ORIGINAL PAPER

DOI: 10.26794/2220-6469-2021-15-2-75-88
UDC 338.45:669(045)
JEL L16

Impact of Institutional Factors on the Technological Level in Metallurgy of Russian Federation

A.A. Blokhin[a], S. Ya. Dranev[b]
[a] Financial University, Moscow, Russia;
[a, b] Institute of Economic Forecasting of the Russian Academy of Sciences (IEF RAS), Moscow, Russia
[a] https://orcid.org/0000-0003-2132-4664; [b] https://orcid.org/0000-0002-7184-3238

ABSTRACT

The article determines the influence of institutional factors on the characteristics of the technological development of Russian metallurgy. We proposed several institutional criteria following identified three samples— Russian multinational corporations, large companies operating in many regions of Russia, the remaining companies operating at the local level. We investigated these samples in the context of several technological criteria. The main ones are access to modern technologies, level of production capacities, interaction with educational organizations. The study shows that the division of companies metallurgical companies into three institutionally different groups is accompanied by their stratification also by their technological level. The first group significantly surpasses the second and third by the volume of financing of technological innovations, the level of interaction with educational institutions, the level of interaction with research institutes and access to high technology. The differences between the second and third groups are also strongly pronounced. The approach described in the article makes possible the determination of the technological limitations in the metallurgical industry associated with its institutional features and shaping public policy, which takes into account the sensitivity of qualitatively different groups of businesses to stimulating measures.

Keywords: institutional factors; institutional rent; ferrous and non-ferrous metallurgy enterprises; largest metallurgical enterprises; technological level

For citation: **Blokhin A.A., Dranev S. Ya. Impact of institutional factors on the technological level in metallurgy of Russian Federation. *Mir novoi ekonomiki = The World of New Economy*. 2021;15(2):75-88. DOI: 10.26794/2220-6469-2021-15-2-75-88**

At present there are more than 30 thous. metallurgical companies and their territorially separate units operating in Russia.[1] Of these, more than 90% belong to the steel industry. They vary in size and product range, market coverage, technological level and depth of transformation. It should be noted that the behaviour of the largest companies is one of the key elements of the economic mechanism for the development of metallurgy [1]. In addition, the dictates of large producers and the neglect of small consumers remain [2].

A convenient tool for analysing such multi-level markets is the theory of economic dominance proposed in [3, 4]. It distinguishes business groups (levels, sectors) working in qualitatively different institutional conditions — alpha, beta and gamma business, respectively. Better conditions than others allow them to obtain institutional rent. However, the choice of institutional attributes that determine the quality of institutions — is far from straightforward. In this article authors rely on the approach proposed for their classification and definition in [5].

The number of criteria for economic development is constantly expanding, including the inclusion of institutional factors [6], since institutional changes are a major direction of transformation and one of the main components of the development of the Russian economy, related to the establishment and maintenance of quality institutions [7]. In order to assess their impact on the technological level of Russian metallurgical companies, a large sample of steel and non-ferrous metallurgical enterprises has been selected according to the following indicators:

- enterprise's earnings with more than 400 million roubles in 2016;
- metallurgical companies with complex technological changes — casting/welding/rolling/dragging/chemical reactions that require sophisticated and expensive equipment;
- the companies' activities continued throughout 2008–2019;
- it differs in terms of individual (verified) institutional characteristics, and can be defined for each company.
- The following enterprises were not sampled:
- affiliated companies with a consolidated report of a group of companies
- or holding in a sample;
- distribution companies;
- machine-building enterprises with metallurgical engineering;
- metallurgical companies with simple technological changes (bends, stamps, etc.);

Completely new high-tech enterprises created during the period under study were also sampled under the above conditions (Abinsk Electric Steel Works, Zagorsk Pipe Plant, Holding company TEMPO and others) and fully modernized (groups Ashinskiy metallurgical works, Arconic Corporation and others) or reformatted in connection with a change of ownership (Amurstal has been a member of the TOREX Group since mid-2017, Svetlinsky ferronickel plant has changed ownership as a result of bankruptcy in 2010 etc.). Companies that were part of non-metal holdings during the period were also considered (PA Bezhitskaya Steel as part of TransMachHolding, Tikhvinsky ferroalloy plant is part of the Turkish Yildirim Group, Transkat until mid-2015 was part of Russian Railways, etc.).

In addition, individual mining companies or holdings with only mining and mining activities were not sampled.

As a result, the sample consists of 105 companies. Among them, the hierarchy of institutional characteristics according to the principles in the authors' earlier studies

[1] Федеральная служба государственной статистики. Статистический сборник «Промышленное производство в России»; 2016.

