

# THE IMPACT OF PUBLIC DEBT SUPPLY ON THE YIELD CURVE

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## Abstract

The paper presents an analysis of the impact of debt contracting by the State Treasury (and generally by the sector of public finance) on the profile of the yield curve. The analysis has been made from the point of view of a debt manager and refers to the specific period of the last 2-3 years. The specificity of this period has been determined by the play of the financial market on the convergence of interest rates resulting from the advancing process of Poland's accession to the European Union (EU) and further on to the Economic and Monetary Union (EMU) carried out under conditions of changing risk premium and increasing public debt (the public finance crisis in the second half of 2001) as well as high interest rates (increases in the central bank interest rates in 2000, maintenance of high real interest rates in 2001 and 2002). A comparison of the yield profile of treasury securities with their supply shows that generally when rates were dropping the sales of medium- and long-term treasury bonds were high and on the contrary: increasing rates did not result from the sales of bonds whose supply was reduced in those periods. This situation indicates that the increasing debt supply in the years 2001-2002 put much less pressure on the increasing yield curve than the impact of the remaining factors affecting decreasing interest rates. These factors include mainly: the process of reduction of the NBP's base interest rates continuing since the first quarter of 2001 and the drop of rates on developed financial markets, the expectations of interest rate convergence and the diminishing risk of investment in fixed-interest securities connected with Poland's entering the EU, the increasing demand for treasury bonds, bills and notes resulting from the rapidly growing potential of the domestic non-banking sector (pension funds, investment funds, insurance companies) and the inflow of foreign capital. The limited impact of debt supply on the interest rate market ensued also from a rather elastic policy of offering treasury securities (predominantly medium- and long-term fixed interest bonds) consisting in increasing the selling in periods of rates falling and a brisk demand, and limiting the offer when there occurred an temporary upward trend in rates.

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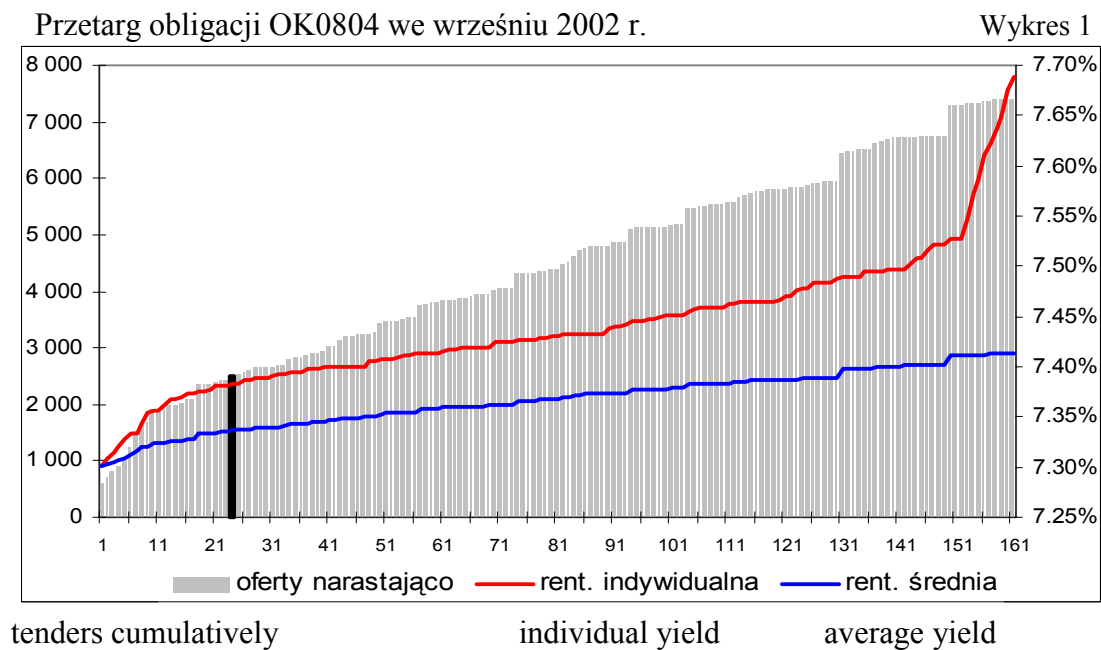
## I Single tender offer of treasury securities and the distribution of yields

Theoretically, the dependence between debt supply and the level of interest rates can be determined most precisely basing on the profile of theoretical sales volume of treasury bills and bonds on the primary market and on the yield levels corresponding to these sales. At a tender for treasury bills, bonds and notes, each investor puts in the value of securities which they want to buy and their price. Thus it is possible to follow what the medium and maximum yields of particular securities would be with increasing value of sales. Two bond tenders of different character, conducted in September and October 2002, will serve as an example of such analysis.

In September 2002 there took place a successive tender for zero-coupon bonds sold since October 1999. The supply of OK0804 bonds amounted to 2.5 bln PLN, demand 7.4 bln PLN, and the value of accepted tenders 2.5 bln PLN (at the supply level). In effect, the minimum yield was 7.302%, average 7.336% and maximum 7.384%. The distribution of tenders (cumulatively) and the corresponding yields are shown in Chart 1 where:

- axis x is the number of tenders
- axis y (left) is the nominal value of tenders cumulatively (million PLN)
- axis y (right) – yield
- black bar – value of accepted tenders (2.5 bn PLN)

Chart 1 Tender for OK0804 bonds in September 2002.



