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Opportunities for Digitalization of Non-state Pension Funds Through the Formation of Entrepreneurial Portfolios of Securities

Olga V. Khmyz[1], Svetlana A. Panova[2], Natalya V. Sergeeva[2]

[1] MGIMO University, Moscow, Russia

[2] Financial University under the Government of the Russian Federation, Moscow, Russia

Author Note

Correspondence concerning this article should be addressed to

Olga V. Khmyz

ORCID: 0000-0003-4178-8677

MGIMO University, 76 Vernadsky Ave., Moscow, 119454, Russia. e-mail: khmyz@mail.ru

Svetlana A. Panova

ORCID: 0000-0001-6834-334X

Financial University under the Government of the Russian Federation, 49, Leningradsky Ave., Moscow, 125167, Russia. e-mail: SAPanova@fa.ru

Natalya V. Sergeeva

ORCID: 0000-0003-4625-8659

Financial University under the Government of the Russian Federation, 49, Leningradsky Ave., Moscow, 125167, Russia. e-mail: NVSergeeva@fa.ru

Abstract: The research focuses on analyzing the impact of digital transformation processes on the investment activities of non-state pension funds to expand their client base. The digitalization of the economy in the field of non-state pension provision involves the use of information and communication technologies between the non-state pension fund and the contributor. However, as more conservative investors than other financial market participants, pension funds are more cautious in introducing digital technologies and products. As a result, there is a certain lag in the degree of their digitalization, which can lead to adverse consequences for the funds and their clients. Therefore, it seems important and timely to analyze this aspect of the activities of non-state pension funds, offering our own solution to the problem. The research was conducted on the data from an official statistical source – the Central Bank of the Russian Federation. The authors used general methods of scientific knowledge, induction, and deduction, as well as methods of mathematical analysis. The research proposes a methodology for forming entrepreneurial portfolios of financial assets by non-state pension funds, starting with a semantic model for grading future pension beneficiaries into four groups depending on the degree of riskiness of the pension portfolio. A mathematical model is applied based on the received semantic indicators. To increase the portfolio's profitability, the authors propose its diversification into trading and investment components.

Keywords: digitalization, digital transformation, non-state pension funds, entrepreneurial portfolios of securities, Russian financial market

JEL codes: C12, G11, J32

Global digitalization trends cover more areas, products, and services in the economy (global and national) and financial markets of different countries. Digital transformation processes also seriously impact business strategies (Domniku & Ahmeti, 2021; Irrera, 2021).

Institutional investors were among the first to take advantage of digitalization by actively developing and managing their trading strategies and securities portfolios (Popkova, 2022). In this regard, it should be noted that pension funds, as a more conservative type of institutional investors, have been adopting digital technologies with some lag behind other types of institutional investors, primarily high-frequency and quantum investment funds (in trading), hedge funds (in investment strategies), and fintech companies. This is not surprising because pension funds are looking at a long-term investment perspective. The development of an individual pension scheme for a particular client of a non-state pension fund (NPF) relates to his or her personal preferences, which will not necessarily be the regular receipt of deferred income. Depending on their risk appetite, a future pension beneficiary can also count on a more aggressive strategy. Recent research (Haber et al., 2022) confirms the traditional view of the inverse relationship between the investor's age and risk appetite.

The COVID-19 pandemic has also had a catalytic effect on digitalization (Abidi et al., 2022), although pension funds began to implement digitalization advances (mainly Reg Tech and SupTech) even before the global disease (Paklina, 2018).

Consequently, at the global level, the main factors intensifying the digitalization of pension funds are global trends, government incentives for digitalization, and the impact of the force majeure factor (in the form of the COVID-19 lockdowns). The same factors have significantly impacted the digitalization of Russian NPFs, which also have to overcome the backlog from the pension funds of developed countries.

The development of the system of non-state pension provision in Russia aims to solve the most important social problem (Ministry of Labour and Social Protection of the Russian Federation, 2012). Additionally, NPFs are significant institutional participants in the financial market throughout the world, providing an influx of long money into the economy (Kulikova & Panova, 2022).

