

Valuation of debt instruments

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Last decade in Hungary the securities market developed very rapidly. During this period the amount of securities increased by more than 50%. Our paper addresses the recording of amounts, giving statistics that show the reasons for the change (transaction, revaluation, other change in volume). We introduce the different types of debt securities with their features. In the third section we summarise the methodology of the measurement, the applied techniques themselves, the problems that arise in the measurement process, and the solutions developed for these problems. We detail the alternative solutions, their benefits and drawbacks. The fourth section presents special cases and their treatment. Finally, we briefly analyse the Hungarian case.

A security is a fungible, negotiable instrument representing financial value. Securities have made good progress up to now. Securities may represent the largest proportion of the financial instruments. For debtors, securities are financing alternatives. Several types of securities have been created through financial innovation.

We can classify securities into various categories, according to the right that the security represents: debt, equity or goods. Securities are broadly categorised into three main groups:

- **Debt securities** are government securities (government bonds, government bills, central bank bonds), corporate bonds (issued by industrial entities, local governments or commercial banks), mortgage bonds and certificates of deposit. The holder of debt securities is typically entitled to payment of principal and interest, together with other contractual rights under the terms of the issue, such as the right to receive certain information. Debt securities are generally issued for a fixed term and are redeemable by the issuer at the end of that term. Debt securities may be protected by collateral or may be unsecured.
- **Equity securities** are mutual fund shares and shares. Equity securities are shares in the capital stock of a company. The holder of equity is a shareholder, owning a share, or fractional part of the issuer. Unlike debt securities, which typically require regular payments (interest) to the holder, equity securities are not entitled to any payment.
- **Title securities** are securities that represent a right to goods. One such security is a warehouse receipt/certificate. A receipt used in futures markets to guarantee the quantity and quality of a particular commodity being stored within an approved facility.

Our paper deals only with debt securities and their statistical problems (types, amounts, valuation).

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The types of debt securities in Hungary

In this section we talk about the types of debt securities step by step. Considering Hungarian securities, we can say that they have a similar structure to that described above.

Government securities

Government securities are issued by the government of a given sovereign country, and come with a guarantee for the payment of capital and interest. Government securities represent the government debt of the country. The Hungarian government has frequently issued government securities to finance the budget and refinance its expired securities. These securities may be bought by players in the economy, eg households. Government securities can be classified by their maturity.

International methodology distinguishes three main types of government securities: 1) Treasury Bill or T-Bill with maturity shorter than one year; 2) Treasury Note or T-Note with maturity of between one and five years; 3) Treasury Bond or T-Bond with maturity of more than five years. Hungarian legislation allows only two types of the government securities: A) government bills with maturity of less than one year, and B) government bonds with maturity of more than one year.

At the time of issuance, the government guarantees to the buyer (the lender) that it will pay interest and settlement, both of which are determined at the time of issuance.

The government securities are the following:

- *Government bonds*: The Hungarian Government Bond is an interest-bearing security with more than one year of original maturity. Currently four maturities exist (3, 5, 10 and 15 years). The Hungarian Government bonds receive annual and biannual payments of interest. Since 2002 interest has been paid once in the case of government bonds. From 1996 these securities have been sold over auction.
- *Interest bearing treasury bonds*: The treasury bond is a bearer government security with fixed, stepped interest and 3 years and 2 months original maturity. It could be redeemable before maturity. It was first issued in 1998, but did not fulfil the issuer requirement, so in 2001 the issue was terminated.
- *Treasury bills*: These securities are issued for large investors, and can be sold over auctions. T-bills have less than 1 year of original maturity, the holders do not receive interest, they could buy it at discounted price (below par value), and on the due date the holders receive the nominal value. The holder's profit is the difference between the purchase price and the nominal value of security. Currently there are T-bills with 3, 6 and 12 months' original maturity.
- *Interest bearing treasury bills*: The first was issued in 1988. It can be bought in local branches of banks, and is intended for small investors. It is an interest bearing security, where the interest is paid to the holders along with repayment at the end of its duration. Their original maturity is 1 year.
- *Treasury saving note*: These securities are sold to households in post offices. It is an interest bearing security. It has stepped interests, so the holder receives interest depending on holding time. These securities are sold continuously and the maturity is 1 or 2 years.