Even a rough graphical analysis indicates that brisker sales of bonds would not have resulted in a significant increase in the maximum and average yield. A jump in the maximum yield would have occurred only with acceptance of the last tenders. This is confirmed by Table 1 which shows changes in the levels of maximum and average yields of bonds (increase) for each 500 million PLN of greater sales (in basis points; 1 b. p. = 0.01%)

Table 1

Value of tenders cumulatively (m PLN)	Yield change (in b. p.) for each 500 m greater sales	
	Maximum yield	Average yield
600 <sup>*)</sup>	0.0	0.0
1,000	2.5	0.6
1,500	0.7	0.9
2,000	3.4	0.9
2,500	1.5	1.0
3,000	1.7	1.0
3,500	1.1	0.8
4,000	1.3	0.8
4,500	0.8	0.8
5,000	1.3	0.8
5,500	1.3	0.6
6,000	2.9	0.6
6,500	0.3	0.9
7,000	3.8	1.3
7,398	16.0	0.3

*\*) the value of the first tender was 600 m PLN*

The described tender is an example, classic of the recent period, of the distribution of tenders on the primary market for treasury securities which are on offer on a regular basis. A relatively small price range of submitted tenders results mainly from:

- the issuer's adopted practice of accepting tenders within which the value of supply is the upper limit of the volume of offer – this is a way of limiting the investors' risk of the so-called "winner's curse" effect occurring, i.e. the situation in which an investor bought bonds, however, at prices much higher than those obtained by other buyers (this refers to the acceptance of tenders above the supply with low prices),
- the existence of a theoretical and practical possibility of accepting tenders below the supply, which is applied in the case of submitted tenders with prices different from market prices,
- the market discounting the value of the supply of bonds after announcing it and when it is assumed that the issuer does not accept tenders above the supply.

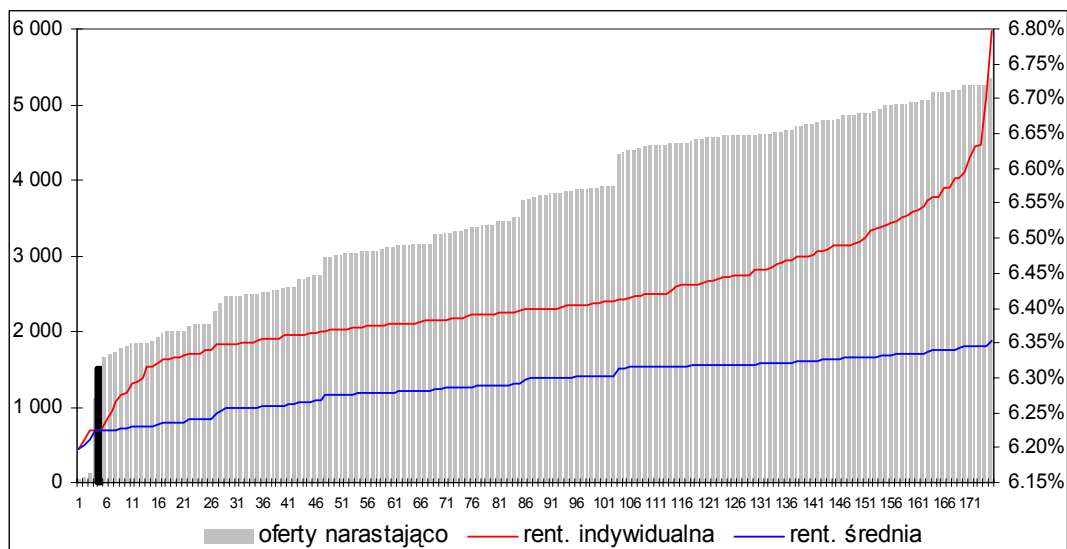
A tender for bonds sold for the first time or at long time intervals (10-year and 20-year long-term bonds) can look slightly different. This was the case with the bonds with the redemption date in 2013 (DS1013) first offered for sale in October this year. The supply and sales of DS1013 bonds amounted to 1.5 bn PLN at a demand of 5.4 m PLN. The minimum yield

amounted to 6.197%, average 6.224% and maximum 6.225%. The distribution of tenders (cumulatively) and the corresponding yields are shown in Chart 2.

Chart 2. Tender for DS1013 bonds in October 2002.

Przetarg obligacji DS1013 w październiku 2002 r.

Wykres 2



tenders cumulatively      individual yield      average yield

As it follows from an analysis of the chart, the maximum yield of bonds increases significantly for tenders above the supply while the average yield increases moderately, pulled down by the great weight of first tenders with lowest yields. This is confirmed by Table 2 which shows changes in the levels of bond maximum and average yields for each 500 million PLN of greater sales.

Table 2

Value of tenders cumulatively (in m PLN)	Yield change (in bp) for each 500 m of greater sales	
	Maximum yield	Average yield
1.120 <sup>*)</sup>	2.9	0.0
1.500	0.0	0.0
2.000	10.3	1.2
2.500	2.5	2.2
3.000	1.6	1.7
3.500	2.5	1.6
4.000	1.7	1.2
4.500	2.2	1.4
5.000	9.3	1.6
5.351	27.2	1.9

*\*) among the first tenders, there was one of 1,000 million PLN*

The analysed tender is an example of a distribution of offers which results from:

- lack of market consensus as to the price profile for a given segment of the yield curve – it usually occurs while introducing an instrument with the longest maturity (10, 20 years) for sale,

- great determination of one investor (a group of investors) to buy a given kind of treasuries,
- market probing done by the issuer.

An increase in yield for last tenders is also more clearly visible than in the first example. This is an effect of frequently occurring tendering behaviours known as “*ground fishing*”. One or several investors submit tenders with prices departing from market prices, knowing that their acceptance is hardly probable although possible under specific circumstances (e.g. when supply is low and the issuer has great credit needs or in the case of the issuer’s mechanical decision such as: if the value of demand > the value of supply, then the value of sales = the value of supply). The probability of accepting tenders with low prices (high yields) grows when there is no explicit market consensus as to the profile of prices for a given fragment of the yield curve.