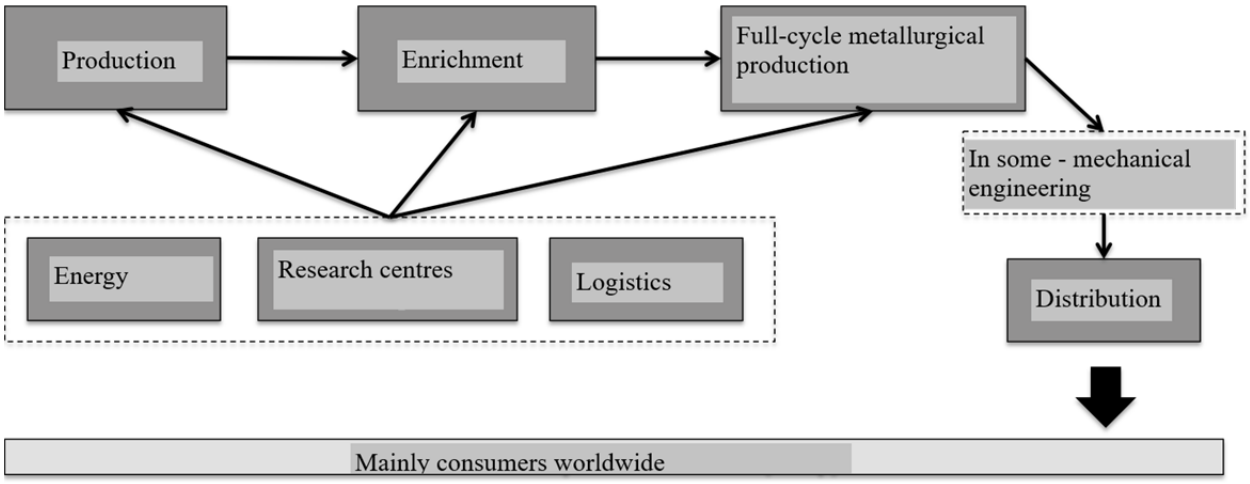

Fig. 1. **Organizational structure of group 1 enterprises**

Source: the authors.

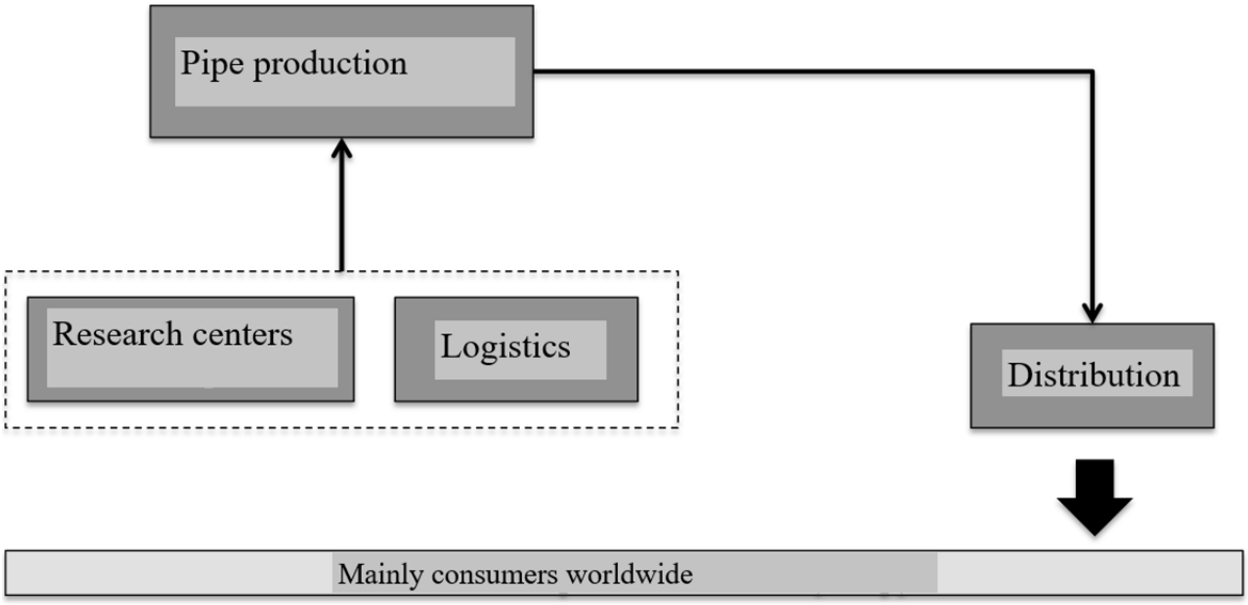

Fig. 2. **Organizational structure of metallurgical holdings of group 1**

Source: the authors.

is defined: the level of rating in which the company is present; the scope of markets; the level, volume and form of government support; the availability of finance; and a number of others [5].

This paper shows that the stratification of metallurgical companies according to the listed groups of attributes has led to a three-level hierarchy. However, level 1 dominates over 2 and 3, and level 2 over 3, as they occupy the best segments of the markets, gain in access to finance, government support and thus gain institutional rents.

Level 1 includes the largest Russian steel companies, which are transnational. They have a wide network of associated marketing, financial, transport, manufacturing and other companies or units in Russia and abroad. They are most often vertically integrated steel holdings (with the exception of tubular

