Interest Rates: An Introduction

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Contents

1 What are interest rates?

1.1 Learning outcomes

After studying this text the learner should be able to:

1. Describe the context of interest rates.
2. Elucidate the bank margin and its role.
3. Describe what a rate of interest is and related concepts such as per cent, basis points and percentage points.
4. Describe the concept "time value of money".
5. Explain compound interest.
6. Define coupon rate and the price of a security.
7. Differentiate floating rate security and fixed rate security.
8. Differentiate primary and secondary market rates.
9. Differentiate nominal value and maturity value.
10. Differentiate yield rate and discount rate.
11. Describe the risk-free rate.
12. Elucidate bid and offer rates / prices and spread.
13. Distinguish between nominal and real interest rates.

1.2 Introduction

Before a study of this material is undertaken, it is important to have an understanding of the financial system – which provides the context of interest rates. We suggest "Financial System: An Introduction" which is available free at http://bookboon.com/en/financial-system-an-introduction-ebook. For those who are familiar with the system, we offer a brief reminder below.

Interest rates are the reward paid by a borrower (debtor) to a lender (creditor) for the use of money for a period, and they are expressed in percentage terms per annum (pa), for example, 6.525% pa, in order to make them comparable. Interest rates are also quite often referred to as the *price of money*. This is not helpful. One should rather refer to interest rates as being the rates (there are various) payable on debt and deposit obligations (a.k.a. instruments and securities) by the borrowers to the lenders, and that the prices of the debt and deposit obligations are derived from the cash flows payable on the obligations in the future – by discounting the cash flows by the rates payable.

Upfront we offer a significant statement: short-term interest rates are not determined by supply and demand; they are controlled by the central bank (and there is an especially good reason for this), and all other interest rates are a function of current short-term rates and expectations as to where they will be in the future. Supply and demand forces do enter the equation – to the extent that the central back reacts to these forces with its administratively-determined interest rate, the policy interest rate (PIR). They do play a role in the rate determination on longer term obligations, but the PIR remains the anchor. We will return to these issues many times.

The term *interest rate/s* can be quite confusing to those unfamiliar with the financial markets. There are many different interest rates; a few examples: call deposit rates, term deposit rates, repurchase agreement (repo) rates, base rates, policy rates, bank rates, government bond rates, corporate bond rates, negotiable certificates of deposit (NCD) rates, Treasury bill (TB) rates, corporate / commercial paper (CP) rates, fixed interest rates, floating interest rates, discount rates, coupon rates, real rates, nominal rates, effective rates, risk-free rates, and so on.

Confusing? Yes, but they are all related and there is a way demystify the terminology. This is the aim of this text. It also elucidates the significant role of interest rates in the economy. We begin with: interest rates apply only to debt and deposit instruments (there are a few exceptions, such as preference shares). To comprehend this, we need to provide a synopsis of the financial system. This is provided next. The organisation of this text is as follows:

- Financial system: a synopsis.
- Debt and deposits.
- The bank margin.
- Rate of interest.
- Time value of money.
- TVM and compound interest.
- Effective rate.
- Coupon rate.
- Price of a security: the principle.
- Price of a security: multiple future cash flows and yield to maturity.
- Other issues and terminology related to interest rates.

1.3 Financial system: a synopsis

We present Figure 1 as the backdrop to this brief discussion. Perusal of the figure will reveal:

First: Ultimate borrowers issue financial securities, meaning that they borrow funds and issue evidences thereof (a.k.a. securities, IOUs, instruments, obligations, etc.). There are only two: debt and shares / equities. The ultimate lenders lend their excess funds, meaning that they purchase securities (evidences of debt and shares). The ultimate lenders and borrowers are comprised of the same four sectors of the economy, as indicated. Some of them are lenders and borrowers at the same time (for example, government), but generally they are one or the other.

Second: Financial intermediaries interpose themselves between the ultimate lenders and borrowers by offering useful financial services. They have assets (buy securities) and liabilities (issue their own securities to fund their assets). The main financial intermediaries are:

- Banks (central bank and private sector banks): They buy debt securities and issue securities known as certificates of deposit (CDs) which are negotiable (i.e. marketable, called NCDs) or non-negotiable (NNCDs). They are overwhelmingly of a short-term nature. Note: The central bank's liabilities are not termed as such; we call them CDs for the sake of simplicity.
- Investment vehicles: They buy debt and shares and issue what may be called "participation interests" (PIs). Other names are *membership interests* and *units*.

Third: Debt securities are divided into long-term (LT) securities and short-term (ST) securities, and they are either marketable debt (MD) or non-marketable debt (NMD), i.e. the financial system has LT-MD, LT-NMD, ST-MD and ST-NMD. Marketable debt is marketable because secondary markets exist for them.

Fourth: Shares are issued by companies and are marketable (MS) or non-marketable (NMS). Debt and shares are issued in primary markets and traded in secondary markets, such as a stock exchange, making them marketable.

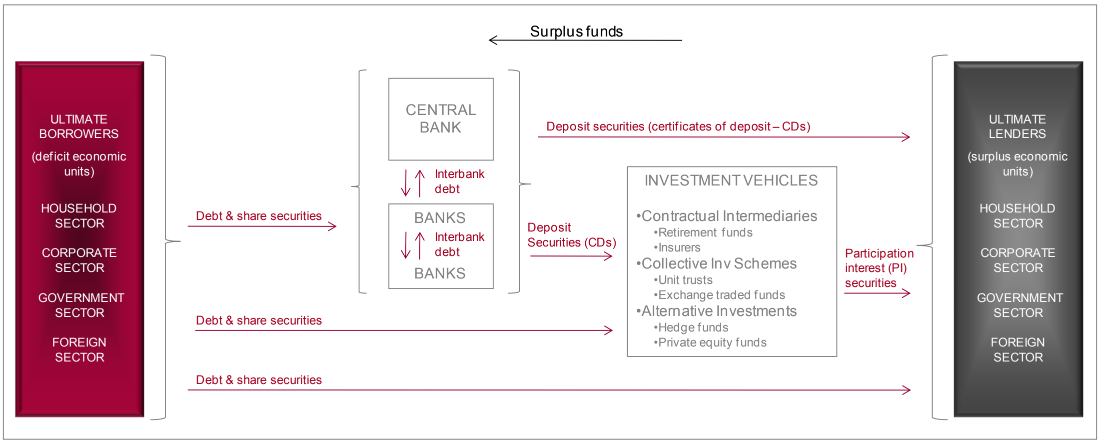

Figure 1.1: Financial system

An example will render the above comprehensible: A bank makes a mortgage loan to you to buy a house, and funds it by issuing CDs to a company:

- You are an ultimate borrower (a member of the household sector) and you issue an LT-NMD (an IOU), meaning you owe the bank.
- The bank buys your LT-NMD and issues CDs.
- The company (ultimate lender, a member of the corporate sector) buys the CDs.

Another way of seeing the financial system: There are six elements:

First: *Ultimate lenders* (= surplus economic units) and *ultimate borrowers* (= deficit economic units), i.e. the non-financial economic units that undertake the lending and borrowing process. The ultimate lenders lend to borrowers either directly or indirectly via financial intermediaries, by buying the securities they issue.

Second: *Financial intermediaries* which intermediate the lending and borrowing process. They interpose themselves between the lenders and borrowers, and earn a margin for the benefits of intermediation (including lower risk for the lenders). They buy the securities of the borrowers and issue their own to fund these (and thereby become intermediaries).

Third: *Financial instruments* (or securities, obligations, assets), which are created / issued by the ultimate borrowers and financial intermediaries to satisfy the financial requirements of the various participants. These instruments may be marketable (e.g. Treasury bills) or non-marketable (e.g. retirement annuities). There are two categories and two subcategories:

- Ultimate financial securities (issued by ultimate borrowers):
    - Debt securities.
    - Share (a.k.a. stock / equity) securities.

- Indirect financial securities (issued by financial intermediaries):
    - Deposit securities, a.k.a. certificates of deposit (CDs) (issued by banks).
    - Participation interests (PIs) (issued by investment vehicles).

Fourth: *Creation of money* (= bank deposits; bank notes are also deposits) by banks when they satisfy the demand for new bank credit. This is a unique feature of banks. Central banks have the tools to control money growth, which they do primarily to tame inflation.

Fifth: *Financial markets*, i.e. the institutional arrangements and conventions that exist for the issue and trading (dealing) of the financial instruments. The financial markets are:

- Money market (all ST-MD, ST-NMD and CDs), in other words the entire short-term debt and deposit market, marketable and non-marketable.
- Bond market (all LT-MD), in other words the marketable part of the long-term debt market.
- Share / stock / equity market (all MS).
- Foreign exchange market (the market for the exchange of currencies).
- Participation interests markets (there are a number, e.g. units of unit trusts, membership interest in a retirement fund).
- Derivatives markets (forwards, futures, swaps, options, etc.).

Sixth: *Interest rate / price discovery*, i.e. the establishment in the financial markets of the *rates of interest* on debt and deposit instruments, and the *prices* of share instruments.

As our interest in this text is interest rates and their discovery, we can ignore shares and PIs, which do not carry interest (there are exceptions, such as preferences shares, but we will ignore them in the interests of pedagogy). Thus, we are left with debt and deposits, and their markets.