The presented differences in the distribution of offers for the selected two tenders are not too big after discarding the extreme quantities. Even if a much bigger pool of bonds had been sold, this would not have resulted in an increase in the yield by more than several to fewer than twenty basis points. This follows from the market’s awareness of the issuer’s application of the mentioned policy of accepting tenders and, first and foremost, from the market’s discounting the value of bond supply after announcing it. However, since the market discounts the value of supply of treasury bills and bonds earlier, then the distribution of tender offers is only a “*photograph*” of the market at a certain moment. So an analysis of investors’ behaviours in tendering can be important information for the debt manager (the costs of debt servicing depend on tendering results) and market participants but if rationality in the policy of accepting offers is assumed, it is of limited value while trying to determine the impact of the state budget’s credit needs on the yield curve at a longer term. In order to identify this impact, it is necessary to make an analysis which would allow for the market’s discounting the expected value of the sales of treasury securities.

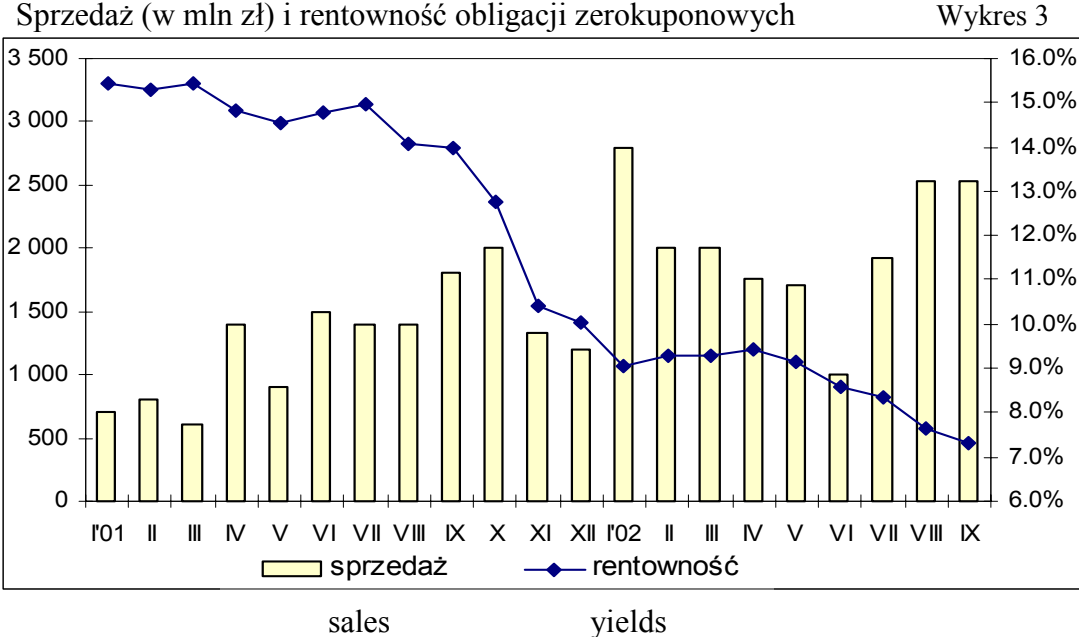
## **II Sales of treasury securities and their yields on the primary market**

The analysis covers the period between the beginning of 2001 and September 2002. In this period, there took place changes in the shape and position of the yield curve. At the beginning of 2001, the yield curve was visibly converted (1-year treasury bonds produced a yield of almost 17.0%, 2-year bonds – 15.5%, 5-year – 12.5% and 10-year - 10.4%). Until July 2001, short term interest rates had continued to drop following the three time repeated reduction of the base rates of the NBP (the policy rate was reduced by 3.5 percentage points, the yield on one-year T-bonds dropped by 1.7 percentage points, and 2-year bonds by one-half percentage

point) while medium- and long-term rates had increased (the yield of 5-year bonds had grown by 1 percentage point, of 10-year bonds by 1.7 percentage points). From August 2001, a fall in the yield of all treasuries began and it continued, with corrections, until the end of the period under analysis.

Chart 3 shows the volume of sales of zero-coupon bonds (with ca 2 years to maturity) by classic monthly tender and by switch operation<sup>2</sup> as well as their average yield.

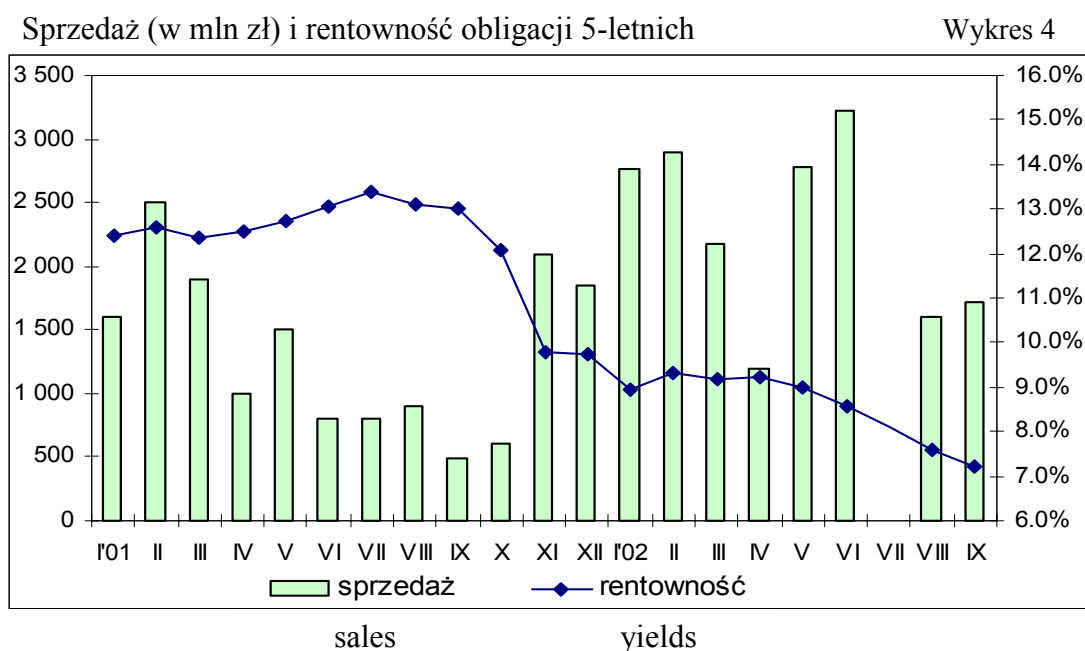
Chart 3 Sales (in million PLN) and yields of zero-coupon bonds



