, a settlement system is a subject of interest in the framework of research in the field of demography, economics, sociology, geography, etc. [2–4]. There are various approaches to understanding the settlement system, which in most cases boil down to its definition as a set of settlements on a territory with such properties as the presence of regular transport inter-settlement connections, certain central places that perform system-wide functions to meet the needs of the population [5]. Thus, the settlement system is a group of settlements interacting with each other [6]. The main elements of the settlement system are settlements and population [7]. An important aspect of state regulation at various levels of the territorial organization is the regulation of the settlement system to increase the level of balanced spatial population distribution. The issues of sustainable development of territories, including from the standpoint of demographic sustainability, are discussed in the works of A.V. Antyufeev, O. O.M. Roi, I.D. Turgel', T.V. Maleeva, and others.

Currently, Russian scientists have developed a number of approaches to optimizing the settlement system in the conditions of Russian reality, their list is

presented in the *Table 1*. It should be noted that this list is not exhaustive, including but not limited to the existence of various combinations of these approaches.

The considered concepts of settlement systems can be conditionally divided into those involving the development of territories of various levels (the concept of GSS, the concept of a unified settlement system) and based on point development (the concept of polarized development, the concept of agglomerations of accelerated development, etc.). In addition, it should be noted that the closest to the modern realities of Russian reality is the concept of GSS, within the framework of which the existing system of settlement took place.

Currently, there is no concept of a balanced settlement system in official documents of Russia at the state level. However, in domestic studies devoted to the issues of the spatial distribution of the population in the 80s, the "balanced system of settlement" was defined as "the rational distribution of productive forces, taking into account the need and availability of labor resources, specialization of the territory, which makes it possible to achieve a decrease in the degree of differentiation of the population of different territories, the organization of public space to ensure a comfortable life for the population, opportunities for the integrated development of human capital, improve transport accessibility between territories, etc.".1 An important goal of Soviet policy in the field of improving the system of population settlement was designated "assistance to increase the stability of the functioning of the national economic complex of the country".

Improving, achieving a balance of the settlement system, and ensuring its sustainability is currently not included in the number of the main priority areas of state policy formulated by the President of the Russian Federation in 2018. Nevertheless, among the existing federal regulatory documents, some are devoted to the issues of the spatial distribution of the population in the country, which include:

- General scheme of settlement on the territory of the Russian Federation (basic provisions)2;
- Strategy for the spatial development of the Russian Federation for the period up to 20253;
- Concept of the state migration policy of the Russian Federation for 2019–2025.4

From the point of view of considering the priority directions of the state's activity in the field of resettlement, the prevalence of the trend of polarized development (mainly focusing on certain territorial systems) can be noted. Such a development option can to a greater extent contribute to the increasing dynamics of population pulling into large economic centres and the desertion of many territorial entities, which, in turn, will violate the country's integrity, affect the sustainability of urban development and threaten national security. Thus, despite the developed documents, a number of unresolved issues remain in this area [12]. In these circumstances, in our opinion, it is necessary to clarify the priority directions of the development of the settlement system to achieve the most even territorial development. An important stage in their

[1] Settlement Modeling Guide. Central Research Institute of Urban Development Gosgrazhdanstroy. M.: Stroyizdat; 1982. p. 144.

[2] "General scheme of settlement on the territory of the Russian Federation (basic provisions)", approved by the Government of the Russian Federation. Minutes dated 15.12.1994 No. 31. URL: https://docplan.ru/Data2/1/4294855/4294855147.pdf (accessed on 01.06.2021).

[3] Order of the Government of the Russian Federation dated February 13, 2019, No. 207-r "On approval of the Strategy for the spatial development of the Russian Federation for the period up to 2025". URL: http://www.consultant.ru/document/cons_doc_LAW_318094/ (accessed on 01.06.2021).

[4] Decree of the President of the Russian Federation of October 31, 2018, No. 622 "On the Concept of the State Migration Policy of the Russian Federation for 2019–2025". URL: http://www.consultant.ru/document/cons_doc_LAW_310139/ (accessed on 01.06.2021).

Table 1

Approaches to optimization of the Russian settlement system

Authors	Concept	Main points
O.K. Kudryavtsev, V.V. Vladimirov and others [8]	The concept of group systems of settlements (GSS)	Centre-periphery system, city-centres, and satellite cities. The socio-economic system of the central city must be sufficient for the base of the city's residents and the population of the entire region, it is necessary to develop transport networks. Developed within the framework of the USSR settlement scheme. In group settlement systems, each city or village is not as an economically isolated unit, but as part of this system, for which the national economic planning is intended to perform certain production and labor functions.
D.G. Khodzhaev, B.S. Khorev, G.M. Lappo and others [9]	The concept of a unified settlement system. Settlement support frame	A unified system of settlement implies the formation of a state policy, according to which urban and rural settlements "should not differ significantly in terms of living conditions, living standards and services, and also equal living conditions in cities of various sizes and the most rational spatial population distribution should be ensured. In addition, it is proposed to limit the growth of large cities with the simultaneous development of small and medium-sized ones. The settlement support frame expresses the hierarchy of the constructed aggregate of settlements of different levels"
I.G. Lezhava [10]	Linear settlement concept	The linear settlement system assumes settlement along the main transport corridors. The author, relying on the importance and role of the creation of the Trans-Siberian Railway, proposes the regulation of settlement by creating a similar transport network. "The central axis of the channel is a system of transport and rail routes along the Eurasian channel from West to East with three transverse branches from North to South"
E.F. Mavlyutov, G.S. Yusin, Yu.V. Raev [5]	Polarized development. Unified settlement system	They offer 2 options for solving the existing problems of settlement: polarized development and a unified settlement system. Polarized development allows us to focus on the potential of already emerging centers of economic growth, the formation of centers of advanced development in the northern regions. The unified settlement system is the provision of general socio-economic development and equal conditions for the economic growth of various urban and rural areas in order, among other things, to preserve the cultural heritage and diversity of the Russian Federation
A.G. Mazaev [11]	The concept of accelerated development agglomerations	The main idea of the approach is to curb the growth of Moscow during the development and enlargement of cities with a million-plus population and their agglomerations, which are on the list after St. Petersburg until the population level is reached according to Zipf law

Source: compiled by the authors.