Central bank bonds (MNB-bonds)

The central bank bonds are issued by the central bank of Hungary. These bonds are denominated in either Hungarian forint (HUF) or other foreign currencies. The holders can

use them as collateral security on their credit operations. There had previously been bonds with maturities of 3 months or 5 years. From 2007 the leading instrument has been a 2-week bill. The leading instrument is to negotiate the optimal interest level for the financial market.

Other bonds (non-government bonds)

We classify the other bonds on the base of issuers' sector. These are the following:

- Bonds issued by local government;
- Bonds issued by credit institutions;
- Bonds issued by other financial intermediaries;
- Bonds issued by non-financial corporations.

These instruments have the same features as normal bonds.

Mortgage bonds

The mortgage bond is similar to the long-term bond, which can be issued only by a specialised financial institution. In Hungary the first such security was issued in 1998. Its market is developing continuously. It is largely similar to long-term government bonds, because both types of securities fall into the same risk category. However, it differs from the government bonds in that it has special collateral.

The mortgage bank issues short- and long-term bonds. The short-term bonds have a 1-year duration, and the long-term bonds have 3–10 years' duration. The commonest bonds for public have 1 year's duration.

Certificates of deposit

This security is issued by a credit institution and works like a bond. The issuer guarantees that the prefixed interest and the face value will be paid to the holder of the security at the given date. The duration of the certificate would be a maximum of 3 years.

Convertible bonds

In Hungary the corporate enterprises may issue registered bonds, which may cover a maximum of half of their capital stock. This security may be converted to shares. This instrument means in practice that the issuer of the convertible bond takes up a credit. At the end of the maturity the holders of the convertible bonds may ask for the board of directors to convert their bonds to shares, if these are more profitable.

Securities statistics in Hungary

In Hungary the Magyar Nemzeti Bank (central bank of Hungary) is responsible for preparing securities statistics, ie statistics on debt securities.

The MNB publishes these statistics at market prices, based on a security-by-security methodology. There are two main products. This section briefly presents these two publications.

When we refer to securities statistics we have in mind the financial and capital markets, and we describe and analyse the activities in these markets etc. Our securities statistics have two main publications:

- Deposit statistics, (eg distribution of securities holdings by institutional sector)
- Securities issues statistics.

Securities holdings (deposit) statistics

In December 1997 the MNB started to publish the “Distribution of securities holdings by institutional sector”: quarterly securities holdings statistics with a time lag of 52 days. These statistics present the stocks of government securities, shares quoted on the Budapest Stock Exchange, and mutual fund shares held by each sector and calculated at market value. In addition to stock data, flows and other changes in stocks are also published. The flow data comprise the calculation of transactions, revaluations and other changes. Data are collected at face value or based on the number of securities, depending on whether debt or equity security is reported.

The data sources of the statistics are monetary financial institutions, investment enterprises, the Central Clearing House and Depository Ltd., the Hungarian State Treasury, the Budapest Stock Exchange and the Hungarian Financial Supervisory Authority.

The methodologies of SNA 1993 and ESA 1995 were used in the data collections and the compilation process, and the amounts of debt securities are therefore given at market value in the securities holdings statistics.

Securities issues statistics

In June 2003 the MNB started to publish securities issues statistics according to recommendations and requirements laid down by the ECB, monthly and with 40 days' time lag. The time series currently date back to December 1994. The aggregated data are available by issuers' sectors. The stock data are presented at nominal value or discounted price.

The outstanding amount of securities at the end of the month is the most important indicator in these statistics. There are also monthly flow data, eg net and gross issue and their components, redemptions. The main equation is the following: Net issue = Gross issue – Redemption (including early redemptions).

