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Pension Funds and Fintech Industry – New Possibilities for the Insured Individuals

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Abstract The universal pension funds in Bulgaria effectively entered their second stage of development—the distribution phase—in 2021. That year, the first insured individuals with accumulated funds in their individual accounts began receiving pension benefits or deferred payments from their chosen fund. However, 23 years after the introduction of universal pension funds in the country, most insured individuals still do not recognize their pension institution, let alone understand the different types of payment options currently available to them. The fintech industry may dramatically change this in the coming years, especially among younger generations who are far more adaptable to new technologies. This paper aims to assess the areas of the pension fund business where fintech applications could enhance efficiency and increase engagement among insured individuals—many of whom currently find the field unfamiliar or unappealing. The research is structured in two parts. The first examines the main risks and factors that influence pension fund accumulation and benefit amounts in a typical defined contribution scheme. The second presents selected findings from a broader study involving the use of artificial intelligence (AI) in VBA code structuring, focusing on a critical decision facing insured individuals today: whether to remain in their private pension fund until retirement.

Keywords Pension Funds, Fintech, Artificial Intelligence, Risk.

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Introduction

Pension security in Bulgaria was successfully reformed a quarter of a century ago. The reformers of that time accurately anticipated the challenges that would emerge in the following decades—challenges stemming from an aging population, shifting demographic structures, insufficient savings to ease future pressure on the public pension system, and the growing dependence of a significant and increasing portion of the population on politically determined income. The introduction of a fully funded component into Bulgaria's pension system aimed to address some of these long-term issues facing both future retirees and public finances. Twenty-five years later, the world has changed dramatically in nearly every aspect of human life. Technological advancements—from the rise of the

Internet and access to vast amounts of information, to the development of artificial intelligence (AI) and the proliferation of fintech applications—have transformed how people communicate, work, and make decisions. In this new environment, the traditionally conservative pension system must find ways to adapt and respond to modern challenges. The 2000 reform successfully transitioned the system from a purely pay-as-you-go (PAYG) model to a hybrid one, combining PAYG with a fully funded component. This shift turned insured individuals into active savers and participants in financial markets. Universal pension funds were established as a mechanism to set aside resources intended to support the pension system in the years ahead, particularly as financial pressure on the PAYG component is expected to intensify.

By the end of 2024, insured individuals had accumulated approximately 23 billion BGN—an average of 1 billion BGN per year since the reform began. However, these savings still do not effectively support the first pillar of the system, due to several fundamental reasons:

1. Short accumulation periods and low savings among the first retirees eligible for second-pillar benefits.
2. Legislation that reduces the individual coefficient, disadvantaging those who opt to receive part of their pension from universal pension funds.
3. Uniform investment regulations that treat all insured individuals the same, limiting pension fund managers' ability to offer personalized, fine-tuned investment products.

This last point contributes to another issue: individuals saving in personal accounts often remain disengaged from how their funds are invested and managed. The fintech industry—especially when combined with AI—has the potential to transform this situation. This paper aims to shed light on how such a transformation could unfold in the coming years. The first part of the research focuses on the key risks faced by insured individuals in defined contribution pension schemes. The second part explores how fintech applications can address some of these risks and demonstrates how AI can support individuals in making informed decisions about their participation in both pension pillars. The paper concludes with recommendations for future reforms in Bulgaria's pension system. The methodology employed includes primarily descriptive and statistical analysis, complemented by deductive and systematic approaches.

1. Basic risks facing insured individuals in the universal pension funds in Bulgaria

The universal pension funds in Bulgaria were established as a result of the pension system reform implemented at the beginning of the 21st century. Following the recommendations of the World Bank (1994), Bulgaria joined many Central and Eastern European countries in supplementing its pay-as-you-go (PAYG) pension structure with fully funded components. The second pillar emerged as a mandatory element, requiring all individuals born after December 31, 1959, to contribute to personal accounts. The third pillar consists of voluntary pension funds, allowing individuals to make additional contributions in order to receive a third pension benefit upon reaching retirement age. The primary aim of the

reform was to address the challenges posed by an aging population and the anticipated financial strain on the PAYG pillar. Universal pension funds operate as defined contribution schemes, where insured individuals bear significant risks during both the accumulation and distribution phases. These risks are well-documented in the literature. For instance, Blake (2006) highlights asset price risk, interest rate risk, and currency risk during accumulation, and interest rate, liquidity, and longevity risks during distribution. Rocha and Vittas (2010) add bequest risk to this list, while James and Vittas (1999) emphasize the importance of proper regulation in annuity markets.

