2 Relationship of interest rates

2.1 Learning outcomes

After studying this text the learner should be able to:

1. Describe the interest rates on debt instruments, and their relationship to the policy interest rate.
2. Elucidate the interest rates on deposit instruments, and their relationship to the policy interest rate.
3. Provide an elucidation of the interbank market, its market-determined rate, and the relationship of the interbank rate to the policy interest rate.
4. Present an analysis of the relationship of all short term interest rates.

2.2 Introduction

There are as many interest rates as there are debt and deposit instruments of various terms to maturity. The purpose of this section is to elucidate them within in the framework of the financial system, and to demonstrate how they are related. The following are the sections:

- Relationship between the policy interest rate and the banks' prime lending rate.
- The many, but related, interest rates on debt and deposits.
- Interbank market interest rates.
- Relationship of money market interest rates.

2.3 Relationship between the policy interest rate and the banks' prime lending rate

We need to begin by introducing the reader to the crucially significant relationship between PIR and PR. We show this in see Figure 2.1 for a particular country[5] for over 50 years (monthly data). A large proportion of this text is later devoted to the determination of interest rates by the central bank. In a nutshell, the central bank controls the banks' prime rate (PR) via its lending rate, the policy interest rate (PIR), to the banks for borrowed reserves (BR) according to its monetary policy dictates.

Clear from Figure 2.1 (50 years, monthly data) is the close relationship, with causation running: PIR → PR. The R^2 is 0.98 (see Figure 2.2). For the past 13 years (monthly data) the correlation has been a perfect one ($R^2 = 1.0$) (see Figures 2.3–2.4). The reason the longer period does not yield $R^2 = 1.0$ is that, at times, there were a range of PIRs (depending on the collateral offered by the banks – TBs, BAs, government bonds, etc.), and, at times, the range of PIRs were, bizarrely, set at different differentials above certain market rates (which caused major distortions in market rates).

The motivation for central bank control over PR is that the demand for bank credit (the foremost source of money creation) is heavily influenced by its level (in real terms). This will be discussed in detail later.

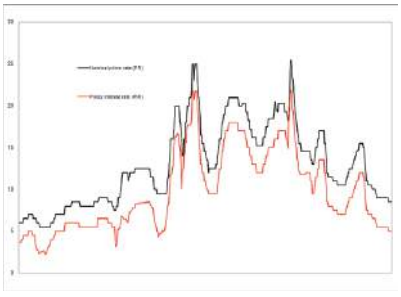

Figure 2.1: PIR and PR (50 years)

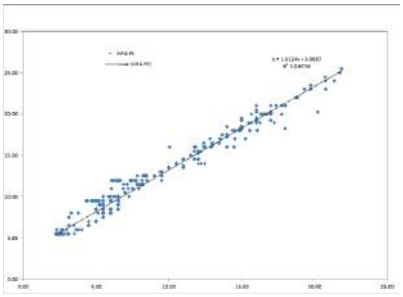

Figure 2.2: Scatter chart: PIR and PR (50 years)

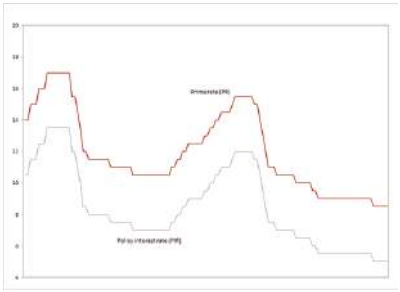

Figure 2.3: PIR and PR (13 years)

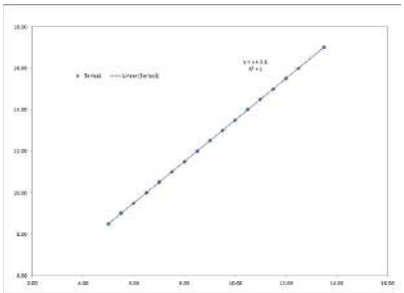

Figure 2.4: PIR and PR (13 years)

We will provide the detail on these significant interest rates later.

2.4 The many, but related, interest rates on debt and deposits

2.4.1 Introduction

We repeat our depiction of the financial system showing only the issuers of debt and deposit securities in Figure 2.5. A reminder: ultimate borrowers issue debt securities and banks issue deposit securities, in both cases marketable and/or non-marketable. Banks buy debt securities in the main and issue deposit securities. The investment vehicles are the main buyers of debt and deposit securities. The ultimate lenders buy the PIs of the investment vehicles, deposits and debt securities, the latter to a small degree.

We introduce at this stage the significant reality that the banks are unique – in that when they buy *new* debt securities (assuming no debt repayments), which means they are providing *new credit*, they create *new* deposit securities, meaning *new* money is created. (Money is bank notes and coins and bank deposits held by the domestic non-bank private sector.) This is an important issue in the interest rate narrative (hinted at earlier), and it will be given much attention later once the reader has grasped the introductory backdrop.

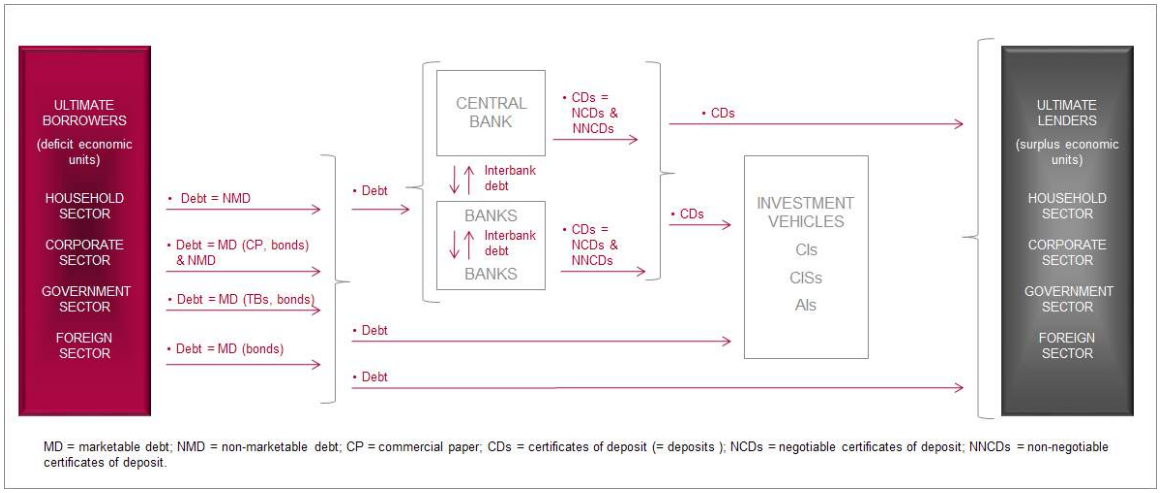

Figure 2.5: Debt and deposits (securities)

As said, interest rates are rates of return paid by the issuers of debt and deposit securities. This section is accordingly arranged and is followed by the interbank market, an all-important market in terms of the execution monetary policy (it being essentially about controlling interest rates):

- Ultimate borrowers' debt interest rates.
- Banking sector deposit interest rates.

2.4.2 Ultimate borrowers' debt interest rates

2.4.2.1 Introduction

The reader will be familiar with the sectors of the economy as far as the financial system is concerned. We can therefore categorise debt securities accordingly:

- Household sector debt.
- Corporate sector debt.
- Government sector debt.
- Foreign sector debt.