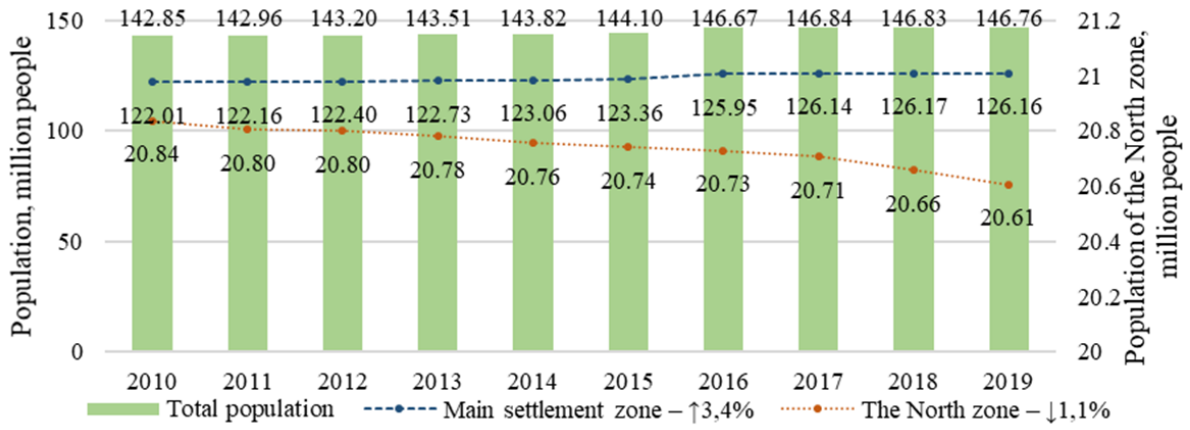

Fig. 1. **Population dynamics of the country, of the main band of settlement and the North zone, with the Republic of Crimea and Sevastopol**

Source: compiled by the authors based on data of the Federal State Statistics Service. URL: https://rosstat.gov.ru/folder/12781 (accessed on 22.02.2021).

determination is the analysis of the current situation in the sphere of resettlement in Russia.

FEATURES OF URBAN SETTLEMENT IN RUSSIA

Russia is one of the states with a low population density and a high degree of unevenness in its distribution. It should be noted that the modern settlement system was significantly influenced by the historical features of the country's development. As a result, today they distinguish between the main zone of settlement (MZS) and the peripheral zone, mainly the territory of the North. MZS is characterized by a population density higher than the Russian average, i.e. more than 8.6 people for 1 sq. km of territories. Mainly MZS is localized on the territory of the Central, North-West, South, North-Caucasian, Volga, Ural Federal Districts, except for several regions (Murmansk, Arkhangelsk regions, the Republic of Karelia, the Komi Republic), but includes Omsk, Novosibirsk, Kemerovo regions, The Republic of Khakassia and the Altai Territory. The main zone of settlement occupies only 22% of the total area of the country's territory and concentrates about 85% of the total population. The key financial and economic centers of the country are also located here.

For the period 2010–2019, the population living in the MZS within the borders of Russia in 2010 increased by 1.5%, while the rest of the population is decreased by 1.1%. Considering the Republic of Crimea and Sevastopol, the population size within the main zone of settlement increased by 3% (*Fig. 1*).

Russia is one of the countries with a high level of urbanization; three- quarters of the country's population live in cities. Within the main zone of settlement of Russia, the urban population reaches 65%.5 These territorial entities in the modern world are becoming the main centres for the development of the economy, industry, human capital, social infrastructure, a comfortable living environment, etc.

According to the Code of Rules6 all cities in Russia are divided by population into extremely largest, very large, large, medium, small (urban-type settlements belong to small cities; large cities are represented by two categories).7 The structure of the urban

[5] Rosstat (2021). The share of the urban population in the total population as of January 1, 2020. URL: https://showdata.gks.ru/report/278932/ (accessed on 22.03.2021).

[6] The Code of Rules 42.13330.2016 "Urban planning. Planning and development of urban and rural settlements. URL: https://docs.cntd.ru/document/456054209 (accessed on 15.02.2021).

[7] Rosstat (2021). The population of the Russian Federation by municipalities, 2011–2019 Official site of the Russian

Table 2

Structure of the distribution of the urban population by city type in Russia (at the beginning of the year), %

City type (depending on the size of the population)	Year			
	2010	2013	2016	2019
1 million +	27.4	32.5	32.5	32.8
500,000–1 million	16.3	12.8	12.7	13.3
250,000–500,000	12.8	13.5	14.9	14.3
100,000–250,000	14.9	14.1	13.5	13.9
50,000–100,000	11.1	10.6	10.6	10.2
Under 50,000	17.6	16.5	15.8	15.5

Source: compiled by the authors based on data of the Federal State Statistics Service. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.02.2021).

population of the country depending on the size of the city is presented in *Table. 2*.

In general, for the period 2010–2019, there is an increase in the share of the urban population living in the largest cities of the country. At the same time, at the beginning of 2010, there were 11 cities with a population of one million, whereas since 2013 their number has increased to 15.8 The share of the population of very large cities decreased to a greater extent due to the transition in 2013 of Krasnoyarsk, Voronezh, Perm, and Volgograd to the category of the very large cities. During the period under review, the share of large cities with a population of 250–500 thousand people increased due to the addition of four territories to this category (Podolsk, Novorossiysk, Yoshkar-Ola, and Khimki). It should be noted that the share of the population living in cities with a population of 100–250 thousand people decreased to 13.9%, despite the increase in the number of cities in this category. The same situation is typical for small and medium-sized cities in the country. These settlements tend to lose demographic stability since the migration outflow of the population from them primarily covers the most active working-age population of fertile age. It is noteworthy that demographic and financial processes are interdependent. Thus, an increase in the population of the extremely large cities makes them "richer" by receiving a larger volume of tax and non-tax revenues to the budgets, increasing investment attractiveness, and increasing the level of income of the population. At the same time, due to economic development, the migration attractiveness of these territories increases, the availability of better-quality health care services, an increase in life expectancy, etc. For small cities, exactly the converse situation is observed.

The bulk of the urban population is concentrated in one of the largest cities, at the regional level in 55 out of 85 constituent entities. At the same time, the most populated territories are of different sizes. In most cases (in 30), the largest city is considered with a population of 250 to 500 thousand people. In 19 constituent entities of the Russian Federation, these are very large cities, in 15 regions —cities with million-plus population, in 14 — cities with a population of 100 to 250 thousand people, in 4 — from

Statistical Agency. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.03.2021).

[8] Rosstat (2021). The population of the Russian Federation by municipalities, 2011–2019 Official site of the Russian Statistical Agency. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.03.2021).