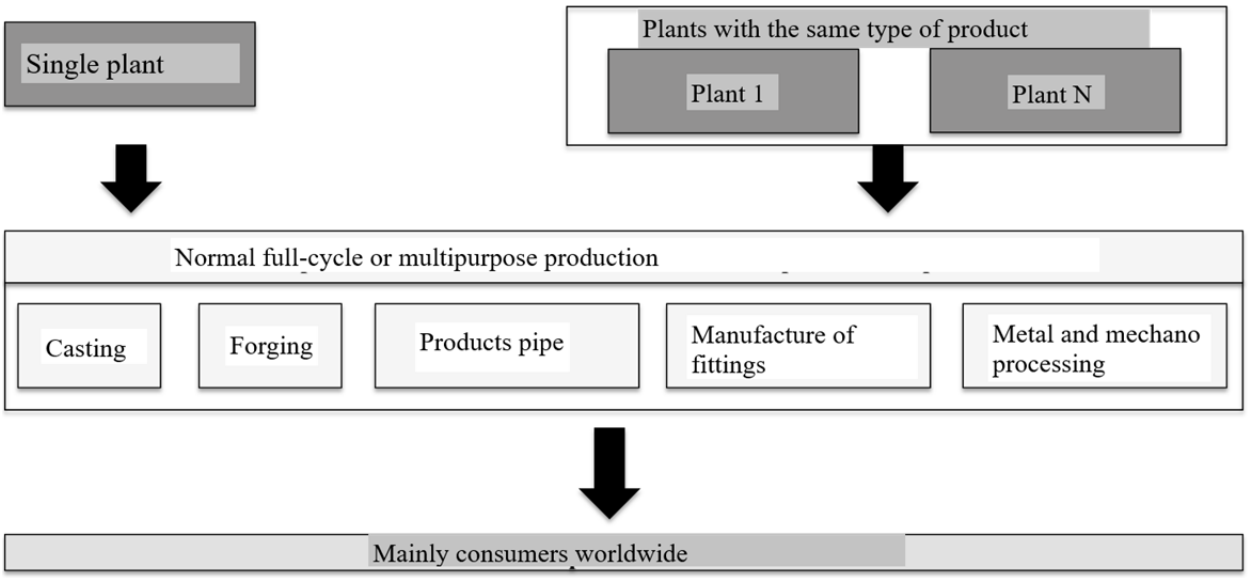

Fig. 3. **Organizational structure of group 2 enterprises**

Source: the authors.

companies that do not produce a conversion) or significant enterprises from vertically integrated allied holdings. In general, their organizational chart is as shown in *fig. 1* or *fig. 2*.

Level 2 includes companies operating mainly on the Russian market, with representation in many of its regions. They are mostly single enterprises or horizontal holdings with full-cycle production. Their organizational chart is generally as follows: (*fig. 3*).

Level 3 includes all other companies. Their organizational structure may be different but simpler than at levels 1 and 2. In most cases, they are one- and two-way production, targeting regional consumers.

Institutional stratification of companies is shown in [5] to be accompanied by significantly different economic performance dynamics, such as revenue growth, profitability, investment, debt levels and debt service. Level 1 companies are growing faster and better, and worse — 2 and 3 levels respectively. Institutional distinctions lead to that each "business layer" is "locked" at its own level, falling into peculiar institutional traps.

The present paper elaborates on the described study. It argues that institutional stratification leads not only to an improvement or deterioration in economic performance, but also to significant differences in the technological level of companies at levels 1, 2 and 3, respectively. The resulting technological divide strengthens firms at their own levels, as not only economic and institutional barriers but also technological barriers need to be overcome in order to move from them to higher levels. Company reports submitted on their websites, information from partners of metallurgical companies, large national and regional periodicals, and other sources of sectoral information are used as the information basis for the study.

Earlier studies have identified a number of institutional factors, such as innovation and technology innovation strategies, academic networks, and company research units [8, 9]. Therefore, the following criteria are used to determine the difference between companies by process factor:

- level of production technology;
- access to high technology;

• level of digitization of business processes;
• interaction with higher and secondary educational organizations.

They are detailed as follows:

The level of production technology determines the competitiveness of enterprises' products both on the Russian and international markets and was evaluated on the following criteria with grading:

– Novelty and technological efficiency of production equipment and infrastructure:
• entirely new (less than 20 years) high-tech equipment, mostly of foreign manufacture;
• entirely new (less than 20 years) equipment, mostly Russian-made;
• partly new equipment of foreign and Russian manufacture;
• mostly obsolete equipment.

– Frequency and scale of modernization of production facilities:
• continuous large-scale modernization (more than 10 per cent of average revenue);
• continuous (from 1% to 10% of average) upgrade;
• partial modernization of selected key production lines or aggregates (between 0.1 and 1 per cent of average revenue);
• minimum modernization to maintain the capacity of the enterprise (less than 0.1 per cent of the average revenue).

– Level of investment in technological upgrading:
• Tens of billions of roubles per year;
• Billions of roubles per year;
• Hundreds of millions of roubles per year;
• Tens of millions of roubles per year;
• up to 10 million rubles per year.

The Russian metallurgical complex is characterized by the complexity of the production cycle — up to 15–18 transitions, starting from the extraction of ore and other raw materials [10]. In addition, the stock of fixed assets is very worn out. Obsolete equipment results in high production costs. According to the Ministry of Industry and Trade of the Russian Federation, the wear and tear of the main equipment in the metallurgy remains high: in the steel industry as of 2017 it exceeded 40%, and in the non-ferrous metallurgy — 35%.[2]

In addition, recently metallurgical companies — world leaders, including the largest Russian companies, are moving to the production of parts and products for mass use, suitable for direct use in engineering and construction without additional processing and finishing [11]. As a result, large metallurgical companies in the first place show high profitability, allowing for the expansion of investment resources in recent years in view of favourable conditions [12].

Due to the above factors, most of group 1 companies operate, including old low-tech and worn-out equipment, but with the modernization plan to remedy this situation in the near future.