2.4.2.2 Household sector debt

The household sector borrows in many forms, and always (there are a few exceptions) from the banking sector. They are liabilities of the borrowers and assets of the banks. The main forms, all of which are non-marketable, are (see Figure 2.6):

- Overdraft facilities utilized.
- Mortgage advances.
- Fixed-term loans.
- Credit card advances.
- Installment sale finance.
- Leasing finance.

This terminology can be confusing. Note that all six forms of borrowing presented are *credit* extended by the banking sector. Also note that some of these forms of borrowing are also available from quasi-financial intermediaries, such as finance and leasing companies.

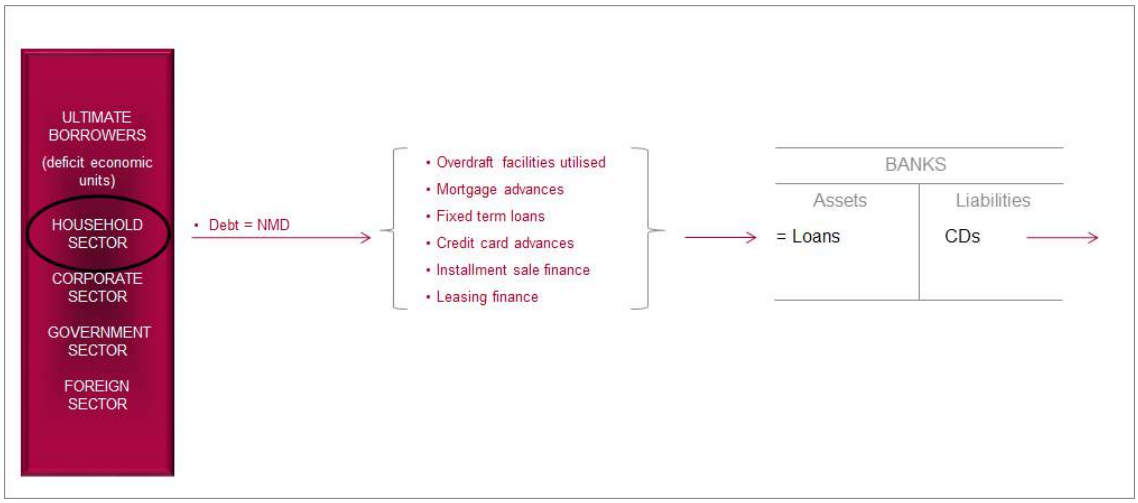

Figure 2.6: Debt securities of household sector

One should also not be confused by the fact that the individual does not actually issue a security in the case of, for example, an utilised overdraft or credit card facility. A debit balance on a bank account statement is a debt / unwritten IOU and is a legal obligation.

What is the interest rate payable on these debts? As we saw earlier, the banks offer floating or fixed rates. Overwhelmingly the banks provide credit at floating rates, and specifically rates that are benchmarked on PR or PIR. The motivation is mitigation of interest rate risk.

Fixed rates are offered in some cases (such as fixed-term loans), and they are *related* to (as opposed to *benchmarked on*) PR and PIR. The fixed rate offered for the period of the credit is usually higher than PR+margin or PIR+margin applied to the same term, reflecting the bank's policy of hedging interest rate risk and market risk (these bank risk-types are discussed in http://bookboon.com/en/banking-an-introduction-ebook).

The level of the fixed rate, and the margin above PIR or PR, are also influenced by:

- The perceived credit risk of the borrower.
- The income of the borrower.
- The quality of the collateral provided by the borrower. Banks require collateral security for any credit, which is a credit risk (i.e. the risk of non-repayment) management tool. For example, if a borrower has a need for a short-term overdraft facility and provides a fixed-deposit (a NNCD which has a longer term to maturity than the term of the overdraft facility) as collateral, s/he will most likely be charged PR-3%.

A few notes on the debt types are relevant:

Overdraft facilities utilised. This is a facility granted by a bank to a current account holder enabling him/her to "overdraw" the account by a certain amount. Even though an overdraft facility may be in place for many years, the facility may be withdrawn by the bank at any time. It can therefore be termed a short-term credit. Overdrafts are usually provided at a rate benchmarked on PR[6]. The PR can be changed at any time, and it is therefore regarded as a floating rate. As we have seen, in the real world PR follows the direction with the PIR of the central bank, which is changed infrequently.

A *mortgage advance*, which has a residence as collateral, is usually provided at a floating rate benchmarked on PR (for example, PR-1%) or PIR (for example, PIR+4%). (The large difference becomes clear when Figure 2.1 is consulted.) The location of the residence plays a role.

Fixed-term loans are provided at either a floating rate (for example, PR+1% or PIR+4%) or a fixed rate (for example, if PR+1% = 8%, the rate could be 9% pa), at the option of the borrower.

Credit card advances are advances granted by banks on credit card accounts up to a stipulated limit. In most cases, the rate is a floating rate, usually benchmarked on PR or PIR (for example, PR+2%). Fixed rates on credit card are available and are related to PR, but are usually high.

Installment sale finance applies to the purchase of goods such as furniture and motor vehicles. The borrower usually has a choice with regard to the repayment period (usually 1–5 years) and the interest rate: fixed or floating. In the latter case the rate is usually benchmarked on PR. In the former case, as with credit card advances, the rate is *related* to PR, and is usually higher.

Leasing finance is finance provided by a bank (lessor) to a borrower (lessee) for the purchase of an asset (for example, equipment or motor vehicle). The lessor owns the asset and the lessee has use of the asset for the period of the lease. The rate of interest on a lease is usually a floating rate linked to PIR of PR.

It is notable that overdraft facilities utilised and mortgage advances make up the overwhelming proportion of the banks' assets in most countries: over 50%.

2.4.2.3 Corporate sector debt

The corporate sector uses the same bank credit facilities as in the case of the household sector, with the addition of:

- Bankers' acceptances (BAs) (usually up to 182-day maturities).
- Promissory notes (PNs) (usually up to 365-day maturities).
- Commercial paper (CP) (usually up to 365-day maturities).
- Corporate bonds (usually 5- to 10-year maturities, but longer maturities are issued in some countries).

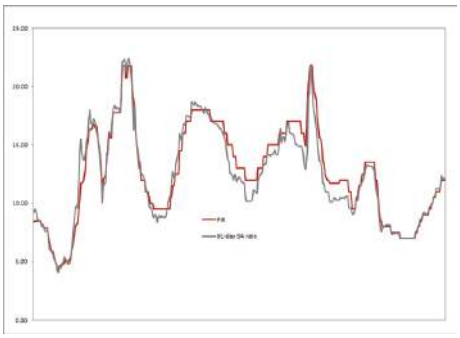

Figure 2.7: PIR & 91-day BA rate

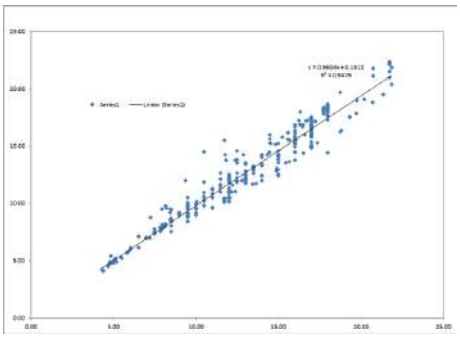

Figure 2.8: Scatter chart: PIR & 91-day BA rate

These debt securities are marketable, and are issued only by the larger, listed companies which are able to acquire a good rating from a rating agency. The rates of interest on BAs, PNs and CP are market-determined in the money market and they are related to the PIR of the central bank (and therefore to PR). Figures 2.7–2.8 shows this clearly (monthly data for a particular country[7] for a period of over 30 years; $R^2 = 0.95$).