Similarly to the situation in developed countries, government-promoted digitalization, which is also a leading modern trend (United System Information, 2019), opens up a number of opportunities for Russian non-state pension funds, primarily in terms of changing approaches to the formation of securities portfolios that ensure the preservation and multiplication of funds of participants in the non-state pension system.

Methodology

Nowadays, Russian NPFs form their securities portfolios from the funds of depositors, regardless of their age (Kulikova, 2021), and, accordingly, not considering the period until the start of pension payments. On the one hand, there is a high probability of the loss of potential profitability. On the other hand, the risk of default on obligations to investors arises

when investing in more risky instruments. This leads to low profitability of NPF portfolios (Kulikova et al., 2022) and causes distrust in non-state pension provision.

The development of the digital economy makes it possible to actively use information and communication technologies between NPFs and clients (Krinichansky & Rubtsova, 2021). The key feature of the proposed model for managing funds in savings accounts is the presence of various funds and the formation of entrepreneurial portfolios of securities, depending on the degree of riskiness of the investment strategy, which, in turn, is determined by the age of contributors to analyzing funds.

It should be noted that the Pension Fund of Russia has some experience in digitalizing the Russian pension system, being the operator of the largest information systems, particularly the Automated Information System. The second major system is the Unified State Social Security Information System. It accumulates all social benefits and payments planned to be provided to citizens at the federal, regional, and municipal levels.

NPFs are also introducing digital technologies into their operations, primarily in terms of simplifying interaction with NPF members. However, the main strategic task of NPFs is to increase the NPF's profitable portfolios (Dutta et al., 2000) to a level that makes achieving the required replacement rates possible.

The semantic model for creating entrepreneurial portfolios of NPFs' financial assets, regarding the risks inherent to different age groups of future pension beneficiaries, is the initial stage of the business process of managing a portfolio of NPFs' securities and includes the following sub-processes (Kulikova et al., 2021):

1. Determination of the risk profile of an NPF client regarding the chosen age group;
2. Estimation of the number of clients, including potential ones, classified into dedicated age groups;
3. Creation of a feasible set of financial instruments, considering legislative restrictions;
4. Evaluation of investment qualities of financial instruments in terms of risk, profitability, and covariance;
5. Creation of investment portfolios according to the profitability-risk level, considering the number of NPF clients in a particular age group, investment terms, and amount of funds;
6. Evaluation of the effectiveness of the formed portfolios;
7. Revision of the portfolio configuration according to the number of clients in considered age groups (sub-process 2) and the composition opportunities brought by affordable financial instruments (sub-process 3).

For a complete understanding of the portfolio creation model with financial instruments permitted to NPFs, it is necessary to provide an explanation regarding the definition of the risk profile of an NPF client regarding the mentioned age group. Determining the client's risk profile is a prerequisite for building a portfolio that meets the client's goals. However, in this case, the client's risk profile is understood not as the risk propensity of the client (as in the classic version of the development of an investment strategy) but as the risk profile of the age group in which the client falls.

We propose to single out the following age groups, or rather, groups whose main classification feature will be the number of years before receiving payments in accordance with Russian legislation (Table 1).

Table 1

Groups in the model for the creation of entrepreneurial portfolios of securities by NPFs, regarding the risk tolerance of different future pensioners age groups

Group/portfolio number	Minimum number of years to receive payments	Portfolio title
1	10	Absolutely conservative
2	20	Moderately conservative
3	30	Moderately aggressive
4	40	Aggressive

Source: Calculated by the authors

It should be noted that the names of portfolios are very conventional and do not imply the inclusion of financial instruments in the portfolio without considering the legal restrictions governing the composition of NPF portfolios.

If the client reaches the threshold age, there is a transition to another group (from 4 to 1) and the transfer of their funds to a more conservative portfolio.

Thus, the business model of managing pension savings is being transformed.

Results

As shown above, one of the main indicators that determine the level of pension provision, and with it, the level of development of the entire Russian pension system, is the replacement rate. In this case, we are talking about a coefficient calculated as the ratio of the average old-age pension to the average wage in the country. The target level, defined in Russian documents and in the recommendations of the International Labor Organization (ILO, 1952), is 40%.