Total investment of steel and non-ferrous metallurgy companies in modernization in 2000–2017 amounted to 4.3 trillion rub.[3] At the same time, thanks to the active investment policy of the companies that have carried out the modernization, the domestic metallurgy far exceeds many of the world's indicators in terms of both technological efficiency and ecological processes. "Russian companies closed the needs of the domestic automobile industry with high-quality and economical sheet steel and significantly increased the production of galvanized and painted rollers".[4]

[2] Ministry of Industry and Trade of the Russian Federation. Presentation "On plans of development of steel and non-ferrous metallurgy in 2017 and implemented measures of industry support"; 2016.

[3] Ministry of Industry and Trade of the Russian Federation. "Volume of investment in the modernization of the Russian metallurgy in 2000–2017"; 2018.

[4] CNIIChermer name of Bardin. Interview of the General Director Viktor Semenov, 2017. URL: https://expert.ru/ural/2017/50/kak-dorozhala-stal/.

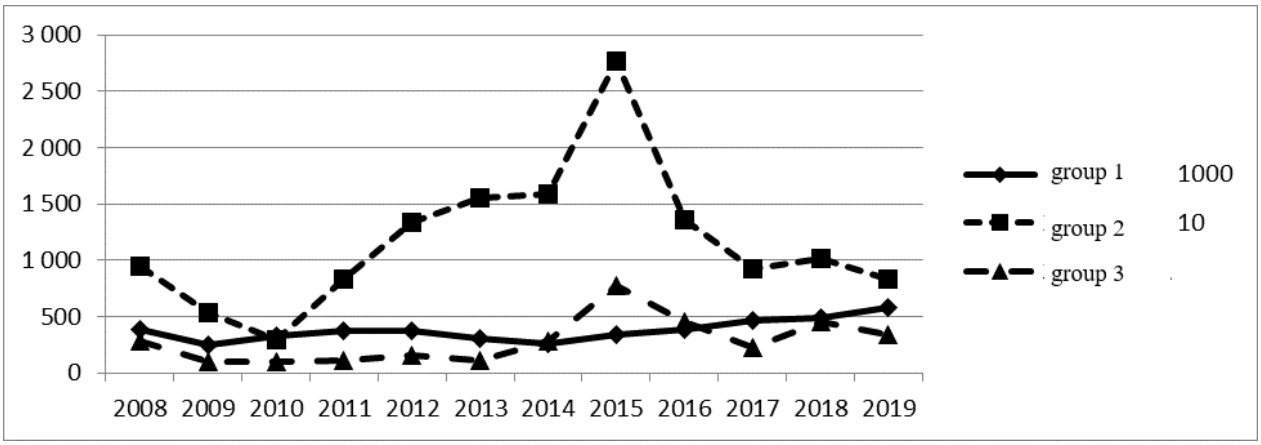

Fig. 4. **Fixed asset investment of metallurgical companies for 2008–2019 (for comparability of dynamics: Group 1 — billion rubles, Group 2 — 10 million rubles, Group 3 — million rubles)**

Source: company reports, data from the Federal State Statistics Service, compiled by the authors.

The share of rolled sheets and cold rolled sheets has increased, and the share of rolled sheets with coatings has tripled. The position of Russian metallurgists in the world has also been strengthened in recent decades. In 2018, 6 Russian companies were among the top 20 world leaders at low cost, 2 were in the top 5 in efficiency.[5]

In recent years, all leading Russian steel companies have submitted large-scale capital investment in fixed assets (FA) programmes ranging from 5 to 20% of annual revenues. In the coming years, new capacities will be put into operation for the smelting of iron and steel, for the manufacture of rolled products, for the manufacture of coated sheets, for pipe products, for wire and for other products. At the same time, investments in FA accounted for more than 20% of the average revenue from 2008 to 2019 in the largest precious metals companies. Many enterprises, especially the largest, are increasing their system-based environmental investments [13].

Some enterprises in group 2 also underwent large-scale modernization (Metallurgical Plant Electrostal, Liskinskiy assembly plant).[6] Modernization in other group 2 enterprises has been mainly at the maintenance level, with the exception of new, recently established enterprises where modernization is not yet required.

The analysis revealed that more than 75% of enterprises in group 3 are either completely new (up to 20 years) and undergoing modernization, or have fully modern production equipment of leading Russian and foreign producers and practically do not need technical re-equipment.

In total, for the period from 2008 to 2019, almost all major metallurgical companies invested tens of billions of roubles in basic funds. In terms of investment in the technical re-equipment of enterprises, the largest program is Norilsk Nickel — investment in FA has amounted to about 510 billion rubles for 2015–2019, that almost 2.3 times the number of second-largest investor in the acquisition of the FA of Rusal holding — about 220 billlion rub.[7] and accounts for almost 22% of the total investment in FA of all selected companies for the same period.

In general, the evolution of investment in metallurgy is as follows (*fig. 4, 5*).

[5] World Steel Dynamics. World steel in figures, 2018. URL: https://www.worldsteel.org/media-centre/press-releases/2018.html.

[6] Federal state statistics service. Reports, 2019. URL: http://old.gks.ru/.