2.4.2.4 Government sector debt

There are three levels of government in most countries:

- Central government.
- Provincial governments.
- Local governments (a.k.a. authorities).

Usually only central government and the local authorities are permitted to borrow in terms of the local statutes. Central government, being able to raise revenue by taxes and to borrow, is regarded as (credit) risk-free, as we discussed earlier. Therefore central government only borrows by the issue of marketable securities:

- TBs (usually up to 182-day maturities, but longer maturities up to 365-days do exist).
- Government bonds (usually 3- to 20-year maturities, but 30-year maturities do exist).

The rate on TBs, being risk-free securities, is the lowest security rate in the money market. It, as in the case of BAs and CP, determined in the money market, and is related to the PIR (see Figures 2.9–210: same period and country as in Figures 2.7–2.8). The R^2 is 0.97.

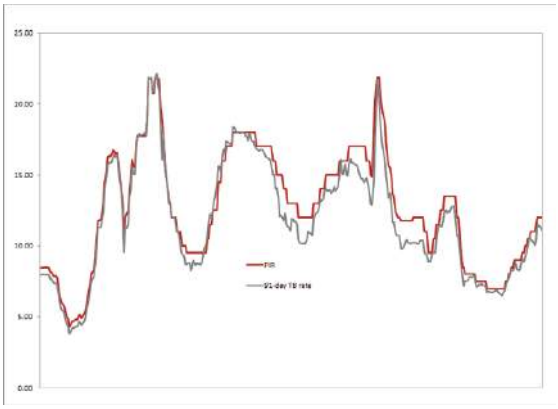

Figure 2.9: PIR & 91-day TB rate

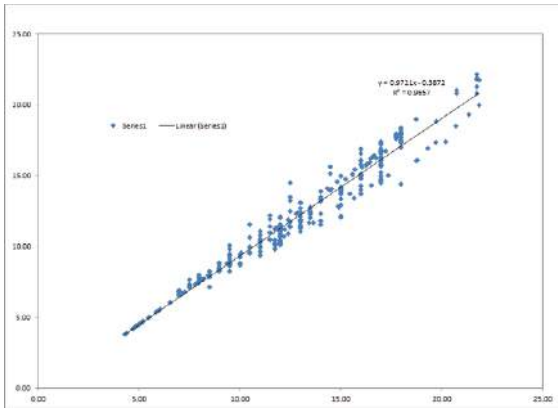

Figure 2.10: Scatter chart: PIR & 91-day TB rate

The rates (ytms) on government bonds are market-determined, and are the lowest rates in the bond market – because they are regarded as risk-free (as we have discussed). As government bonds become shorter in maturity with the effluxion of time their rates become equal to equivalent-term TB rates. Rates on longer term bonds are anchored in the money market (as explained earlier) but reflect a premium related to term to maturity (discussed more deeply later). The relationship between the PIR and government bond rates is shown in Figures 2.11–2.13 (monthly data for almost 50 years for a particular country[8]). It clearly shows the dominant influence of the central bank's PIR on all rates, including the 10-year rate (R^2 for PIR and 3-year bond rate = 0.9; R^2 for PIR and 10-year bond rate = 0.8).

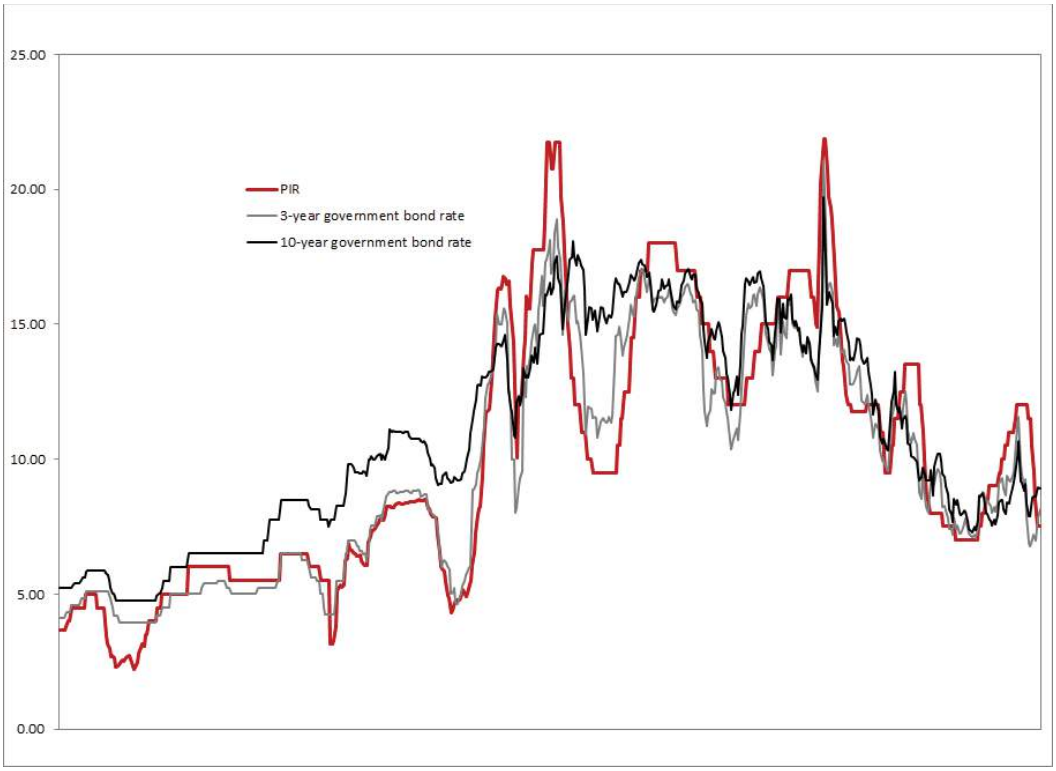

Figure 2.11: PIR & government bond rates

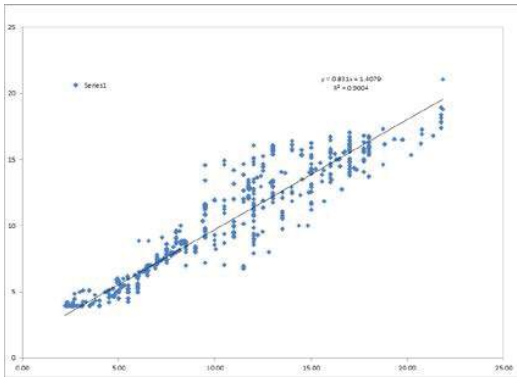

Figure 2.12: PIR & 3-year government bond rate

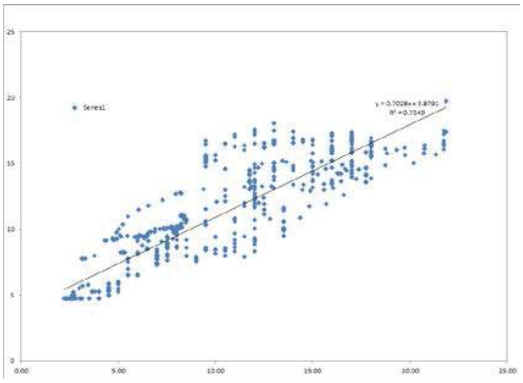

Figure 2.13: PIR & 10-year government bond rate

Most local governments borrow in one or both of two ways: bank overdraft at PR or related, and in the bond market. The rates on the bonds issued by them are: equivalent-term government bond rates plus a premium for risk (detailed later).

