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BIANKA BIRÓ
Government Debt Management Agency Pte. Ltd., Hungary

ANDRÁS BEBES
Government Debt Management Agency Pte. Ltd., Hungary

RICHÁRD FARKAS
Government Debt Management Agency Pte. Ltd., Hungary

RETAIL FINANCING IN THE HIGH INFLATIONARY ERA

Abstract:

Retail financing was part of the Hungarian debt management framework even before the millennium but it only gained momentum after 2012. As FX debt reduction became a strategic goal of the economic policy after the Great Financial Crisis such as the financial inclusion of households, widening the retail investor base and boosting the sales of retail debt securities with competitive yields and higher publicity was an obvious choice. Currently, more than 20% of the Hungarian public debt is in household ownership, indicating the need for careful monitoring of retail debt and also different challenges as experienced in the previous years when, while combatting their impacts on the wholesale market and financing costs, the high inflation and interest rates rearranged the retail debt as well. This paper aims to present the evolution of the Hungarian retail debt programme, its importance in public debt financing and how the high inflation and interest rate environment affected the behavior of retail investors. Also, the paper assesses a what-if analysis that was conducted to estimate the real cost effect of the retail debt programme as it is often considered an expensive form of funding.

Keywords:

Public Debt, Retail Debt Programme, Household Assets, Inflation, AR model

Disclaimer

The authors of this paper are employees being responsible for the support of decision-making in the course of the development of the debt management strategy of the Hungarian Government Debt Management Agency Pte. Ltd. (in Hungarian: Államadósság Kezelő Központ Zrt.; “ÁKK”). Therefore, this paper should be construed as how ÁKK implements its respective policies and, for the purposes of this paper, how the authors demonstrate the modelling thereof.

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All data and formulas contained in this paper are provided solely for the purpose of illustrating the modelling framework for projecting possible outcomes under different economic scenarios. The data contained in this paper is a computer-generated output from respective mathematical models using available statistical and economic data and the output of the models should not be regarded as representative of any current data or forecasts, furthermore, must not be relied upon as an accurate prediction of current or future market performance, etc.

Results published in this paper, including but not limited to macroeconomic forecasts and the composition of the Hungarian government debt, do not represent the official views of ÁKK regarding debt financing. The only purpose of disclosing such results is to illustrate the features and possibilities of the optimal debt portfolio model.

The authors give no warranty and make no representation as to the accuracy, reliability, timeliness or other features of any data contained in this paper or data obtained from using the model.

All models must be scientifically validated by the user for the strategy for which it is to be used, and for the most appropriate and safe application of models, scientific and expert interpretation and adequate advice is required.

Introduction

The Hungarian public debt[1] stood at HUF 35,957 billion in end-2020, of which the most important funding source, the local institutional market represented a share of 50%, followed by the retail and FX markets with 26% and 20%, respectively.

Such significant contribution of the household sector is rare in the global debt management practice as according to the data from the same year, besides being Bangladesh the only country with higher retail debt share but the general direct retail participation (if there is any) rounds up to only 1-2% which is not material from funding point of view. However, when retail debt represents 20-25% of the public debt, it requires higher attention and may raise different challenges when it comes to crises. The Hungarian Government Debt Management Agency ("ÁKK") has a dedicated retail securities strategy and constantly monitors the market tendencies in order to keep the retail debt carefully managed, especially in such challenging years as experienced in the current decade.

As a small, open EU economy and outside the Euro Area, Hungary is highly exposed to various risks and uncertainties driven by global events and circumstances causing market volatility and FX risk. Similar to many other countries, Hungary experienced the highest inflation rates in decades during the past years. The year-on-year CPI peaked at 25.7% in January 2023, in sharp contrast to the mid-term inflation target set at 3%.

The inflationary pressure emerged in the first half of 2021 as a consequence of the Covid-19 related monetary and fiscal stimuli, amplified by the impact of supply shortages and rising global inflation in the second half of 2021. In June 2021, the National Bank of Hungary ("NBH") started a rate hike cycle increasing the central bank base rate on a monthly basis by 15-30 bps, starting from the level of 0.60% and reaching 2.40% in December 2021.

The impact of the monetary tightening materialized immediately in Hungarian Government Bond ("HGB") yields. In spite of inflation slowly approaching double-digit territory, there was no significant change in the demand for retail debt securities during this period. This is a crucial aspect to consider in managing the Hungarian public debt as investor base diversification and significant share of retail financing are strategic objectives of both the economic policy and ÁKK. On 31 December, 2021, the central government debt stood at HUF 40,454 billion, of which retail debt securities represented 25%, in the amount of HUF 10,260 billion.

In 2022, the Russian-Ukrainian war affected inflation not only directly through soaring energy prices, but also indirectly as higher global level of uncertainty exerted additional upward pressure on HGB yields and on the local currency as well. Inflation reached a level that was conspicuous even for common people, and worsening inflation projections prompted more aggressive monetary actions by the central bank. By July 2022, the base rate entered double-digit territory and in September 2022, reached 13%, a level not seen since early 2000.

During that period, ÁKK faced constantly rising interest rates driving financing costs on the institutional bond market higher. On the retail market, demand was fading amid increased redemption volumes since the accelerating inflation obliterated formerly positive real yields on retail securities. In order to keep these securities attractive and to avoid losing a significant part of the investor base, ÁKK adjusted the coupons of many securities to be in line with the actual market conditions. On 31 December, 2022, central government debt amounted to HUF 45,095 billion and the share of retail securities decreased to 19.9%. As the inflation rate reached 24.5% in December

[1] Excluding Repos and MTM deals.

2022, retail investor preference shifted towards inflation-linked securities, representing 48.2% of retail securities and 9.6% of total central government debt. In parallel with the rise of institutional interest rates, ÁKK experienced increasing retail demand for Discount T-Bills and institutional government bonds as well.

