

# A cautionary note on the choice of the risk-free interest rate in Japan

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## 1. Introduction

In empirical research of Japanese financial markets the risk-free interest rate is usually chosen from among one of the government bonds issued by the Ministry of Finance or, for shorter terms, the call money rate or the *gensaki* rate (Hamao (1991)). This practice neglects the fact that the Japanese Postal Savings System has accepted until December 1998 deposits that for all purposes were as risk free and as liquid as the liabilities of the Ministry of Finance and that from the point of view of the private investor differed from them in just one major point: usually they offered somewhat higher interest rates. The differential between the rates paid by these deposits and the other risk free rates varied but became considerably large during periods of low interest rates. As any rational investor would deposit in the Postal Savings System the funds he allocated to the risk free asset before buying any other risk free instruments, disregard of this possibility in empirical work involving periods before the end of 1998 will result in a serious systematic underestimation of the risk free interest rate.

In this note, after a brief description of the institutional environment in the next section, we show in Section 3 that until the end of 1998 there was a floor on the rates paid on time deposits in the Postal Savings System. In other words, irrespective the rate that the Postal Savings System quoted for each maturity, it would pay a rate no lower than that floor. We point that for deposits with maturity of less than one year this floor varied inversely with the maturity of the deposit and that for the most short interest paying maturity (1-week) the annual rate paid would never fall below 5.33% (after taxes).

## 2. The Institutional Environment

The Japanese Post Office is under the direct administration of the Ministry of Posts and Telecommunications. It has three main business units that although share installations and personnel have independent accounting. These are the Postal Service, that offers the usual services of mail collection and distribution, the Postal Savings System (PSS) that accepts deposits, gives loans, handles foreign exchange and makes domestic and international remittances, and the Postal Insurance System (PIS) that sells life insurance and individual pension plans.

The larger part of funds collected by the PSS and PIS are paid in trust to, respectively, the Trust Fund Bureau and Postal Annuity Fund which are administered by the Ministry of Finance's Finance Bureau. These Funds are in turn the main funding sources of the government's Fiscal Investment and Loan Program (FILP), known also as the government's second budget. Although the FILP is drawn in parallel with the budget it is considered to be relatively free of meddling from politicians. The Ministry of Finance uses it as a counter-cyclical fiscal tool that allows investment in infrastructure and public works without recourse to taxes or debt issued directly by it. Its size is about 50 percent of the size of the government's general budget (see Bronte (1982), Ito (1992) and Nakamura and Yamada (1996) for short complementary descriptions of the FLIP).

It is difficult not to emphasize the importance of the financial business of the Post Office in Japan. Even not taking account of its insurance business, the Japanese Post Office qualifies as Japan's (and the world's) largest financial institution: for example, in volume of deposits it dwarfs the largest banks (by the end of 1996 all the then 164 Japanese banks taken together had a total amount of ¥ 436,280,000 million in deposits and Certificates of Deposit against ¥ 223,122,400 million in deposits in the PSS), and also has more branches than all other Japanese banks (also for 1996, it had 24,587 versus the 16,675 branches of City Banks, Regional Banks I, Regional Banks II, Trust Banks and Long-term Credit Banks).

The PSS offered, at the end of 1998, 15 different types of postal saving accounts (not counting differences in maturity or minimum amounts required), most of which were very much like bank depository accounts. Besides offering higher interest rates than those offered by similar deposits in banks and higher convenience due to the extensive number of Post Offices, deposits in the PSS were, and still are, widely perceived by the public as being less risky than deposits in banks: while the former are still direct liabilities of the Japanese government (and thus no more risky than bonds issued by the Ministry of Finance) the latter have had more than five consecutive years of bad and intense publicity due to a handful of bankruptcies. Thus it is not surprising that the PSS share of deposits has been steadily increasing over the last years, and it is only natural that banks resent this as unfair competition and have long been calling for the break up and privatization of the PSS, that, it is claimed, constitutes an unnecessary encroachment on the private sector by the government.

### **3. The PSS' time deposits**

Any person, either individual or legal (corporation, partnership, cooperative, public entity, etc.), is entitled to open accounts and deposit up to ¥ 10,000,000 (equivalent to about US\$ 91,000 at the exchange rate of 110 ¥/US\$) in the PSS. Obviously, in a household with 4 people ¥ 40,000,000 (about US\$ 364,000) can be put into PSS'

deposits. As a rule, interest is taxed at 20% (as in other financial institutions), allowance being made for some exceptions of social character (for example, disabled and handicapped persons, people aged above 65, etc., are allowed to tax free interest in deposits up to ¥ 3,500,000).