2.4.2.5 Foreign sector debt

In most countries the foreign sector is permitted to issue debt securities and, in most cases, the debt instruments are long-term bonds. They are issued by foreign central governments and prime corporate entities.

The interest rates at which the bonds are issued and traded are market determined, but at a margin above the local government bond or corporate bond rates. In both cases the credit rating of the bonds plays a significant role in determination of the margin.

2.4.3 Banking sector deposit interest rates

Ignoring insignificant items, as well as interbank deposits / loans (with the exception of notes and coins) a typical bank's balance sheet appears as in Balance Sheet 2.1. Note that NBPS denotes domestic non-bank private sector.

BALANCE SHEET 2.1: BANKS	
Assets	Liabilities
Notes and coins Credit to government Credit to NBPS	Deposits of NBPS • Call deposits (NNCD) • Savings deposits (NNCD) • Fixed term deposits (NCD & NNCD) • Notice deposits (NNCD) • Etc. (NNCD)

There are various deposit types, including call deposits, savings deposits, fixed term deposits, notice deposits, etc. All are NNCDs (a reminder: non-negotiable certificates of deposit), with the exception of fixed term deposits, a large part of which are NCDs. The most rate sensitive of all the deposits is call deposits, which are 1-day deposits. Call deposits are the short-term liquid reserves of large companies (which have savvy money managers in employ), and the deposit amounts are large. As such banks compete fiercely to hold on to their call deposits and gather in more when they lose other deposits.

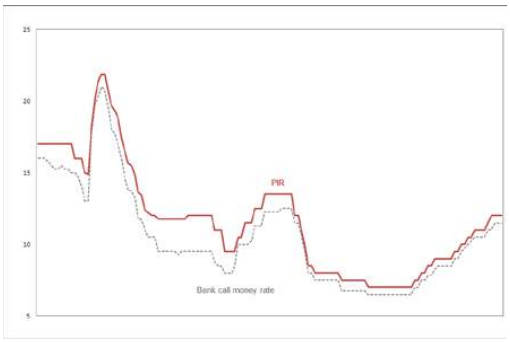

Figure 2.14: PIR & bank call money rate

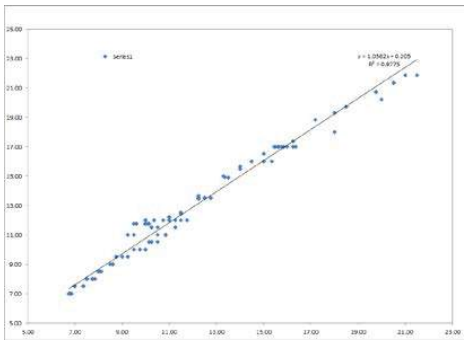
Figure 2.15: Scatter chart: PIR & bank call money rate

Call deposits represent the "book-balancing" activity of the banks – in order to replace lost deposits and, most importantly, avoid borrowing from the central bank at the PIR (= the highest 1-day money rate). This is a critical issue in monetary policy – because the call money rate closely follows the PIR, and other deposit rates take a cue from the call money rate. We discuss this in detail in the next section. The relationship of the call money rate and the PIR is shown in Figures 2.14–2.15 (month-end data for close on 11 years for a particular country[9]). The correlation is clear ($R^2 = 0.98$).

In Figures 2.16-2.19 we present the relationship between PIR and non-call bank deposit rates (month-end rates for 3-month, 12-month and 36-month NCDs for a particular country[10] for 25 years). The evidence is clear: deposit rates, including longer term rates, take their cue from the PIR of the central bank. The R^2 numbers are:

- PIR and 3-month NCDs: 0.93.
- PIR and 12-month NCDs: 0.88.
- PIR and 36-month NCDs: 0.72.

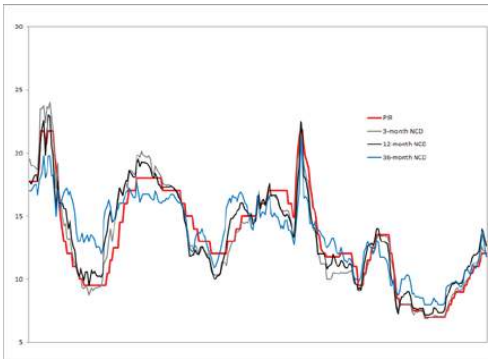

Figure 2.16: PIR & bank deposit rates (NCDs)

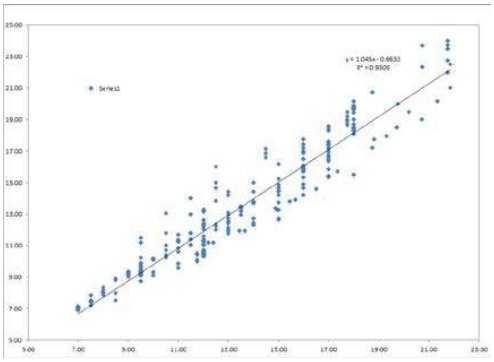

Figure 2.17: Scatter chart: PIR & 3-month NCD rates

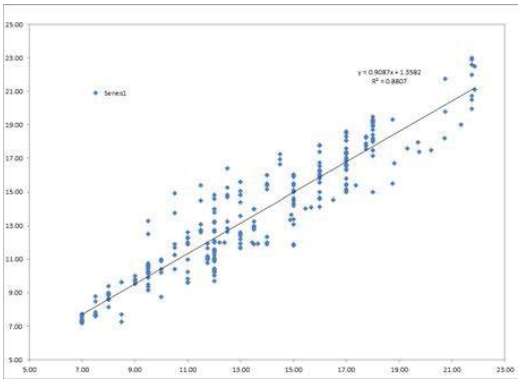

Figure 2.18: Scatter chart: PIR & 12-month NCD rates

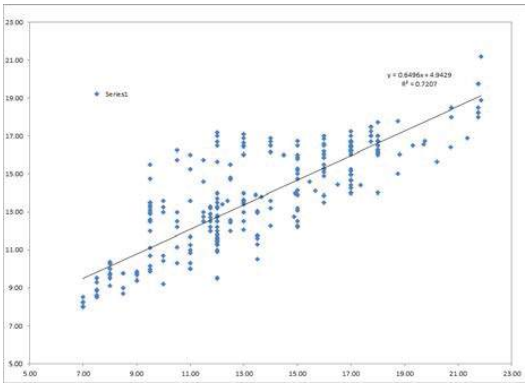

Figure 2.19: Scatter chart: PIR & 36-month NCD rates

It is quite evident that the closer a security rate is to the PIR in terms of maturity, the higher is the R^2. We have a clear path of causation:

> PIR → bank call money rates → other bank deposit rates → PR (and other asset rates such those on BAs, TBs and bonds).