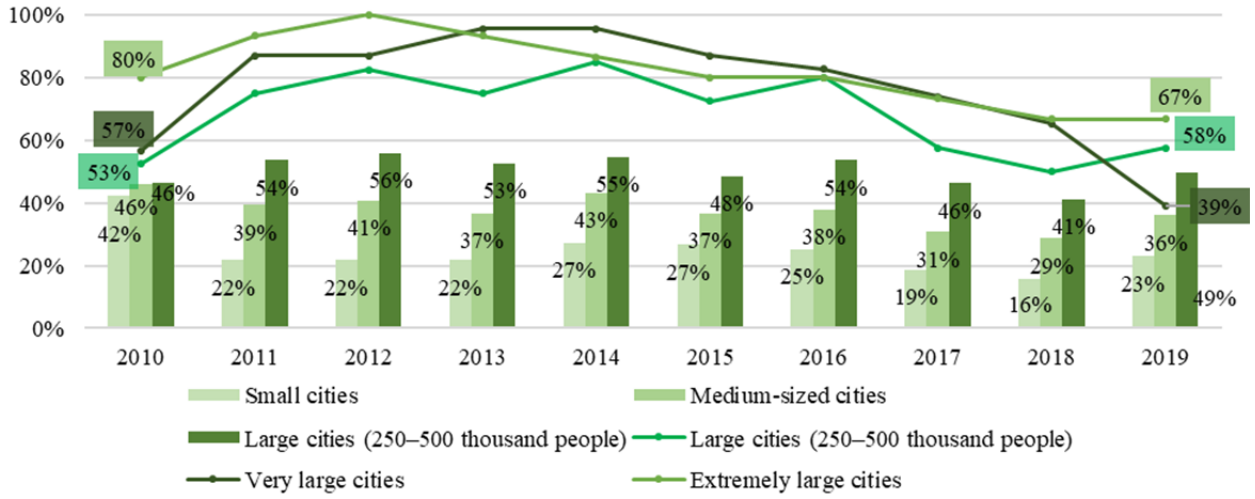

Fig. 2. **Share of Russian cities in the size group with population growth (compared to the previous year)**

Source: compiled by the authors based on data of the Federal State Statistics Service. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.03.2021).

50 to 100 thousand people, in 3 — under 50 thousand people.

Remarkably, the dynamics of the population size within each group are significantly different. Thus, the population in cities with a population of one million over the period under review increased by 14% (by 4.2 million people in absolute terms), in cities with a population of 250 to 500 thousand people — by 9% (1.2 million people), in cities with a population of 100 to 250 thousand people — by 4% (by 518.8 thousand people), while the population of medium and small-sized cities decreased by 3% (by 330.4 and 508.1 thousand people, respectively). *Fig. 2* shows the proportion of cities in each group that has seen an increase in population compared to the previous year.

It should be noted that for all groups, with the exception of very large and large (with a population of 250 to 500 thousand people), a decrease in the share of cities in which there has been an increase in population is characteristic. If in 2010, 42% of small cities experienced population growth, then in 2019 this share decreased by almost half (to 23%), thus depopulation of the population and an increase in the risk of loss of demographic stability are characteristic of the majority of small cities.

Thus, the key trends in the development of urban settlements in Russia are the concentration and reduction of the bulk of the population in the extremely large and very large cities of the country, as well as a high level of outflow from medium and small-sized cities. The same dynamics continue at the regional level. Given the large territory of the country, the presence of various climatic zones, unfavorable territories, but strategically important from an economic point of view, the formation and strengthening of such a settlement system, which would make it possible to achieve the most even and balanced distribution of the population, taking into account the expedient need for human capital, plays a special role. The modern socio-economic state of urban settlements is characterized by a high level of differentiation of the socio-economic development of territorial entities of different types. Moreover, this polarization of territories is increasing, which ultimately leads to the outflow of a significant part of the active population and the gradual degradation of settlements. These circumstances contribute to the development

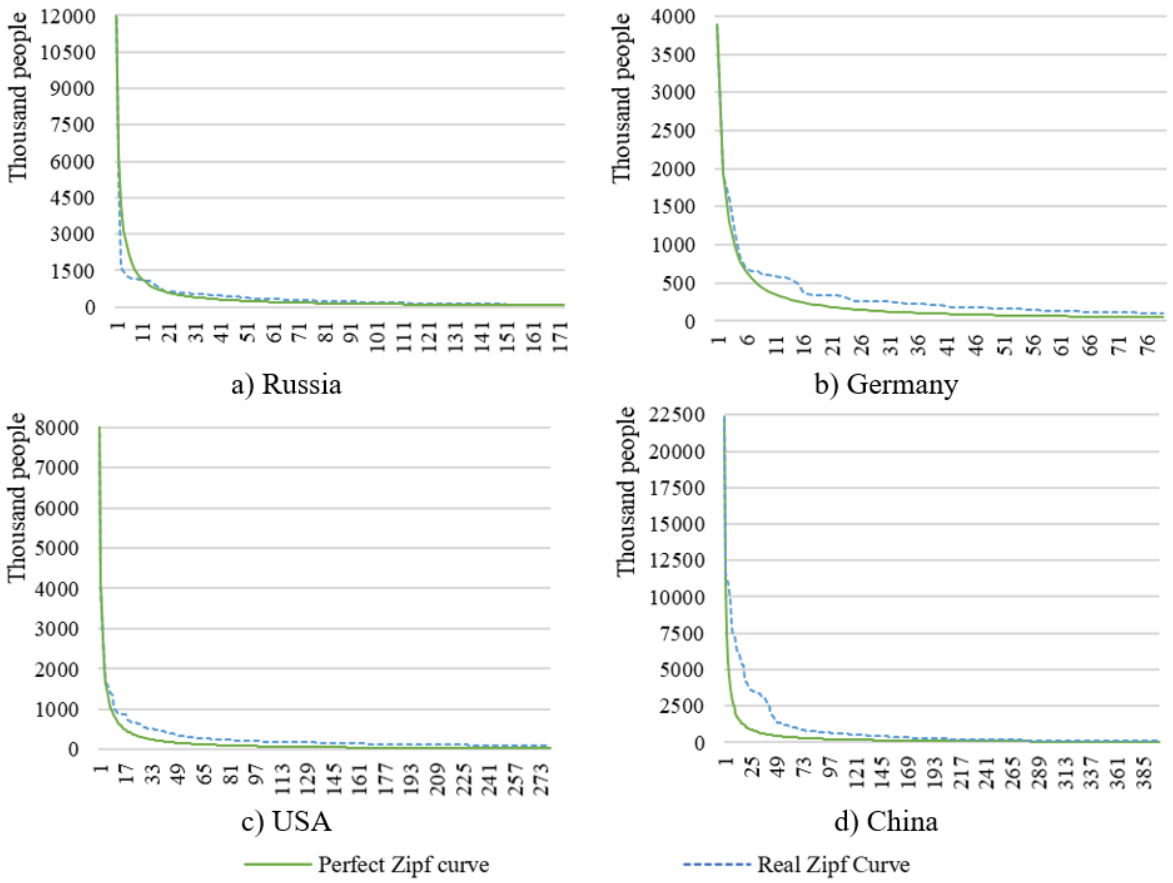

Fig. 3. **Zipf curves for cities with a population of more than 100 thousand people by countries**

Source: compiled by the authors based on data of the Federal State Statistics Service, World Population Review for Germany, USA, China. URL: https://rosstat.gov.ru/compendium/document/13282; https://worldpopulationreview.com/countries/cities/germany; https://worldpopulationreview.com/us-cities; https://worldpopulationreview.com/countries/cities/china (accessed on 22.03.2021).

of the state policy measures in the field of optimizing the national settlement system developing various territories and increasing the level and quality of life of the population, etc. In this case, the objective need is to determine the level and dynamics of differentiation of urban settlements of the country and regions, to identify crisis, problem areas, and ways to improve the current situation. This requires significant financial resources.