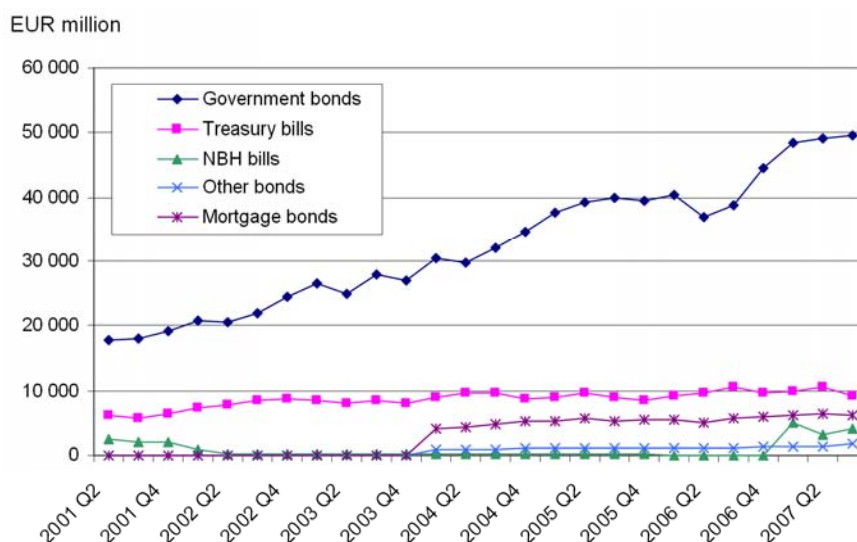
MNB compiles the above-mentioned statistics using a proprietary computer system (called EPSJ). As a satellite of the first system a register of securities is also used containing all basic information about each security issued by Hungarian residents. This register is capable of handling changes in the various characteristics of securities (for example, changes of ISIN-code, face value, form of securities).

Stocks of debt securities

In Hungary the outstanding amount of debt securities consists mainly of long-term government bonds, which grew continuously in the reference period. The outstanding amount of government bonds is currently close to EUR 48 billion. The stock of T-bills is about EUR 9 billion (see Chart 1).

Chart 1

Stocks of debt securities



Source: Magyar Nemzeti Bank (Securities and Financial Accounts Statistics).

Valuation of debt securities

In deposit statistics all debt securities are calculated at market prices. The key users (financial accounts, balance of payment) of these data require information according to this methodology.

The following relation is true for prices of all debt securities:

Dirty price = Clean price + Accrued interest

Dirty price is quoted in most markets, but there are exceptions, and consequently either clean price is the starting point or accrued interest is deducted from gross price.

The next chapter deals with the calculation of market prices by individual instruments.

Publicly issued government bonds

Clean price of publicly issued government bond is calculated in order of the following priority:

- The primary source of market price is derived from OTC (over the counter markets). In OTC markets dirty price is quoted from which we can deduct the actual accrued interest in order to obtain clean price.
- When there is no OTC transaction on the reference day, we use the average net price (weighted by values of transactions) which is settled on the Budapest Stock Exchange (BSE) (secondary source).
- Where there is no transaction neither at OTC nor on BSE, we take the mathematical average of bid and ask prices of all government bonds calculated by the Hungarian State Treasury.

We are generally in the position of having information about the prices of government bonds from the sources mentioned above, but if not, we go back the nearest historical date and use the same procedure.

Privately placed government bonds

In the case of privately placed government bonds we use different methods to calculate the prices of fixed or floating (variable) interest bearing bonds.

Fixed bonds

In the case of fixed bonds we determine first the gross price on the base of yield curve, by counting the present value (PV) of the security by discounting future cash flows, which is by definition the gross (market) price.

Discount rate as zero coupon yield can be calculated on the basis of yield curve, using the following formula:

$$PV = \sum_{t=1}^n \frac{C_t}{(1+r)^t} \quad , \text{ where}$$

C_t = future cash flow,

r = zero coupon yield

Clean price is computed by deducting the accrued interest:

Clean price = Dirty price – Accrued interest

Floating bonds

Future cash flows of floating bonds are unknown, because coupon payments are determined only for the next period of duration, so we cannot use the formula above. In this case we simply regard these prices as 100% of nominal value.

Treasury saving notes

In Hungary, treasury saving notes are zero coupon bonds, because the whole of the interest is paid to the holders at redemption, together with nominal value of securities. We determine the gross price on the basis of yield curve using methods similar to the case of fixed bonds.

Clean price = Dirty price – Accrued interest.

This differs from 100% of par value in only case, when the beginning of interest bearing differs from the issuance date.