However, there is a missing link: the interbank market rate (IBMR), which is the rate first affected by the central bank's PIR. Before we get to the detail in the next section we introduce the central bank's balance sheet (see Balance Sheet 2.2: it ignores insignificant items as well as, at this stage, interbank deposits / loans (with the exception of notes and coins).

BALANCE SHEET 2.2: CENTRAL BANK	
Assets	Liabilities
Foreign assets Credit to government	Notes and coins Deposits (government) Foreign loans

As in the case of the banks, we are interested in the liability side. Notes and coins (N&C) are deposits evidenced by the physical N&C. Government deposits usually carry no interest. In many countries banks also have government call deposits – styled Tax and Loan Accounts (TLAs) – with the private sector banks, which do carry a rate of interest, usually related to the TB rate. Foreign loans are usually small, and carry a rate linked to a foreign rate) (this is unimportant for this discussion).

2.5 Interbank market interest rates

2.5.1 Introduction

It will be evident that banks' balance sheets are dominated by deposits (liabilities) and credit (assets). We made it clear that deposit rates are linked closely with the central bank's PIR. In this section we take the balance sheets further and introduce the small (relative to the other) balance sheet items which play a significant role in the level of all debt and deposit rates and in terms of monetary policy. Again, removing the insignificant items from the banks' and the central bank's balance sheets – in the interests of pedagogy – the balance sheets will appear as indicated in Balance Sheets 2.3–2.4. The new items are shown in red, and numbers are included to show the relative sizes.

BALANCE SHEET 2.3: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
D. Foreign assets	1 000	A. Notes and coins	1 000
		B. Deposits	
E. Credit to government	1 100	1. Government	900
		2. Banks' reserves (total reserves – TR)	500
F. Loans to banks (borrowed reserves – BR) @ PIR	400	a. Required reserves (RR = 500)	
		b. Excess reserves (ER = 0)	
		C. Foreign loans	100
Total	2 500	Total	2 500

BALANCE SHEET 2.4: BANKS (CONSOLIDATED) (LCC BILLIONS)			
Assets		Liabilities	
C. Notes and coins	100		
D. Reserves with central bank (TR)	500	A. Deposits of NBPS (BD)	5 000
1. Required reserves (RR = 500)			
2. Excess reserves (ER = 0)		B. Loans from CB (BR)	400
F. Credit to government	1 000		
G. Credit to NBPS	3 800		
Total	5 400	Total	5 400

We defined the money market as the market for short-term debt and deposits, marketable and non-marketable. What we left out at that stage and introduce now is the 1-day loans of banks to other banks (a.k.a. deposits of banks with other banks), called the interbank market (IBM). Here we need to differentiate the private sector banks (which we denote as banks) and the central bank.

From the balance sheets of the central bank we can gauge its main functions. Banks are uncomplicated intermediaries; they take deposits from the public and provide credit to government and the NBPS – or do they? In a static balance sheet it seems so, but when their balance sheets expand the story is different – as we have indicated, new credit creates new deposits (= money). Apart from this main function they have transactions with the central bank as you can see from the other balance sheet items. Again, note the red font: it is through these accounts that the IBM functions.

The IBM is where the settlement of interbank claims takes place and where monetary policy begins. In some countries banks have two accounts with the central bank: a *reserve account* on which required reserves (RR) are held and a *settlement account* (SA) over which the settlement of interbank claims takes place, and excess reserves (ER) are held. In other countries banks have one account with the central bank, and it has many names: reserve account, settlement account, cash reserve account, and so on. Here we refer to it as *reserve account*. On these accounts the banks hold their required RR and, if any, their ER. The total of the two amounts we call total reserves (TR). Thus:

$$TR = RR + ER.$$

There are three interbank "markets" of which only one is a true market, i.e. where a market rate is determined (the IBM rate or IBMR). This rate, the role of which will become clear as we progress, is the missing link referred to earlier. The IBMR is shown, together with the PIR and the banks' call money rate in Figure 2.20[11]. Note that the IBMR is consistently below the PIR, and that the call money rate is below the IBMR.

The correlation between the PIR and call rates was shown earlier in Figures 2.14–2.15 (monthly data for close on 11 years for a particular country[12]) ($R^2 = 0.98$). In Figures 2.20–2.21 we show the correlation between the PIR and the IBM rate for the same period ($R^2 = 0.97$).

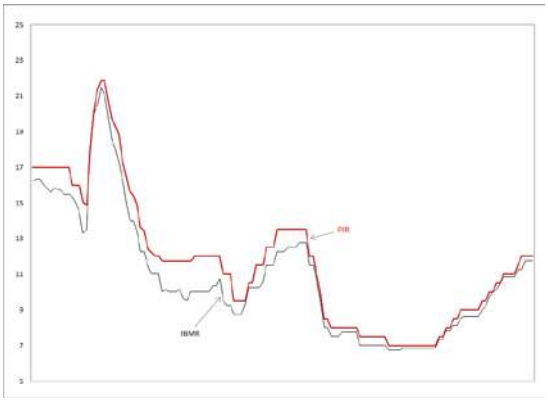

Figure 2.20: PIR & IBMR

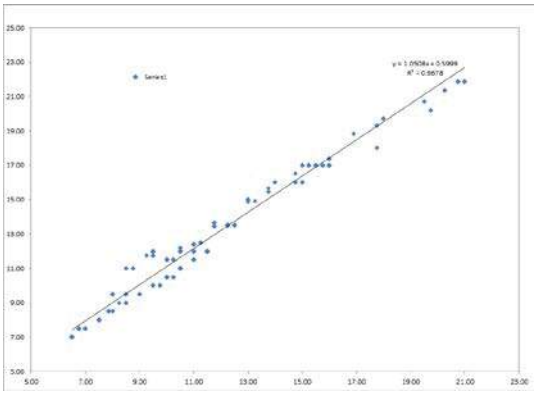

Figure 2.21: Scatter chart: PIR & IBMR

The reason for these relationships is the successful conduct of monetary policy: the central bank's target is interest rates, specifically PR, the motivation being that the demand for bank credit (which reflects growth in aggregate demand) and therefore money creation is affected by the level of real PR. It manages rates via creating a permanent bank liquidity shortage (LS), which makes the PIR effective, as we will see later. This means, as seen in the figure, that the IBMR is set by the banks with reference to the PIR. In normal times this is the style of policy adopted by most central banks. Quantitative easing (QE) is a policy followed in abnormal times.

The three interbank markets are:

- Bank-to-central bank interbank market.
- Central bank-to-bank interbank market.
- Bank-to-bank interbank market.

After we discuss these, we briefly introduce:

- Money creation.
- Money creation and the central bank-to-bank interbank market.

2.5.2 Bank-to-central bank interbank market

The first IBM is the bank-to-central bank interbank "market", or *b2cb IBM*. It is an "administrative" market in which the flow is one-way: from the banks to the central bank in the form of the cash reserve requirement, the volume of which we refer to as required reserves (RR). The banks' RR are held on their reserve accounts with the central bank. In the vast majority of countries the RR balances earn no interest, which is an essential element in monetary policy. Another important element of monetary policy in most countries is that banks are kept chronically short of reserves by the central bank (see later), such that ER for the banking system does not exist. (The converse is the case under a QE policy, which is designed to drive interest rates down to the lowest possible level.)