ANALYSIS OF URBAN POPULATION DISTRIBUTION IN RUSSIA

The most commonly used method for determining the correspondence of the distribution of the urban population of a country to the "perfect" variation is the Zipf curve (Zipf coefficient). This approach is based on calculating a logarithmic equation that considers the size of the population and the rank of the city [13–15]. According to Zipf law, "the distribution of cities by population is subject to the "rank-size" or "power law" model [16], that is, when ranking cities by population, the ratio of the number of two cities will be inversely proportional to the ratio of their ranks" [14]. Zipf curves for Russia, Germany, the USA, and China are shown in *Fig. 3*. The graph shows that the real Zipf curve differs from the "perfect" distribution of cities by population. In the reference version for Russia, the next city after St. Petersburg has to be a city with a population of 4.2 million, followed by 3.2 million etc. [17].

China, the United States, and Germany were considered in the comparative assessment as

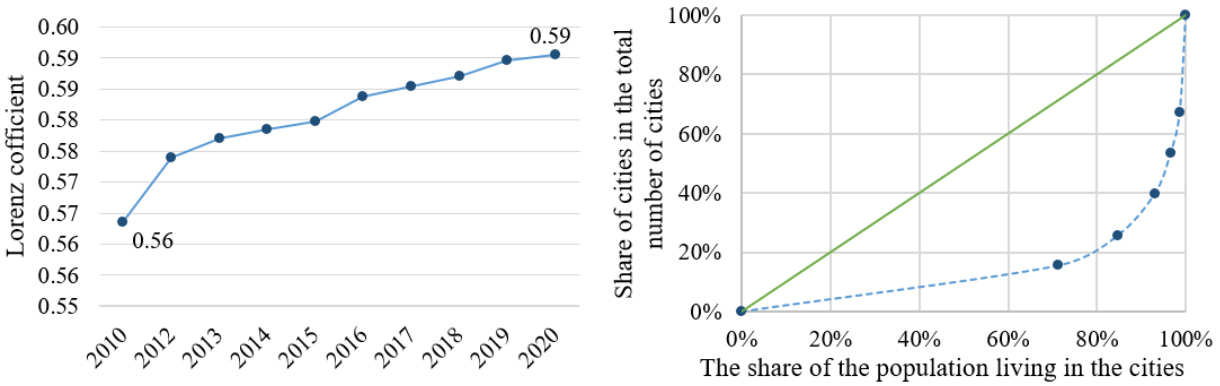

Fig. 4. **Dynamics of the Lorenz coefficient for the period 2010–2020 (left) and the Lorenz curve for the Russian urban settlement system for 2020 (right)**

Source: compiled by the authors based on data of the Federal State Statistics Service. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.03.2021).

countries with large populations. The analysis was carried out in the context of 400 cities in China, 279 cities in the USA, 173 cities in Russia, 79 cities in Germany with a population of more than 100 thousand people. The real Zipf curves for China, the United States, and Germany are higher than perfect, which is typical for countries with a high population density and a large number of cities. On the graph of Russia, the real Zipf curve is at the beginning lower than the perfect one, which is more typical for developing countries, the rest of the real curve is higher than the reference one, which corresponds to the population distribution in developed countries. Scientists explain this effect by the vast territory of the country and the high level of differences in social, economic, natural, and climatic conditions.

As a rule, the Zipf method is recommended to be used to analyze on the basis of the list of the country's largest cities [18]. Considering that its application for a greater level, for example, for regions, does not allow to obtain adequate results. In this case, to assess the distribution of the population in the territories of a smaller scale under comparison, as well as the definition of trends, the dynamics of changes are possible to use the Lorenz concentration curve. This method is more known as a method for assessing the distribution of income between population groups to identify and determine the degree of inequality. In the case of absolute equality, the Lorenz curve takes the form of a diagonal straight line (every 20% of the population is obtained 20% of income), while with absolute inequality — the type of vertical direct (1% of the population is obtained by 100% income). If this approach is used to analyze the uniformity of the distribution of urban population in the regions, the share of the population living in a particular group of cities will appear, and the share of this group of cities in their total quantity for the region. The Lorenz concentration coefficient varies from 0 to 1, where 0 is absolute equality (uniform distribution of the population by type of cities of the region), and 1 is an absolute inequality (in this case, the concentration of the population in one territorial education). The formula for calculating the coefficient to assess the distribution of urban population is presented below [19, p. 246].

$$C_L = \frac{\sum |d_i - q_i|}{2},$$

where C_L — Lorenz concentration coefficient;

d_i — share of cities of the i-th category in the total number of cities;

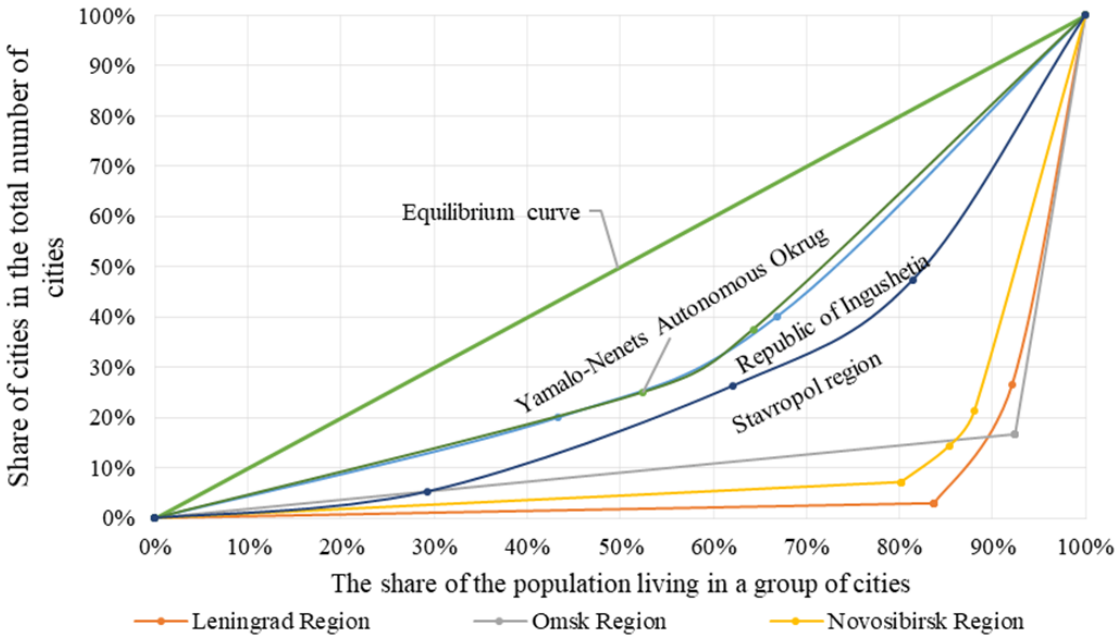

Fig. 5. **Lorenz curve for the first and last three regions by the uniformity of urban settlement**

Source: compiled by the authors based on data of the Federal State Statistics Service. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.03.2021).

q_i — share of the population living in cities of the i-th category in the total number of residents.