In the period under discussion, the average yields of zero-coupon bonds fell by 8.1 percentage points, and the debt in them increased by 21.8 billion PLN. At the same time, in the period of the highest yields of zero-coupon bonds their offer was limited (first quarter of 2001). The briskest sales of bonds took place in the period when they reached their periodically lowest yields (January 2002). In the next four months, the yields of the bonds slightly increased and the value of sales diminished. As it follows from graphical analysis, the value of sales did not, generally, affect increasing yields. This is confirmed by the correlation coefficient of sales value and yields which was equal to  $-0.68$  for the analysed period. The situation was similar in the case of sales results for bonds with maturity dates close to 5 years (in classic tendering and switch operations).

<sup>2</sup> A switch operation consists in redeeming some bonds before their maturity date in exchange for other bonds (cashless transactions). Such operations are booked as two separate transactions: pre-maturity redemption of *old* bonds and sales of *new* bonds.

Chart 4. Sales (in million PLN) and yields for 5-year bonds

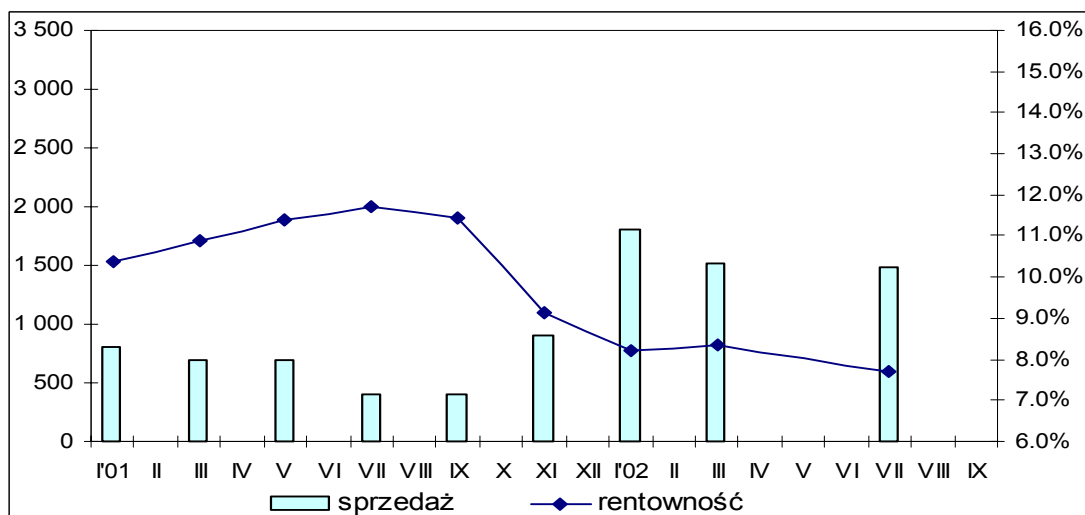


Unlike the results for sales of zero-coupon bonds in the first quarter of 2001, the value of sales of 5-year bonds in the same period was large. In the next months the yields of bonds increased and their offer was limited until October 2001. A sharp fall in the yields in November was accompanied by a jump in the value of sales. The high sales continued until June (except for April), and the yields did not change much. Only in August and September a fall in the value of sales was accompanied by a drop in yields, due to which the correlation coefficient in the period between January 2001 and September 2002 equalled *only*  $-0.60$  (from January 2001 to June 2002 it was  $-0.74$ ). In the analysed period, the accrued debt in terms of 5-year bonds amounted to 22.6 billion PLN, and the average yield dropped by 5.2 percentage points.

The negative correlation between the value of sales of T-bills and T-bonds and their yields occurs most distinctly in the case of bonds with maturities close to 10 years (Chart 5)

Chart 5. Sales (in million PLN) and yields of 10-year bonds

Sprzedaż (w mln zł) i rentowność obligacji 10-letnich Wykres 5



For the needs of analysis, the values of 10-year bonds sold by switch operation in the months when no classic auctions were conducted were added to the values of sales by classic tender in the closest periods. Even a rough graphical analysis shows a clearly inverse relationship between the value of the sales and their yields, which is confirmed by the value of correlation coefficient: -0.93. In the period under discussion, the average yields of 10-year bonds dropped by 2.7 percentage points, and the debt in these bonds increased by 8.8 billion PLN.

All the presented examples of relations between the yields of bonds and their sales indicate that it was not the value of bond supply that decisively affected the profile of the yield curve but on the contrary: the supply of bonds was adjusted to the profile and position of the yield curve. The power of market in shaping this curve (particularly its longer end) was much bigger than changes in bond supply.