To elucidate the RR further: in most countries banks are required by statute to hold a certain ratio of their deposits in an account with the central bank. It has its origin in the gold coin reserves held by the goldsmith-bankers from the seventeenth century and later in voluntary note and deposit holdings with the Bank of England. In our accompanying Balance Sheets 2.3 and 2.4, the banks have deposits (BD) of LCC 5 000 billion, an assumed statutory RR ratio (r) of 10% of deposits, and RR with the central bank of LCC 500 billion. They therefore are holding the minimum required (TR = RR), and they do so because, as noted, the central bank does not pay interest[13] on reserves. Note also in this example that the banks are borrowing LCC 400 billion from the central bank (called borrowed reserves – BR), so they will not have ER. In summary, as regards the b2cb IBM:

BD × r	= RR	= TR.
LCC 5 000 billion × 0.10	= LCC 500 billion	= TR.
ER	= 0.	

2.5.3 Central bank-to-bank interbank market

The second IBM is the central bank-to-bank interbank "market", or *cb2b IBM*. It is also an "administrative" market, and it is *at the very centre* of the vast majority of countries' monetary policy implementation. It represents loans from the central bank to the banks (BR). The central bank provides these reserves at its PIR. As seen in the balance sheets above:

BR = LCC 400 billion.

In most countries monetary policy is aimed at ensuring that the banks are indebted to the central bank *at all times* so that the PIR is applied and therefore is "made effective" on part of the liabilities of the banks (recall from Balance Sheet 2.4: bank liabilities = BD + BR). The PIR has a major influence on the banks' deposit rates and, via the more or less static bank margin, on the banks' PR[14]. This is an extremely successful monetary policy protocol, as we saw in Figures 2.1-2.2, which we repeat here in Figures 2.22–2.23 (recall that $R^2 = 0.98$).

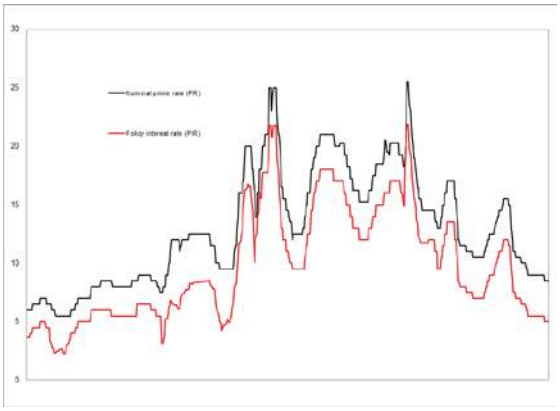

Figure 2.22: PIR and PR (50 years)

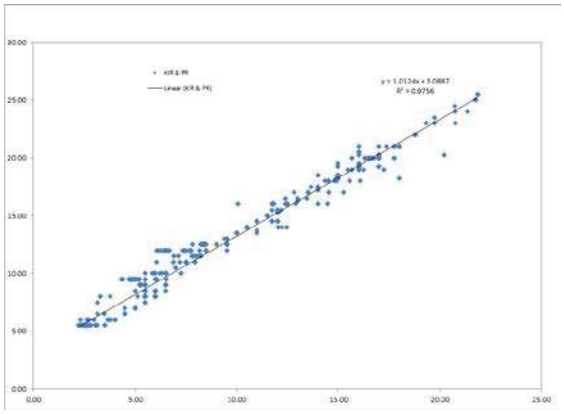

Figure 2.23: Scatter chart: PIR and PR (50 years)

2.5.4 Bank-to-bank interbank market

The third interbank market is a true market: the bank-to-bank interbank market, or *b2b IBM*. This market operates during the banking day but particularly at the close of business each day (banks "close off" their books every day). Allow us present an example: a large corporate customer (Company A) withdraws LCC 100 billion of its call money deposits from Bank A and deposits it with Bank B – because Bank B offered a higher call money rate.

How does the settlement of these transactions take place between the two banks? It takes place over the banks' reserve accounts: item B2 in Balance Sheet 2.3, and item D in the Balance Sheet 2.4. Balance Sheets 2.5–2.8 elucidate the story (CB = central bank).

BALANCE SHEET 2.5: COMPANY A (LCC BILLIONS)			
Assets		Liabilities	
Deposit at Bank A Deposit at Bank B	-100 +100		
Total	0	Total	0

BALANCE SHEET 2.6: BANK A (LCC BILLIONS)			
Assets		Liabilities	
Reserve account at CB	-100	Deposits (Company A)	-100
Total	-100	Total	-100

BALANCE SHEET 2.7: BANK B (LCC BILLIONS)			
Assets		Liabilities	
Reserve account at CB	+100	Deposits (Company A)	+100
Total	+100	Total	+100

BALANCE SHEET 2.8: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
		Reserve accounts: Bank A Bank B	 -100 +100
Total	0	Total	0

Assuming that at the close of business yesterday the two banks were not borrowing from the central bank (BR = 0) and they did not have any surpluses with the central bank (TR = RR; ER = 0):

- Bank A is now short of RR by LCC 100 billion, and therefore does not comply with the RR (TR < RR).
- Bank B now has surplus reserves (TR > RR or TR–RR = ER = LCC 100 billion).

We assume this is the only transaction that takes place during the day, and that Bank B does not have outstanding borrowings from the central bank. We are now at the close of business. The electronic interbank settlement system presents the two banks with the above information that pertains to each of them. Bank A needs to borrow LCC 100 billion and Bank B would like to place its ER somewhere at a rate of interest. The *somewhere* at the end of the business day is only the other banks (in this case Bank A).

The final interbank clearing process at the end of the business day takes place over these same reserve accounts with the central bank. In this b2b IBM the surplus bank, Bank B, will place its ER of LCC 100 billion with Bank A, and this will take place at the IBMR (after some haggling). Bank B will instruct the central bank to debit its reserve account and credit Bank A's reserve account. The central bank's balance sheet will be unchanged, and the banks' balance sheets appear as in Balance Sheets 2.9–2.10.

BALANCE SHEET 2.9: BANK A (LCC BILLIONS)			
Assets		Liabilities	
		Deposits (Company A) Loan (Bank B)	-100 +100
Total	0	Total	0

BALANCE SHEET 2.10: BANK B (LCC BILLIONS)			
Assets		Liabilities	
Loan to Bank A	+100	Deposits (Company A)	+100
Total	+100	Total	+100

Thus, in the b2b IBM, banks place funds with or receive funds from other banks depending on the outcome of the clearing. Surpluses are placed at the IBMR. A critical issue here is that this rate is closely related to the PIR (as shown earlier) because banks endeavour to satisfy their liquidity needs in this market before resorting to borrowing from the central bank at the PIR. In this example it was possible. Later we will show that when the central bank does a deal in the open market (= open market operations or OMO) it affects bank liquidity.

It should be clear now that when one speaks of bank liquidity one makes reference to the state of balances on the banks' reserve accounts: the status of TR, RR, ER and BR. As we will demonstrate later, the central bank has total control over bank liquidity, and therefore over interest rates.