It should be noted that a certain disadvantage of using this method in relation to the indicated indicators is that the coefficient does not allow considering the absence of entire groups of cities in the region. At the same time, this method can be useful for identifying trends in the distribution of the population across the cities of the region.

Fig. 4 shows the dynamics of the Lorenz coefficient for Russia, as well as the Lorenz curve for the country's settlement system at the beginning of 2020.

The results of the analysis show that over the past 10 years in Russia, the Lorenz concentration coefficient has increased from 0.56 to 0.59, which characterizes an increase in the level of differentiation of urban settlement. To a greater extent, this dynamic is due to the increase in the share of the population living in the largest and large cities, while its decrease is in small and medium-sized ones.

It seems interesting to test this hypothesis at the regional level. To achieve this goal, similar calculations were carried out based on data from official statistical collections on the population of cities and the number of cities in the regions of Russia for the period 2012–2020. The choice of the time interval is due to the peculiarities of the presentation of statistical data in the publicly available (information is indicated at the beginning of the year, excluding urban-type settlements).9 The regions excluded from the analysis should be noted: the Nenets Autonomous Okrug, the Republic of Adygea, the Republic of Kalmykia, the Altai Republic, the Kamchatka Territory, the Magadan Oblast, the Jewish Autonomous Oblast, the Chukotka Autonomous Okrug, as well as the Republic of Crimea, and Sevastopol. Such a list of subjects is due to such reasons as a small number of cities (less than 3) in the composition of a subject or insufficient

[9] Rosstat (2021). The population of the Russian Federation by municipalities. 2011–2019 Official site of the Russian Statistical Agency. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.03.2021).

data for the analyzed period (the Republic of Crimea and Sevastopol). Moscow and Leningrad regions include Moscow and St. Petersburg, respectively, since these cities are actually the economic centers of these entities.

Based on the calculations obtained, a rating of regions was compiled by the value of the Lorenz coefficient at the beginning of 2020. The following graph shows the Lorenz curves for the first three and last regions in this ranking (*Fig. 5*). The closer the Lorenz curve for the region's settlement system is to the equilibrium line, the more evenly the population is distributed over a given subject.

As of the beginning of 2020, the Republic of Ingushetia, the Yamalo-Nenets Autonomous Okrug and the Stavropol Region are closest to an even distribution of the population by categories of cities. The concentration ratios in these cases were 0.26, 0.27 and 0.36, respectively. A distinctive feature of these regions is that less than 52% of the total urban population of the region lives in the largest cities, and the most densely populated cities are large. So, for example, at the beginning of 2020, there were five cities in Ingushetia — Magas (12.2 thousand people), Malgobek (38.6 thousand people), Karabulak (42.7 thousand people), Sunzha (66.3 thousand people) and Nazran (122.3 thousand people).10 The first three cities are classified as small with a total population of 93.5 thousand people. (33% of the total population of the region). Sunzha, being a medium-sized city, concentrates almost a quarter of the entire population of this subject of the federation. The largest city in the region is Nazran, which in 2010–2012 also belonged to the category of medium-sized cities, but in 2013 it moved to the category of large ones. Earlier, in 2001–2009, this city also belonged to the category of large cities, but from July 1, 2009, the Barsukinsky and Plievsky districts were abolished, removed from its structure as the villages of Barsuki (10.3 thousand people) and Plievo (13, 7 thousand people) were returned to the Nazran region. Currently, 43% of the region's population lives in Nazran. Thus, largely due to the indicated change in the status of the city of Nazran in comparison with the base year 2012, the distribution of the population according to the Lorenz coefficient has become more even.

At the same time, Novosibirsk, Omsk, and Leningrad regions are far from even urban settlement, the concentration coefficients here were 0.73, 0.75, 0.80, respectively. In these regions, more than 77% of the urban population is concentrated in the largest city with a population of over one million. In general, it should be noted that out of 10 regions with a high value of the Lorenz coefficient, which characterizes a significant level of uneven distribution of the population, 6 are "owners" of a municipality with a population of more than 1 million people.

Considering the dynamics of the concentration coefficient by region for 2010–2020, it can be noted that 80% of the subjects participating in the analysis are characterized by an increase in the differentiation of cities in terms of population within 1–10%. At the same time, only in 9 regions, there is a decrease in the level of uneven distribution of the urban population. *Table 3* presents a list of regions with the greatest increase in the level of differentiation of cities and regions, in which this indicator decreased over the period under review.

As a result of the analysis, several groups of regions were identified, which are characterized by different patterns of change in the Lorenz coefficient for the period under consideration. These are the regions in which the growth of this indicator took place, i.e. increased unevenness of urban settlement (positive values); regions in which there is a decrease in the indicator — a decrease in the

[10] Rosstat (2021). The population of the Russian Federation by municipalities. 2011–2019 Official site of the Russian Statistical Agency. URL: https://rosstat.gov.ru/compendium/document/13282 (accessed on 22.03.2021).

Table 3

List of regions with the most significant dynamics of the Lorenz coefficient

Region (dynamics of the Lorenz coefficient for 2012–2020)	Population growth by city type (% of cases)					
	Over 1 million people	500 thousand people – 1 million people	250–500 thousand people	100–250 thousand people	50–100 thousand people	Under 50 thousand people
Regions with an increase in the level of differentiation of urban settlement						
Amur region (10%)	–	100	100	67	50	40
Sakhalin region (9%)						
Tyumen region (9%)						
Kemerovo region (8%)						
Republic of Khakassia (8%)						
Krasnodar region (7%)						
Republic of Karelia (7%)						
Khanty-Mansi Autonomous Okrug – Ugra (7%)						
Republic of Buryatia (6%)						
Republic of Mordovia (6%)						
Regions with a decrease in the level of differentiation of urban settlement						
Kabardino–Balkar Republic (–1%)	–	–	–	50	43	56
Yamalo–Nenets Autonomous Okrug (–1%)						
Novgorod Region (–1%)						
Republic of North Ossetia – Alania (–1%)						
Komi Republic (–2%)						
Karachay–Cherkess Republic (–2%)						
Chechen Republic (–3%)						
Murmansk Region (–4%)						
Republic of Ingushetia (–10%)						

Source: compiled by the authors.