Contrary to many other European countries, the Hungarian inflation rate was still rising in late 2022 and peaked only in January 2023. The improving global and Hungarian inflation prospects led to deflating institutional yields, prompted the NBH to cautiously ease monetary conditions, and the retail market re-stabilized as well. A favorable consequence of the extreme inflation was that it caught and opened the eyes of even the financially less conscious citizens. The number of retail clients increased significantly, mostly in case of small-time holders. The central government debt amounted to HUF 50,520 billion on 31 December 2023 of which the retail debt was HUF 10,550 billion with a slight increase in the share to 20.9%. The inflation-linked retail securities represented 66.3% of retail securities and reached 13.8% of the central government debt, exceeding the end-2021 world average of 11% and indicating significant interest expenditures.

Even prior to the global inflation surge, the Hungarian retail debt programme had received criticism for being an expensive form of financing compared to other alternatives (HGBs and FX), especially in a low interest rate regime. In order to estimate the possible extra cost of retail financing on a 9-year horizon between 2012 and 2020, ÁKK conducted a what-if analysis in 2021. This analysis was conducted again in 2024 with a methodological change with respect to financeability and covering the period 2021-2023 to estimate how the recent market events, re-pricing of retail securities and the shift of retail debt profile towards the inflation-linked securities affected the actual cost of Hungary's retail debt programme.

The paper is organized as follows. First, it presents the programme itself and how it changed Hungary's debt profile until and after the Covid-19 and inflation crisis. Second, it describes the methodology of the what-if analysis and assesses its results.

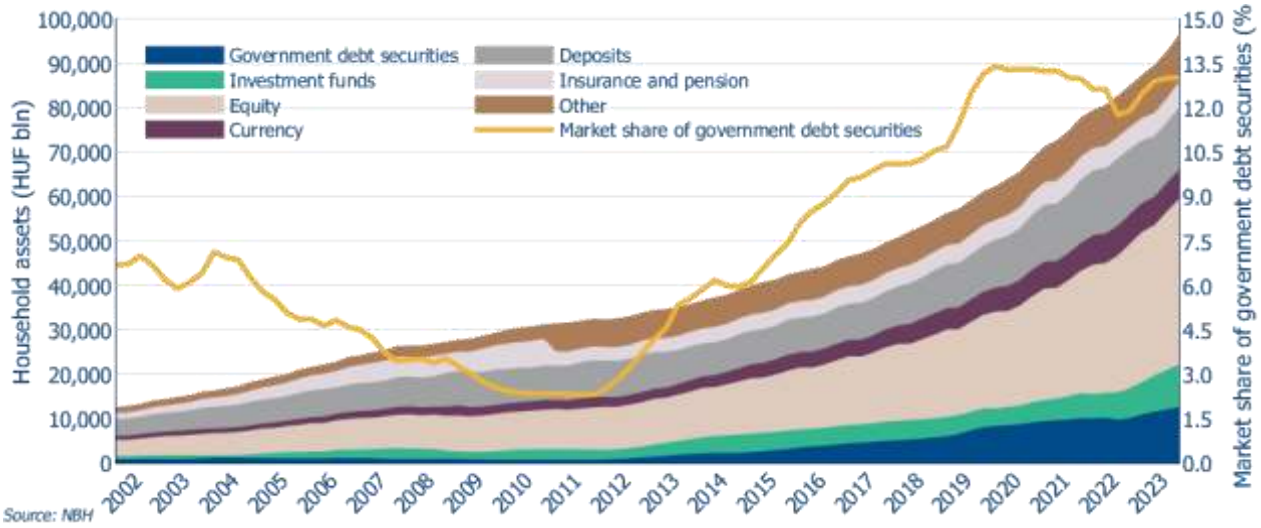
1 The Hungarian Retail Debt Programme

1.1 The history of retail financing in Hungary

In the early 2000s, domestic and foreign currency institutional bonds were the dominant tools in the Hungarian debt management while the volume of retail securities represented only 5-6% of the central government debt. Back then, retail financing was not part of the common debt management practice and financial inclusion of households was not a high priority objective of the Government either. In spite of being one of the most secure and liquid investment opportunity, retail government securities were not generally well-known and popular among households as the available products did not offer competitive yields relative to other alternatives on the market such as equities, mutual fund shares, pension fund reserves and bank deposits.

The popularity of low-risk, liquid investment opportunities grew during the 2008 financial crisis, however, mostly in favor of the banking sector. Due to their increased need of liquidity, banks started offering even higher interest rates for deposits. In spite of introducing an inflation-linked government security ("PMÁP") in 2009 and hence, offering positive real interest rates, the share of government securities decreased from the pre-crisis end-2007 level of 5.4% to 2.3% by 2012 within the household assets, in contrary to bank deposits.

Figure 1: The historical volume of household assets



Source: NBH

1.2 The retail debt programme

Starting from 2012, ÁKK has put higher focus on its retail debt programme as a part of the debt management strategy with two major goals. First, it aimed at creating a more balanced and stable debt profile by reducing the external vulnerability without putting too much pressure on the domestic institutional bond market and including widest possible range of retail investors and thus, diversifying the investor base involved in financing. Second, it also aimed at improving the investment and saving attitude of the household sector that in Q4 2011 held 7% of their financial assets in currency (cash in local and foreign currency) contrary to the 2.3% of government debt securities.

Given this 7% share and HUF 2,324 billion volume of currency within the household assets, there was clearly a significant part of savings that was potentially subject to invest, making room for retail debt securities on the market without supplanting other financial instruments.

In order to make retail debt securities an attractive investment opportunity, the major pillars of the programme were offering a variety of secure, competitive products to Hungarian households with real interest rates, increasing the publicity of retail government securities via more intense marketing activity and the accessibility through sales channels such as financial institutions and the Hungarian State Treasury's branch network along with its electronic platforms.