In the face of the budget deficit increasing in the years 2001-2002 and revenues from privatisation decreasing, elasticity of bond supply according to market developments was only possible while using supplementary financing (treasury notes) actively and creating reserves of liquid assets. In the discussed period, debt in treasury bonds increased by 20.8 bn PLN, and the value of means in budget accounts at the NBP in 2002 reached a level which, for the first time in history, made it possible to give up debt contracting in instruments of shortest maturities. In addition, increasing the issuance of notes was justified because of a rapid fall in their yields (by 9.6 percentage points in the mentioned period). Regarding T-notes as an instrument of managing the liquidity of state budget meant that their sales could not be subordinated to the yield curve profile as in the case of bonds. Despite this fact no meaningful dependencies were observed between the value of sales of notes and their yields (the correlation coefficient for primary 52-week notes was  $-0.29$ ).

### **III Balance of treasury securities and of their yields**

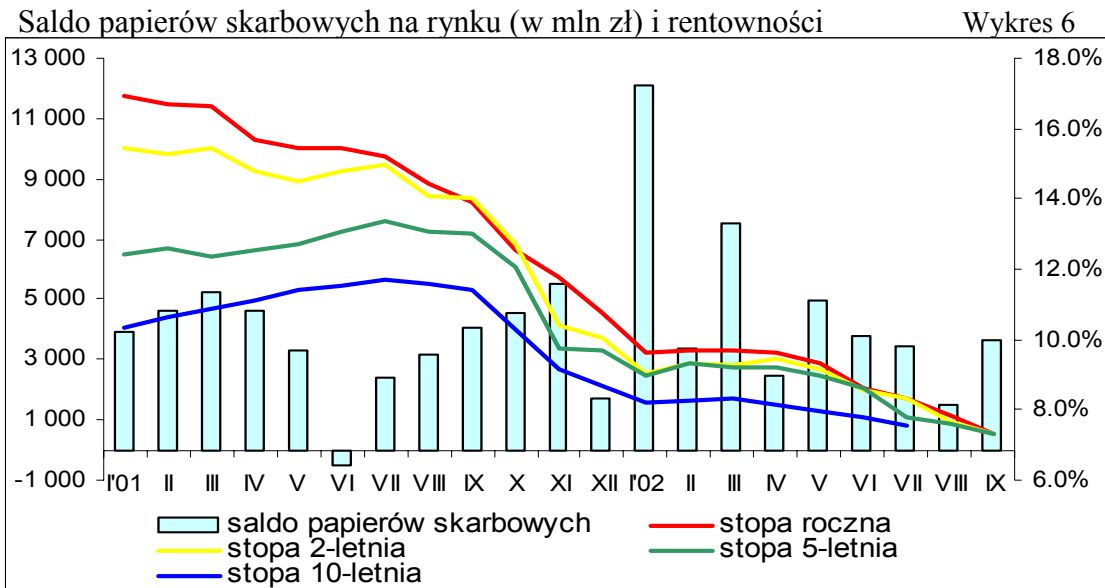
Huge issuance of treasury notes and redemption of bonds issued in previous years mean that the maturing debt must be rolled over frequently so it is worth checking whether the observed relations between the value of sales of treasuries and their yields also refer to the balance of treasury bonds, bills and notes (the difference between the sales and redemption) and the yield curve. Chart 6 shows the profile of monthly balances of treasuries issued on the domestic market<sup>3</sup> and the yields of particular kinds of treasuries.

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<sup>3</sup> The balance refers to treasury securities owned by all subjects exclusive of the NBP. So the value of treasury bonds sold by the central bank from its portfolio by outright operation and the value of redeemed non-market bonds are taken into account.



Chart 6. Balance of treasuries on the market (in million PLN) and yields



balance of treasuries  
2-year rate  
10-year rate

1-year rate  
5-year rate

The yield profile of primary treasury securities did not show a positive correlation with the fluctuations of the value of treasuries on the market. In one month in which the balance of treasuries was negative (June 2001) the levels of yields of medium- and long-term bonds were close to maximum values and in the month of a jump in balance (January 2002) the yields of all the primary treasury securities reached their periodical minima. The correlation coefficients for the balance of T-securities and the yields of particular types of the treasuries were as follows:

- -0.13 for 52-week T-notes,
- -0.17 for 2-year bonds,
- -0.21 for 5-year bonds,
- -0.57 for 10-year bonds.

#### IV Net debt supply and the yields of T-securities

So far we have considered the impact of treasury securities supply on the yield curve. However, the state budget's borrowing needs are a much wider category whose size is composed of:

- budget deficit
- repayment of liabilities (T-securities, credits and loans, remaining debt – e.g. compensations)
- granted loans and credits,

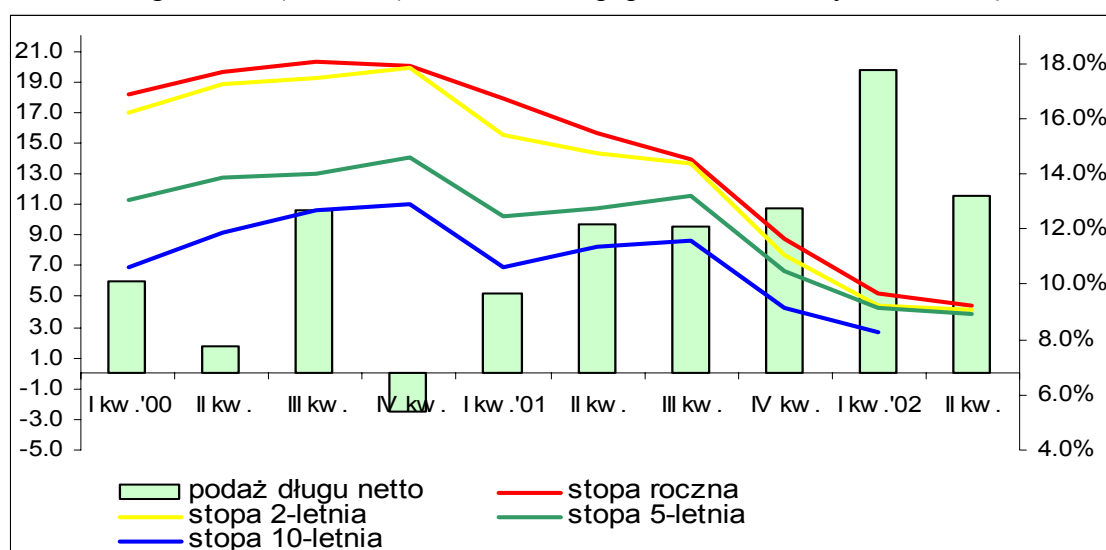
- means designed for liquidity management and other expenditure related to debt management.