1.4 Debt and deposits

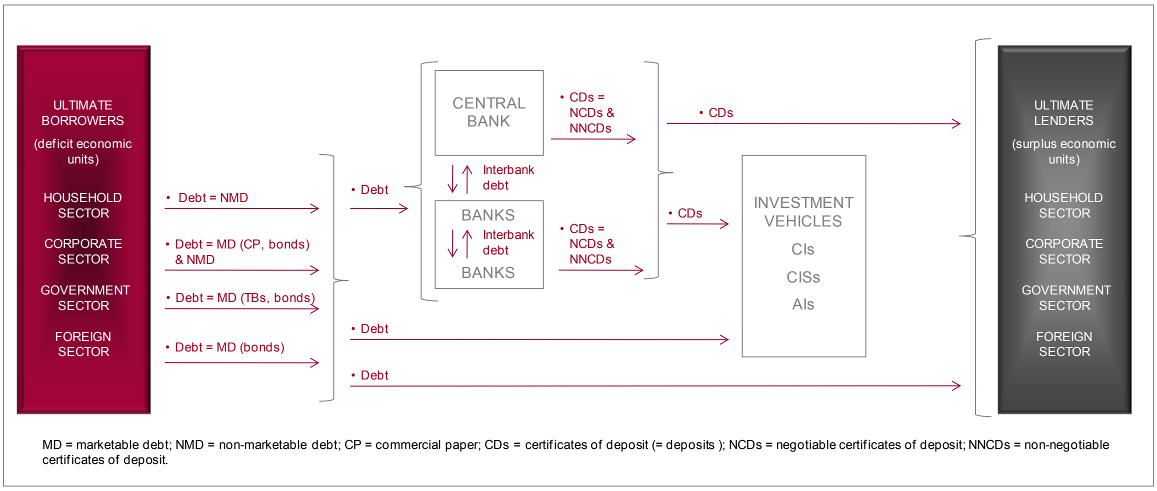

Figure 1.2: Debt and deposit securities

Debt securities are evidences of debt issued by the borrower to the lender. The lender may be a financial intermediary (bank, central bank or investment vehicle) or an ultimate lender (one of the four sectors). As may be seen in Figure 2, the following debt securities exist:

- Household sector:
  - MD (none, because they are not able to issue MD).
  - NMD (examples: leases, mortgage loans, overdraft facilities utilised).

- Corporate sector:
  - MD [commercial paper (CP), bankers' acceptances (BAs), promissory notes (PNs), corporate bonds].
  - NMD (examples: leases, mortgage loans, overdraft facilities utilised).

- Government sector:
  - MD [central government: Treasury bills (TBs), bonds].
  - NMD (issued by the lower levels of government, for example, local government bonds).

- Foreign sector:
  - MD [foreign commercial paper (CP), corporate bonds].
  - NMD (none as only the large foreign corporate entities are able to issue, and they issue MD).

Figure 2 shows: Deposit securities (CDs) are issued by banks to lenders, and the funds are used to purchase debt securities, in the form of MD and NMD. The vast majority are NMD, and specifically mortgage loans and overdraft facilities utilised. As we have seen, there are two categories of CDs: NCDs and NNCDs. The vast majority are NNCDs.

It is necessary at this time to make reference to the middle part of Figures 1 and 2, and enhanced in Figure 3: The interbank debt market (IBM). There are three parts to the IBM:

- Bank-to-bank interbank market (b2b IBM). This is where interbank claims and loans are settled, and this is effected over the accounts that banks are required to have with the central bank.
- Bank-to-central bank interbank market (b2cb IBM). This represents the reserve requirement amount, i.e. the requirement that banks are to hold a certain proportion of their deposits with the central bank (in most countries).
- Central bank-to-bank interbank market (cb2b IBM). This represents the (usually overnight) loans made by the central bank to the banks for monetary policy purposes.

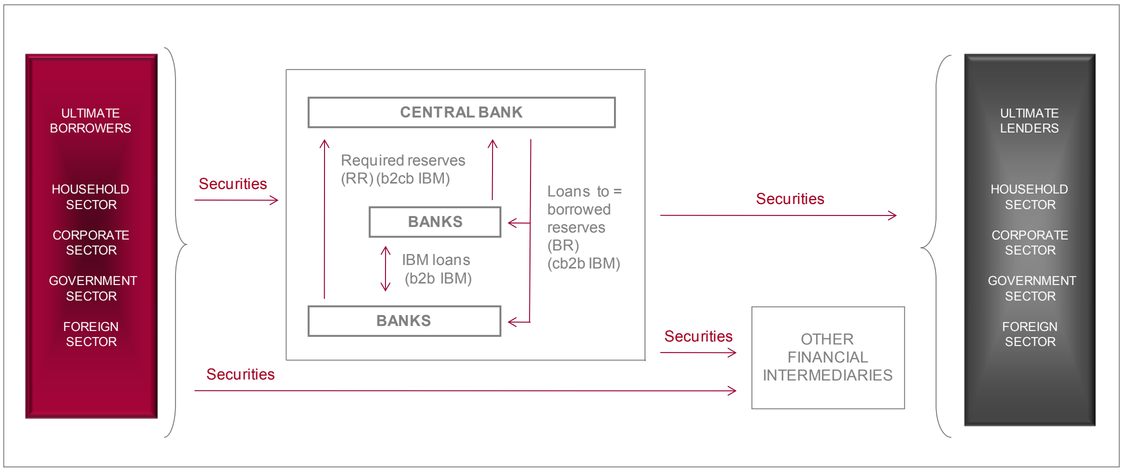

Figure 1.3: Interbank market

This significant market and its role in *interest rate determination* will be elucidated in detail later.

It will be evident that each ultimate borrower security [i.e. the different types of NMD and MD (CP, BAs, PNs, TBs, corporate and government bonds)] carries a different interest rate. Similarly, each NNCD and NCD carries a different rate of interest. This also applies to the IBM. However, the story is different in the IBM in that the genesis of interest rates is found here, and it is determined administratively to a significant degree, as we will show later.

Ignoring the influence of the central bank on interest rates (and therefore on inflation), each interest rate is dependent upon / influenced by:

- Term to maturity. The rate increases as the term to maturity increases.
- Risk profile of the issuer (borrower: ultimate borrower or bank). The rate rises as the risk rises.
- Marketability (all issues of securities take place in their *primary markets*, but only certain securities have *secondary markets* – where they can be sold or bought). The rate decreases as marketability increases.

One final point, which we have not indicated in Figures 1 and 2 (but rectify in Figure 4), is the existence of direct financing. Not all lending and borrowing takes place via the financial intermediaries. It can also occur directly (an example is a company or wealthy individual buying bonds with excess funds). However, the vast majority is undertaken via the financial intermediaries.

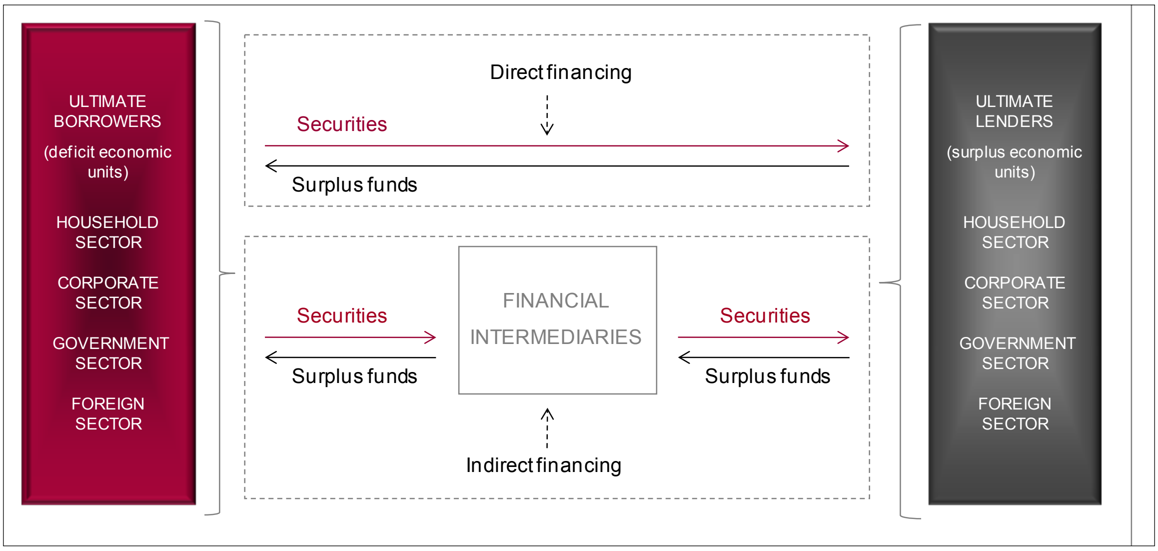

Figure 1.4: Direct and indirect financing

1.5 The bank margin

It is important at this stage to introduce the bank margin. In simple terms (see Figure 5; we will elucidate later) banks intermediate the lending and borrowing process, in the process transmuting NMD into NNCDs and NCDs. In essence, they are creating liquidity and reducing risk for the lenders (buyers of CDs = depositors) by taking on the information costs and providing diversification of assets.

For this service they charge a "fee" in the form of a lower rate of interest earned by the lender (the buyer of CDs) than they earn on the MD and NMD securities purchased (i.e. their loans / credit). This difference is the *bank margin* (I.e. – IP), and it is "sticky" in that it is jealously guarded by the banks as it represents a major part of their profits. It is kept at a reasonable number by competition in the banking sector.