Regulatory risks are particularly critical in countries like Bulgaria, where there is limited experience in managing fully funded pension schemes and enforcing the rule of law. Effective regulation and independent oversight are essential for protecting the rights of insured individuals, especially over the long term. Pandurska (2018) rightly observed that certain regulations can destabilize the system, citing the 2015 legislative change that allowed individuals to switch between the first and second pillars multiple times before retirement. Orszag and Stiglitz (1999) and Casey (2013) also stress the importance of sound regulation to prevent future issues. Within defined contribution schemes, insured individuals face numerous risks that can negatively impact the amount of funds accumulated by retirement, thereby reducing their pension benefits. However, when properly regulated, pension funds can significantly enhance post-retirement income and improve the replacement ratio, reducing poverty among retirees. This perspective is supported by the work of Kirov (2010), Daneva (2016), Davis (1995), and Gochev and Manov (2003). Bulgaria's universal pension funds were primarily designed to support the PAYG pillar, as demographic trends in the mid-1990s—driven by high emigration and declining birth rates—highlighted the need for reform. In a system where contributors are decreasing and beneficiaries are increasing, decisive action is required to ensure long-term sustainability. As part of the reform, policymakers introduced a reduction in the individual coefficient (a measure comparing an individual's insurable income to the national average) for those contributing to second-pillar funds. The rationale was straightforward: if part of the contribution is redirected from the first to the second pillar, the latter should be responsible for a portion of the pension benefit. The adjustment roughly corresponds to the ratio between second- and first-pillar contributions[1]. However, this rule—combined with the later option to transfer funds back to the first pillar to avoid coefficient reduction—introduced instability. The first and second pillars began to compete rather than complement each other. Another significant issue is the widespread disengagement of insured individuals from their pension arrangements. Many are unaware of which universal pension fund they contribute to, the amount accumulated, or the benefits they may receive from either pillar. This creates a substantial opportunity for AI and fintech applications to act as intermediaries between individuals and pension providers.

[1] The exact methodology for reducing the individual coefficient is provided by the Regulation on Pensions and Insurance Records, Promulgated State Gazette, No. 21/17.03.2000, effective 1.01.2003

Currently, the information provided by the National Social Security Institute (responsible for first-pillar benefits) and second-pillar institutions is fragmented and difficult to interpret. As a result, insured individuals struggle to make informed decisions that could maximize their retirement income.

2. Fintech apps – A Potential Game Changer in Bulgaria's Pension Fund Industry: New Opportunities for Insured Individuals

Fintech applications have seen rapid development across many areas of the financial world in recent years—from instant money transfers in multiple currencies to direct access to securities and cryptocurrency markets. However, when it comes to pension savings—particularly their planning and management—the situation becomes more complex. Globally, pension systems are traditionally conservative and heavily regulated. Yet, they are expected to undergo significant transformation in the coming years due to several objective factors: population aging, declining birth rates, increasing life expectancy, and the rise of new technologies that are reshaping the financial landscape, including the risk-averse domain of pension insurance.

Fintech applications, especially when combined with artificial intelligence (AI), have the potential to fundamentally change the rules of the game. They can make pension systems more flexible, user-friendly, and—most importantly—more efficient.

Bulgaria's pension system is a three-pillar structure that successfully integrates the two fundamental principles found in most global pension systems: the pay-as-you-go and the fully funded models. Although these principles are implemented through separate pillars, they share a common goal—to provide individuals with sufficient income after retirement. Achieving this goal requires synchronization and coordination between the pillars to effectively support people during the retirement process.

Each pillar can adopt new technologies to engage future pensioners in a more meaningful way, helping them navigate complex decisions related to savings, investments, and financial planning—factors that are crucial for post-retirement income. Fintech and AI can significantly enhance both the supply side (e.g., the National Social Security Institute and private pension funds) and the demand side (e.g., insured individuals and pensioners) of pension services.