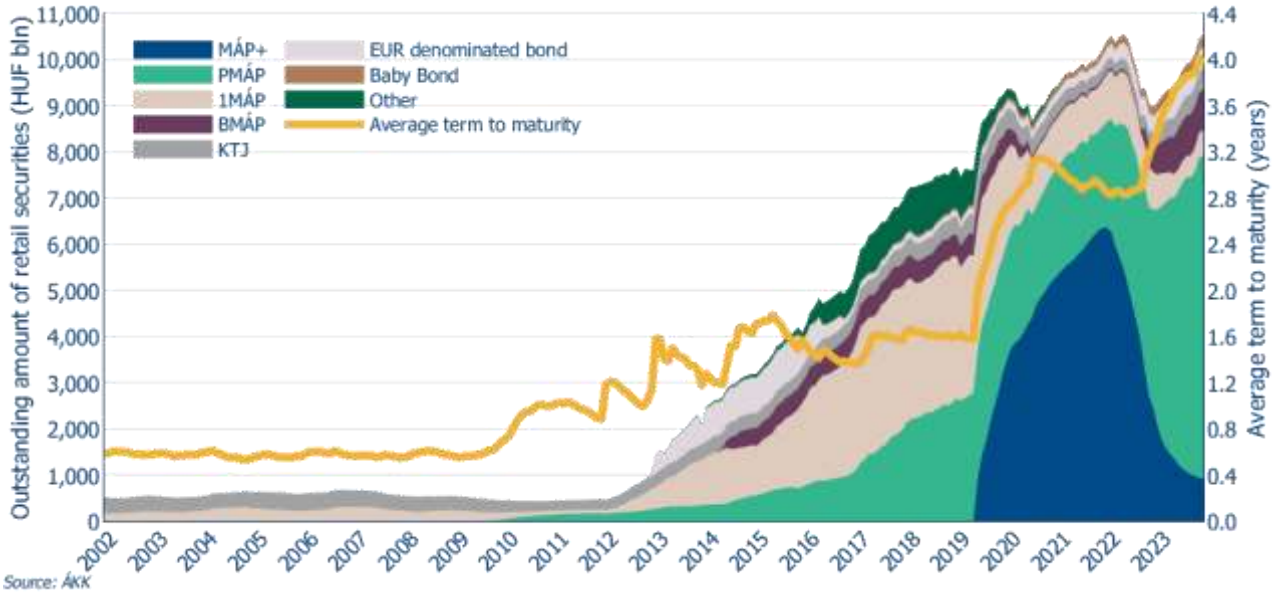
In 2012, the product palette consisted of the inflation-linked "PMÁP" with 3- and 5-year maturities, and two, fixed-coupon papers: the dematerialized "1MÁP" and the printed "KTJ", both with short, 1-year maturity and the latter with a maturity of 2 years as well. During the following years, ÁKK introduced the first euro-denominated retail security ("P€MÁP") which was linked to the Euro Area inflation rate with 3-year maturity, followed by another long-term floater ("BMÁP") with yields linked to the Hungarian Treasury Bill rates, and some other fixed-coupon securities with shorter maturities that turned out to be less popular among the households.

In June 2019, the interest tax on retail securities was abolished which had a significant effect on their popularity. At the same time, ÁKK suspended the sales of some of the retail securities with lower sales volume and introduced MÁP+, a 5-year, step-up coupon paper with the possibility of redemption at face value at interest payment dates. When introducing MÁP+, its internal rate of

return (“IRR”) was 4.95% which, with the Hungarian CPI being around 3% that and along with the favorable buyback conditions, immediately resulted in extremely high demand for the security and very soon, MÁP+ became the flagship product on the market. Later that year, ÁKK introduced its printed equivalent, which also became a popular alternative of the other printed securities.

Pareto-dominating other retail securities, a large shift was observed in the portfolio as most maturities were renewed in MÁP+ after its introduction. As both the dematerialized and physical papers became alternatives of the short-term securities, a significant rise was observed in the average term to maturity (“ATM”) of the retail debt. It was favorable from debt management point of view as it also meant lower re-financing risk, too.

Figure 2: Retail debt volume and ATM



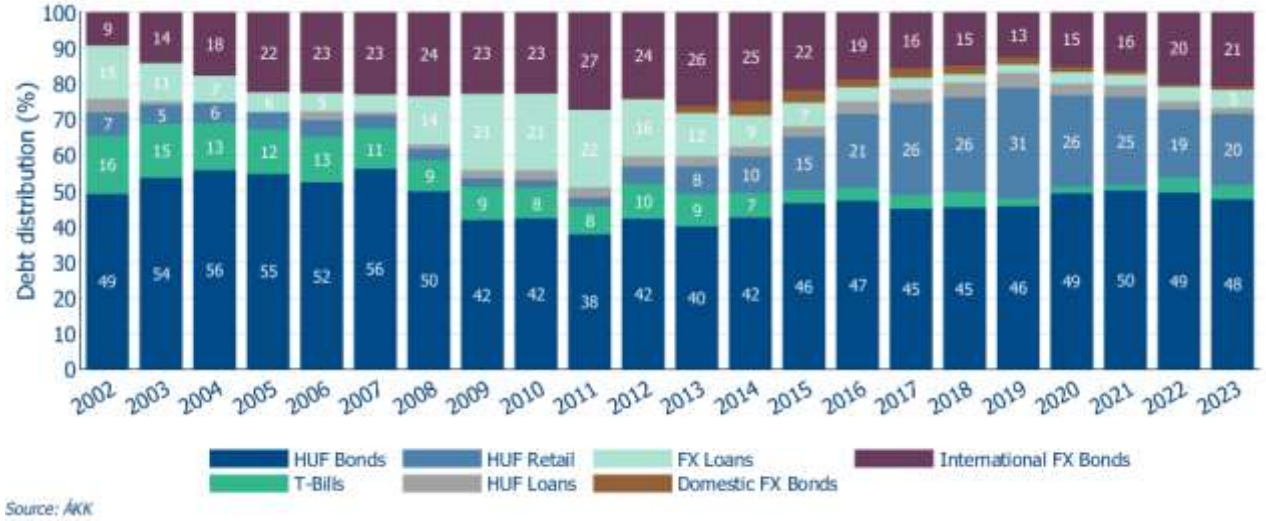
Source: ÁKK

By the end of 2019, the volume of retail securities reached HUF 9,227 billion, of which 35% was MÁP+.

2 Retail financing during challenging times

By the time the crisis surge started in early 2020 with the Covid-19 pandemic, Hungary has managed to reduce the external vulnerability of the country and build up a more stable and resilient debt profile. According to the end-2019 figures, the FX share decreased to 17.4%, the debt-to-GDP ratio reached 65.3% and 26.9% of the central government debt was in household ownership.