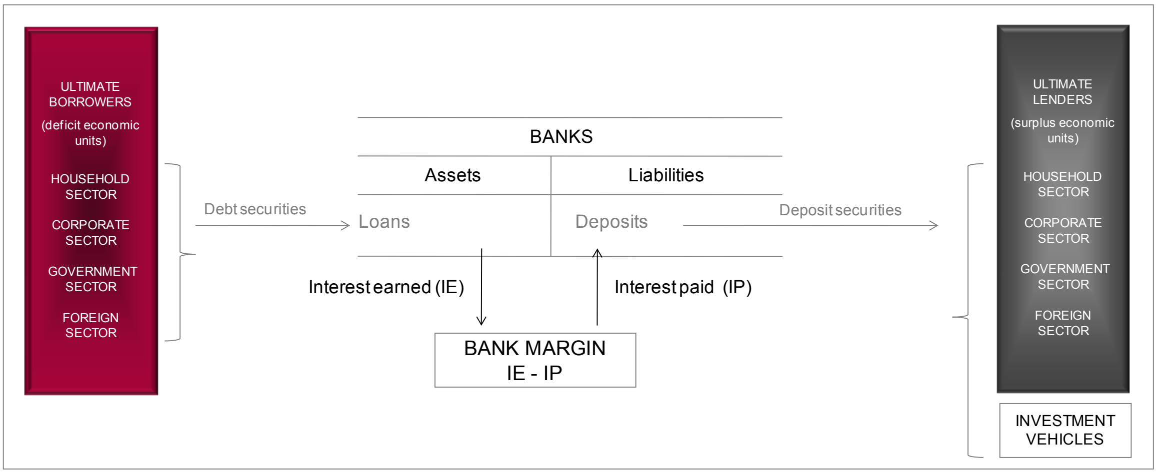

Figure 1.5: Bank margin

The bank margin is significant for another important reason: The central bank, by influencing the cost of the banks' liabilities ("at the margin"), via the policy interest rate (PIR), are able to directly influence the banks' lending rates. The benchmark bank lending rate is called *prime rate* (PR). PR is the high profile rate one sees in press announcements, and all bank lending rates are related to it. For example, a mortgage loan may be granted to a small borrower at PR+1%, and to a large borrower at PR-2%. Its prominence in monetary policy will become clear later.

1.6 Rate of interest

In order to concretise the understanding of interest, we need to go back to basics. The rate of interest is the price or fee paid by a borrower of money to the lender for the use of the money for a period, divided by the amount borrowed. The borrower is thus advancing consumption and paying for this privilege. From the perspective of the lender, the price or fee charged is his / her compensation for delaying consumption for the period of the loan.

Thus, seen simply, there are two elements to the rate of interest, the price or fee paid and the amount loaned / borrowed. An example:

Fee / price paid	= LCC[1] 100
Amount loaned / borrowed	= LCC 1 000.

The interest rate (ir) is as follows:

ir = fee paid / loan amount
= 100 / 1 000
= 0.10 (or 0.10 LCC per one unit of LCC loaned)
= 10%.

It should be evident that the rate of interest is a ratio, i.e. the ratio of (in this example) 100 / 1 000. Also, this is the rate of interest for the relevant period. As said above, in practice interest rates are expressed in pa terms, in order to make them comparable.

The term of the loan, the rate and the pa convention are important. For example, if the loan is for 91 days (t), and the 10% rate is for this period, the amount payable is LCC 100, but the rate is not 10% pa; it is (assuming the day-count convention is 365 days):

Effective rate pa $= ir \times (365 / t)$
$= 0.1 \times (365 / 91)$
$= 0.40110$
$= 40.11\%$ pa[2].

If the 10% rate is a pa rate, then the amount payable on a LCC 1 000 loan after 91 days is:

Interest payable (IP) $=$ loan amount $\times (ir \times t / 365)$
$=$ LCC $1\,000 \times (0.1 \times 0.24932)$
$=$ LCC 24.93.

These numbers can be used to derive the ir pa:

ir pa = (IP / loan) × (365 / t)
= [(LCC 24.93 / LCC 1 000) × (365 / 91)]
= 0.1
= 10% pa.

Compounding and multiple regular future interest payments will be introduced later. The above discussion hints at the fact that money has a value over time. We cover this next.

1.7 Time value of money

The *time value of money* (TVM) concept, a significant concept in economics and finance, means that *money has a value over time*. It is founded on the notion that money represents a command over goods and services (i.e. consumption), and that if you delay consumption by lending part of your money supply to someone, you will expect compensation, otherwise you would not lend the money. What's the point? Even if you were inclined to lend the money to a friend compensation-free, this is a foolish idea, and there is a sound reason for this: the future is uncertain. There are two factors to consider in relation to the future: you cannot be certain that you will receive the money loaned and / or the compensation amount when they are due (= credit risk), and inflation may erode the value of the money lent (= inflation risk). As we know, the compensation amount is called interest.

Another way of looking[3] at this concept is that LCC 1 received today is worth more than LCC 1 received in the future. This of course is because the LCC can be invested and its value enhanced by the rate of return, the interest amount.

This is the basic tenet of the TVM concept, i.e. money has a *future value* (FV) and a *present value* (PV):

- FV is PV plus interest.
- PV is FV discounted at the relevant interest rate.

Another basic principle of the concept is that interest is compounded, i.e. interest that is earned is reinvested, and an essential assumption here is that interest earned is reinvested at the rate earned on the principal amount. The PV-FV concept is the foundation of all financial market mathematics.

From the previous section, we know that the principal amount (amount invested) is the PV and the FV is the sum of the PV and the interest amount (IA) earned, as follows.

FV = PV + IA.

This may be expressed as:

$$FV = PV + [PV \times (ir \times t / 365)]$$
$$= PV \times [1 + (ir \times t / 365)].$$

From this we are able to derive the PV formula:

$$PV = FV / [1 + (ir \times t / 365)].$$

Example: PV to FV:

PV = LCC 1 000 000
ir = 14% pa
t = 90 days

$$FV = PV \times [1 + (ir \times t / 365)]$$
$$= LCC\ 1\ 000\ 000 \times [1 + (0.14 \times 90 / 365)]$$
$$= LCC\ 1\ 000\ 000 \times 1.03452055$$
$$= LCC\ 1\ 034\ 520.55.$$

Example: FV to PV:

FV = LCC 1 350 000
ir = 12% pa
t = 120 days

$$PV = FV / [1 + (ir \times t / 365)]$$
$$= LCC\ 1\ 350\ 000 / [1 + (0.12 \times 120 / 365)]$$
$$= LCC\ 1\ 350\ 000 / (1.0394521)$$
$$= LCC\ 1\ 298\ 761.20.$$

1.8 TMV and compound interest

Compound interest takes into account interest earned on interest and on the principal amount (i.e. the original amount of the investment / borrowing). It assumes always that the interest earned is reinvested at the original rate of interest from as soon as it is paid.

A simple example may be useful: a LCC 1 million investment for 2 years at 13% pa payable in arrears (see Figure 6).

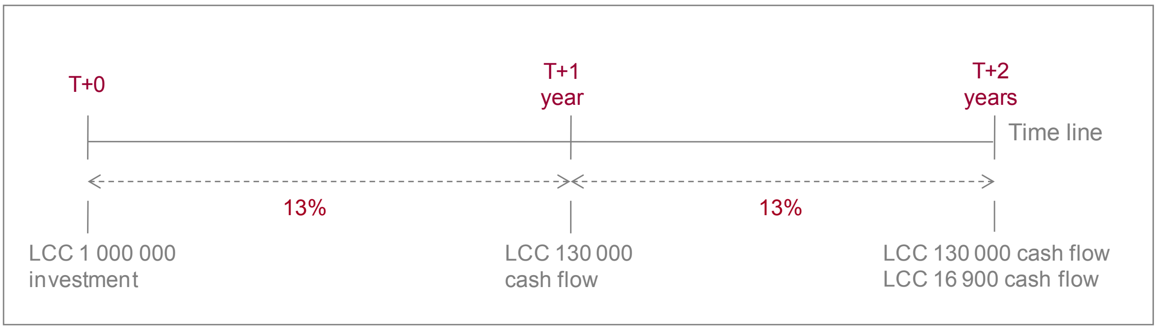

Figure 1.6: Compound interest (cash flows)

The LCC 1 million investment earns interest at 13% pa twice (LCC 130 000), i.e. at the end of each year. The first interest payment is also invested at 13% (the assumption as explained) for the last year [yielding LCC 16 900 (130 000 × 0.13)]. Thus the value of the investment at the end of the period of 2 years (FV) is:

$$\text{LCC } 1\,000\,000 + (2 \times \text{LCC } 130\,000) + \text{LCC } 16\,900 = \text{LCC } 1\,276\,900.$$

The compound interest formula is:

$$FV \quad = PV \times (1 + ir\ /\ not)^{y.not}$$

where

ir = interest rate pa
y = number of years
not = number of times interest is paid per annum.

Example:

PV = LCC 1 000 000
ir = 13% pa
y = 2
not = 1

$$
\begin{aligned}
FV &= \text{LCC } 1\,000\,000 \times (1 + 0.13 / 1)^{2\times 1} \\
&= \text{LCC } 1\,000\,000 \times (1.13)^{2} \\
&= \text{LCC } 1\,000\,000 \times (1.2769) \\
&= \text{LCC } 1\,276\,900.00.
\end{aligned}
$$

Another example:

PV = LCC 1 000 000
ir = 15% pa
y = 1
not = 12 (i.e. monthly)

$$
\begin{aligned}
FV &= \text{LCC } 1\,000\,000 \times (1 + 0.15 / 12)^{1\times 12} \\
&= \text{LCC } 1\,000\,000 \times (1.0125)^{12} \\
&= \text{LCC } 1\,000\,000 \times (1.16075452) \\
&= \text{LCC } 1\,160\,754.52.
\end{aligned}
$$

Yet another example:

PV = LCC 1 000 000
ir = 15% pa
y = 3
not = 2 (i.e. six-monthly)

$$
\begin{aligned}
FV &= \text{LCC } 1\,000\,000 \times (1 + 0.15 / 2)^{3\times 2} \\
&= \text{LCC } 1\,000\,000 \times (1.075)^{6} \\
&= \text{LCC } 1\,000\,000 \times (1.54330153) \\
&= \text{LCC } 1\,543\,301.53.
\end{aligned}
$$

The PV of an investment may be derived from the FV:

$$PV = FV / (1 + ir / not)^{y.not}.$$

An example: What amount must be invested now (PV) at 12% pa compounded semi-annually to end up at LCC 1 million in 3 years' time? The answer is:

$$\begin{aligned} PV &= LCC\ 1\ 000\ 000 / (1 + 0.12 / 2)^{3.2} \\ &= LCC\ 1\ 000\ 000 / (1.06)^{6} \\ &= LCC\ 1\ 000\ 000 / 1.41851911 \\ &= LCC\ 704\ 960.54. \end{aligned}$$

This is a significant formula in economics and finance. Borrowings and investments have future cash flows (FVs). This formula enables one to calculate the price (= PV) of an investment with future cash flows. Note that the interest rate is part of the denominator, which means that when a rate rises, the price (PV) of the investment falls. The converse obviously holds.