Key Areas Where Fintech Can Improve Efficiency:

1. Cost Reduction: Automation and digitalization reduce the fees associated with managing pension funds, which can significantly increase participants' net savings.
2. Automated Administration: Fintech streamlines administrative tasks such as record-keeping, compliance, and reporting, reducing complexity and operational costs for pension fund managers.

3. Personalized Retirement Planning: AI and machine learning can analyze individual financial data to offer tailored retirement solutions, helping users make better-informed decisions.
4. Increased Accessibility: Digital platforms make it easier for individuals to access and manage their pension accounts, broadening participation and making retirement planning more inclusive.

These improvements can positively influence individuals' behavior throughout their working lives, potentially increasing the pension benefits they receive upon retirement. In a three-pillar system like Bulgaria's, understanding the factors that determine pension amounts and adjusting behavior accordingly is essential for maximizing post-retirement income. Bulgaria's pension system has some unique features. Individuals must carefully monitor the benefits they will receive from each pillar and make informed decisions about their participation. Currently, making such decisions is nearly impossible due to the lack of integration and transparency across the three pillars.

The most significant factors influencing pension amounts include:

- The growth rate of the average insurable income in the country
- The individual's own insurable income
- The investment yield achieved by the pension fund
- The amount of contributions paid into the second and third pillars

Making these factors transparent and understandable could significantly influence individual behavior. If people could access personalized retirement information with just a few clicks, they would be more likely to actively manage their contributions, investment strategies, and risk exposure throughout their careers.

Fintech apps, combined with AI, can effectively guide individuals through the process of accumulating pension rights and savings. This would help them feel more connected to the financial world and more aware of how capital market dynamics directly impact their future well-being.

Illustrative Example:

Consider a scenario where an individual invests 100 BGN per month for 40 years:

- With an average annual return of 3%, the accumulated amount would be 92,837.46 BGN.
- If the return increases by just 1 percentage point to 4%, the total grows to 118,590.12 BGN—an increase of 27.74%.
- If the monthly contribution increases to 105 BGN, the accumulated amount becomes 97,479.34 BGN (at 3%) or 124,519.63 BGN (at 4%).

This means that a slight increase in return or contribution can boost the final amount by over 30%, demonstrating the importance of informed financial decisions—something fintech apps can help facilitate.

Beyond the investment process, fintech applications and AI can also be highly beneficial in addressing another critical aspect of the Bulgarian pension system. The current option to transfer resources into the first pillar and receive a single, higher pension benefit places insured individuals in an uncertain position just a few years before retirement. Under current legislation, the decision to either receive a pension benefit calculated using the full individual coefficient or two separate benefits from both mandatory pillars (with a reduced state pension) must be made no later than one year before retirement. However, this decision window is expected to gradually extend to five years[2]. This is a difficult decision—especially in the context of a fragmented information system, where estimates provided by the National Social Security Institute offer no insight into private pension benefits, and vice versa. An integrated approach to retirement planning would involve presenting individuals with a complete overview of their participation in all three pillars of the pension system, as well as any additional savings schemes, they may have and intend to use as supplementary income during retirement.

Today, AI—when provided with the necessary data—can perform all relevant calculations and guide individuals in making informed retirement decisions. The following example illustrates how AI (in this case, Microsoft's Copilot) could be used for retirement planning and decision-making.

Example: Three individuals are set to retire in five years (in 2030):

- *Individual 1* has been insured on the minimum insurable income throughout their working life.
- *Individual 2* has contributed based on the national average insurable income.
- *Individual 3* has contributed based on the maximum insurable income.

All three have 40 years of insurable service, with 12 of those years not contributing to a universal pension fund. None have missing contribution periods.

The AI is provided with the following data:

1. Historical minimum, average, and maximum insurable income from 2000 to 2024.
2. Contribution rates for the State Social Security "Pension Fund" and Universal Pension Funds.
3. Historical values of one pension unit (2002–2024) for 6 universal pension funds operating during that period.
4. Technical interest rates and mortality tables used by universal pension funds to calculate life annuities (i.e., lifelong pension benefits without additional conditions).