[7] Federal state statistics service. Reports, 2019. URL: http://old.gks.ru/

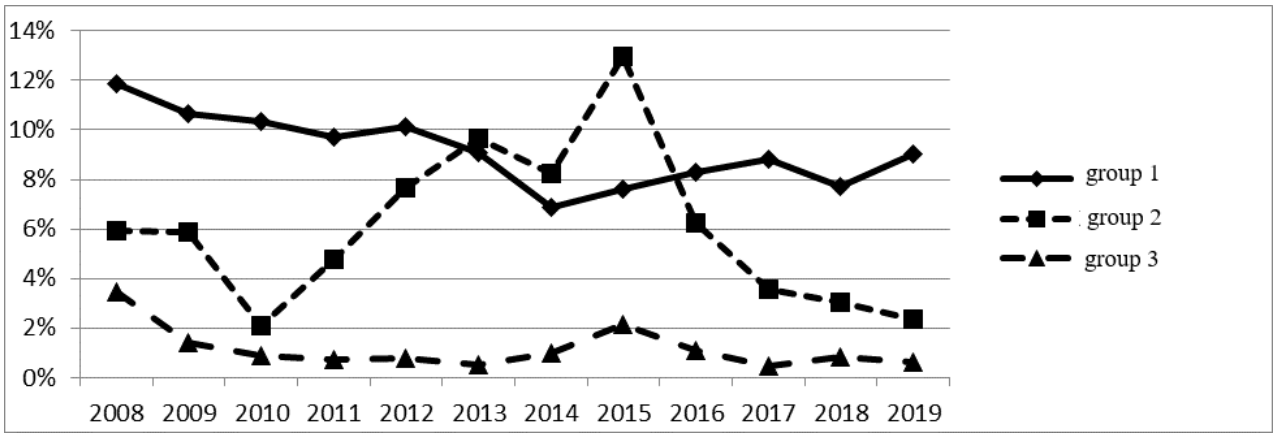

Fig. 5. **Fixed asset investment of metallurgical companies for 2008–2019 (%)***

* *Note:* in figure 5 for comparison of the dynamics, the values of the 1st group are divided by 1000, the values of the 2 groups — by 10.

Source: Company reports, data from the Federal State Statistics Service, compiled by the authors.

As a result of the analysis, it can be seen that the pattern of investment in FA is fundamentally different for all groups. The stratification of companies has become stable. Investment lags behind all groups, but groups 2 and 3 fare worse than group 1 in terms of reproduction and future modernization. In recent years, only group 1 has been growing. The size of investments in group 1's FA is ten times greater than the total investments in group 2 and group 3's FA, with the share of investments in group 1's FA hovering around 10%, group 2 around 2–13%, and group 3–1–2%.

In general, according to the analysis, within the 3 groups divided by institutional factors, the attributes of the set of criteria considered as the "level of production technology" are divided as follows (*table 1*).

Thus, within the criteria under consideration, there is almost complete correspondence between the hierarchy of groups for the second and third topics. With regard to the first topic, group 1, along with a number of enterprises in group 2, is worse off.

Access to high technology determines the technological (including research) prospects of a company. It was evaluated on the basis of the following graded topics:

– Opportunity to acquire technology:

• access to world-class technology from abroad;

• access to Russian innovative technologies;

• access to Russian obsolete technology.

– Development of new technologies, inventions (R&D):

• development of new modern technologies and self-inventions;

• development of new modern technologies and inventions in cooperation with research institutes;

• commissioning of new technologies and inventions from research institutions;

• lack of development or commissioning of new technologies.

– Having an in-house research base:

• own research centres;

• small research laboratory and/or a modern design office;

• existence of a quality control laboratory;

• lack of research units.

Group I enterprises have maximum access to high technology at any level, as most of them (or their parent companies, in the case of metallurgical enterprises in non-metallurgical holding companies) are have units in the leading metallurgical technology countries. At the same time, the 1st group has a tendency to create its own research and engineering units

Table 1

Criteria for matching the level of production technologies to groups of metallurgical companies by institutional characteristics

Indication	Group 1	Group 2	Group 3
Novelty and sophistication of production equipment and infrastructure	1. Partly new foreign and Russian-made equipment	1. Completely new (less than 20 years) high-tech equipment, mostly of foreign manufacture. 2. Completely new (less than 20 years) equipment is mostly Russian-made. 3. Partly new equipment of foreign and Russian manufacture. 4. Mostly obsolete equipment	1. Completely new (less than 20 years) high-tech equipment, mostly of foreign manufacture. 2. Completely new (less than 20 years) equipment is mostly Russian-made. 3. Partly new foreign and Russian-made equipment
Frequency and scale of modernization of production facilities	2. Continuous large-scale modernization	5. Partial upgrading of selected key production lines or aggregates 6. Minimum modernization in order to maintain the capacity of the enterprise	4. Partial upgrading of selected key production lines or aggregates
Level of investment in technological upgrading	3. Investment in technology — billions and tens of billions of rubles per year	7. Investment in technology — hundreds of millions and billions of rubles per year	5. Investment in technology — tens of millions of rubles per year

Source: official websites of metallurgical companies, interviews with heads of metallurgical companies in open sources; compiled by the authors.

within its structures or in partnership with research and engineering centres, for example Hypronickel Research Institute LLC at Norilsk Nickel,[8] or The Institute of Light Materials and Technologies (ILM&T), established UC RUSAL in cooperation with NITU MISIS (Moscow Institute of Steel and Alloys) with the support Aluminium Association of Russia, Ministry of Industry and Trade и Ministry of Education and Science of the Russian Federation.[9]

Group 2 enterprises, for the most part, do not have direct access to the world's best metallurgical technologies and do not have their own research or engineering centres. These enterprises mainly have quality control laboratories, and some of them cooperate with Russian research institutes and engineering centres in obtaining or developing technologies, for example Omutinskiy Metallurgical Plant's partnership with the OJSC Scientific-Research Institute of Metallurgical Heat Engineering[10] or scientific and technical cooperation in joint development between Aluminium Metallurg Rus (JSC AMR) and All-Russian Scientific Research Institute of Aviation Materials VIAM.[11]

Since, as already determined, the vast majority of enterprises in group 3 are modern

[8] Norilsk Nickel website. URL: www.nornickel.ru.