Note also that this formula is applied differently in the case of financial instruments with multiple regular cash flows (FVs). As we will show later, each cash flow is discounted to PV and then added.

1.9 Effective rate

Rates of interest pa in the financial markets are quoted with the interest frequency stated. These rates are referred to as the *nominal* rates. For example, a rate may be quoted as 13.5% pa with interest payable *monthly*, or a rate may be quoted as 12% pa with interest payable *quarterly*.

The terminology used in the market for these two rates are 13.5% *nacm* (nominal annual compounded monthly) and 12% *nacq* (nominal annual compounded quarterly). In the case where interest is payable six-monthly and at the end of a year, the terminology would be *nacs* (nominal annual compounded semi-annually) and *naca* (nominal annual compounded annually).

In order to compare these rates, the term *effective rate* is applied. *Nominal rates* are converted to *effective rates* with the use of the following formula:

$$ir_e = [(1 + ir_n / t)^t - 1]$$

where
ir_e = effective rate
ir_n = nominal rate
t = number of interest periods per annum.

An example: A 12% *nacm rate* converts to an *effective rate* as follows:

$$\begin{aligned} ir_e &= (1 + ir_n / t)^t - 1 \\ &= (1 + 0.12 / 12)^{12} - 1 \\ &= (1 + 0.01)^{12} - 1 \\ &= 1.12683 - 1 \\ &= 0.12683 \\ &= 12.68\%. \end{aligned}$$

Another example: A 12% *nacq rate* converts to an *effective rate* as follows:

$$\begin{aligned} ir_e &= (1 + ir_n / t)^t - 1 \\ &= (1 + 0.12 / 4)^4 - 1 \\ &= (1 + 0.03)^4 - 1 \\ &= 1.12550 - 1 \\ &= 0.12550 \\ &= 12.55\%. \end{aligned}$$

It will be evident that a 12% *naca* rate will be equal to an *effective rate* of 12%. Thus, the more interest periods involved, the higher the effective rate will be.

1.10 Coupon rate

Ninety-nine per cent of bonds and long-term NCDs have a *coupon rate* printed on the face of the certificate (or on the computer generated letter / printout in the age of dematerialisation). This is the fixed rate of interest payable to the registered holders of the bonds on the specified interest payment dates. The payment dates may be monthly, quarterly, semi-annually or annually. Semi-annually is the most common.

The origin of the word *coupon* is the bond certificates of decades ago which had coupons attached. These bonds were issued to bearer and they had a coupon for each interest payment. On interest dates the holder detached the relevant coupon and presented it to the issuer (mainly the government) for payment of the interest.

The modern equivalent of the physical coupon is the coupon rate (cr) printed on the face of the certificate. For example, a LCC 1 million bond may have a coupon of 12.0% pa and interest payment dates of 30 June and 30 December. On these interest dates an amount of LCC 60 000 would be paid to the registered holders:

Interest payable = (cr / not) × LCC 1 000 000
= 0.12 / 2 × LCC 1 000 000
= LCC 60 000.00.

The bonds that do not have a coupon rate are:

- Variable rate bonds (such as the inflation-linked bonds).
- Zero coupon bonds.
- Islamic bonds.

Zero coupon bonds are issued for periods of longer than a year and only the nominal / face value (FV) is payable on the maturity date. This of course means that zero coupon bonds are issued at a *discount*, and that the interest earned = FV – PV.

It is to be noted that the coupon earned by the holder is not necessarily the *actual* rate that s/he is earning. The coupon rate is the rate earned only if the bond is issued or trades at a price of 1.0 or 100%. In most cases bonds are issued and trade at a price *premium* (for example 102.4%) or a price *discount* (for example 92.8%). We take this further in the next section.

1.11 Price of a security: the principle

The price of a fixed interest rate security is inversely related to the market interest rate for the security. The best example to demonstrate this is that of a bond that has a fixed rate payable but has no maturity date: the perpetual bond. The price of this bond is:

Price = cr / ir

where

cr = coupon payment (assumed to be annual)
ir = interest rate (at which the perpetual bond trades).

It should be clear that when cr = ir, the price is 1.0 or 100%. However, in the case of a perpetual bond that has an annual coupon of 10% pa, but is trading at 9% pa, the price is:

Price = 10% / 9%
= 1.1111111.

The principal at work here is that when the market rate for the perpetual bond falls from 10% pa to 9% pa, the buyers are prepared to earn 9% pa in perpetuity. This means that they are prepared to pay a *price* for the security that will yield them 9% pa. On a LCC 1 million nominal / face value perpetual bond the annual income is LCC 100 000 (= cr = 10% pa). Thus, the buyers will be prepared to pay LCC 1 111 111.11 for the bond:

Consideration = (10% / 9%) × LCC 1 000 000
= 1.1111111 × LCC 1 000 000
= LCC 1 111 111.11.

Another example is called for:

Security	= government bond
Nominal value	= LCC 1 000 000
Coupon rate (cr, i.e. fixed rate for the period)	= 15% pa
Coupon payable	= in arrears, on maturity
Term to maturity	= 365 days
Market rate	= 15% pa.

The price of the bond on the issue date is 1.0 or 100%, i.e. the investor pays LCC 1 000 000 for the bond. If s/he holds the security for the period of 365 days, s/he will earn the coupon:

Coupon = LCC 1 000 000 × 15.0 / 100
= LCC 1 000 000 × 0.15
= LCC 150 000.

However, if the *interest rate* for the bond in the secondary market falls to 7.5% pa on the same day (the day of issue), the price of the bond will be 2.0 or 200%. This is because there are buyers that are willing to accept a fixed interest rate of 7.5% pa for the period. (Remember that the coupon rate of 15% pa does not change.) In terms of the formula shown above the price of the bond changes to:

Price = cr / ir
= 15.0% / 7.5%
= 2.0.

The consideration payable is:

Consideration = nominal value × price
= LCC 1 000 000 × 2.0
= LCC 2 000 000.00.

It will be evident that the buyer will earn:

Rate earned	= coupon / LCC 2 000 000
	= LCC 150 000 / LCC 2 000 000
	= 0.075
	= 7.5% pa.

This is the market rate at which s/he bought the bond. This demonstrates the principle: price and market rates are inversely related. We now turn to reality: most bonds worldwide have longer terms and have multiple regular interest payments.

1.12 Price of a security: multiple future cash flows and yield to maturity

As said, the vast majority of bonds have longer terms to maturity (up to 30 years) and have multiple and regular (usually twice pa) coupon interest payments. It is best to elucidate with an example However, before we do so we need to introduce the concept yield to maturity (ytm). Although in the bond markets of the world the broker-dealers refer to a "rate" on a long-term security, they are actually referring to its ytm.

Ytm is a measure of the *rate of return* on a bond that has a number of coupons paid over a number of years and a face value payable at maturity. It may also be described as the price that buyers are prepared to pay now (PV) for a stream of regular payments and a lump sum at the end of the period for which the bond is issued. It is an *average rate* earned per annum over the period.

Formally described, the ytm is the *discount rate that equates the future coupon payments and principal amount of a bond with the market price*. Another way of stating this is: the *price* is merely the *discounted value of the income stream (i.e. the coupon payments and redemption amount), discounted at the market yield (ytm).*

The following example will illuminate the PV-FV of a longer term bond or NCD. We choose a 3-year maturity and annual interest payments to elucidate:

Settlement date:	30 / 9 / 2014
Maturity date:	30 / 9 / 2017
Coupon rate (cr):	9% pa
Nominal / face value:	LCC 1 000 000
Interest date:	30 / 9
Ytm (i.e. market rate)	8% pa (payable annually in arrears).

The cash flows and their discounted values (the ytm is used) are as shown in Table 1.

Date	Coupon payment (C)	Nominal / face value	Compounding periods (cp)	Present value $C / (1 + ytm)^{cp}$
30/9/2015	LCC 90 000	-	1	LCC 83 333.33
30/9/2016	LCC 90 000	-	2	LCC 77 160.49
30/9/2017	LCC 90 000	-	3	LCC 71 444.90
30/9/2017	-	LCC 1 000 000	3	LCC 793 832.24
Total	LCC 270 000	LCC 1 000 000		LCC 1 025 770.96
C = coupon payment. cr = coupon rate. cp = compounding periods (years).				

Table 1.1: Cash flows and discounted values

The value now of the bond is LCC 1 025 770.96, and the price of the bond is 1.02577096. The price is calculates as follows:

$$\text{Price (PV)} = [cr / (1 + ytm)^1] + [cr / (1 + ytm)^2] + [cr / (1 + ytm)^3] + [1 / (1 + ytm)^3]$$

where:

cr = coupon rate pa (expressed as a fraction of 1)
ytm = yield to maturity (expressed as a fraction of 1).

Using the same numbers as above (coupon rate = 9% pa, ytm = 8% pa):

Price (PV) = (0.09 / 1.08) + (0.09 / 1.166400) + (0.09 / 1.259712) + (1 / 1.259712)
= 0.08333333 + 0.07716049 + 0.0714449 + 0.79383224
= 1.02577096.