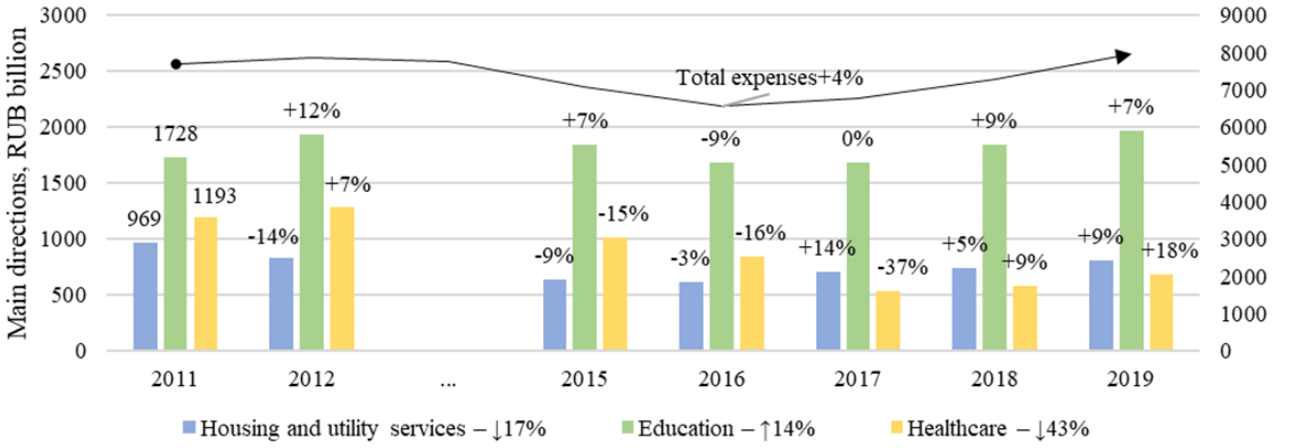

Fig. 6. **Dynamics of expenditures of the consolidated budget of Russia for the period 2011–2019 in 2011 prices**

Source: compiled by the authors based on data of the Federal State Statistics Service. URL: https://rosstat.gov.ru/folder/210/document/13206 (accessed on 22.03.2021).

level of the unevenness of urban settlement (negative values); in other regions, the dynamics of the values of this coefficient ranges from 0 to 3%.

In general, based on the dynamics of the Lorenz coefficient, some features can be identified for different groups of regions. For the subjects in which there is an increase in the uneven distribution of the population, depopulation, and loss of demographic stability of small and medium-sized cities are characteristic. Moreover, for example, the emergence in the Amur Region of a new small city, Tsiolkovsky, did not improve the situation. At the same time, there is an increase in the share of the population living in other categories of cities.

At the same time, the regions in which there is a decrease in the degree of uneven distribution of the population are characterized by lower rates of decline in the share of the population living in small medium-sized cities. Only in 50% of cases there is an increase in the share of the population of large cities with a population of 100 to 250 thousand people. In addition, in all municipalities of this group with a population of 250 to 500 thousand people the share of the population living in this group has decreased.

Thus, the growth in the differentiation of urban settlement is characterized by a high level of depopulation of small and medium-sized cities in most regions, with a contraction and concentration of population in the largest city of the subject, which occurs even despite the emergence of new settlements of this type. In turn, the level of differentiation of urban settlement decreases in the regions in which the decrease in the share of the population of small and medium-sized cities occurs at a slower pace, while the share of the population living in larger cities decreases. These results are largely due to the transition of small cities to the category of medium-sized ones (4 cases). In the Republic of Ingushetia — the transition of a medium-sized city to the category of large and in only one case — the transition of a city to the category of smaller ones. In general, the current situation indicates a decrease in the demographic stability of settlements of this type in Russia.

IMPACT OF SOCIAL INFRASTRUCTURE FINANCING ON DEMOGRAPHIC PROCESSES IN RUSSIA

A significant factor determining the direction and dynamics of demographic processes and, as a consequence, changes in the settlement system, is the level of development of social

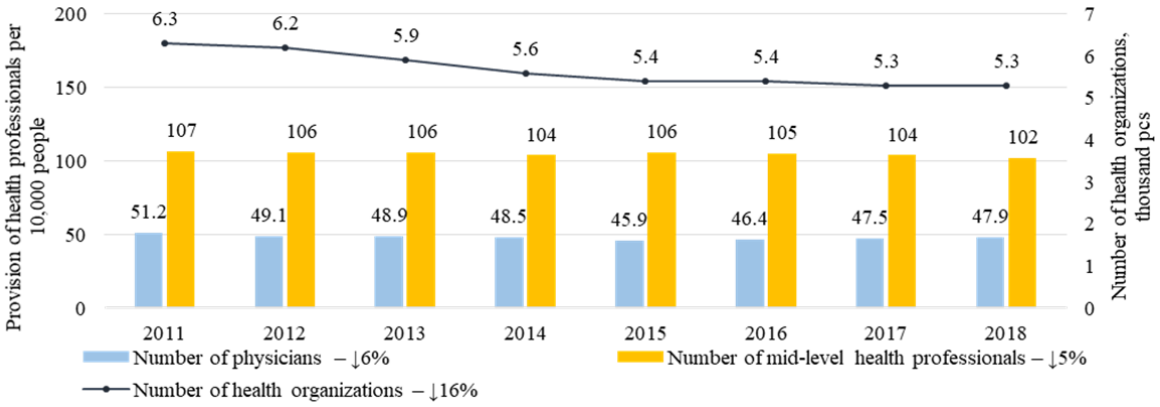

Fig. 7. **Dynamics of the main indicators of the social infrastructure of healthcare in Russia**

Source: compiled by the authors based on data of the Federal State Statistics Service. URL: https://rosstat.gov.ru/folder/210/document/13206 (accessed on 22.03.2021).

infrastructure. It should be noted that the system of financing this sphere in Russia presupposes the priority of the budgetary component. The declared principle of transition to public-private partnership in the development of healthcare and education is currently being implemented rather limitedly. At the same time, the sphere of trade and provision of services, as well as a number of other areas, are significantly developing thanks to private financing.

Consolidated budget expenditures of Russia for 2011–2019 increased by more than one and a half times in actual prices.11 At the same time, expenditures on education almost doubled, and on the housing and utility sector — by 42%. At the same time, healthcare financing decreased by 2%. It is worth noting that a sharp decrease in budget expenditures in this area was observed in the period 2016–2017, which may in part be due to a change in the system of grouping and reflection of expenditures.

It should be noted that the growth in nominal expenditures in most of the areas considered is due to inflationary processes and does not reflect the real situation. To ensure comparability of data, let us consider the dynamics of the values of indicators in prices of the base year, considering the consumer price index (*Fig. 6*).