[9] UC RUSAL website. URL: www.rusal.ru.

[10] OJSC Scientific-Research Institute of Metallurgical Heat Engineering website. URL: http://www.vniimt.ru/.

[11] All-Russian Scientific Research Institute of Aviation Materials VIAM website. URL: www.viam.ru.

Таблица 2 / Table 2

Критерии соответствия характеристик доступа к высоким технологиям различным по институциональным признакам группам металлургических компаний / Criteria for matching the characteristics of access to high technologies to different institutional groups of metallurgical companies

Indication	Group 1	Group 2	Group 3
Opportunity to acquire technology	1. Access to world-class foreign technology. 2. Access to Russian innovation technologies	1. Access to Russian innovative technologies. 2. Access to Russian obsolete technologies	1. Access to Russian innovative technologies. 2. Access to Russian obsolete technologies
Development of new technologies, inventions (R&D)	3. Development of new modern technologies, inventions in-house. 4. Development of new modern technologies, inventions together with research institutions. 5. Order to develop new technologies, inventions from research institutions	3. Development of new modern technologies, inventions together with research institutions. 4. Order to develop new technologies, inventions from research institutions	3. Development of new modern technologies, inventions together with research institutions. 4. An order for the development of new technologies, inventions from research institutions. 5. No development or commissioning of new technologies
Existence of own research centres	6. Existence of own research centres	5. A small research laboratory and/or a modern design bureau. 6. Existence of a quality control laboratory	6. A small research laboratory and/or a modern design bureau. 7. Existence of a quality control laboratory

Source: official websites of metallurgical companies, interviews with heads of metallurgical companies in open sources; compiled by the authors.

and high-tech, the level of research units is sometimes higher than in group 2. In particular, we would like to mention the following enterprises in group 3, which are close to group 1 on this topic: SIBPROJECT JSC, have a subsidiary SIBPROJECT-Engineering LLC[12] and Prioksky Non-Ferrous Metals Plant JSC, developing in-house unique technologies with a range of copyright certificates and patents.[13]

In general, according to the analysis, in 3 groups divided by institutional factors, the indicators according to the considered criterion "access to high technology" are divided as follows (*table 2*).

From all the indications of the set of criteria under consideration, there is a clear difference between the 1st and the other groups in the bulk of enterprises in each group of hierarchy.

The level of digitization of business processes is one of the main trends in Russian metallurgy in recent years.

In the present work, the level of digitization of business processes was assessed in the phases of the digital transformation of an industrial enterprise, both in terms of management processes and production processes, according to the following characteristics and grading according to them:

- Launch of digital transformation projects.
- Introduction of Industry Elements 4.0.
- Automation of production and business processes.

[12] SIBPROJECT JSC website. URL: http://sibproekt.ru.

[13] Prioksky Non-Ferrous Metals Plant JSC website. URL: https://www.zvetmet.ru.

Table 3

Criteria for compliance of the level of digitalization of business processes with groups of metallurgical companies by institutional characteristics

Group 1	Group 2	Group 3
1. Launch of digital transformation projects. 2. Introduction of Industry Elements 4.0	1. Introduction of Industry Elements 4.0. 2. Automating part of business processes	1. Automation of production and business processes 2. Automating part of business processes

Source: official websites of metallurgical companies, interviews with heads of metallurgical companies in open sources; compiled by the authors.

• Automating part of business processes.

Almost all group 1 companies have begun or are beginning to develop digital transformation strategies. In 2017–2018, most large enterprises implemented a number of pilot projects and formed digital transformation programs. Many of them have already introduced certain elements of Industry 4.0, such as, Norilsk Nickel,[14] Magnitogorsk Iron & Steel Works, Metalloinvest and others.

Enterprises of group 2 are mainly engaged in automation of business processes, less often — digitization of part of production processes. Some enterprises, such as Omutinskiy Metallurgical Plant, are beginning to invest in the development and implementation of "smart" technologies in production.[15]

Since group 3 enterprises are mostly new, automation is already present. Therefore, in the near future these enterprises will aim to introduce elements of Industry 4.0 and after — full digital transformation.

In general, according to the analysis, within the 3 groups divided by institutional factors, the attributes of the set of criteria considered as "the level of digitization of business processes" are divided as follows (*table 3*).

The division of companies according to this criterion is almost entirely in line with the hierarchy groups.

The interaction with educational organizations, which makes it possible to assess the competences of both workers and engineering technicians (ET) personnel, in the industrial enterprise was defined on the basis of the following topics, with grading them:

• organization of the education programs necessary for the company employees in the specialized universities, colleges and technical colleges.

• cooperation with universities, colleges and technical colleges in the field of enterprise internships, open days and other mass promotional events for students who are — potential employees of the enterprise.

• availability of specialized colleges or technical colleges within walking distance.

Cooperation with educational organizations was considered in this area only within the framework of metallurgy technologies. There is almost a clear division into groups.