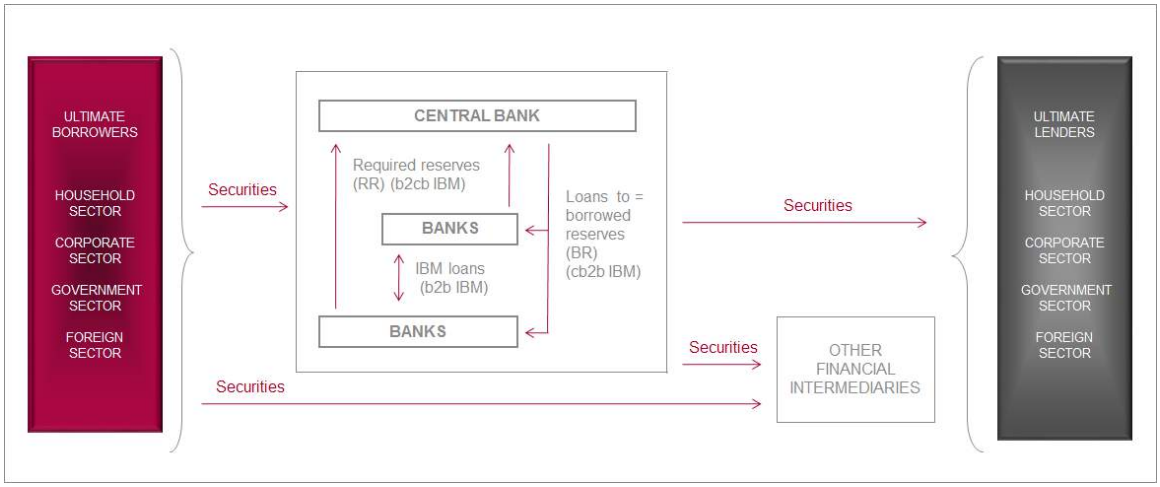

Figure: 2.24: Interbank markets

In the b2b IBM no new funds are created; existing funds are merely shifted around. New funds (reserves) are created in the cb2b IBM (in the long term). The latter is a function of the ability of banks to create money in the form of deposit money, and this is so because the general public accepts deposit money as a means of payment. This they are able to do without restraint[15] and the central bank supports this by the creation of the additional RR (a function of deposit growth).

We portray the interbank markets in Figure 2.24.

In order to concretise comprehension of the b2b IBM we present another example:

- Company A sells goods to Company B to the value of LCC 100 million. Company A's banker is Bank A.
- Company B borrows LCC 100 million to buy the goods. Company B's banker in Bank B.

It will be evident that this is a case of bank deposit money creation; the balance sheets appear as in Balance Sheets 2.11–2.15 just before the final interbank market clearing takes place. Note that we ignore the effect of the transactions on RR for now.

BALANCE SHEET 2.11: COMPANY A (LCC MILLIONS)			
Assets		Liabilities	
Goods Deposits at Bank A	-100 +100		
Total	0	Total	0

BALANCE SHEET 2.12: BANK A (LCC MILLIONS)			
Assets		Liabilities	
Reserve account at CB	+100	Deposits (Company A)	+100
Total	+100	Total	+100

BALANCE SHEET 2.13: COMPANY B (LCC MILLIONS)			
Assets		Liabilities	
Goods	+100	Loans from Bank B	+100
Total	+100	Total	+100

BALANCE SHEET 2.14: BANK B (LCC MILLIONS)			
Assets		Liabilities	
Credit extended to Company B Reserve account at CB	+100 -100		
Total	0	Total	0

BALANCE SHEET 2.15: CENTRAL BANK (LCC MILLIONS)			
Assets		Liabilities	
		Reserve accounts: Bank A Bank B	 +100 -100
Total	0	Total	0

The final IBM takes place: Bank A makes an interbank loan to Bank B at the interbank rate, and instructs the central bank to debit its account and credit the account of Bank B. Company A's and Company B's balance sheets do not change; only the banks' do and end up as indicated in Balance Sheets 2.16–2.17.

BALANCE SHEET 2.16: BANK A (LCC MILLIONS)			
Assets		Liabilities	
Loan to Bank B	+100	Deposits (Company A)	+100
Total	+100	Total	+100

BALANCE SHEET 2.17: BANK B (LCC MILLIONS)			
Assets		Liabilities	
Credit extended to Company B	+100	Loan from Bank A	+100
Total	+100	Total	+100

2.5.5 Money creation

Seen without the detail, money (M3) is defined as "anything" that the general public generally accepts as the means of payments / medium of exchange. These are bank deposits (BD) and notes and coins (N&C). Thus:

$$M3 = BD + N\&C \text{ (held by the NBPS)}.$$

If we consolidate the banks' balance sheet changes in the last example (Balance Sheets 2.16–2.17), which means we net out interbank claims on one another, i.e. the IBM loan of LCC 100 million, we get a consolidated balance sheet as shown in Balance Sheet 2.18.

BALANCE SHEET 2.18: BANKS (LCC MILLIONS)			
Assets		Liabilities	
Credit extended to Company B	+100	Deposits (Company A)	+100
Total	+100	Total	+100

In this example we have:

$$\begin{aligned} \Delta M3 &= \Delta BD && + \Delta N\&C \\ &= +\text{LCC 100 million} && + \Delta 0 \\ &= +\text{LCC 100 million.} \end{aligned}$$

The money stock increased by LCC 100 million (= deposit of Company A) and the balance sheet source of change (BSSoC) is the bank credit increase of LCC 100 million:

$$\begin{aligned} \Delta M3 &= \Delta BD && = \Delta\text{bank credit} \\ &= +\text{LCC 100 million} && = +\text{LCC 100 million.} \end{aligned}$$

The real cause is the demand for credit by Company B which was satisfied by its banker, Bank B.

2.5.6 Money creation and the central bank-to-bank interbank market

In the above example we left out the central bank (because we ignored the effect of a deposit increase on the RR). We now include the effect of deposit (i.e. money) creation on the RR. As we have seen, the b2cb IBM represents the banks' RR (= a ratio of BD required by statute) on which interest is not paid. Thus as BD increases, the amount of additional RR required is:

$$\Delta RR = \Delta BD \times rr.$$

When BD increases, the reserves required to be held increases by $\Delta BD \times rr$, thus by LCC 10 million:

$$\begin{aligned} \Delta RR &= \Delta BD \times rr \\ &= +\text{LCC } 100 \text{ million} \times 0.10 \\ &= +\text{LCC } 10 \text{ million.} \end{aligned}$$

This brings us to the cb2b IBM: in order to comply with the increased reserve requirement the banks have no option but to borrow the funds from the central bank at the PIR. This is so because we assume that this is the only transaction that has taken place on the day, and that the banks have a BR condition, i.e. there is no ER in the banking system.

The liquidity shortage (LS) increases by LCC 10 million (BR = +LCC 10 million). This is indicated in Balance Sheets 2.19–2.20.