The difference between the amount of the state budget's borrowing needs and the value of revenues from other sources than debt contracting (privatisation, means from accounts and deposits, repayment of loans granted by the State Treasury) determines the level of net debt supply of the State Treasury. The State Treasury's net debt supply is the primary category of public finance affecting the level of market interest rates, but, of course, not the only one. Besides the State Treasury, there exist many subjects of the government and self-government sectors (among others: territorial self-government units, National Insurance, public health care units, target funds, agencies, state university rank schools). Together, they constitute the public finance sector. The data concerning the public finance sector's debt are available by the end of each quarter. Thus it is possible to analyse the fluctuations of the level of the public finance sector's domestic debt (net debt supply) and the profile of yields of primary types of T-securities every three months (Chart 7)

Chart 7. Net debt supply<sup>4</sup> (in billion PLN) and the yields of T-securities

Podaż długu netto<sup>1</sup> (w mld zł) i rentowności papierów skarbowych

Wykres 7



net debt supply  
2-year rate  
10-year rate

1-year rate  
5-year rate

<sup>4</sup> Changes in the public finance sector's domestic debt after consolidation (i.e. after removing mutual indebtedness between the subjects within this sector), without dollar bonds from 2001 and without exchange rate differences on dollar bonds of 1991. The yields of T-securities in a given quarter constitute the arithmetic average of yields in particular months of this quarter.

Also in this case no positive correlation occurs between net debt supply and the yields of T-securities. In the period of the greatest increase of the debt (first quarter of 2002) the yields of treasury securities dropped noticeably. The correlation coefficients for all types of T-securities and net debt supply varied between  $-0.70$  and  $-0.76$ .

### **V Factors affecting the yield curve in the years 2001-2002**

The conclusions that the impact of debt supply on the yield curve is weak and that this supply is adjusted to market conditions ought to be completed with the statement that although any increase in the debt of the State Treasury (the public finance sector) adversely affects the level of market interest rates, other factors, however, affect the profile of the yield curve with much greater power. Between 2001 and 2002, the net debt supply in Poland reached a high level. However, the impact of this supply on the yield curve was much weaker than the total impact of other elements, the most important of which are the following:

1. The reductions of the central bank rates.
2. The expectations of interest rate convergence.
3. The diminishing risk of investment in treasury securities.
4. The increasing demand for treasury securities.

As an employee of a debt managing institution I hope that the limited impact of debt supply on the market partly resulted also from the sufficiently elastic policy of offering treasury securities (mainly fixed interest medium- and long-term bonds) which consisted in increasing the offer in the periods of falling rates and great demand and in reducing the offer when there occurred a periodic upward trend in rates.

#### **Re 1. Reductions of the central bank rates**

The impact of the process of reducing the base interest rates of the NBP, which started in the first quarter of 2001, on the level of the yield curve referred directly to the short end of the curve and indirectly to its longer segment. Between the beginning of 2001 and October 2002 the repo rate was reduced by 12 percentage points.

#### **Re 2. Expectations of interest rate convergence**

An impact of the reduction of the base rates of the NBP on the longer end of the curve was possible in conjunction with increasing expectations of their further lowering connected mainly with the process of interest rates converging to the falling level occurring in the EU countries. These expectations obviously resulted from the approaching date of Poland's accession to the EU in prospect to the EMU. In the second half of October, after the joint announcement of the Ministry of Finance and the NBP on the rightness of Poland's entering

the EMU as soon as possible, the market discounted the full convergence in 2007 (Charts 8 and 9).