By 2019, expenses of the consolidated budget of Russia in comparable prices increased by 4%. Expenditures on education during this period increased by 14%. However, there has been a significant reduction in real government spending in areas such as the housing and utility services (–17%) and healthcare (–43%). Such dynamics affect demographic processes and, as a consequence, the settlement system, but their influence in most cases "stretches" over time. Thus, changes in the level of availability of high-quality health care services affect life expectancy. According to the report of the Ministry of Health of the Russian Federation, its value in 2020 decreased by 1.84 years, to 71.5 years. This is largely due to an 18% increase in mortality compared to the 2019 level.12 In absolute terms, it is 323.8 thousand people, which corresponds to the number of 16 average small cities in the country.

The graph shows the dynamics of healthcare indicators, showing the total changes in% (*Fig. 7*).

During the period under review, the provision of the population with health

[11] Ministry of Finance of the Russian Federation. 2021. URL: https://roskazna.gov.ru/ispolnenie-byudzhetov/konsolidirovannye-byudzhety-subektov/974/ (accessed on 22.03.2021).

[12] Rosstat (2021). Regions of Russia. 2019. URL: https://rosstat.gov.ru/bgd/regl/b19_14p/Main.htm (accessed on 22.03.2021).

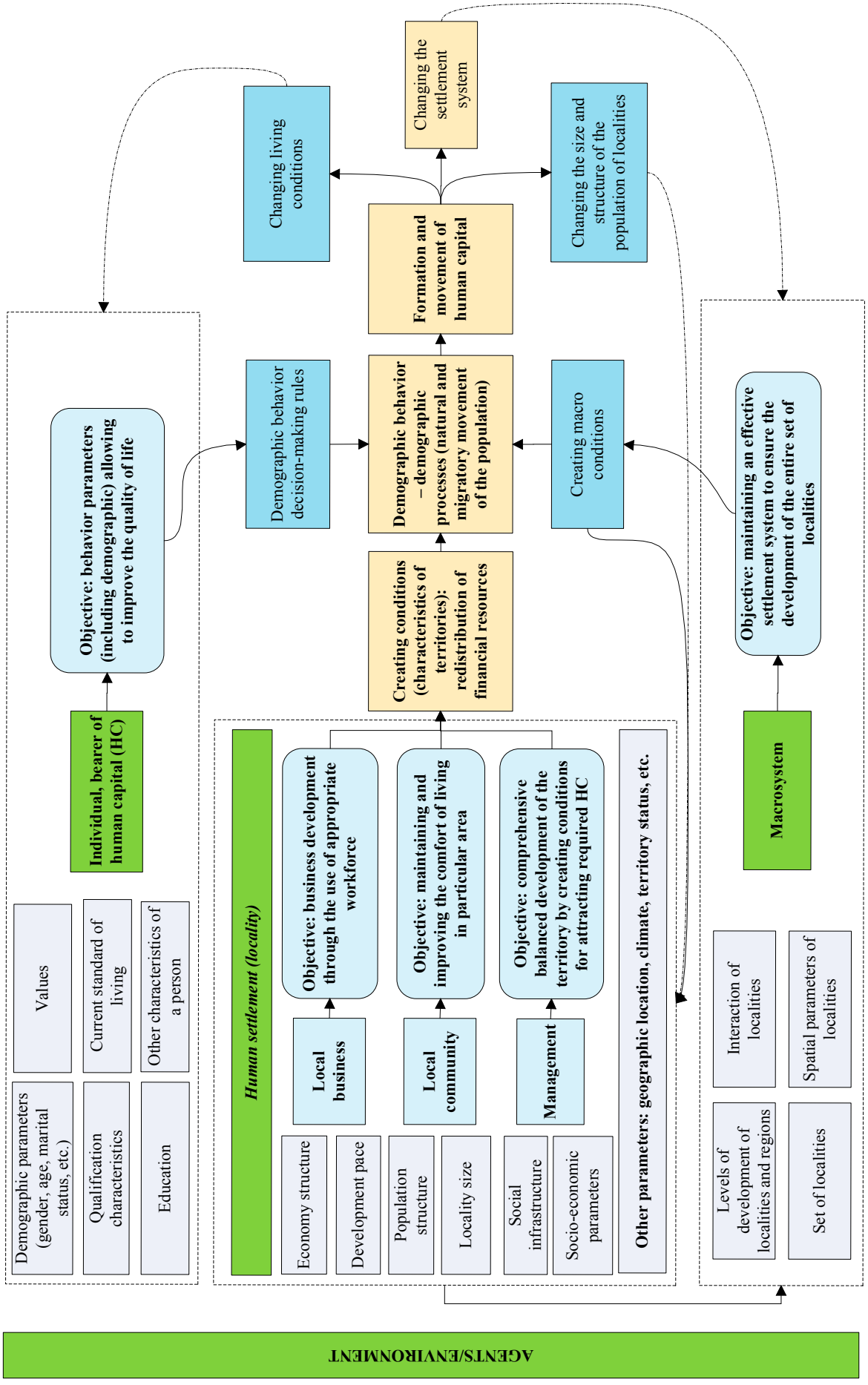

Fig. 8. **Conceptual flowcharts of the agent-based model of the urban settlement system**
Source: compiled by the authors.

professionals and hospital organizations decreased. The Pearson correlation coefficient between these indicators and budgetary health spending at comparable prices is 0.77 and 0.83, respectively, indicating a significant relationship. However, the full impact of these changes on the settlement system will manifest itself only in a few years or even decades.

It should be noted that the real financing of social infrastructure in Russia is characterized by rather contradictory trends. An even more obvious imbalance between resource provision and the development of this direction is observed at the regional level. To solve the problem of assessing the compliance of the level of funding with the result obtained, the regions were grouped according to indicators of the development of healthcare, education, and housing and utility services. As part of the study, the amount of funding and the level of development of these areas (in specific conditions) were correlated with the average Russian values. When comparing the data for the three regions under consideration, a number of regions were identified, which in all cases were attributed to the same groups. Thus, St. Petersburg, the Republic of Tatarstan, and the Yaroslavl region are characterized by a combination of relatively high values of both indicators of the development of social infrastructure and its financing. It is not surprising that this was reflected in the dynamics of demographic processes (for example, in the Leningrad Region, the increase in migration in 2019 was 204 people per 10 thousand population).

The group with a similar level of development of social infrastructure, but with a low level of funding includes Chelyabinsk, Oryol, Ryazan, Tambov, Voronezh, Orenburg, Saratov, Bryansk regions.

Regions with a low level of development of social infrastructure and a high level of funding include the Republic of Komi and Karelia, Krasnoyarsk and Kamchatka Territories, Arkhangelsk, Murmansk, Kemerovo, and Amur Regions, Chukotka Autonomous Okrug, and the Jewish Autonomous Oblast.