Figure 3: The historical distribution of central government debt



Source: ÁKK

When the pandemic-related expenses and lower revenues of the budget resulted in elevated financing requirement and ÁKK was in need of extra funding source, higher-than-planned FX issuances were inevitable in order to cover that. However, as a result of the actions taken in the previous years regarding the FX debt reduction and the retail debt programme, local investor presence was higher and the extra FX issuances did not affect the debt profile significantly.

Also, it is safe to say that the household sector turned out to be a stable investor base during the pandemic. In the first half of 2020, ÁKK experienced somewhat higher but not excess redemption and slightly lower sales volumes as a consequence of the lockdown and uncertainty but the net sales turned positive in the further waves of the pandemic in late 2020 and early 2021.

From mid-2021, the worsening inflation projection required monetary tightening, indicating the rise of institutional interest rates as well. As the majority of retail debt consisted of fixed coupon securities and the annual re-pricing dates of the inflation-linked floaters were not yet on the horizon, the rising institutional interest rates slowly started to approach and exceed the yields of retail securities. Similarly, as many other retail asset types on the market were linked to the interest rates of institutional government bonds, these products started to offer higher yields and became more attractive than retail government debt securities.

In the beginning, the shift of demand in the favor of other investment types was notable mostly in case of more financially conscious and wealthier investors, however, this phenomenon affected a significant volume of the retail debt because it was highly concentrated to this sub-segment of the retail investor base.

Later, as the inflation reached such an extraordinary level that it caught the eye and affected financially a greater number of households than the pandemic and also the interest rates of retail debt securities were less competitive than in 2020, ÁKK experienced a generally different investor behavior in household sector than during the Covid-19 crisis as the attractiveness of MÁP+, the former flagship product has been fading. Therefore, in order to keep up with the constantly changing conditions on the market and not to lose the popularity of debt securities among retail investors, several actions had to be taken.

2.1 Measures taken by ÁKK

ÁKK's primary objective in this period was to adjust the product palette in a way that it would be more competitive in the actual market environment and to reduce the concentration risk of the retail debt.

To avoid significant loss of investor base, ÁKK decided to re-introduce BMÁP with quarterly re-pricing dates, adding a security to the product palette that dominates and dynamically follows the Discount Treasury Bill rates in September 2022. Moreover, the first coupon of the available inflation-linked PMÁP series was adjusted until the following re-pricing to the 2022 annual inflation in January 2023, as PMÁP offered only a coupon of 6.6% based on the 2021 annual inflation rate which was no longer attractive in a double digit interest rate and inflationary environment.

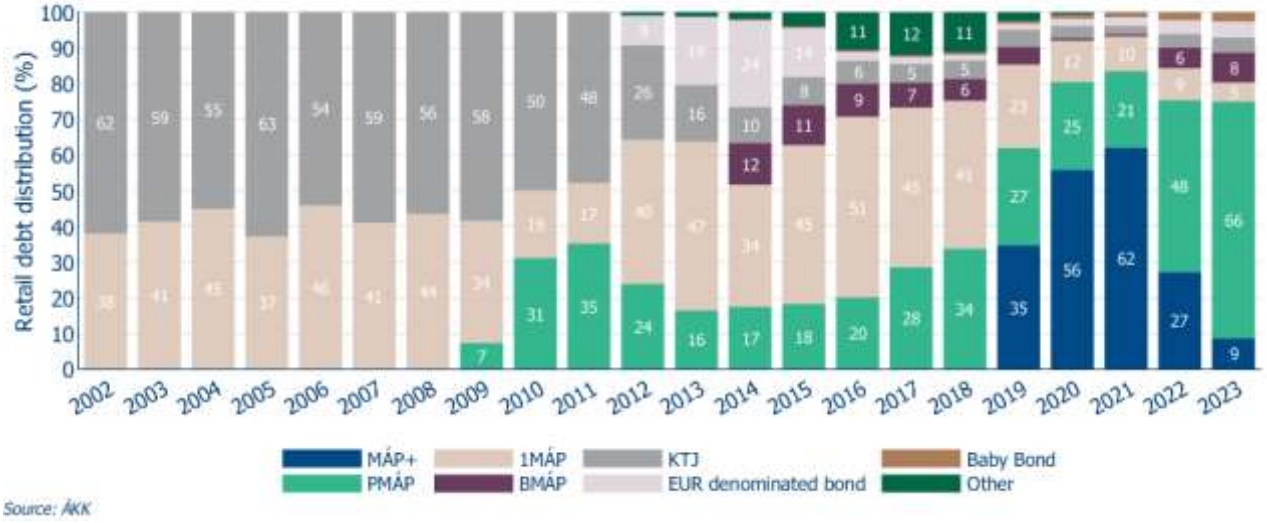
Increasing the yields of MÁP+ was not an option as fixing interest expenditures longer on a product with embedded put option did not fit in ÁKK's medium-term debt management strategy. Therefore, with alternative options provided in form of a revised product structure, ÁKK kept the conditions of MÁP+ unchanged.

In the past, ÁKK did not apply any limitations regarding the sales activity and used to accept all the demand for retail debt securities as retail concentration risk was not of a material volume in the beginning and redemptions did not exceed significant levels either. However, the introduction of MÁP+ attracted many wealthy retail investors, resulting in increased concentration risk, especially in case of the first issued series of MÁP+. When ÁKK revised its retail debt securities strategy in early 2022, concentration risk mitigation was set as a key objective for the upcoming years. Later that year, approaching the interest payment dates of the most concentrated MÁP+ series, a significant concentration risk became subject to realization based on the previously experienced redemption trend. In order to avoid such situations in the future and considering that double-digit yields should not be paid without limitation, right after the interest rate rationalization of PMÁP and re-introduction of BMÁP, ÁKK started to apply a sales cap in case of these securities. By the end of 2023, this sales cap was extended to other securities as well and became an important retail debt management tool, enabling ÁKK to intervene in the retail sales by choosing the level of the sales cap in light of the actual market conditions and demand.