Chart 8 Annual interest rate in Poland and the EU<sup>5</sup>

Roczna stopa procentowa w Polsce i EU<sup>2</sup>

Wykres 8

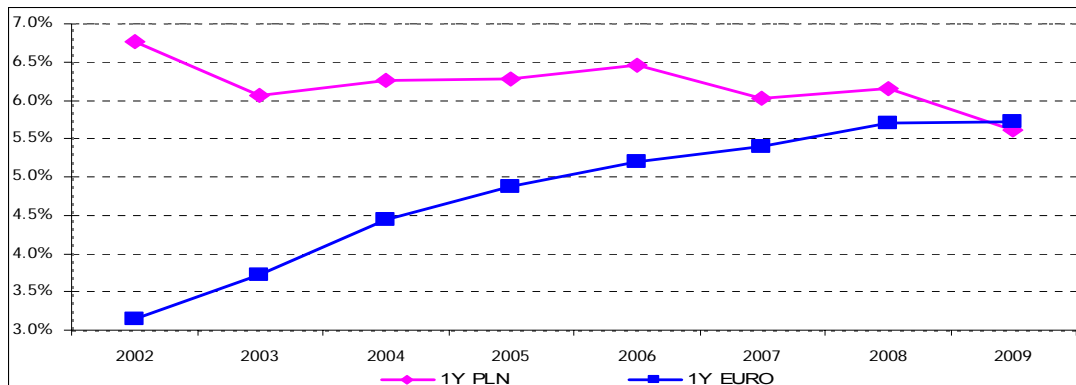
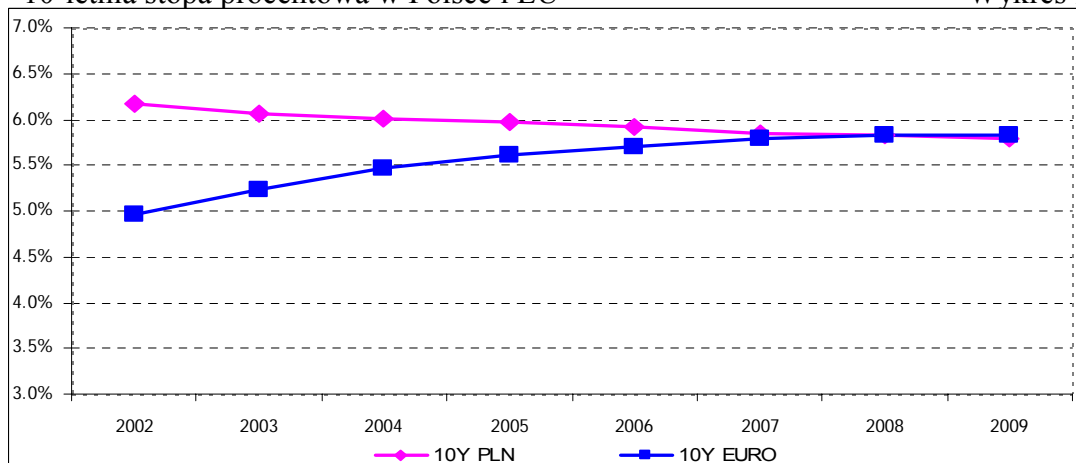


Chart 9. 10-year interest rate in Poland and the EU

10-letnia stopa procentowa w Polsce i EU

Wykres 9



Any information on Poland's accession to the EU and the EMU being threatened was reflected in market interest rates. Also the risk of stopping the process of further reduction of the NBP rates resulting from the crisis in public finance in mid-2001 brought about a temporary increase in the yields of medium- and long-term treasury bonds.

The macroeconomic situation of Poland was not without significance for the expectations of the central bank rates reduction, either (lower GDP growth rate, inflation falling to the EU levels, growth of unemployment, noticeable reduction of the negative current account balance, a fall in the credit growth rate).

<sup>5</sup> Implied interest rates on the basis of the swap curve.

### **Re 3. Diminishing risk of investment in treasury securities**

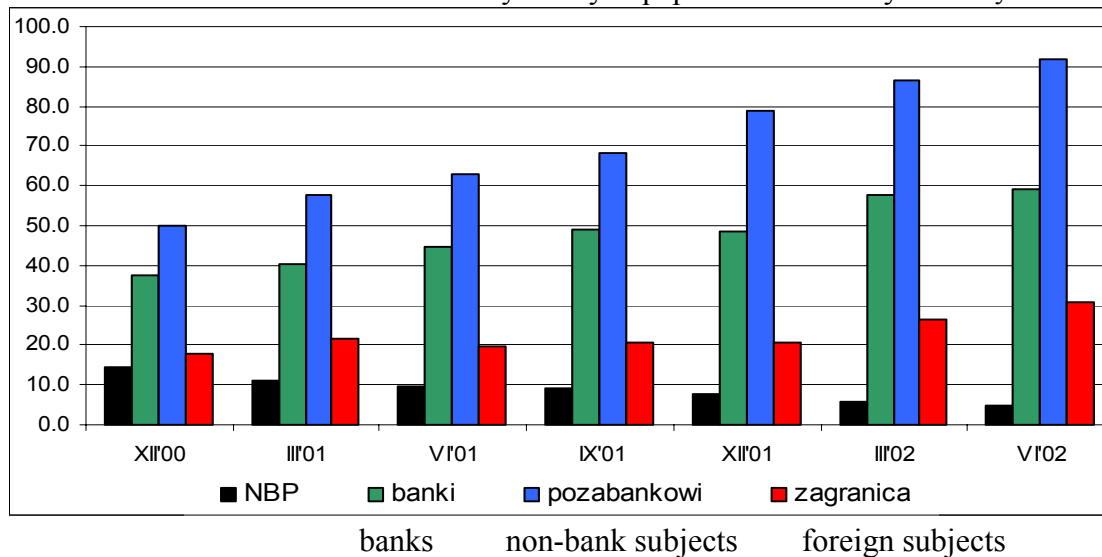
The process of Poland's accession to the EU, the prospects of entering the EMU and the improvement of macroeconomic indicators significantly affecting investors' behaviours (current account deficit, inflation) had a decisive impact on the falling risk of investment in treasury securities. The reduction of credit risk (risk of issuer's insolvency) was of particular importance since due to this not only short-term but also long-term capital coming from non-bank investors started to flow into the treasury securities market. Also the remaining kinds of risk were reduced, i.e. those relating to market liquidity (with the development of treasury securities market infrastructure) and the general economic situation in Poland.

### **Re 4. Increasing demand for treasury securities**

Placing the increasing debt supply on the market without an increase in interest rates must take place under conditions of sufficient demand. Between 2001 and 2002, the investors' base in all the primary groups of subjects was expanding (Chart 10)

Chart 10. Structure of debt in market treasury securities according to subject

Podmiotowa struktura zadłużenia w rynkowych papierach skarbowych Wykres 10.



In 2001 and in the first half of 2002 the value of market treasury securities in the portfolios of domestic banks (exclusive of the NBP) increased by 21.9 bn PLN (58.4%), in those of domestic non-bank investors by 41.7 bn PLN (83.3%) and of foreign investors by 13.1 bn PLN (73.6%). In the same period, the value of the NBP's treasury securities fell by 9.4 bn PLN (66.2%). The increasing involvement of domestic banks in investments in treasury securities resulted not only from the growth of the balance total of the banking sector but also

from the economic situation (reduction of lending activity). The demand of the domestic non-bank sector was mainly generated through the growing potential of pension funds, investment funds, insurance companies and other financial institutions. The inflow of foreign capital was, in turn, connected with both the play on convergence and the reduction of investment risk in Poland as well as high spreads between interest rates in Poland, the EU countries and the USA.