Interest bearing treasury bills

We obtain clean price of an interest bearing treasury bill using the Hungarian State Treasury data. This institution also has accrued interest information, so dirty price can be calculated easily. (Dirty price = Clean price + Accrued interest)

Treasury bills

In the case of treasury bills dirty price will be determined in the same way, which is formalized in the case of publicly issued government bonds (OTC information, Stock Exchange average, average of bid and ask price of Hungarian State Treasury). If we have no information about the given security, we use the following estimation:

Using discount factors of the security and the formula $PV=(1-dt)*C$, we calculate the dirty price of the security. Then we obtain the clean price by deducting accrued interest from the dirty price.

Non-government bonds

For these securities, which are traded on the Stock Exchange, we use the actual information on a transaction. If we have no price data about the bonds, we determine the necessary data from database information on the securities using the following formula:

Dirty price = Clean price + Accrued interest

For this calculation we assume that the clean price is 100%.

Mortgage bonds

In the case of securities traded on the Stock Exchange, we use actual information. If we have no price data about the bonds, we determine the necessary information from descriptive data of the securities using the following formula:

Dirty price = Clean price + Accrued interest

For this calculation we assume that the clean price is 100%.

In determining dirty price the main question is measuring accrued interest of securities. Debt securities allow the payment of interest to their holders. Below, we show the calculation of accrued interest by individual instruments.

Calculation of debt securities' accrued interests

If we have precise information about the securities, we naturally use these data for the calculation. If we do not, we have to calculate the accrued interest using the predefined methodology.

To calculate accrued interest it is essential to obtain information about issue and maturity date, stock of securities at the reference date, and the next interest payment date.

We follow this methodology for every group of instrument, because every type has own particularities.

Considering accrued interest we have to separate the government bonds into fixed and floating bonds.

Fixed bonds

The accrued interests of fixed government bonds are calculated on the basis of **Actual/Actual method**, as also used by the Hungarian Government Debt Management Agency.

$$AI_i = c_{i+1} * (d_s - d_{t0}) / (d_{t1} - d_{t0}), \text{ where}$$

AI_i = accrued interest in per cent at the reference month

d_s = settlement date

d_{t0} = previous interest payment date

d_{t1} = next interest payment date

c_{i+1} = coupon in per cent at the next interest payment date

When have calculated the accrued interest in per cent, we can specify the amount of interest in the given currency (in Hungary in HUF) using the stock value. We assume that interest is always paid on the interest payment date, so the accrued interest is equal to zero at the end of the settlement day.

Floating bonds

In case of floating rate bonds we use different formulae to calculate the accrued interest depending on the reference product on which the interest calculation is based.

1. If the reference product is an interest bearing treasury bill, then the formula is the following:

$$\text{Accrued interest} = \frac{g_v * (d_s - d_{i-1} - \text{leap-day})}{365}, \text{ where:}$$

g_v = actual coupon of the government bond

d_i = date of the i-th cash-flow element (interest payment and redemption)

d_s = settlement day

2. If the reference product is a treasury bill, or any index-linked treasury bill (eg DWIX index), or any derivative or money market product (base rate, repo rate, BUBOR etc), then the formula is the following:

$$\text{Accrued interest} = g_v \times \frac{d_s - d_{i-1}}{360}$$

3. If the reference product is a fixed government bond, any derivative or consumer price index, then the formula is the following:

$$\text{Accrued interest} = \frac{g_v}{f} \times \frac{d_s - d_{i-1}}{d_i - d_{i-1}}, \text{ where:}$$

f = the number of interest payment or coupon announcements in a year.

MNB (central bank) bonds

We calculate the accrued interest of central bank bonds presently outstanding using the same method as in the case of floating government bonds.

$$\text{Accrued interest} = \frac{g_v \times (d_s - d_{i-1} - \text{leap-day})}{365}, \text{ where:}$$

g_v = actual coupon of MNB-bond with floating rate.

Interest bearing treasury bills

Interest bearing treasury bills are zero coupon securities as well, so interest is paid out only upon redemption. For this calculation we determine the period from the issue date to the settlement day out of the total interest paid on the whole period.

$$AI = \frac{k}{(d_n - d_0)} * (d_s - d_0), \text{ where}$$

k : nominal interest rate

d_s : settlement day

d_0 : issue day

d_n : maturity day

Discount treasury bills

In the case of discount treasury bills we deem the difference of nominal value and redemption price as being accrued interest in line with ESA95 methodology.