As of January 1, 2021, the replacement rate calculated according to Rosstat (2021) is as follows:

$$16790.0 / 51352.0 = 0.327 (32.7\%).$$

It should also be noted that countries with the best pension system to date have this coefficient equal to 70% (OECD Statistics, 2022). The presented figures are included in the chronological framework of the research, limited to the period until 2022 to obtain more accurate and complete statistical data. In the future, the Russian pension system should strive for the value of the most social-oriented countries by developing accumulative and voluntary pension insurance.

The mathematical model for creating NPFs' securities portfolios regarding the risks inherent in different age groups of future pension beneficiaries is based on the semantic model outlined above. We believe the replacement rate should increase as the number of years before the payments start increases. After ten years, it should be 40% for the oldest

premium-paying age group. Accordingly, the replacement rate should be 70% for people in the youngest age group, whose first payment will be made in 40 years (Table 2).

Table 2

Replacement ratios in the model for the creation of NPF securities portfolios regarding the risk tolerance in different age groups of future pensioners

Replacement rate at the time of the first payment, %	Portfolio number	Minimum number of years to receive payments
40	1	10
50	2	20
60	3	30
70	4	40

Source: Calculated by the authors

In this case, the replacement rate is equal to the sum of the accrued pension from the Pension Fund of Russia and the payment from the NPF, referred to as the average accrued wages. In this case, the calculation of the replacement rate can be made according to Formula (1):

$$\omega_{in} = \omega_0 + \frac{FV_{PP}}{PV_{AWin}}\ 100 \quad (1)$$

where:

n – year number, n = 1, …, 10;

i – group/portfolio number, i = 1, …, 4;

ω_{in} – replacement rate for clients of the i-th group in the n-year, %;

ω_0 – replacement rate at the initial date of portfolio formation, %. In essence and the general case, it is the replacement rate obtained when calculating a pension from the Pension Fund of Russia.

Following the methodology, FV_{PP} is the pension payment at the expense of funds accumulated in NPF (rub/month).

$$FV_{PP} = FV / l \quad (2)$$

where:

FV – the total amount of funds accumulated in the NPF and payable to the client, rubles;

l – the number of months of payment from the funds accumulated in the NPF.

The calculation of the total amount of funds accumulated in the NPF and payable to the client (FV), can be carried out using Formula (3):

$$FV = \sum_{i=1}^{4} \sum_{n=1}^{10} PV_{PPin}(1 + r_i)^{10-n} \quad (3)$$

where:

PV_{PPin} – contribution in the n-th year to the i-th NPF portfolio;

r_i – average accretion rate (average return) for the i-th portfolio, in fractions of 1.

$$PV_{AWin} = PV_{AW1}(1+k)^m \quad (4)$$

PV_{AWin} – accrued wages (average for the country) in the year of payment to clients of the *i*-th group (initial) in the *n*-year, rubles;

k – wage indexation coefficient for the entire period of clients funds in NPFs, in fractions of 1;

m – total period of client contributions in NPF, years;

PV_{AW1} – accrued wages (average for the country) in the year when the payment of contributions to the NPF began, rubles/month.

Thus, Formula (1) takes the following form:

$$\omega_{in} = \omega_0 + \frac{[\sum_{i=1}^{4}\sum_{n=1}^{10} PV_{PPin}(1+r_i)^{10-n}]/l}{PV_{AW1}(1+k)^m}\ 100 \quad (5)$$

As can be seen from the formula presented, there are three parameters that can be changed.

The first parameter is wage indexation, k_i. NPFs practically cannot influence this parameter. Thus, we assume that it is equal to inflation.

The second parameter is the contribution in the *n*-th year to the *i*-th NPF portfolio. The higher it is, the formally the portfolio return can be lower.

However, for any financial asset, there is a required return; potential clients of NPFs will focus on the third parameter, namely, the return on each portfolio of NPFs.