The profile of the yield curve was significantly affected by the structure of the demand for treasuries according to its subjects and objects. As long as domestic banks concentrated on increasing the portfolio of treasury notes, non-bank subjects and foreign investors clearly preferred investments in treasury bonds (Charts 11 and 12).

Chart 11. Debt structure in treasury notes according to subjects

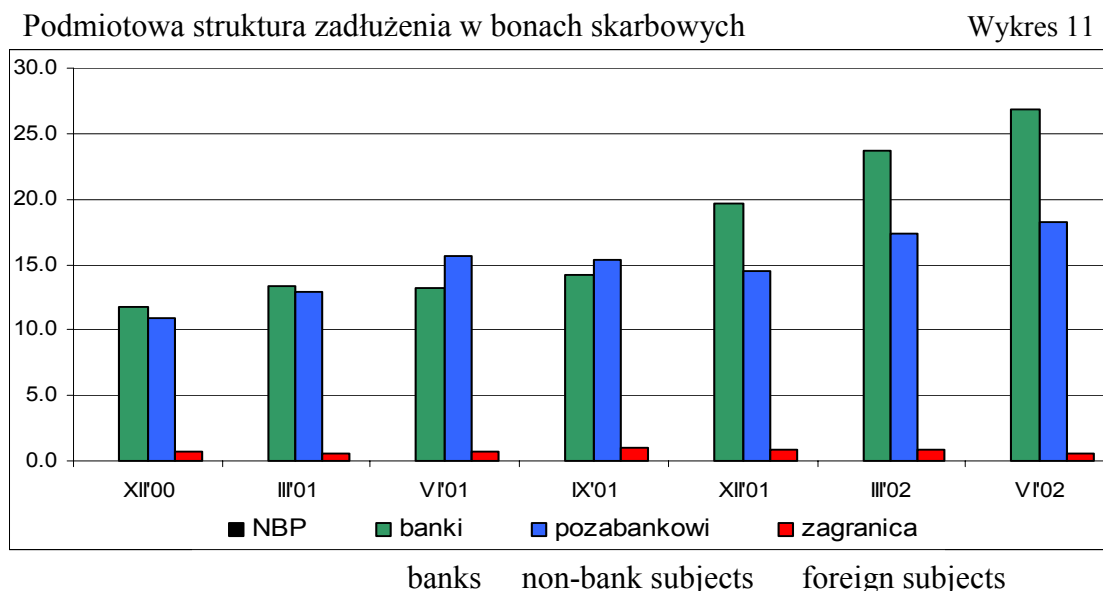
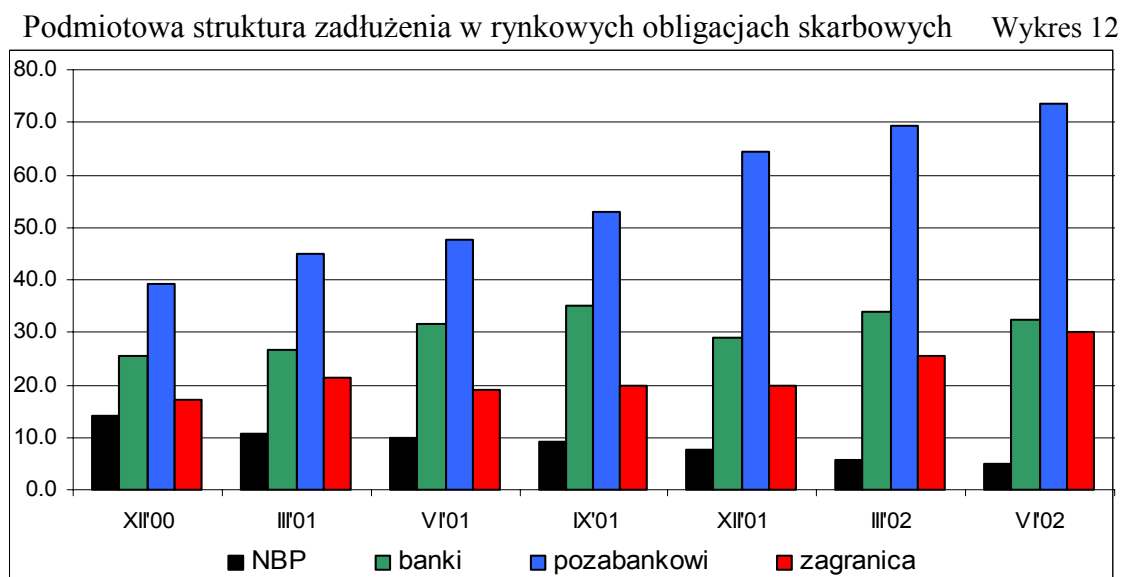


Chart 12. Debt structure in market treasury bonds according to subjects



banks      non-bank subjects      foreign subjects

In the period under discussion, the portfolio of treasury notes in domestic banks increased by 15.1 bn PLN (127.2%), and the portfolio of bonds by 6.8 bn PLN (26.6%). In the domestic non-bank sector the situation was reverse: the portfolio of notes increased by 7.2 bn PLN (65.9%), and the portfolio of bonds by 34.5 bn PLN (88.2%). Foreign investors were interested in bonds only, which was evidenced by the fall in the value of the portfolio of notes by 0.1 bn PLN (-12.7%) and increase in the portfolio of bonds by 13.2 bn PLN (76.9%).