BALANCE SHEET 2.19: CENTRAL BANK (LCC MILLIONS)			
Assets		Liabilities	
Loans to banks (BR) @ PIR	+10	Reserve accounts (TR) (RR = +10)	+10
Total	0	Total	0

BALANCE SHEET 2.20: BANKS (LCC MILLIONS)			
Assets		Liabilities	
Credit extended to Company B Reserves accounts (TR) (RR = +10)	+100 +10	Deposits (Company A) Loans from CB (BR) @ PIR	+100 +10
Total	+100	Total	+100

Thus, when BD increases, the RR increases by ΔBD × rr. It is also important to know that whenever a central bank does a deal itself (an open market operation -OMO) it brings about a change in its balance sheet. This is a critical element in monetary policy, because it means that the central bank can influence its balance sheet at will, and specifically the amount that it lends to banks (BR) at its PIR. In other words, the central bank, depending on the deal, will be a part of the interbank clearing (apart from assisting banks to settle amongst themselves). We present an OMO example:

- The central bank sells LCC 100 billion TBs (usually on tender).
- Bank A buys the TBs.
- This is the only transaction of the day.

The balance sheets of the central bank (CB) and Bank A change as indicated in Balance Sheets 2.21–2.22.

BALANCE SHEET 2.21: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
TBs	-100	Reserve accounts: Bank A	-100
Total	-100	Total	-100

BALANCE SHEET 2.22: BANK A (LCC BILLIONS)			
Assets		Liabilities	
TBs Reserve account at CB (TR)	+100 -100		
Total	0	Total	0

Bank A is now short of RR to the extent of LCC 100 billion. As this is the only deal done in Local Country on the day, there are no funds available in the b2b IBM. And here comes a critical point: as we have seen, Bank A cannot create central bank money; only the central bank itself can do so. Thus, critically, this deal ends up with the central bank making a loan to Bank A (BR) so that it again complies with the reserve requirement. Their balance sheets end up as indicated in Balance Sheets 2.23–2.24.

BALANCE SHEET 2.23: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
TBs Loan to Bank A @ PIR	-100 +100		
Total	0	Total	0

BALANCE SHEET 2.24: BANK A (LCC BILLIONS)			
Assets		Liabilities	
TBs	+100	Loan from CB @ PIR (BR)	+100
Total	+100	Total	+100

The liquidity of the banking sector, as measured by excess reserves (ER) less central bank loans to the banks (BR) = NER (net excess reserves)

$$NER = ER - BR,$$

has deteriorated by LCC 100 billion. This fairly intricate concept will be expounded upon later.

What was the reason for the central bank doing this deal? It was to increase the bank's indebtedness to the central bank (i.e. reduce bank liquidity – as measured by NER), in order to indicate a tougher stance on monetary policy. The banks are in a worse liquidity situation in that they are paying the PIR on a larger borrowing from the central bank. *This IBM is where monetary policy, that is, interest rates, has its genesis.*

The bottom end of the yield curve (specifically the one-day rate[16]) is heavily influenced (almost "set" as we shall see later) by the central bank through "manipulating" the *liquidity condition* of the banks. Through open market operations the central bank ensures (in most countries) that the banks at all times are in *liquidity shortage* (LS) condition (also called the *money market shortage* – MMS – in some countries). This means that they are kept (by the central bank) perennially short of liquidity and the central bank supplies the required liquidity (BR) at the PIR, thus making the PIR *effective*.[17]

As said before, the purpose is to influence the cost of bank liabilities, specifically bank deposits, and via the sticky bank margin, the banks' lending rates. The level of bank lending rates affects the demand for credit which, when satisfied, creates BD (money).

Given the above discussion of the IBM, we are now able to complete the causation path of interest rates:

> PIR → IBMR → bank call money rates → other bank deposit rates → PR (and other bank asset rates such those on BAs, TBs and bonds).

2.6 Relationship of money market interest rates

We have already said much on the relationship of interest rates. In this section we provide a summary.

We know the causation path of interest rates and we know the role of the sticky bank margin (in parenthesis and colour):

> PIR → IBMR → bank call money rates → other bank deposit rates → ["sticky" bank margin] → PR (and other asset rates such those on BAs, TBs and bonds),

We also know that there are other factors that impact on the relative levels of interest rates:

- Term to maturity.
- Credit risk.
- Marketability.
- Quality of collateral.

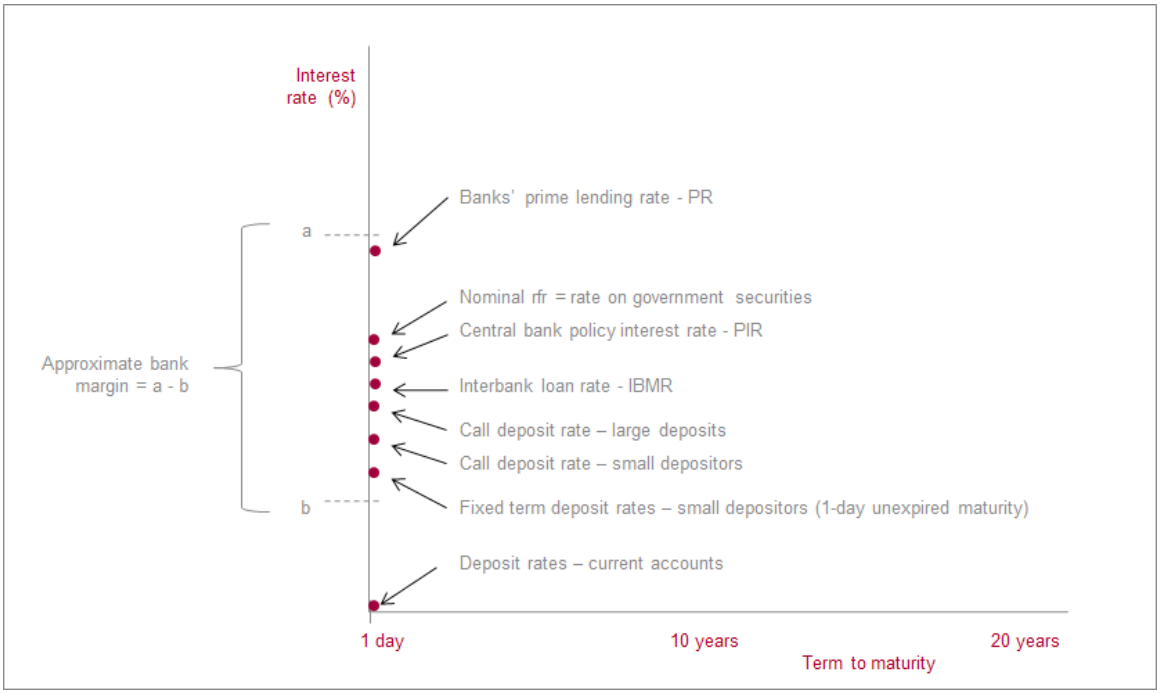

Figure 2.25: Money market rates & bank margin

The most obvious one is *term to maturity*: the longer the term of debt or deposit the higher the rate is. *Credit risk* is the risk of default on the principal and/or interest. *Marketability* obviously applies to marketable (in the secondary market) instruments, which carry a lower rate that their non-marketable family members. For example, NCDs trade at lower rates than NNCDs of equivalent term. *Quality of collateral*: the better the collateral pledged for credit extended, the lower the rate. For example, a bank credit with collateral in the form of a high quality property will demand a lower rate than a bank credit with collateral in the form of a debtors' book.

In conclusion we present an illustration of the relationship of 1-day interest rates (see Figure 2.25), as well as the approximate bank margin. We take this further, and include the all-important term to maturity, as well as the real rfr rate (part of the nominal rfr rate), in the following text on "The composition of interest rates".

2.7 References

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