Discussion

During the analysis of the current situation with Russian NPFs, the features of its portfolio strategies and ways to attract customers, as well as the use of digitalization achievements, it is necessary first of all to note the specifics of the environment in which NPFs were born in the Russian Federation, and their policies were initially formed. This happened spontaneously in the mid-1990s; non-state pension programs were implemented mainly in the form of additional instruments to the state pension provision (Khmyz, 2003). Constant adjustments to the ongoing Russian pension reform also make a negative contribution, including the long-term freeze of contributions allocated to the funded component of pensions.

On the other hand, the perception of non-state pension provision as an additional component to that guaranteed by the state provides NPFs with greater freedom – investment and management. However, even these are limited by appropriate rules so as not to increase the risks to future pension beneficiaries.

In connection with the mentioned above, it seems expedient to increase the digitalization degree of investment entrepreneurial portfolios of NPFs in the direction indicated by Kulikova et al. (2021).

As shown above, NPFs currently use a rather limited list of financial instruments to place clients' funds. As a possible option for increasing the profitability of the portfolio, the authors propose dividing it into two nominal sub-portfolios – trading and investment.

The authors recommend building a trading portfolio based on the liquidity factor of a quoted financial instrument. To include it in this part of the pension portfolio of NPFs, it is advisable to focus on short-term instruments with a term of up to 180 days, which either expires soon (and income from redemption will be received) or will be resold at a profit, thereby contributing to portfolio growth.

Following the logic of our analysis, it is advisable to include in the investment portfolio less liquid but longer-term instruments, the potential of which can bring the desired financial result in the long-term investment horizon. In times of uncertainty, such financial instruments can help improve the quality of entrepreneurial pension portfolios.

The model proposed for forming NPF securities portfolios, regarding the risks inherent in various age groups of future pensioners, is a portfolio customization model, considering the period until the first payment is received. The formation of portfolios with longer investment periods makes it possible to include riskier financial instruments with higher potential returns in the portfolio.

Following the direct and inverse portfolio problems formulated by H. Markowitz (1952), depending on the rate of a given risk level and expected return, it is advisable to solve the inverse problem (to minimize the risk level) for the first portfolio (Table 1) and solve the direct problem with an increase in the level of risk and expected return for portfolios 2, 3, and 4.

To assess the quality of the portfolio, the authors recommend calculating VaR risk indicators and expected return EaR using non-parametric and parametric methods.

It is necessary to consider the adopted normative innovations, including ahead of time. For example, it could be proposed that pension regulative plans should not increase the estimated life expectancy used in pension calculations due to the negative impact of the COVID-19 pandemic on the demographic situation.

Conclusion

The analysis showed the advantages of using the achievements of digitalization to optimize the formation of securities portfolios of NPFs to achieve the best results in managing pension savings. So far, RegTech and SupTech are predominantly used. As for the use of artificial intelligence by NPFs (Sanders, 2021), there is still work to be done.

Nevertheless, the identified opportunities made it possible to propose a method for managing funds on savings pension accounts, which considers the presence of different funds (according to the parameters of age and risk appetite of the client) and the specifics of the formation of entrepreneurial securities portfolios depending on the degree of riskiness of the investment strategy. To increase the portfolio's profitability, the authors propose its diversification into trading and investment components. Portfolio quality assessment involves the determination of risk and expected return indicators. The determined leading influencing

indicators are wage indexation, contributions volumes, and the period of portfolio formation, which together predetermine the portfolio's profitability. The consistent use of semantic and mathematical models is analyzed based on the proposed gradation of future pension beneficiaries into four groups depending on the degree of riskiness of the pension portfolio and the results obtained.

For optimization, the authors proposed dividing the portfolio into contingently trading and investment components. It is recommended to include short-term, highly liquid financial instruments in the first one, and longer-term ones in the second. Thus, the pension portfolio will be customized and optimized over time. Moreover, it will consider the client's investment preferences, including in the event of a change in risk appetite. This can help address the likely loss of profitability if the time remaining until pension payments are not taken into account from the time of contribution and optimize the return on a non-state pension fund's portfolio, as well as the digital accessibility of the services of these institutional investors. The broader effect could increase overall confidence in non-government pension funds.

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