Time deposits in the PSS were submitted to the following rules until the end of December of 1998:

a) Each deposit was made in units of ¥1,000.

b) The minimum amount required to make a deposit was 1 unit (¥1,000) and the maximum amount allowed was 10,000 units (¥10,000,000), provided there were no other deposits.

c) Deposits could have maturities of one, three or six months, or one, two or three years.

d) Interest, and taxes due on that interest, were computed on each unit individually. Total interest on the deposit equaled computed interest computed for one unit multiplied by the number of units in the deposit. Total tax equaled computed tax for one unit multiplied by the number of units.

e) When the amount of interest on each unit was not an integer the amount of interest that was paid was rounded up to the next integer.

f) If the amount of taxes on interest earned by one unit was not an integer it was rounded down to the previous integer.

g) The depositor could choose between either that at maturity the principal and interest be transferred to an ordinary account (ending the time deposit), or that the deposit be automatically renewed. If he chose this later possibility he had to further choose between either only the principal being re-deposited (the interest being transferred to an ordinary account) or both the principal and interest being re-deposited. In what follows we will assume that this later course was the usually adopted. Of course, the renewal was made at the then prevailing interest rates.

A change to the above rule d) came into effect in January 1999. From this time on interest on new time deposits started to be calculated not on each unit individually but on the total amount of the deposit. Thus the analysis below applies to time deposits made after January 1999 only if their amount is exactly ¥1,000. For deposits made until the end of December 1998 that have been automatically renewed since then, the old rule still applies. As there is no time limit until for the application of the old rule to time deposits that were made before the end of December 1998, this old rule will probably be applied until the last "old regime" time deposit is not renewed.

We will use the term stated interest rate to designate the value of the rate that the PSS quotes, and actual interest rate to designate the rate that it actually pays under the old rule d). Mathematically the above rules can be expressed as follows. Let  $[x]$  denote the largest integer that does not exceed  $x$  and let  $\langle x \rangle$  denote the least integer that exceeds  $x$ . Then  $I_m$  the actual interest paid on each unit on a time deposit of maturity  $1/m$ , is equal to:

$$I_m = \left\langle \frac{u \cdot i}{m} \right\rangle, \quad (1)$$

where  $u$  is the size of each unit (¥ 1,000),  $i$  is the stated interest rate expressed in annual terms, and  $m$  is the number of interest periods per year ( $1 \leq m$ ). Likewise, the tax paid on each unit,  $T_m$ , is equal to:

$$T_m = \left[ \frac{t \cdot u \cdot i}{m} \right], \quad (2)$$

where  $t$  is the tax rate. Letting  $n$  be the number of units, the total amount of interest  $I_m^T$  and taxes  $T_m^T$  on that interest are equal to:

$$I_m^T = n \cdot I_m \quad (3)$$

and

$$T_m^T = n \cdot T_m \quad (4)$$

respectively. The after tax actual interest rate  $\theta_m$  of a time deposit with a maturity equal to one  $m$ th of a year is equal to (in annual terms):

$$\theta_m = \left( 1 + \frac{I_m - T_m}{u} \right)^m - 1 \quad (5)$$

The after tax actual interest received is equal to the difference between  $I_m^T$  and  $T_m^T$  or, alternatively, to the product of the number of units with their value and with the after tax actual interest rate. More succinctly:  $I_m^T - T_m^T = n \cdot u \cdot \theta_m$

From the above equation (5) the following should be noticed:

— the shorter the maturity of deposits with the same stated interest rate, the higher the actual interest rate. This is due to two factors. One is that if  $(u \cdot i / m)$  is not an integer the interest paid on each unit is rounded to the next integer. This factor becomes more important as stated interest rates become lower: more frequent capitalization makes  $(u \cdot i / m)$  approach zero but  $I_m$  will never fall below 1. The other factor is that more frequent capitalization makes possible to earn interest on interest.

— deposits become tax free for  $\langle u \cdot i / m \rangle < 5$ ; as  $i$  increases depositors have only to choose a shorter maturity (a larger  $m$ ) to remain tax free.

Table 1 presents the stated interest rates for the different maturities of PSS time deposits as of the end of May, 1997. It also presents for each maturity the interest rate actually paid, the actual tax rate on interest, and the before tax interest rate that an alternative financial instrument or deposit has to pay to achieve an after tax return equivalent to the PSS' time deposit of similar maturity. Notice that as a time deposit

with maturity of 3 years pays ¥ 9 per unit per year, it will pay ¥ 1 of tax per unit per year (or 11.1%), exactly the same amount of tax that a 2-year deposit pays on the ¥ 5 that it yields per unit in one year.