Almost all group 1 companies have organized or are organizing the education programmes needed by the company's employees in the relevant universities,

[14] Norilsk Nickel website. URL: www.nornickel.ru.

[15] Omutinskiy Metallurgical Plant website. URL: https://ommet.ru.

Table 4

Criteria for the correspondence of the level of interaction with educational organizations to different institutional groups of metallurgical companies

Group 1	Group 2	Group 3
Organization of the education programs necessary for the company's employees in specialized universities, colleges and technical colleges	Cooperation with universities, colleges and technical colleges in the field of enterprise internships, open days and other mass promotional events for students who are potential employees of the enterprise	Existence of specialized colleges or technical colleges within walking distance

Source: official websites of metallurgical companies, interviews with heads of metallurgical companies in open sources; compiled by the authors.

colleges and technical colleges and in the practice of potential employees in their own enterprises. For example, Chelyabinsk Pipe-Rolling Plant (CPRP) based on First Ural College of Metallurgy implements the unique educational program "Future of White Metallurgy", and Severstal has developed the educational program "Young Resources".

The group 2 also includes individual enterprises that interact with higher educational establishments at the level of the organization of training programmes and in specialized educational organizations. For example, Omutinskiy Metallurgical Plant opened at Vyatka State University an educational program "Metallurgy",[16] or Prioksky Non-Transferrous Metals Plant JSC which organized at NITU MISIS (Moscow Institute of Steel and Alloys) an educational project on the program of vocational retraining "Metallurgy of non-ferrous metals".[17]

It should be noted that only one company of group 3 was able to establish close cooperation with educational organizations — PLC AKOM–Invest (part of Group of companies AKOM) as part of the acceleration program for 15 companies, included in the project "Support of private high-tech companies-leaders" ("National champions"), organized by National Research University — Higher School of Economics (HSE University) with Ministry of Economic Development of the Russian Federation and the Russian Venture Company (RVC).[18]

In addition, a number of enterprises in group 2 and group 3 have organized production practices for students of specialized universities and colleges. It's Stupino Metallurgical Company, Ural pipe plant, SIAL holding, Zagorsk Pipe Plant, Novosibirsk Integrated Tin Works, Bor Tube Factory, Neftegazdetal LLC and others.

At the same time some enterprises of group 2 and most enterprises of group 3 don't actively cooperate with educational organizations.

In general, according to the analysis, within 3 groups divided by institutional factors, the attributes according to the set of criteria under consideration "level of interaction with educational organizations" are divided as follows (*table 4*).

[16] Omutinskiy Metallurgical Plant website. URL: https://ommet.ru/.

[17] Prioksky Non-Transferrous Metals Plant JSC website. URL: https://www.zvetmet.ru/.

[18] Group of companies AKOM website. URL: http://gk-akom.ru/

The separation of companies according to the criterion in question takes place almost entirely according to the hierarchy groups.

Thus, a comparison of the technological characteristics of three institutionally different groups shows that the vast majority of enterprises in each hierarchy largely correspond to their unique indicator values.

Most of group 1 companies have the greatest technological advantages in terms of the scale of modernization programmes, access to and development of state-of-the-art technologies, digitization of business and production processes, organizing their own training programmes in conjunction with leading specialized educational organizations. This allows for continued competitiveness in external markets. In the domestic market, they maintain and reinforce their dominance by effectively creating barriers to entry into the privileged part of the market for the remaining companies. The country is currently in the process of stabilizing the institutional environment [14], including in the metallurgy. Concentration of [15] enterprises through mergers and acquisitions continues, but overall the group of leaders is well established and is unlikely to change significantly [In 2021, the last major merger took place — Tube Metallurgical Company (TMC) and Chelyabinsk Pipe-Rolling Plant Groups], which allows them to prevent other enterprises from joining the leading group [16] in the current Russian imbalance of institutional reforms [17].

Group 2 companies (with the exception of a few transitions to group 1 and a few unique enterprises) demonstrate a significantly lower level of both technological development and interaction with universities and colleges. They may remain at the level of simple reproduction, but they have serious difficulties with regard to the forthcoming improvements.

Group 3 enterprises show relatively high technological development mainly due to the fact that some of them are affiliated with large companies in other industries, while others occupy a certain market niche (e.g., ferro-metal production). Most of these enterprises have been established in recent years and are at a high technological level. However, given that most of them have low financial capacity, no direct access to the world's leading metallurgical technologies and no interaction with educational organizations, it's unlikely that they will demonstrate significant technological development in the coming years. Unlike group 2 companies, some of them are able to take up promising niches in the Russian market and even in the world market, gain a foothold and eventually become leaders.

The largest companies are continually increasing the efficiency of informal rules of operation [18], and the gap in technological development between 1st and other groups is constantly widening. It may become unsustainable in the coming years, leading either to a new wave of mergers and acquisitions of medium-sized and small enterprises or to the closure of the most technologically backward ones. Institutional stratification is entrenched. The traps in which companies find themselves are reinforced [19].

REFERENCES

1. Tirole J. The theory of industrial organization. Cambridge, MA: The MIT Press; 1994. 496 p.
2. Budanov I. A. The role of administrative and market relations in the development of metallurgy. *Nauchnye trudy: Institut narodnokhozyaistvennogo prognozirovaniya RAN = Scientific Articles: Institute of Economic Forecasting. Russian Academy of Sciences.* 2018;(16):210–235. (In Russ.). DOI: 10.29003/m262.sp_ief_ras2018/210–235
3. Blokhin A. A. Institutional rent in a multilevel economy. *Studies on Russian Economic Development.* 2019;30(4):376–383.