Other bonds and mortgage bonds

We calculate the stocks of accrued interest of non-government bonds and mortgage bonds using the following formula and the descriptive data of securities:

$$AI_i = k_{i+1} * (d_s - d_{t0}) / (d_{t1} - d_{t0}), \text{ where}$$

AI_i = accrued interest in per cent at the reference month

d_s = settlement day

d_{t0} = previous interest payment day

d_{t1} = next interest payment day

k_{i+1} = coupon in per cent at the next interest payment date

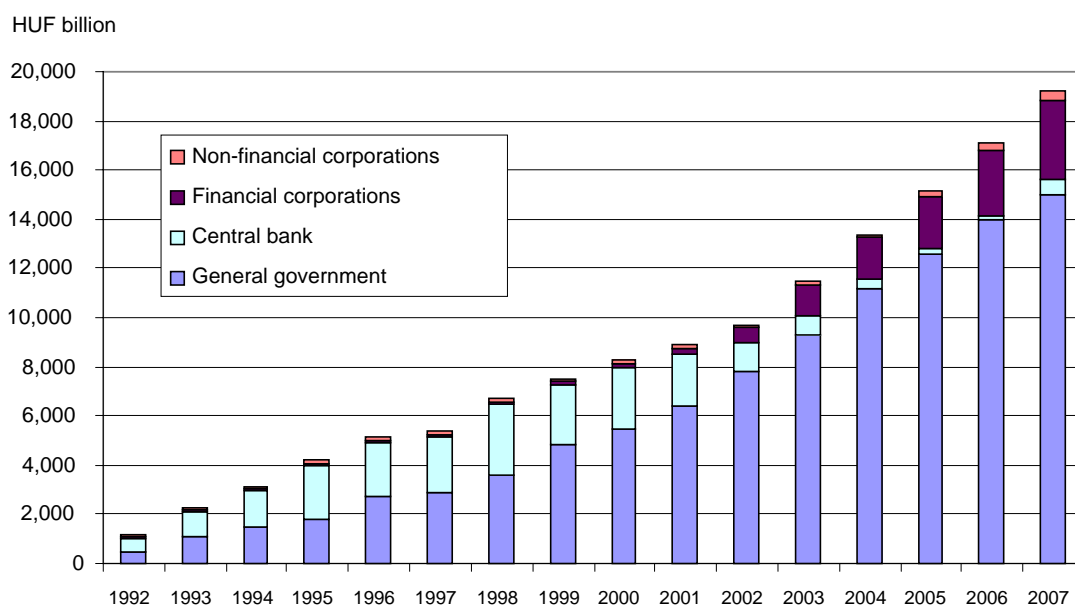
Finally, we summarise the most important issuer and holder sectors in the Hungarian securities market.

Securities debtors in Hungary

In the course of the 1990s and 2000s, the stock of securities issued by residents was on a steady rise, while the selection of security types did not change considerably. The role of different economic sectors, however, changed in relation to the issue of securities (see Chart 2).

Chart 2

Stock of securities issued by resident institutional sectors



Source: Magyar Nemzeti Bank (Securities and Financial Accounts Statistics).

Up to 1995, the MNB was the leading securities debtor in Hungary. Its sustained leading position is attributable to the fact that in this period there were major changes affected the composition of the central bank's liabilities. At the end of 1990, bonds represented only 30% of its liabilities vis-à-vis the rest of the world (thus, the larger share was composed of loans), but this ratio was reversed in five years. From 1991, the MNB did not finance general

government through lending, therefore the central bank's issue of bonds in the first half of the 1990s served the substitution of earlier loan debts and the increase of foreign exchange reserves. From 1996, the repayment of foreign exchange bonds dominated over new issues, but the volume of stocks did not fall significantly until 2001, as a result of the change in the foreign exchange rate and the issue of domestic HUF bonds commencing at the end of 1997.

Central government was the second-largest securities debtor in the first half of the 1990s, going head to head with the central bank, to take over the lead from 1996. If we disregard the central bank loans of the government, most of its debt was always represented by securities (government securities).

The behaviour of non-financial corporations – ranked third for some time in the area of securities supply – is very interesting. At the beginning of the 1990s, this sector assumed a considerable short-term and long-term debt (ie composed of bills of exchange and bonds) which, disregarding temporary increases in such stocks in the mid-1990s, has basically remained unchanged until 2004, amounting to approximately HUF 100 billion. This is possibly explained by the fact that companies primarily raised domestic funds through the issue of securities. The above trend is well illustrated by the fact that in ten years, the rate of issued securities within the total liabilities of companies fell from 1% to 0.2%. From 2005, the outstanding amount of securities increased significantly because of corporate bonds issued abroad.