2.2 The new retail debt profile

In line with the actions taken, ÁKK witnessed a major structural break in the sales tendencies and retail debt profile.

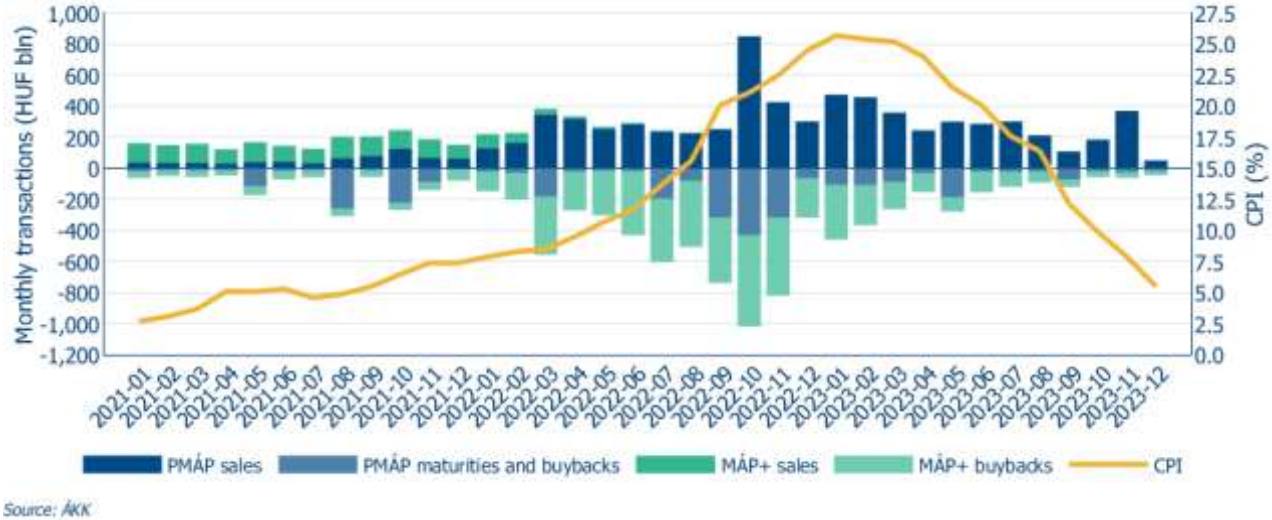
Figure 4: The historical distribution of retail debt



Source: ÁKK

While the outstanding amount of MÁP+ has been decreasing as a result of low sales and high redemption volume, the inflation-linked PMÁP has gained high popularity among households as it had the highest available initial coupon among retail products. Institutional government bonds and Treasury Bills have also become attractive alternatives for many retail investors as they offered interest rates higher than many retail instruments.

Figure 5: Shift in product preference with the inflationary pressure



Source: ÁKK

However, as the premium of retail debt securities compared to other investment opportunities on the market kept decreasing a fallback was observed in the share of government securities in retail savings in late 2022, mostly in the favor of mutual fund shares. The decreasing sales trend switched back to growth when in January 2023, ÁKK issued the first series of PMÁP with coupons based on the 2022 average inflation rate, offering an interest rate base of 14.5% with a premium depending on the term of the security. By the end of 2023, PMÁP overgrew the former popularity of MÁP+ and its outstanding volume reached a 66% share within the retail debt.

2.3 The role of inflation-linked securities

Inflation-linked papers were introduced in 2009 but have never been as popular as in 2023 due to reaching the highest interest rates among retail debt securities. It is without doubt that the PMÁP phenomenon have contributed to the elevated interest expenditures of Hungary but has also several advantages from both economical and debt management point of view.

In December 2023, the interest expenditure paid to households with regard to 2024 was expected to be close to 2% of the GDP which is a significant amount that partially can be subject to reinvest or spend. On the other hand, being the most secure option to preserve the real value of household savings even on longer time horizon and in any market circumstances contrary to the fixed coupon alternatives, inflation-linked securities can be issued with longer maturities and thus, they have contributed to mitigating refinancing risk and improving the ATM of the retail debt portfolio. Moreover, in transitory high interest rate periods as experienced in the previous years, issuing annually re-pricing securities with long maturity might be more favorable than issuing fixed-rate coupon securities and locking in higher rates for a longer time period or issuing short-term securities elevating refinancing risk. However, it is also worth noting that inflation-linked debt leads to uncertainty regarding costs and annual re-pricing in an increasing inflation and interest rate environment leads to immediate effects in the retail financing costs as well. Therefore, in order to manage extreme fluctuation of financing costs in a volatile market environment, inflation-linked debt exposure of the central government debt should be limited to a level that can be naturally hedged by inflation-linked revenues of the budget.

3 The Extra Cost of Retail Financing

By 2012, the share of retail securities in the debt portfolio dropped to 2.3%. Concurrently, the share of government securities in the total assets of households was also 2.3%, down from the 5.4% figure of 2008. It is safe to assume, that without an improved retail debt programme consisting of higher interest rates, product development and extra marketing activities, the share of government securities in household assets would not have reached the end-2020 figure of 13.8%.

3.1 Methodological overview

In 2021, ÁKK conducted a what-if simulation with the objective of estimating the real extra cost of the improved retail debt programme [2]. To do so, the realized costs of retail and domestic wholesale debt were compared to the costs of a no policy change scenario (no actions to improve retail financing) from 2012. This alternative scenario could have resulted in hypothetically lower retail debt with lower costs, however, the funding gap left by lower retail issuances should have been compensated with extra issuances on the domestic or foreign wholesale market. As in the post-crisis era of the Great Financial Crisis, FX debt reduction had been a strategic goal of the Hungarian government to reduce external vulnerability. Consequently, the key assumption of the analysis was to cover the funding gap with extra issuances exclusively from the domestic institutional market, assuming no change in the net funding needs.