4. Blokhin A. A., Lomakin-Rumyantsev I.V., Naumov S. A. Alpha business in the Russian food market. *Ekonomicheskie strategii = Economic Strategies*. 2019;21(6):68–77. (In Russ.). DOI: 10.33917/es-6.164.2019.68–77
5. Blokhin A. A., Dranev S. Ya. The differences in the institutional environment of the activities of firms of varying size on the example of ferrous metallurgy. *Mir novoi ekonomiki = The World of New Economy*. 2019;13(1):36–47. (In Russ.). DOI: 10.26794/2220–6469–2019–13–1–36–47
6. Agapova E. V., Batueva T. B., Kosyanchuk E. V., Ryabov I. V., Smirnova O. O. Impact of the institutional environment structure on economic growth in the industrial sector. Moscow: RANEPA; 2014. 86 p. (In Russ.).
7. Tereshchenko D. S. Institutional factors of economic growth: Identification, assessment and revealing of non-linearity of impact. *Vestnik NGUEU = Vestnik NSUEM*. 2016;(3):299–314. (In Russ.).
8. Ryabov I. V., Smirnova O. O., Agapova E. V. Assessment of institutional factors on economic growth: Approaches to the evaluation and modeling. *Ekonomika: vchera, segodnya, zavtra = Economics: Yesterday, Today and Tomorrow*. 2013;(5–6):39–46. (In Russ.).
9. Volchik V. V., Krivosheeva-Medyantseva D. D. Institutions, technology and increasing returns. *Zhurnal institutsional'nykh issledovanii = Journal of Institutional Studies*. 2015;7(1):45–58. (In Russ.). DOI: 10.17835/2076–6297.2015.7.1.045–058
10. Kovaleva A. M., Kukanova N. V. Economic development of enterprises of the metallurgical complex of Russia. Materials for the International Economic Forum. Oryol State Agrarian University; 2014.
11. Budanov I. A., Ustinov V. S. Innovation and investment processes for the development of metallurgical production in Russia. *Nauchnye trudy: Institut narodnokhozyaistvennogo prognozirovaniya RAN = Scientific Articles: Institute of Economic Forecasting. Russian Academy of Sciences*. 2015;(13):324–347. (In Russ.).
12. Ustinov V. S., Budanov I. A. The role of metallurgy in the resource provision of economic growth in Russia. In: Topical issues of economics and sociology. Proc. 15th Autumn conf. of young scientists in the Novosibirsk Akademgorodok (Novosibirsk, Nov. 18–20, 2019). Novosibirsk: Institute of Economics and Organization of Industrial Production SB RAS; 2019:314–318. (In Russ.).
13. Budanov I. A., Terentiev N. E. Problems and directions of technological modernization of the metallurgical complex of Russia in the context of "green" economic growth. *Nauchnye trudy: Institut narodnokhozyaistvennogo prognozirovaniya RAN = Scientific Articles: Institute of Economic Forecasting. Russian Academy of Sciences*. 2017;(15):76–91. (In Russ.).
14. North D. C. Institutions, institutional change and economic performance. Cambridge: CUP Publ.; 1990. 159 p. (Russ. ed.: North D. Instituty, institutsional'nye izmeneniya i funktsionirovanie ekonomiki. Moscow: Nachala; 1997. 180 p.).
15. Bourdieu P. Social space: Fields and practices. Coll. pap. Transl. from French. St. Petersburg: Aletheia; Moscow: Institute of Experimental Sociology; 2005. 576 p. (In Russ).
16. Fligstein N. The architecture of markets: An economic sociology of twenty-first-century capitalist societies. Princeton: Princeton University Press; 2002. 288 p. (Russ. ed.: Fligstein N. Arkhitektura rynkov. Ekonomicheskaya sotsiologiya kapitalisticheskikh obshchestv XXI veka. Moscow: HSE Publ.; 2013. 392 p.
17. Orekhova S. V. Institutional factors in the choice of the resource strategy of the enterprise. *Zhurnal institutsional'nykh issledovanii = Journal of Institutional Studies*. 2016;8(4):106–122. (In Russ.). DOI: 10.17835/2076–6297.2016.8.4.106–122
18. Radaev V. V. A new institutional approach: Building a research framework. *Ekonomicheskaya sotsiologiya = Economic Sociology*. 2001;2(3):5–26. (In Russ.).
19. Polterovich V. M. Institutional traps and economic reforms. *Ekonomika i matematicheskie metody = Economics and Mathematical Methods*. 1999;35(2):3–20. (In Russ.).

ABOUT THE AUTORS

Andrey A. Blokhin — Dr Sci. (Econ.), Chief Researcher, Institute of Economic Forecasting of the Russian Academy of Sciences (IEF RAS), Professor, Financial University, Moscow, Russia
andraleks@rambler.ru

Sergey Ya. Dranev — Applicant, Institute of Economic Forecasting of the Russian Academy of Sciences (IEF RAS), Moscow, Russia
sedrick77@gmail.com

The article was received on 10.03.2021; revised on 20.03.2021 and accepted for publication on 05.04.2021.
The authors read and approved the final version of the manuscript.