It will be apparent that the coupon rate (0.09) for the periods and the face value (1) that takes place at maturity (all FVs) are discounted at the ytm to PV. Because the coupon rate is higher than the ytm, the price is *higher than 1* (a premium to par). Where the coupon rate is equal to the ytm (assume 9% pa) the price is *equal to 1* (par):

Price (PV) = (0.09 / 1.09) + (0.09 / 1.1881) + (0.09 / 1.295029) + (1 / 1.295029)
= 0.082569 + 0.075751 + 0.069497 + 0.772183
= 1.000000.

As noted, when the coupon rate is lower than the ytm (assume coupon rate = 9% pa, ytm = 11% pa), the price is *lower than 1* (i.e. at a discount to par):

Price (PV) = (0.09 / 1.11) + (0.09 / 1.232100) + (0.09 / 1.367631) + (1 / 1.367631)
= 0.081081 + 0.073046 + 0.065807 + 0.731191
= 0.951125.

The *inverse relationship* between ytm and price is clear. This is because the ytm is the *denominator* in the formula. Thus, if the ytm falls, the price of the bond rises. It follows that if the ytm increases the price falls. Another way of seeing this phenomenon is the logic of: As the ytm rises the future cash flows are worth less when discounted to present value, pulling down the price.

In reality bonds are slightly more complicated but the principle remains the same. The majority (by far) of bonds issued in the bond market have coupons that are payable six-monthly in arrears, and they are issued and traded for periods that are broken, i.e. issues and secondary market settlement dates are between interest payment dates.

In the case where interest payments are made six-monthly in arrears (ignoring settlement between interest payment dates), the coupon rate is halved and the compounding periods are doubled (assume a three-year bond):

Price (PV) = $[(cr / 2) / (1 + ytm / 2)^1] + [(cr / 2) / (1 + ytm / 2)^2] +$
$[(cr / 2) / (1 + ytm / 2)^3] + [(cr / 2) / (1 + ytm / 2)^4] +$
$[(cr / 2) / (1 + ytm / 2)^5] + [(cr / 2) / (1 + ytm / 2)^6) +$
$[1 / (1 + ytm / 2)^6]$.

The bond formula is usually written as:

$$\text{Price} = \sum_{t=1}^{n} [cr / (1 + ytm)^{t}] + [1 / (1 + ytm)^{n}]$$

where

cr = coupon rate (cr / 2 if six-monthly)
ytm = yield to maturity (ytm / 2 if six-monthly)
n = number of periods (years × 2 if six-monthly).

1.13 Other issues and terminology related to interest rates

1.13.1 Basis points, percentage points

It has been uttered that "interest rates have increased by one per cent", or "the central bank cut rates by a half per cent". Both expressions are incorrect, because a *percentage change* implies the change in interest rates from *one level* to *another level.* For example, if a rate of interest changes from 10.5% pa to 11.5% pa, then the *percentage increase* is 9.52% [(11.5 / 10.5) – 1) × 100], not 1%.

The correct terminology is the interest rate increased by *100 basis points* or *1 percentage point*. The basis point concept was developed to explain small movements in interest rates. Thus, a basis point is equal to 1 / 100 of a percentage point.

1.13.2 Floating rate and fixed rate securities

We saw above that a fixed rate security (a.k.a. fixed interest security) is a security (evidence of debt), which carries a fixed rate of interest, i.e. the rate of interest payable by the issuer (borrower) remains unchanged throughout the life of the security, irrespective of the rate at which the security *trades* in the secondary market.

On the other hand, a floating rate security is a security on which the rate of interest changes daily or less frequently (depending on the deal). An example of a true floating rate security is a "call deposit", i.e. the interest rate on the deposit can change daily. Another example is a 3-year corporate bond issued at the 91-day TB rate + 100 basis points. It re-prices every 91 days with the issue of new 91-day TBs. In other words a floating rate debt security is a debt on which the rate is benchmarked on a well-publicised rate.

Apart from the TB rate, the most often used benchmark rates are:

- A well-publicised interbank rate. An example is the UK LIBOR rate (London interbank offer rate), which in theory can change daily.
- The prime lending rate (PR) of the banks (a.k.a. base rate, bank rate, etc.).
- The policy interest rate (PIR) of the central bank (a.k.a. discount rate, repo rate, bank rate, key interest rate, etc.).

1.13.3 Primary and secondary market rates

As said earlier the *primary market* is the market for the issue of new securities and the *secondary market* is the market for the trading of existing securities (i.e. securities that are already in issue). The rate in the primary market can be called an *issue rate* or a *primary issue rate,* but usually the former. The rate in the secondary market is called the *secondary market rate* or just the *market rate* (usually the latter). For example, when a new government bond is issued it is issued at an *issue rate*. When it trades in the secondary market it trades at the *market rate* (the ytm).

Primary market rates are unimportant (in terms of analysis), compared with secondary market rates, because they are issue rates that applied at a particular time, and they in any case are established with reference to the secondary market rates. Also, issues of particular securities are not made on all days. Secondary market rates are important and studied by analysts and academics because they are discovered / established in some cases every second of the day. Because of this they provide *time series*' of various rates.

However, this does not apply to certain high profile primary rates that originate in markets that do not have secondary markets: Examples are the call money rates paid by banks, the prime lending rate (PR) of banks, the mortgage rate of banks and the policy interest rate (PIR) of the central bank (which of course are all closely linked).

1.13.4 Nominal value and maturity value

We have covered *nominal value* and hinted at the concept *maturity value*. We need here to distinguish between money market (all short-term) and bond market (marketable long-term) securities. As we have seen, the plain vanilla bond is one that pays a *coupon* periodically for a number of years on an amount. This *amount* is the nominal value (a.k.a. face value) of the bond. An example will elucidate:

Security	= government bond
Nominal value	= LCC 1 000 000
Coupon rate (i.e. fixed rate for the period)	= 15% pa
Coupon payable	= annually in arrears
Term to maturity	= 5 years
Market rate	= 10% pa.

When this bond has less than 12 months to maturity, on maturity it will pay LCC 1 000 000 + the coupon amount of LCC 150 000 = LCC 1 150 000 to the holder. This is the *maturity value* (MV). If someone buys this bond when it has 85 days to maturity at a rate (*rate*, no longer *ytm*, applies here) of 9.5% pa, she will pay:

Consideration (PV) = MV (= FV) discounted at 9.5% pa
= LCC 1 150 000 / [(1 + (0.095 × 85 / 365)].
= LCC 1 150 000 / 1.02212329
= LCC 1 125 108.89.

Because this bond has less than a year to maturity, it falls into the money market, and is also called an *interest add-on* security. In the money market here are two main types of fixed interest securities (they have one interest payment):

- Interest add-on securities.
- Discount securities (covered later).

An example of the former is the bond covered above. Another is the NCD. A buyer of a new NCD (i.e. a depositor) will deposit at the bank LCC 1 000 000 at a rate of 8.25% pa for 182 days. The maturity value (MV = FV) of the NCD is:

MV (FV) = PV × [1 + (0.0825 × 182 / 365)]
= LCC 1 000 000 × 1.04113699
= LCC 1 041 136.99.

If this NCD is sold in the secondary market after 10 days (i.e. has 172 days to maturity) at 7.5% pa, the calculation of the consideration (PV) is done according to the PV-FV formula presented above in the case of the short bond:

Consideration (PV) = MV (= FV) discounted at 7.5% pa
= LCC 1 041 136.99 / [(1 + (0.075 × 172 / 365)].
= LCC 1 041 136.99 / 1.03534247
= LCC 1 005 596.72.

1.13.5 Yield rate and discount rate

So far we have worked with *yields*, which are the *actual rates of return* on securities. A variation is *ytm* in the case of bonds, which is an average yield / return.

We said above that in the money market we find *discount* securities. An example is the TB. A TB with a nominal / face value of LCC 1 000 000 matures at LCC 1 000 000 (= FV), but it is issued and traded at a *discount rate*. This TB can for example trade at LCC 950 000 (depending on the discount rate), calculated according to (dr = discount rate; d = days to maturity):

PV = FV × [1 – (dr × d / 365)].

If a LCC 1 000 000 (= FV) TB has 91 days to run and trades at 11.0% pa, its consideration is:

Consideration (PV) = LCC 1 000 000 × [1 – (0.11 × 91 / 365)]
= LCC 1 000 000 × (1 – 0.02742466)
= LCC 1 000 000 × 0.97257534
= LCC 972 575.34.

From the above it will be apparent that there is a fundamental difference between a *discount* rate and a *yield* rate and therefore between a *discount* amount and a *yield* amount. A yield amount is based on the PV, and the FV is the sum of the two. The discount amount, on the other hand, is based on the FV, and the PV is the difference between the two. It follows that the yield rate of interest is always expressed as a percentage of the PV, while the discount rate is expressed as a percentage of the FV.

It will be evident that the FV of the LCC 1 000 000 TB is also a MV. Thus, we can arrive at the same consideration as above if we convert the discount rate to a yield rate using the conversion formula:

$$\begin{aligned} ir &= dr / [1 - (dr \times d / 365)] \\ &= 0.11 / [1 - (0.11 \times 91 / 365)] \\ &= 0.11 / (1 - 0.02742466) \\ &= 0.11 / 0.97257534 \\ &= 0.1131 \\ &= 11.31\%. \end{aligned}$$

The proof (refer to the last consideration calculation above):

$$\begin{aligned} \text{Consideration} &= MV / [1 + (0.1131 \times 91 / 365)] \\ &= \text{LCC } 1\,000\,000 / 1.02819753 \\ &= \text{LCC } 972\,575.34. \end{aligned}$$ [4]

In conclusion, the yield interest rate to discount rate conversion formula:

$$dr = ir / [1 + (ir \times d / 365)].$$

1.13.6 Risk-free rate

Some textbooks are confusing on the subject of the risk-free rate (*rfr*). Some define it as the rate on 3-month TBs, while others say it does not exist. Our view is that there are many rfrs and they can be found on the government security (bonds and TBs) yield curve. The government security yield curve is a snapshot of all rates on government securities in issue (ytms on bonds and yields on TBs) at a specific point in time. A yield curve, also called *the term structure of interest rates*, presents the relationship between term to maturity and rates at a point in time. It is discussed in detail later.