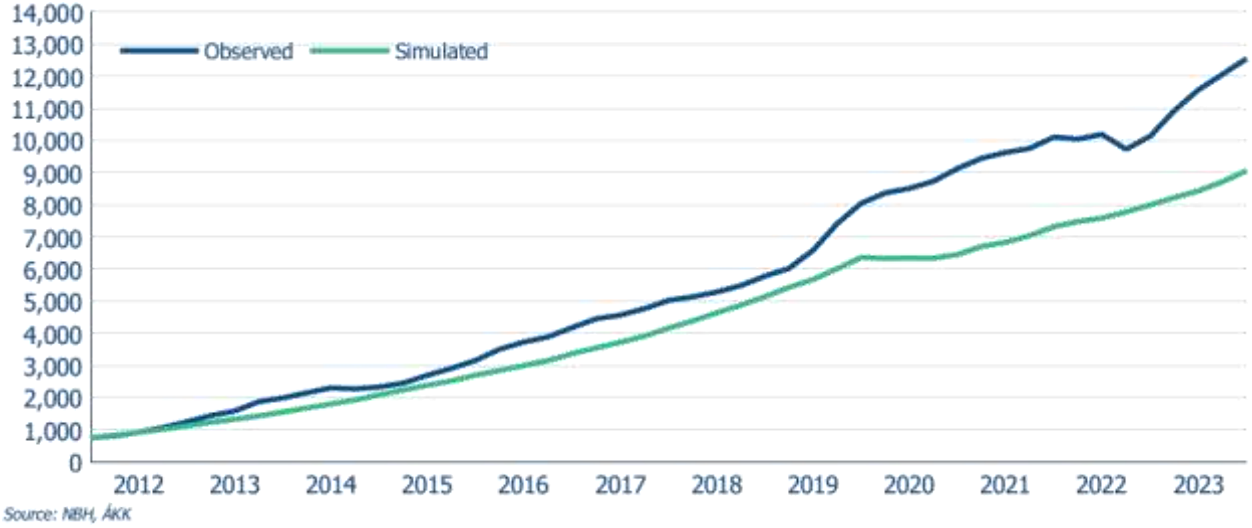
The simulation has two main phases. First, ÁKK estimated the hypothetical volume of retail debt with the moderate retail debt programme by applying several assumptions drawn from observations on retail investor behavior over the last decade. Once the alternative retail debt volume and hence, also the funding gap was obtained, ÁKK simulated the modified domestic wholesale issuances and corresponding yields based on historical HGB auction data. In the light of the alternative retail debt

volume, interest rates, extra wholesale issuances and corresponding institutional yields, the cost effect of the alternative scenario was possible to calculate.

The analysis provided two major takeaways. First, the alternative scenario without the improved retail debt programme may not have been cheaper on the 9-year horizon between 2012 and 2020 due to the extra wholesale issuances with higher yields and also slower re-pricing of wholesale debt in a decreasing interest rate environment. Second, the funding gap could not have been completely covered by extra wholesale issuances on the whole time horizon.

Therefore, in order to be able to satisfy the financing requirement, especially during the Covid-19 pandemic and the following energy crisis, ÁKK may have had to find extra source for funding. One option could have been issuing more FX bonds but based on the experienced volatility of the EUR/HUF exchange rate, higher FX exposure may have indicated extreme financing costs. Also, as FX debt ratio is a key indicator for investors and rating agencies, it could have effected in Hungary's rating grade negatively, resulting in higher risk premium and hence, higher funding costs as well. Second, focusing on the domestic wholesale market, increasing the offered amounts for auctions could have generated higher demand but also higher interest rates and costs without extra advantages. Taking into consideration the goals of the government and ÁKK with all the social and economic advantages of retail financing, it is safe to assume that investing in the domestic retail market could have been the most favorable option. Therefore, ÁKK re-constructed the simulation focusing on both the expenses and financeability between 2012 and 2023, comparing the realized costs with the costs of a new alternative scenario, assuming that there would have been a moderate retail debt programme to meet the goals and the financing requirement.

Figure 6: Observed and simulated debt volume owned by households



Source: NBH, ÁKK

In the alternative scenario, ÁKK assumed that with only a moderate retail programme, starting from 2012, there would have been some marketing activity, more competitive yields than earlier but no product development and the retail debt structure would not have changed.

With these conditions, it was assumed that the share of government securities in household assets would have risen linearly from the initial 2.3% to 10.4% by the end of 2019, then from 2020, would have stayed at a slightly lower 9.4% level until the end of 2023. In this case, the amount of government securities owned by households would have reached HUF 9,065 billion by the end of

2023, leaving a gap of HUF 3,489 billion to be financed via extra issuances on the domestic wholesale market.

To determine the amount and costs of these extra issuances, all 1-year Treasury Bill and fixed coupon Hungarian Government Bond auctions were re-simulated between 2012 and 2023 in the light of the financing gap and based on ÁKK's historical auction data containing the bid amounts and yields of primary dealers with the accepted amounts and corresponding yields at every auction.

3.2 Simulation of auctions

In the first step of the simulation, the bid amounts of primary dealers were adjusted. It is assumed based on the historical data about household assets that a significant amount of savings was held in cash and bank deposits before retail debt securities. Consequently, lower retail debt volume may have resulted in a higher volume of cash and bank deposits, indicating possibly higher demand for government bonds by primary dealers.

Since other retail asset types followed a similar quadratic trend as the total amount of household assets, the volume of currency and bank deposits in the alternative scenario was estimated assuming the same, and that its share within the household assets could have stayed around 30%.

Let D denote the observed and D^S the simulated volume of currency and bank deposits, and r the applicable adjustment at the i^{th} auction, that can be written as

$$r(i) = \frac{D^S(i)}{D(i)}. \tag{1}$$

The historical submitted bid amount of primary dealer k for paper j on the i^{th} auction is denoted by $A_B(i,j,k)$. Thus, the adjusted bid amounts can be given by the formula

$$\tilde{A}_B(i,j,k) = r(i) * A_B(i,j,k). \tag{2}$$

Given the amount of increased financing need at each auction and the adjusted bid amounts representing the possibly higher demand, the volume of extra issuances and the corresponding yields were determined in the second step.