Table 1 Interest and tax rates of PSS' time deposits, May, 1997 (annual rates, in percent)

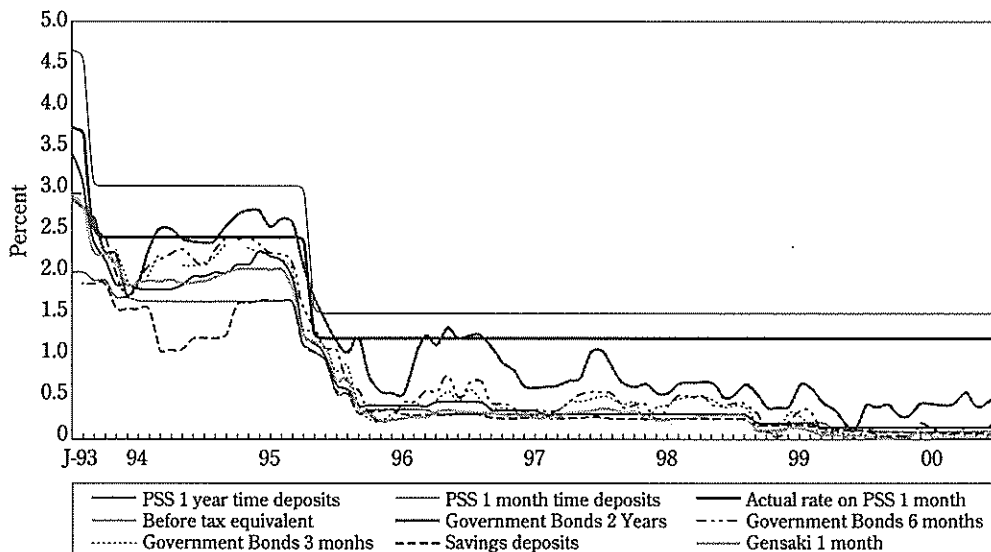
	1 month	3 months	6 months	1 year	2 years	3 years
Stated interest rate	0.30	0.30	0.30	0.30	0.45	0.90
Actual interest rate	1.21	0.40	0.40	0.30	0.50	0.90
Actual tax rate	0.00	0.00	0.00	0.00	20.00	11.1
Before tax equivalent interest rate	1.51	0.50	0.50	0.375	0.50	1.125

Of much interest is the fact that at that time, although the time structure of the stated interest rate of the PSS was flat for deposits with maturities of up to one year, the before tax equivalent interest rate was downward sloping. Only for term maturities of one year and above do the curvatures of the term structure of the two rates become similar.

Figure 1 presents several rates for the period from July 1993 to July 2000. These are the stated interest rates for PSS' time deposits with maturity of 1 month, 1 year, the actual interest rate paid by the 1 month PSS' time deposit and its before tax equivalent interest rate, and also the before tax yields of government bonds with maturity of 2 years, 6 and 3 months, the 1 month *gensaki* yield, and the rate paid by the savings deposits (deposits of no less than ¥ 300,000) of banks. It can be easily observed that for most of the time during this period the before tax equivalent of the interest rate paid by 1 month PSS' time deposits largely exceeds the before tax yields offered by alternative instruments.

Besides what has been said above, time deposits in the PSS were submitted to

Figure 1 Interest rates in Japan



one further rule that allowed depositors to get even higher actual interest rates:

f) Withdraws were allowed in time deposits that had not attained maturity: if the withdraw was within 1 week of the deposit no interest was paid; if it was after one week but before maturity an interest rate lower than the stated interest rate would be paid.

Obviously as long as this lower interest rate is larger than zero (it doesn't matter how low it is), this rule allowed depositors who withdraw and re-deposit the withdrawn amount every week to earn at least ¥ 1 per unit per week, what resulted in an annual actual interest rate of 5.33% (and in a before tax equivalent of about 6.66%). However, it should be noticed that to earn this rate considerable inconvenience was involved as the depositor needed to go (or send someone) to make the early withdraw and the new deposit every week.

These inconvenience costs without doubt did deter some investors from earning the high rate that weekly withdraw and re-deposit allowed. Also, the limit of ¥ 10,000,000 in deposits in the PSS made that only a very small proportion of the investments of large investors (especially corporations) could be put in them. However, in the portfolio decisions of most personal investors in Japan the existence of the PSS' 1 month time deposits should have loomed large.

#### 4. Concluding remarks

Rational agents (or simply sophisticated investors) in Japan should have deposited their funds in 1 month time deposits at the PSS before buying other risk-free securities, and this should have been more so the more the level of interest rates was low. As a consequence of this, the use of yields of other default free instruments in empirical research will underestimate the risk-free interest rate.

#### Appendix

All data used in this note was collected from the several issues of *Economic Statistics Monthly* and *Economic Statistics Annual* both published by the Research and Statistics Department of the Bank of Japan. The only exception are the stated interest rates of PSS' time deposits that were collected from several issues of *Savings and Economic Statistics Monthly* published by the Research Division of the Savings Bureau of the Ministry of Posts and Telecommunications. Notice that data on the interest rate paid upon early withdraw of time deposits at the PSS, mentioned in the text above, is not published. However, for the period from mid-1995 until the end of December, 1998, it was 0.1% per year.

## References

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