Why is the rfr important? It is a rate that is used in many financial market calculations, especially in the derivative markets. It also represents the basis of the rate that an investor should accept on risky assets (i.e. non-government securities, such as shares, corporate bonds, etc.). Thus, the rate on a risky security, a.k.a. required rate of return (rrr), is equal to the rfr plus a risk premium (rp):

$$\text{rrr} = \text{rfr} + \text{rp}$$

The investor has to decide what the rp should be. There are many studies on the size of the rp, such as the capital asset pricing model (CAPM).

What does risk-free mean? Government securities are considered risk-free because they have the ability to raise revenue (tax and issue securities), and thus always service debt and honour maturities. As is well known, some countries' government securities are not risk-free, but such countries are few.

1.13.7 Bid and offer rates / prices and spread

There are two debt / deposit market types:

- Order driven markets.
- Quote driven markets.

In order-driven financial markets, such as share exchanges, sellers or buyers place *orders* to sell or buy shares with their brokers. In the age of share exchanges' Automated Trading Systems (ATS), the ATS's central order book arranges the sell and buy prices according to best price followed by the inferior prices. Deals are struck by the ATS when the buy and sell prices coincide.

In the debt and deposit markets, the main market type is *quote-driven* (there is an element of order placing), in the sense that the market (certainly in most bond markets) is "made". This means that market makers (usually the banks) quote both buy and sell rates / prices simultaneously. They are the *bid* (the market maker's buying rate; the selling rate from the perspective of the client) and *offer* rates (the market maker's selling rate; the buying rate from the viewpoint of the client). In some countries these rates are known as *bid* and *ask* rates.

The bid price is always lower than the offer price and the difference is called the *spread*. The spread is the compensation for the market maker for the risk taken in quoting firm bid and offer prices simultaneously. *Firm* means that the market maker is prepared to deal at the prices quoted in a given volume (which disclosed by the client). We will return to this issue later, as it is an important part of price discovery of rates.

1.13.8 Nominal and real interest rates

Any interest rate published in the media is a *nominal* interest rate (nir). An interest rate adjusted for inflation (π) is a *real* interest rate (rir), and it reflects the true cost of borrowing / the true earning rate. The first person to "split" the rate is Prof Irving Fisher, and the equation of the real interest rate, named for him (*Fisher equation*), is:

$$\text{rir} \quad = \text{nir} - \pi.$$

The inflation rate used can be the current rate if it is low and has been level for some time, or the expected rate if this is not the case. We will return to this issue later.

1.14 References

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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.

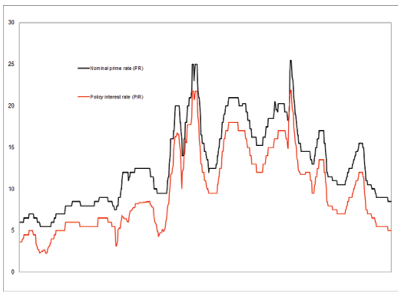


Figure 2.1: PIR and PR (50 years)

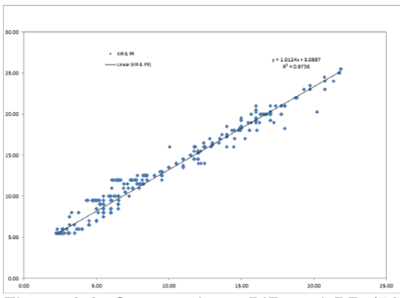


Figure 2.2: Scatter chart: PIR and PR (50 years)

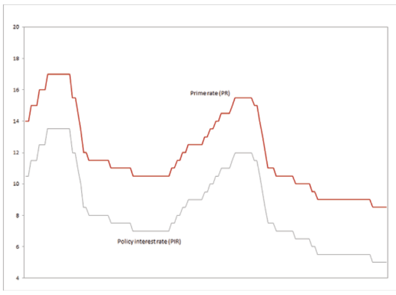


Figure 2.3: PIR and PR (13 years)

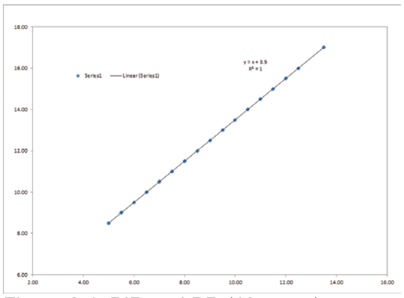


Figure 2.4: PIR and PR (13 years)

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.

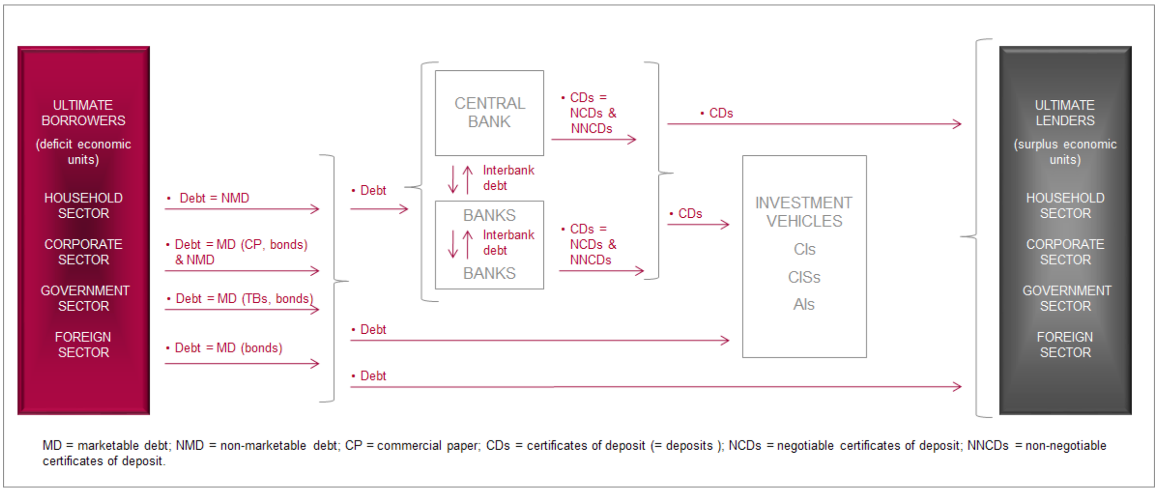


Figure 2.5: Debt and deposits (securities)

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.

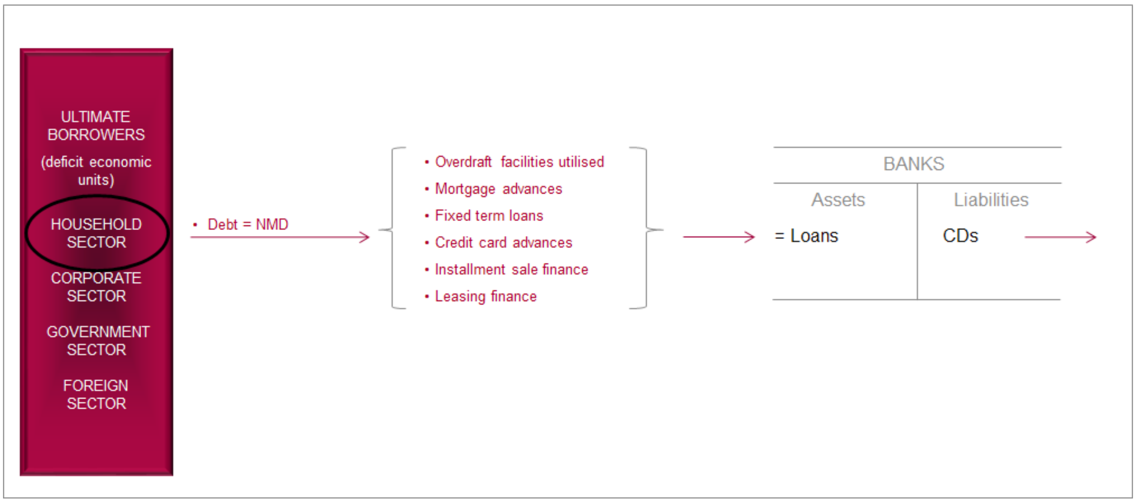


Figure 2.6: Debt securities of household sector

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).

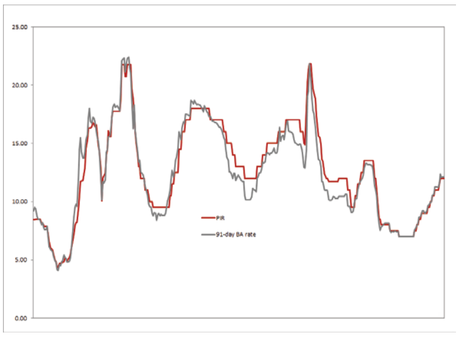


Figure 2.7: PIR & 91-day BA rate

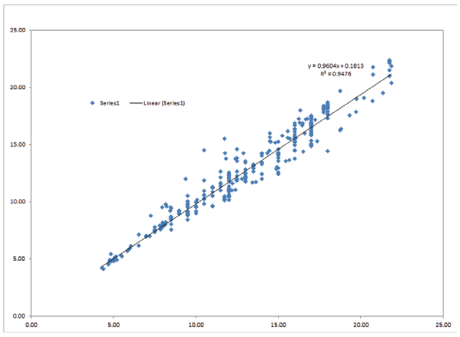


Figure 2.8: Scatter chart: PIR & 91-day BA rate

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.