Let $I_E(i)$ denote the necessary extra issuance at auction i, $A_C(i,j)$ the originally accepted amount, and $I_P(i,j)$ the possible extra issuance in case of paper j based on the adjusted bid amounts. Then suppose that there are d primary dealers, m papers and let

$$I_P^{Total}(i) = \sum_{j=1}^{m} I_P(i,j) = \sum_{k=1}^{d} \tilde{A}_B(i,j,k) - A_C(i,j). \tag{3}$$

The new accepted amounts of paper j at auction i is given by

$$\tilde{A}_C(i,j) = A_C(i,j) + q(i,j) * \min\left(I_E(i), I_P^{Total}(i)\right), \tag{4}$$

where $q(i,j) = \frac{I_P(i,j)}{I_E(i)}$.

The new auction yields corresponding to the new accepted amounts can be determined as

$$\tilde{Y}_C(i,j) = \frac{\sum_{k=1}^{h} Y_B(i,j,k)\tilde{A}_B(i,j,k)}{\sum_{k=1}^{h} \tilde{A}_B(i,j,k)} \tag{5}$$

where $h = argmin\left(\sum_{k=1}^{m} \tilde{A}_B(i,j,k) \geq \tilde{A}_C(i,j)\right)$.

In the final step, all $\tilde{Y}_C(i,j)$ values were adjusted as well, taking into account that the higher level of auction yields for several consequent auctions may have affected the bid yields of the following auctions, indicating even higher auction yields.

To do so, the time series of the auction yields were modeled by autoregressive processes. As both the original and new yields are integrated in the first order according to the ADF [3] tests, linear trends were removed from the time series with a breakpoint set to early 2017 to achieve stationarity. Let Y_C^D denote the time series of the detrended original auction yields and $\tilde{Y}_C^D$ the detrended new auction yields, corresponding to the higher issuances. When selecting the ideal autoregressive model, ÁKK considered AR(3) to be an appropriate model intuitively but based on the Akaike [1] and Bayesian [4] information criteria and the significance of parameters, AR(2) turned out to be a better fit for tenors 1 and 5.

Table 1: The selected AR models for the original yields

Tenor	Model	
1Y	*AR(2)*	$\boldsymbol{Y_C^D(i,1) = 1.24Y_C^D(i-1,1) - 0.3Y_C^D(i-2,1) + \varepsilon(i,1)}$
3Y	*AR(3)*	$\boldsymbol{Y_C^D(i,3) = 0.84Y_C^D(i-1,3) + 0.21Y_C^D(i-2,3) - 0.12Y_C^D(i-3,3) + \varepsilon(i,3)}$
5Y	*AR(2)*	$\boldsymbol{Y_C^D(i,5) = 1.02Y_C^D(i-1,5) - 0.04Y_C^D(i-2,5) + \varepsilon(i,5)}$
10Y	*AR(3)*	$\boldsymbol{Y_C^D(i,10) = 0.95Y_C^D(i-1,10) - 0.01Y_C^D(i-2,10) + 0.01Y_C^D(i-3,10) + \varepsilon(i,10)}$
15Y	*AR(3)*	$\boldsymbol{Y_C^D(i,15) = 0.56Y_C^D(i-1,15) + 0.36Y_C^D(i-2,15) - 0.14Y_C^D(i-3,15) + \varepsilon(i,15)}$

Source: ÁKK

In this setup, the AR model parameters describe the innovation dynamics of the yields and the $\varepsilon \sim N(0,1)$ i.i.d. random process represents the effect of market events on the yields, which are safe to be considered independent from the retail debt programme. Let $Y_C(i,j)$ denote the original accepted yield of a bond in tenor j at auction i, and $\nabla Y(i,j) = \tilde{Y}_C(i,j) - Y_C(i,j)$ is the price of the extra issuance.

Adjusting the new auction yields by incorporating ∇Y recursively in the innovation dynamics, starting from the initial values of the new auction yields as presented in **Chyba! Nenalezen zdroj odkazů.**, the rollover effect of the extra price payed for extra issuances can be captured. $\hat{Y}$ denotes the estimated yields after the adjustment.