With the exception of the MNB, among financial corporations, the securities debt of credit institutions grew at the highest rate in past years, and in 2000, this sector was therefore ranked third ahead of non-financial corporations. In 2003, it even changed places with the central bank, which reduced its foreign debts rapidly. Thus, after central government, the sector is currently the second-largest securities debtor in Hungary. The rising rate in the issue of securities by credit institutions is related to the increased volume of mortgage loans.

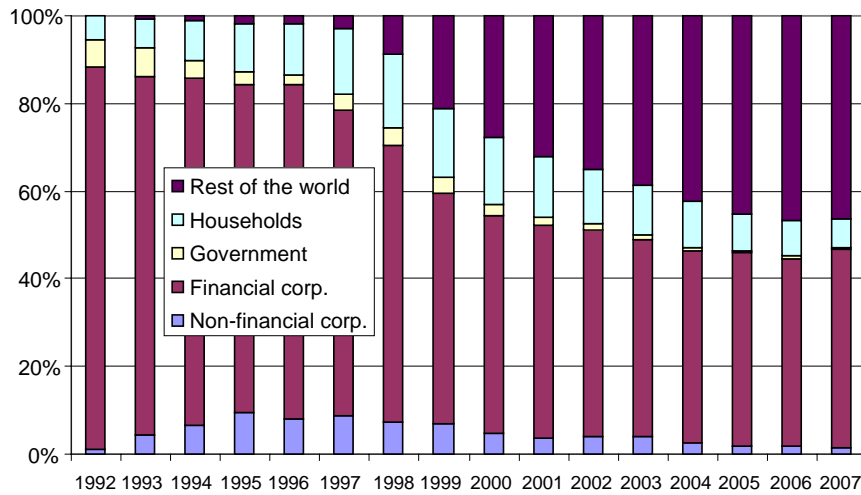
From the end of 2003, the role of this sector has been enhanced on the capital market by way of the securities issue of the Student Loan Center Co.

Holders of domestic securities

Approximately 55–60% of the total value of securities issued by resident institutional units has always been held by residents. In the first half of the 1990s, of the total quantity of outstanding securities, government securities and MNB-bonds, each representing roughly half of such quantity, were typically held by residents and non-residents, respectively. In parallel with the growing proportion of government securities, the increasing acquisition of these securities by non-residents commenced from 1998. Presently, the rate of foreign holding approximates 46% of government securities. Financial corporations are considered to be the largest resident holders of government securities; their share of outstanding securities has remained stable in past years, at nearly 50%. However, the role of individual subsectors in holding securities has changed. With the permanent domination of credit institutions, a considerable quantity of stocks was held by the central bank until 1997. In parallel with the reduction of these quantities, from the end of the 1990s, the investments of insurance companies and pension funds grew rapidly. Thus, this subsector has now basically caught up with credit institutions, considered to be the main investors in this area. The share of the second-largest holder sector, households, has gradually fallen from the peak value of 16%, measured in 1998, to the present 6–7% (see Chart 3).

Chart 3

Distribution of government securities by main holder sectors

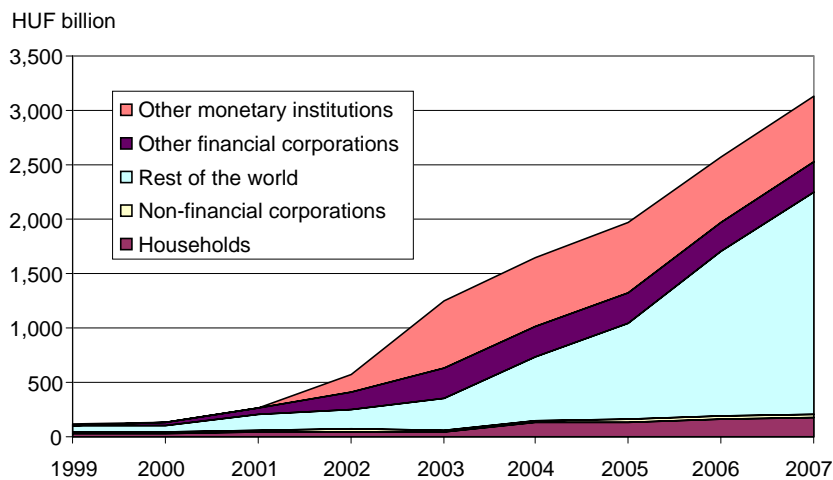


Source: Magyar Nemzeti Bank (Securities and Financial Accounts Statistics).