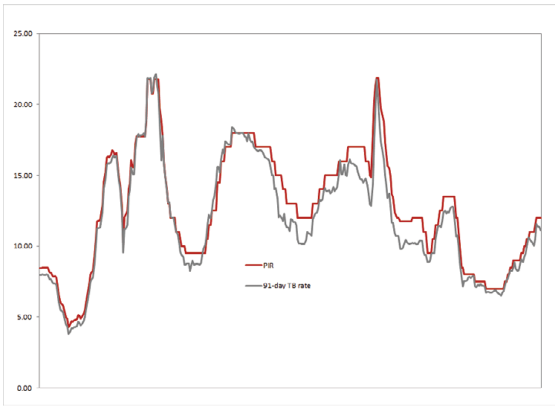


Figure 2.9: PIR & 91-day TB rate

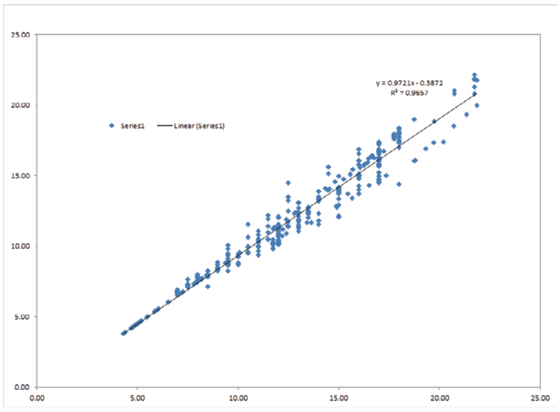


Figure 2.10: Scatter chart: PIR & 91-day TB rate

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).

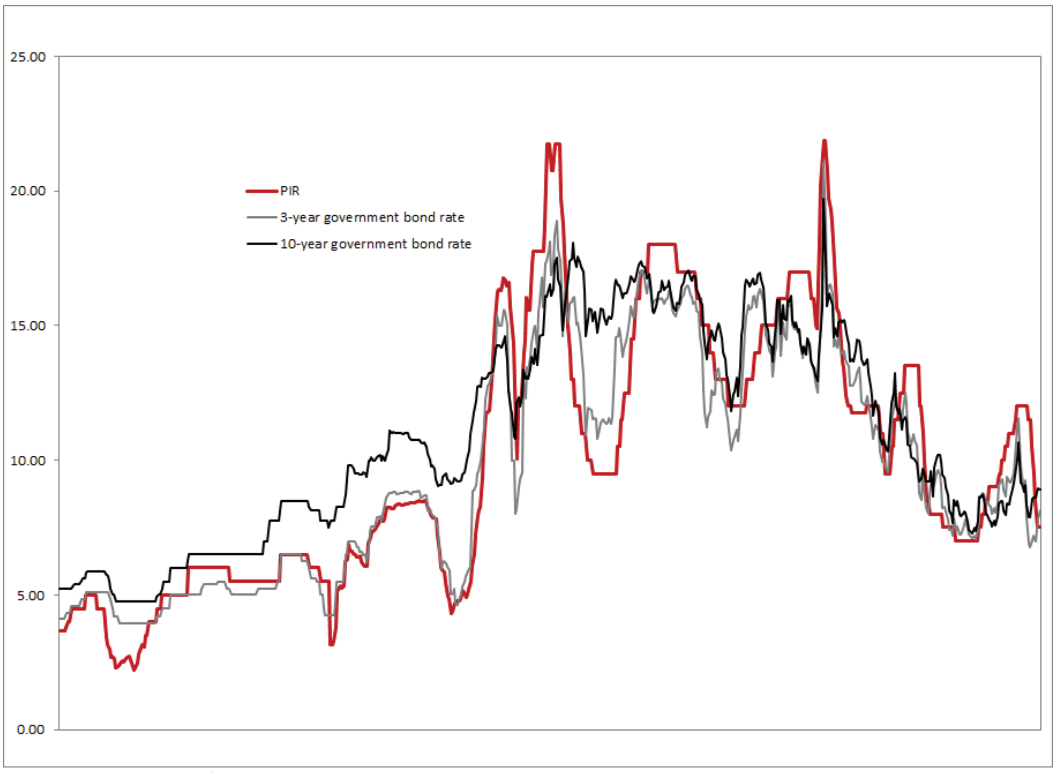


Figure 2.11: PIR & government bond rates

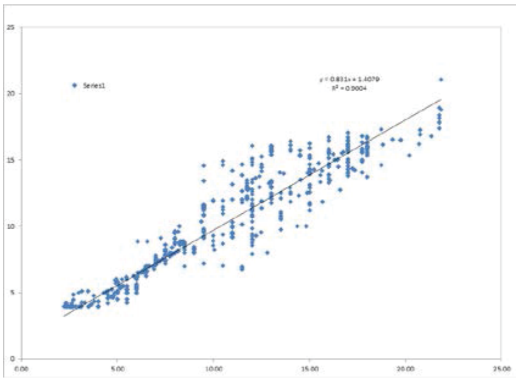


Figure 2.12: PIR & 3-year government bond rate

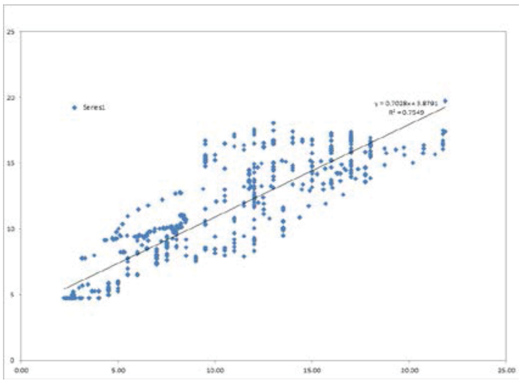


Figure 2.13: PIR & 10-year government bond rate

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.

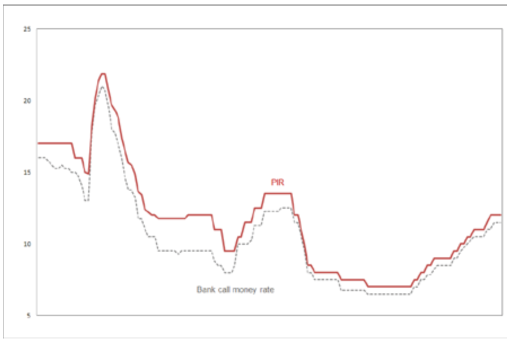


Figure 2.14: PIR & bank call money rate

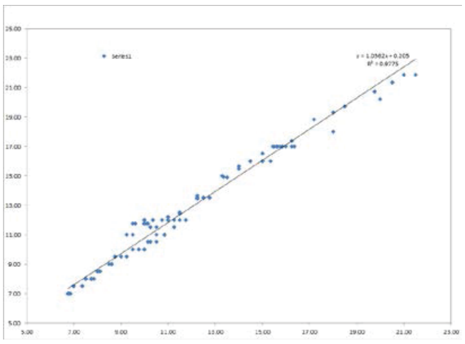


Figure 2.15: Scatter chart: PIR & bank call money rate

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.

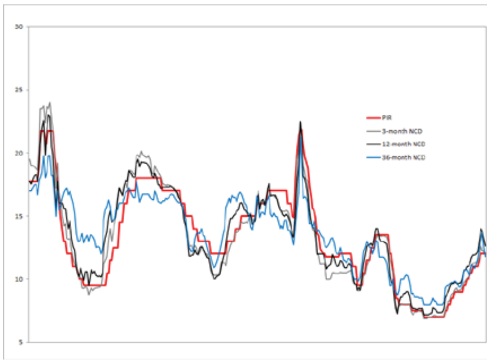


Figure 2.16: PIR & bank deposit rates (NCDs)

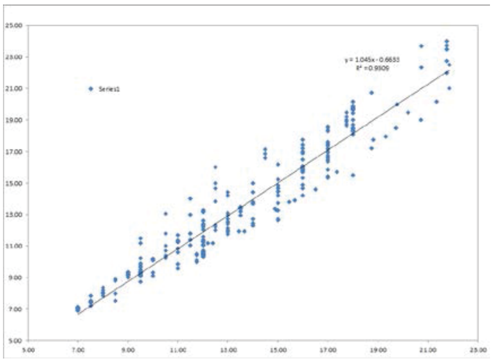


Figure 2.17: Scatter chart: PIR & 3-month NCD rates

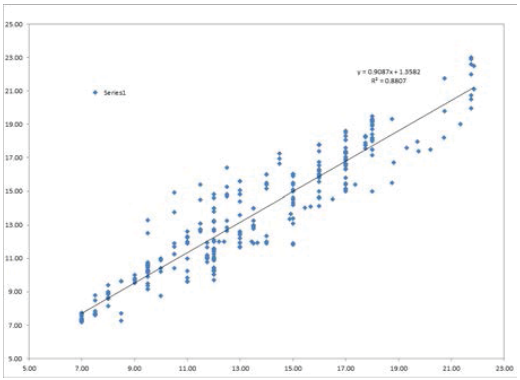


Figure 2.18: Scatter chart: PIR & 12-month NCD rates

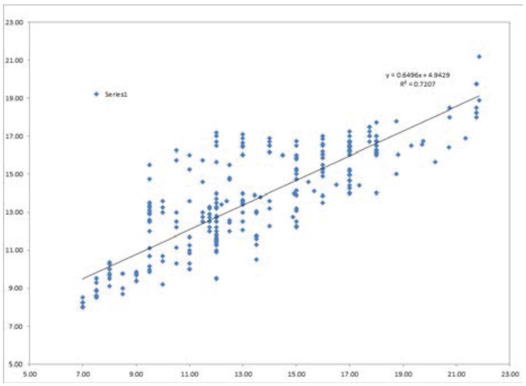


Figure 2.19: Scatter chart: PIR & 36-month NCD rates

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).