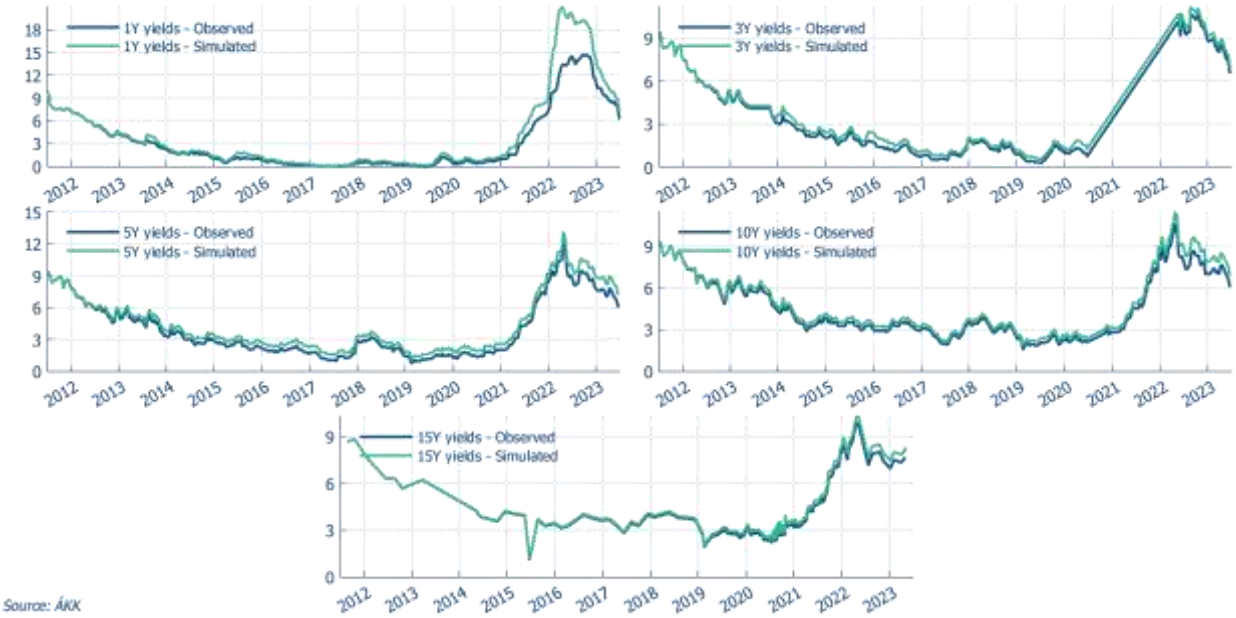
Table 2: Estimated yield adjustments

Tenor	Estimation
1Y	$\boldsymbol{\hat{Y}(i,1) = 1.24\hat{Y}(i-1,1) - 0.3\hat{Y}(i-2,1) + \nabla Y(i,1) + \varepsilon(i,1)}$
3Y	$\boldsymbol{\hat{Y}(i,3) = 0.84\hat{Y}(i-1,3) + 0.21\hat{Y}(i-2,3) - 0.12\hat{Y}(i-3,3) + \nabla Y(i,3) + \varepsilon(i,3)}$
5Y	$\boldsymbol{\hat{Y}(i,5) = 1.02\hat{Y}(i-1,5) - 0.04\hat{Y}(i-2,5) + \nabla Y(i,5) + \varepsilon(i,5)}$
10Y	$\boldsymbol{\hat{Y}(i,10) = 0.95\hat{Y}(i-1,10) - 0.01\hat{Y}(i-2,10) + 0.01\hat{Y}(i-3,10) + \nabla Y(i,10) + \varepsilon(i,10)}$
15Y	$\boldsymbol{\hat{Y}(i,15) = 0.56\hat{Y}(i-1,15) + 0.36\hat{Y}(i-2,15) - 0.14\hat{Y}(i-3,15) + \nabla Y(i,15) + \varepsilon(i,15)}$

Source: ÁKK

The simulated yields in comparison with the original observed yields are illustrated in Figure 7.

Figure 7: Observed and simulated historical yields



Source: ÁKK

The results show higher difference between the observed and the simulated yields of the alternative scenario on shorter maturities, mainly because of the generally higher demand for short-term bonds, allowing to cover the major part of the extra financing need by these tenor segments.

3.3 Results

The cumulative financing costs of the alternative scenario were compared to the factual costs on the 12-year horizon.

When calculating the annual costs, ÁKK considered the cumulative costs of annual domestic wholesale and retail issuances.

Table 3: Cost effects proportional to GDP

	Fact cost	Simulated cost	Retail effect	Wholesale effect	Total effect
2012	4.56%	4.69%	0.06%	0.06%	0.13%
2013	4.52%	4.77%	0.00%	0.25%	0.25%
2014	3.97%	4.23%	-0.11%	0.37%	0.26%
2015	3.44%	3.64%	-0.19%	0.38%	0.19%
2016	3.09%	3.28%	-0.24%	0.43%	0.19%
2017	2.65%	2.79%	-0.30%	0.44%	0.14%
2018	2.33%	2.42%	-0.34%	0.43%	0.09%

2019	2.23%	2.19%	-0.42%	0.39%	-0.04%
2020	2.36%	2.35%	-0.53%	0.52%	-0.01%
2021	2.54%	2.58%	-0.52%	0.55%	0.04%
2022	3.18%	3.63%	-0.33%	0.79%	0.45%
2023	3.68%	4.31%	-0.49%	1.11%	0.63%
Total	3.13%	3.35%	-0.33%	0.55%	0.15%

Source: ÁKK, HCSO

As Table 3 shows, the overall cost of the alternative scenario was higher by 0.15% than the overall factual cost and there were only two years (2019 and 2020) when the annual factual costs exceeded the costs of the alternative scenario. These results seem surprising given that the offered interest rates for retail debt securities in the retail debt programme were generally higher than wholesale interest rates.

The reason behind this phenomenon is that the program was introduced in a high then decreasing interest rate regime and the costs of short-term and inflation-linked retail debt securities adjusted to the changes in the market environment faster than domestic wholesale debt due to their shorter average term to maturity and re-fixing.

It is reflected in the results that the introduction of MÁP+ in 2019 with the highest retail premium compared to wholesale interest rates resulted immediately in higher factual costs. Also, starting from 2021 as the increasing wholesale interest rates demolished the premium, the cost effect of the retail debt program turned negative again.

4 Conclusion

Since the introduction of the retail debt program, ÁKK has managed to build a less vulnerable debt profile and a diverse investor base while providing a favorable investment opportunity for Hungarian households. By the time Hungary had to face the financial challenges of the Covid-19 pandemic and the following high inflationary and interest rate regime, debt managers did not have to worry about liquidity issues and were able to meet the increased financing need even in difficult market circumstances.

In spite of being considered as an expensive form of financing, comparing the factual costs between 2012 and 2023 with the costs of an alternative scenario that is based on the assumption of a less improved retail debt program, the results show that a higher volume of domestic institutional issuances would have indicated higher financing costs.

The greatest cost-benefit of retail financing can be seen exactly in most critical years of 2022 and 2023 when due to a higher reliance on the domestic institutional bond market in the alternative scenario, the wholesale interest expenditures could have been higher by 0.7 and 1.11 percentage points, respectively, exceeding the cost effect of the retail debt program (0.33% and 0.49%) significantly. At the same time, it is important to note that in the alternative scenario the higher interest expenditures would have been payed to wholesale investors while currently the household sector is the beneficial.

On the other hand, the shift of retail demand towards the inflation-linked PMÁP is also favorable from debt management point of view regarding the future. The same way it happened in the mid-

2010s, with PMÁP being re-priced on an annual basis, its costs are expected to adjust to the decreasing inflationary and interest rate environment faster than the costs of mid- or long-term fixed coupon wholesale alternatives.

The simulation has several limitations and improvement opportunities. First, the simulation is based on a static financing requirement that may have been affected by the lower level of retail in the alternative scenario. Second, in the lack of historical relationship between the announced and bid amounts, it is unknown, how higher announced amounts could have affected the auction bids. Also, as an improvement opportunity of the methodology, the estimated effect of NBH's quantitative easing might be subject to quantification in the future and ÁKK also aims to make the methodology compatible with time series extension.

5 References

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