Volgograd, Kurgan regions and the Republic of Dagestan are characterized by a low level of development and financing of social infrastructure.

Thus, these are not just special cases of imbalance in resource provision and the results obtained, but a certain stable characteristic of the region in terms of the effectiveness of the measures being implemented. Solving the problems of effective allocation and use of financial resources of the state for the creation of social infrastructure and, in general, the implementation of measures to regulate the processes of changing the settlement system requires a search for best practices. It should be noted that the development of regions and cities is influenced by a complex of dissimilar factors, and therefore, to improve the situation, an integrated approach is also required, the implementation of which requires the use of modern formalized methods of analysis and forecasting.

CONCEPTUAL APPROACH TO FORMATION OF THE URBAN PAYMENT SYSTEM

Currently, the uneven distribution of the urban population across the country continues to increase, which is also manifested at the regional level. These circumstances are due to various factors, including a high degree of differentiation of territorial entities in terms of socio-economic development, the financial security of both the population and regional budgets, climatic conditions, geographical location, etc. [20]. These factors form a multitude of overlapping heterogeneous influences that affect the demographic behavior of the population as a whole and each person individually. The complexity of this situation does not allow to fully reflect all its components when using expert methods of analysis and

assessment of possible directions for the development of the settlement system in Russia. In this regard, the task of forming tools for supporting decision-making is being actualized, and, first of all, developing a set of economic and mathematical models that could be considered as the core of such tools. This approach makes it possible to increase the effectiveness of public policy measures in the area under consideration by building scientifically based scenario forecasts of the consequences of their implementation. Based on the specifics of the problem under consideration, the most promising is the use of the agent-based approach [21–23]. The concept of forming a model of a settlement system developed within the framework of the study considers it as a set of interacting subsystems-agents. Undoubtedly, the main agents in the settlement model are the settlements and the population, between which various relationships are built taking into account economic, social, demographic, climatic, and other processes. At the same time, within the framework of the proposed model, special attention is paid to the formation of monetary incomes of the population and financing of social facilities. It should be emphasized that from the point of view of state regulation of the processes of formation of the settlement system, in fact, we are talking about the redistribution of financial resources between individual events, departments, and territories. *Fig. 8* shows a conceptual diagram of a model of demographic processes from the point of view of the formation of a settlement system.

The key agent within the framework of the proposed model is "Individual", which has many diverse characteristics that can be grouped in such areas as value orientations, demographic characteristics, qualifications, educational level, etc. All these parameters in one way or another determine the demographic behavior of a person including his propensity to create a family, attitude towards raising children, the desired number of children, the propensity to change their place of residence, as well as the likelihood of death at a given age. It should be noted that within the framework of the formed model, the demographic behavior of a person is considered as an integral part of a more complex system, including, among other things, his financial, labor, social, and other behavior [24]. In this case, the target task of this agent within the framework of the developed model is to determine such parameters of his behavior that would improve the quality of life of the individual and his household.

At the same time, solving the problem of modeling the processes of forming a settlement system and assessing the demographic stability of a territory is impossible without considering the parameters of the territories, in this case, cities. To describe the characteristics of these agents, it is necessary to take into account the multiplicity of their interests, since settlements are considered not so much geographically as socio-economically. This predetermines the need to reflect cities as an aggregate of the population living in them, the business located on their territory, and the local authorities that govern them. Thus, the set of characteristics of settlements includes parameters that describe the structure of the economy (including the number of employees and levels of wages by type of economic activity), the structure of the population (as a set of agents of "Individual" type), parameters for the development of social infrastructure, financial characteristics such as the level of household income, the level of prices, the volume of income and the structure of expenditures of the budget of the territory, the financial indicators of the enterprise and organization, their investment policy, etc. In addition, such characteristics of cities are considered that, within the framework of the built model, are unchanged and uncontrollable, for example, geographic

location, climate, etc. These characteristics and the results of the action of the "Human settlement" agent determine the living conditions in the territory that are influenced by the decision-making by the "Individual" agent in the region of its demographic behavior.

In addition, the external environment, which in this case is a macrosystem, has a certain impact on the development and behavior of both of the above agents. It should be noted that within the framework of the proposed model, it was not considered as a separate agent, and its parameters are set by scenario conditions, however, *Fig. 8* shows the conceptual idea embodied in its description.

Thus, the interaction of agents in the model and their characteristics determine the demographic behavior of the population and form demographic processes (both in terms of natural and migratory movement of the population). This leads not only to a multitude of reactions of individual agents of the "Individual" type but to the formation and spatial movement of human capital and the adjustment of the settlement system in the country. As feedback, there is a change in the living conditions of each of the agents of the "Individual" type and the characteristics of settlements. It should be noted that the territorial level of modeling can cover a set of cities in a region or the country as a whole, based on the goals of modeling. The developed approach to the model of the settlement system, considering the mutual influence of dissimilar factors and processes as a result of the implementation, will determine the dynamics, trends of settlement and develop a forecast of changes in the demographic stability of a territorial entity. The modeling results, in turn, provide for the possibility of developing the main measures and directions to improve the situation by creating conditions for the socio-economic development of the territory with various directions of state policy.

CONCLUSIONS

At present, the system of urban settlement in Russia is characterized by an uneven population distribution over the territory of the country, which is due to historical, geographical, climatic features, but at the same time socio-economic conditions. The latter, in turn, are more amenable to government regulation. The results of the analysis based on the calculations of the Lorenz coefficient indicate an increase in the differentiation of cities in terms of population in the regions of the country, which is expressed in an increase in the unevenness of the spatial population distribution across the territory of subjects. These trends are due to the processes of population reduction and concentration in large cities of the country, a high migration outflow of the population from small and medium-sized cities, as a result of which the differentiation of cities increases, the threat of depopulation of the space between the largest municipalities are being created, the load on the social infrastructure of such cities is increasing, and the risks of instability of development of territories are formed.

In this regard, it becomes important to determine the priorities and directions of regulation of the spatial population distribution. Despite the existence in Russia of developed regulatory documents in the field of the territorial organization of the population, a number of aspects still require the attention of federal authorities. An important decision could be the development of a federal document in the field of regulation of the settlement system, within the framework of which the main position of the state on resolving the current situation will be indicated. The most effective and convenient tool for determining the directions of state regulation in these conditions can be a model developed based on an agent-based approach. Its application will allow, among other things, to justify the feasibility of redistributing financial

resources of the budget to ensure state policy in the development of the settlement system in the country.

The basis of the federal policy in the field of spatial settlement should be the interconnected development of municipalities, including an increase in the convenience of using inter-municipal territories in combination with the development of individual settlements. At the same time, an integrated approach is needed on the part of government bodies based on considering the interests of all types of cities, including within the framework of the Strategy for the Spatial Development of Russia.

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Fattakhov R.V. — developed the research methodology, justified the choice of indicators for analysis, interpreted the results.
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