The securities of financial corporations (primarily credit institutions), other than the central bank, have traditionally been held by households and non-residents. As a result of the rise in the rate of home loans and mortgage bonds, from the end of 2000 the range of securities-holding sectors expanded: non-financial corporations and financial corporations, primarily insurance companies and pension funds, assumed a determining role in this area. In 2002, certain credit institutions started to finance the mortgage banks they owned through the purchase of securities, accompanied by the stalled purchase of securities by companies and households, which in turn drew loans. Since 2004, the increase in the outstanding amount has been driven by the issues of bonds abroad. Presently, financial corporations hold 28% of securities issued by credit institutions; most of the outstanding amount is held by non-residents (see Chart 4).

Chart 4

Stock of securities issued by other monetary financial institutions by main holder sectors



Source: Magyar Nemzeti Bank (Securities and Financial Accounts Statistics).

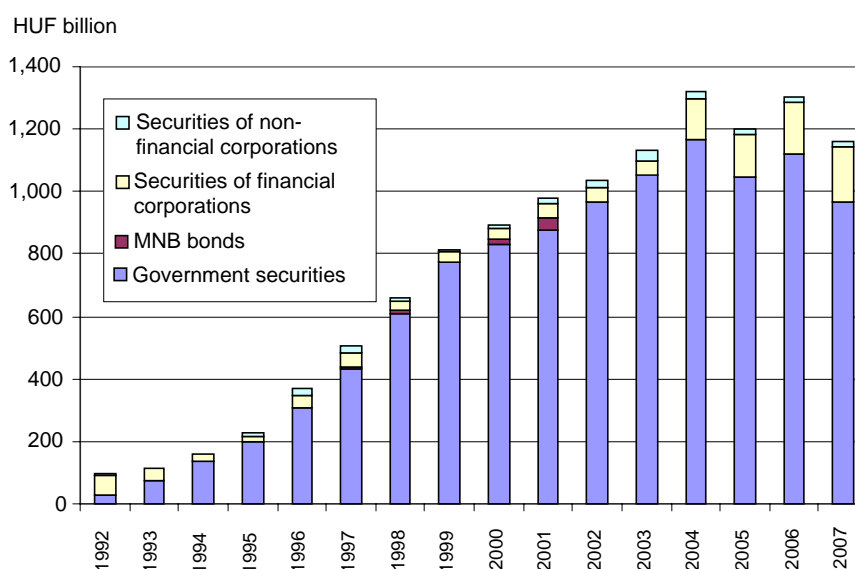
Portfolio of securities holders

Central government, the leading issuer of securities, holds the fewest debt securities representing credit relationships. Among the claims of institutions comprising part of general government, in addition to government securities, corporate and credit institution securities are also introduced, albeit in symbolic quantities.

The stock of securities held by households and non-profit institutions serving households increased at an accelerated rate in the course of the 1990s, but the growth rate slackened and evened out from the beginning of the following decade (see Chart 5). The share of government securities dominates among debt securities, followed by the bonds of financial corporations (credit institutions, other financial intermediaries).

Chart 5

Domestic securities investment of households and non-profit institutions serving households