The task assigned to the AI is to generate a VBA code in Excel that simulates multiple scenarios for each individual[3]. These scenarios aim to answer the key question: Should

[2] The exact period of time before retirement when the final decision to participate in both pillars must be made is provided by Article 4b of the Social Security Code

[3] All estimations made by AI are double checked by the author for correctness

individuals remain in their universal pension fund until retirement, or should they transfer their resources to the state pension system? Since individuals are expected to make this decision in advance (five years before retirement), the AI also incorporates projections for insurable income and pension fund returns over the next five years. These projections are based on historical growth rates of insurable income and average returns of universal pension funds over the past 5, 10, and 15 years.

Table 1. Pension amount from the first pillar of pension system of an individual, insured on the average, minimum and maximum insurable income.

	Income type	Full pension amount	Reduced pension amount	Difference
Projected growth rate of income for the next 5 years equals the last 5 year average growth rate (appr. 11%)	Average	1519.20	1315.10	204.09
	Minimum	755.76	648.53	107.23
	Maximum	4640.84	4050.04	590.80
Projected growth rate of income for the next 5 years equals the last 10 year average growth rate (appr. 9%)	Average	1378.33	1193.16	185.17
	Minimum	688.11	590.39	97.72
	Maximum	4231.86	3692.07	539.79
Projected growth rate of income for the next 5 years equals the last 15 year average growth rate (appr. 7.5%)	Average	1275.01	1103.72	171.29
	Minimum	643.26	551.67	91.58
	Maximum	3933.08	3430.50	502.59

Source: AI estimations checked by author's own estimation

Table 2. Pension amount from the second pillar of the pension system of an individual, insured on the average insurable income (insurable income growth rate equals to the last 10-year growth rate).

Universal pension fund	Pension fund 1	Pension fund 2	Pension fund 3	Pension fund 4	Pension fund 5	Pension fund 6
Pension amount if projected return for next 5 years equals the last 5-year average return	115.32 (23 847)*	134.56 (26 654)	110.15 (23 155)	108.54 (23 199)	122.95 (25 015)	143.43 (29 596)
Pension amount if projected return for next 5 years equals the last 10-year average return	117.71 (24 343)	142.19 (28 166)	113.67 (23 895)	108.64 (23 218)	124.36 (25 302)	143.42 (29 594)
Pension amount if projected return for next 5 years equals the last 15-year average return	121.31 (25 087)	146.23 (28 966)	116.63 (24 519)	111.32 (23 793)	127.47 (25 935)	145.87 (30 101)

*The amounts in brackets are the projected accumulated amounts in each fund

Source: AI estimations checked by author's own estimation

Table 3. Pension amount from the second pillar of the pension system of an individual, insured on the minimum insurable income (insurable income growth rate equals to the last 10 year growth rate).

Universal pension fund	Pension fund 1	Pension fund 2	Pension fund 3	Pension fund 4	Pension fund 5	Pension fund 6
Pension amount if projected return for next 5 years equals the last 5-year average return	62.06 (12 833)*	72.18 (14 299)	59.31 (12 469)	58.46 (12 496)	66.09 (13 447)	76.84 (15 856)
Pension amount if projected return for next 5 years equals the last 10-year average return	63.33 (13 097)	76.23 (15 101)	61.18 (12 862)	58.51 (12 506)	68.84 (13 600)	76.84 (15 855)
Pension amount if projected return for next 5 years equals the last 15-year average return	65.24 (13 492)	78.38 (15 525)	62.76 (13 194)	59.94 (12 812)	68.50 (13 936)	78.14 (16 123)

*The amounts in brackets are the projected accumulated amounts in each fund

Source: AI estimations checked by author's own estimation

Table 4. Pension amount from the second pillar of the pension system of an individual, insured on the maximum insurable income (insurable income growth rate equals to the last 10 year growth rate).