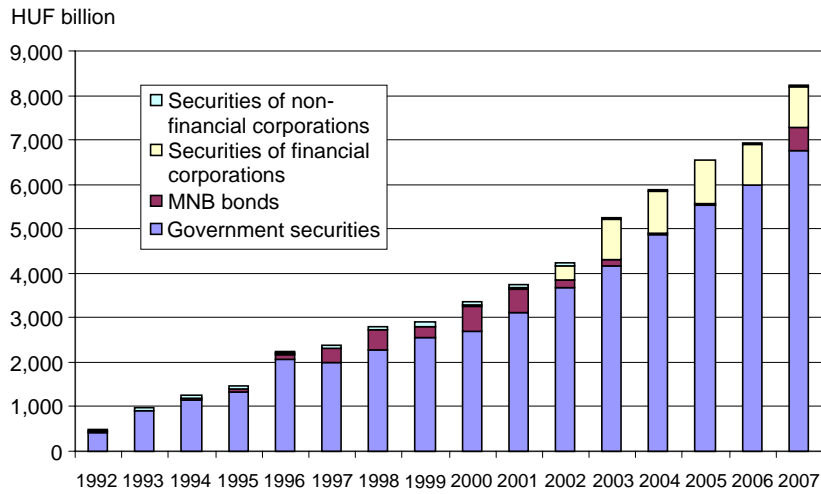
Source: Magyar Nemzeti Bank (Securities and Financial Accounts Statistics).

The domestic securities investments of non-financial corporations rose gradually until 1999, and have basically remained at a constant level until 2003 (nearly HUF 400 billion). From 2004 onwards, the securities holdings of non-financial corporations decreased gradually. The fall in the rate of intercompany securities is linked to the slump in the use of short-term commercial securities (bills of exchange) and the decrease in the stock of long-term corporate bonds held by non-financial corporations.

The stock of domestic securities held by financial corporations (the MNB, credit institutions, insurance companies, pension funds, mutual funds, other financial intermediaries) has shown a steady rise from year to year (see Chart 6). Similar constant growth characterises the stock of government securities, dominating securities portfolios. Between 1997 and 2002 and from 2007, domestic bonds issued by the MNB, from 2002 the securities (mortgage bonds) issued by credit institutions are noteworthy among the assets of the sector.

Chart 6

Domestic securities investment of financial corporations

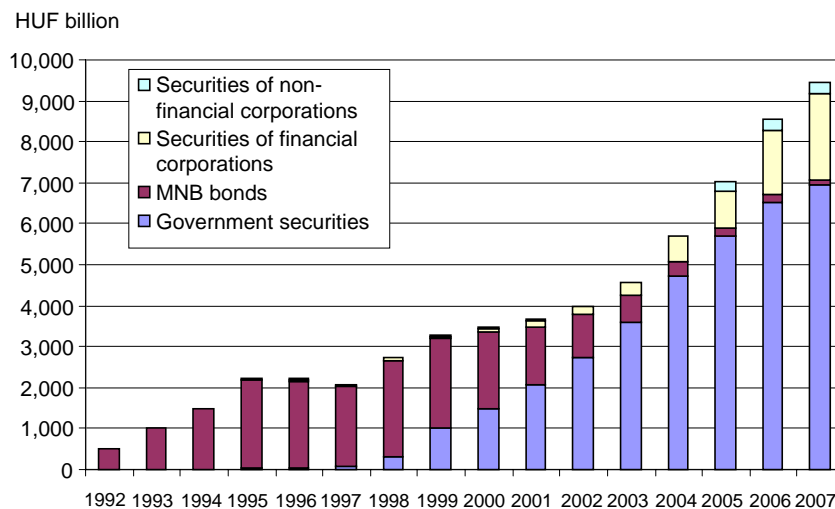


Source: Magyar Nemzeti Bank (Securities and Financial Accounts Statistics).

The most distinctive picture is provided by the composition of securities held by non-residents according to the time series and the type of securities (see Chart 7). Prior to 1998, practically only the MNB had a presence on the foreign bond market. From 1995, the central bank terminated its direct net lending to general government. The above trend is reflected by the fact that the stock of MNB-bonds held by non-residents decreased at a moderate rate up to the end of the 1990s, followed by a plunge in stocks. From 1998, the investment of non-residents in securities gained momentum and has since remained constant. Thus, by the end of 2001, general government became the largest securities debtor abroad. Furthermore, we may also observe the enhanced role of the securities of financial corporations (credit institutions) among foreign investments. These securities have always been in the majority of the instruments of non-residents, compared to securities issued by non-financial corporations. Of the latter papers, short-term commercial papers (bills of exchange) were purchased by the rest of the world in the first half of the 1990s and long-term bonds from 2005.

Chart 7

Stock of domestic securities held by the rest of the world



Source: Magyar Nemzeti Bank (Securities and Financial Accounts Statistics).