Universal pension fund	Pension fund 1	Pension fund 2	Pension fund 3	Pension fund 4	Pension fund 5	Pension fund 6
Pension amount if projected return for next 5 years equals the last 5-year average return	314.83 (65 107)*	372.45 (73 778)	299.82 (63 029)	294.68 (62 984)	337.17 (68 602)	399.88 (82 515)
Pension amount if projected return for next 5 years equals the last 10-year average return	321.72 (66 531)	394.64 (78 174)	309.96 (65 160)	294.95 (63 041)	341.26 (69 434)	399.86 (82 511)
Pension amount if projected return for next 5 years equals the last 15-year average return	332.10 (68 679)	406.40 (80 503)	318.49 (66 953)	302.65 (64 689)	350.24 (71 260)	407.02 (83 987)

*The amounts in brackets are the projected accumulated amounts in each fund

Source: AI estimations checked by author's own estimation

The data from the tables above show that, in each scenario, the accumulated amount in the Universal Pension Funds (UPFs) is insufficient to compensate for the projected reduction in the pension amount provided by the state pension system. The reasons behind these results can be grouped into two main categories.

First, the unprecedented growth in insurable income in recent years. Annual increases between 7.5% and 11% over the past 15 years are largely due to the initially low wage base. These growth rates significantly exceed the returns realized by pension funds, which have ranged between 1% and 4% annually. Such high wage growth is unlikely to persist in the medium and long term, as the base level of wages rises and growth rates are expected to gradually decline.

Second, the recent growth in PAYG pension benefits has been made possible by substantial deficits in the state "Pension Fund" of the social security system. These deficits have been covered by large subsidies from the state budget. While this may not pose an immediate fiscal threat—so long as the total deficit of the consolidated fiscal program remains within reasonable limits—it highlights a structural issue in the methodology used to calculate the individual coefficient. Currently, the individual coefficient reflects only the ratio of contributions paid into the first and second pillars, without accounting for the state subsidies that cover the PAYG system's deficit. As a result, future pensioners face a disproportionately high reduction in their state pension benefits if they remain in the fully funded system. Using AI and a structured VBA code in Excel, an estimation was made to determine the maximum allowable reduction of the individual coefficient—below which pensioners begin to lose financially by staying in the fully funded component of the pension system.

Table 5. Maximum reduction of individual coefficient below which individuals start to lose from staying within fully funded part of the system

Universal pension fund	Pension fund 1	Pension fund 2	Pension fund 3	Pension fund 4	Pension fund 5	Pension fund 6
Insured on minimum income	0.45136 -34.66%*	0.44196 -21.35%	0.45292 -36.88%	0.45487 -39.64%	0.44880 -31.04%	0.44152 -20.73%
Insured on average income	0.91428 -36.19%	0.89646 -22.93%	0.91723 -38.39%	0.92090 -41.12%	0.90944 -32.59%	0.89556 -22.26%
Insured on maximum income	2.82052 -39.76%	2.76742 -26.10%	2.82909 -41.96%	2.84002 -44.77%	2.80629 -36.10%	2.76362 -25.13%

*The negative percentages indicate how much the actual reduction deviates from the hypothetical reduction at which an individual reaches their break-even point

Source: AI estimations checked by author's own estimation

The table above demonstrates that if the individual coefficient is reduced by 20% to 45% less than its current reduction, insured individuals reach their break-even point—the threshold at which they would be indifferent between remaining in both pillars or opting solely for the PAYG component of the system. Given that the state subsidy to the PAYG pension system accounts for approximately 50% annually, it becomes evident that future pensioners would be more inclined to remain in the capital-funded component of the pension system—if this subsidy were factored into the calculation of the reduced individual coefficient.

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Conclusion

The rapid development of the fintech industry and artificial intelligence is transforming the way people perceive pension insurance. Both the first and second pillars of the system can benefit from these technologies by offering products that provide clearer projections of future retirement income. Insured individuals must be actively involved in the entire process, as only well-informed people can make sound decisions. Pension insurance companies have a strong incentive to make fully funded, capital-based pension plans more attractive to insured individuals, thereby reducing some of the political risks they currently face. By introducing personalized pension products, pension funds can better engage with their clients—especially younger generations. In this context, the introduction of a multi-fund system—a topic of much debate in recent years—represents a step forward in raising awareness of pension rights. New fintech technologies, combined with AI, can efficiently transform large datasets into user-friendly, actionable information for all insured individuals. From a financial perspective, the pension system in Bulgaria is the most significant in the country, as no other system requires such substantial resources year after year. Each of its components requires further development and refinement. The existing three pillars should be viewed as interconnected parts of a unified system that must be well-coordinated to effectively serve the interests of the millions of individuals who rely on it.

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