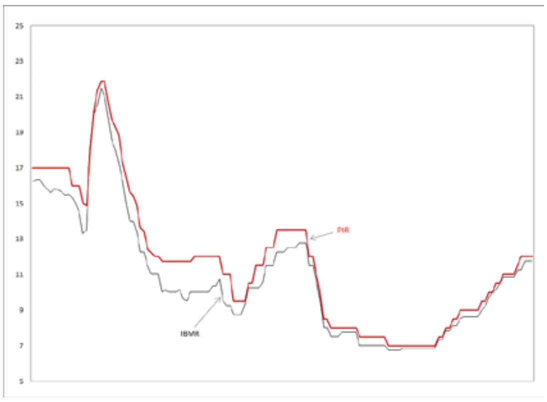


Figure 2.20: PIR & IBMR

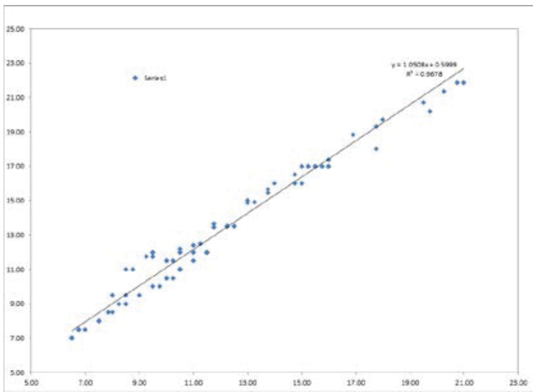


Figure 2.21: Scatter chart: PIR & IBMR

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 $R^2 = 0.98$).

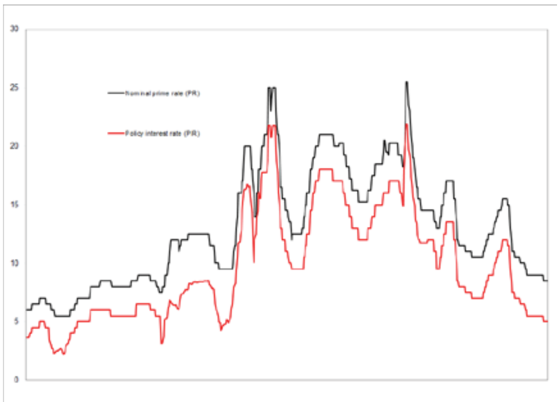


Figure 2.22: PIR and PR (50 years)

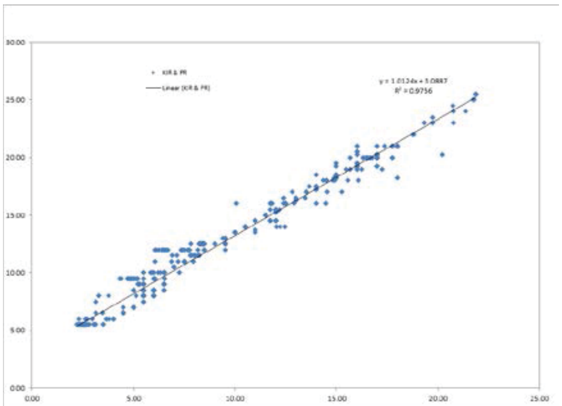


Figure 2.23: Scatter chart: PIR and PR (50 years)

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.

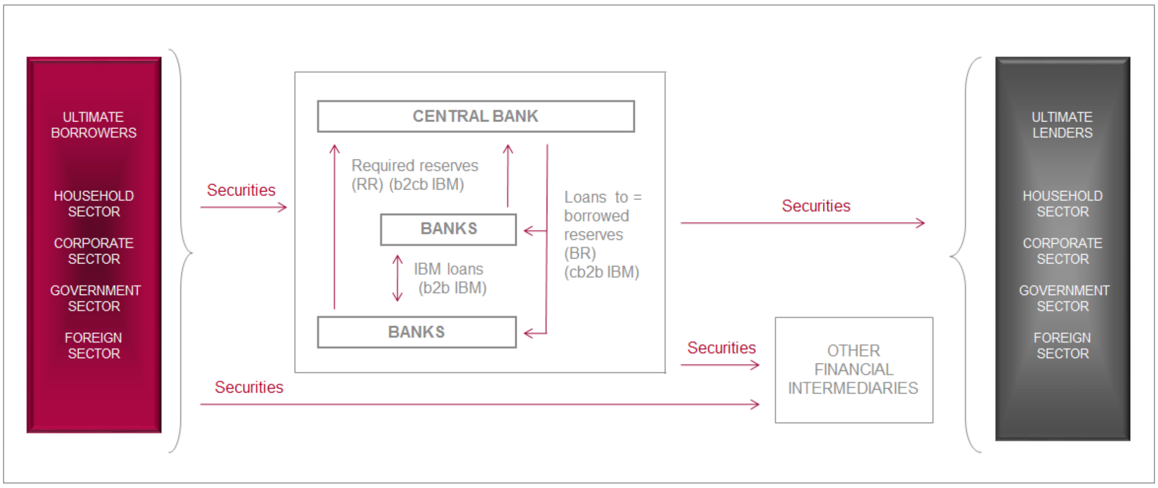


Figure: 2.24: Interbank markets

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 (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:

ΔM3 = ΔBD + ΔN&C
= +LCC 100 million + Δ0
= +LCC 100 million.

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:

ΔM3 = ΔBD = Δbank credit
= +LCC 100 million = +LCC 100 million.

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:

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

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 $\Delta BD \times rr$. 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.

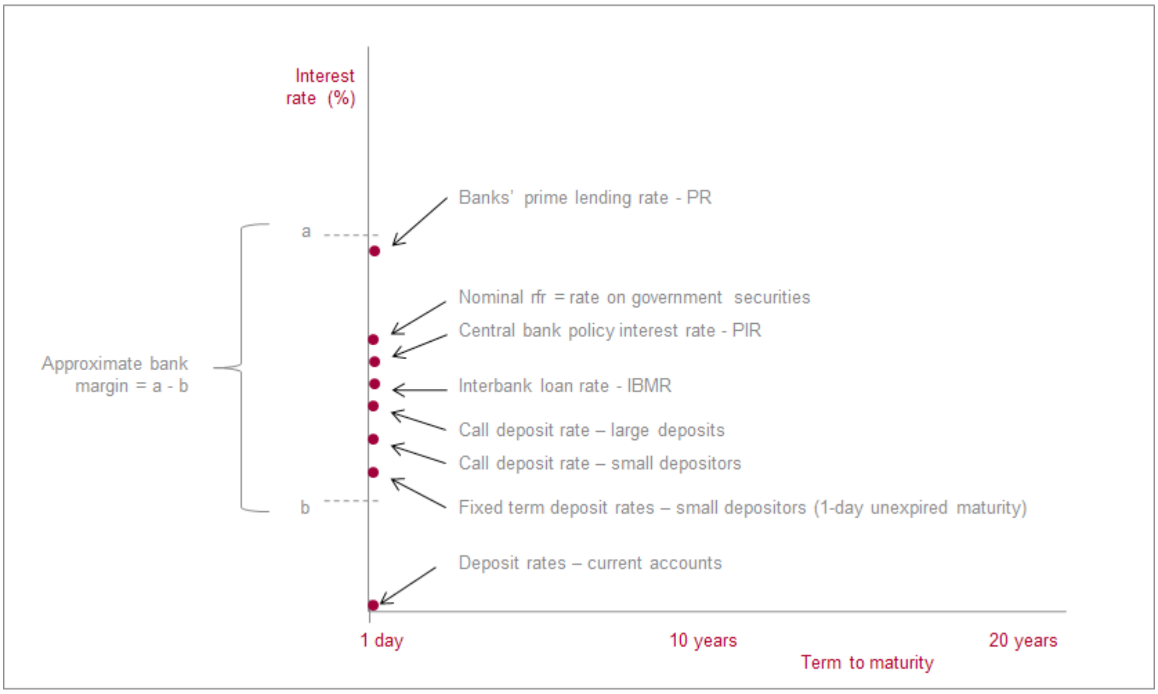


Figure 2.25: Money market rates & bank margin

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

Faure, AP (2012–2013). Various which can be accessed at http://ssrn.com/author=1786379.

Faure, AP (2013). Various which can be accessed at http://bookboon.com/en/banking-financial-markets-ebooks

3 Composition of interest rates

3.1 Learning outcomes

After studying this text the learner should / should be able to:

1. Describe the yield curve.
2. Be familiar with the literature on the composition of interest rates.
3. Describe the components of interest rates.
4. Elucidate the risk-free rate.

3.2 Introduction

We have discussed the relationships of short-term nominal interest rates and hinted at the relationship between short- and long-term rates. We now take this further.

A number of economics and finance scholars have decomposed the nominal rate of interest. We offer a refinement to the analyses, which has as its starting point the 1-day real risk-free rate (rfr). It is equal to the 1-day nominal rfr less inflation. Before we begin the analysis we need to elucidate the yield curve, which we only touched upon briefly earlier. The following are the sections:

- The yield curve.
- Literature on the composition of interest rates.
- Composition of interest rates: an alternative analysis.
- Literature on the risk-free rate.
- The risk-free rate: an alternative view.
- Relationship of interest rates revisited.

3.3 The yield curve

3.3.1 Introduction

A yield curve (YC) depicts the rates on bonds of various remaining terms to maturity at a point in time. In other words it is a snapshot of the relationship between bond rates and terms to maturity. It is also called the *term structure of interest rates*. We present a *positively-sloped* (a.k.a. *normal*) YC in Figure 3.1.

In order to elucidate, let us assume that this is a YC for government securities (i.e. TB and bond rates[18]) at 4 p.m. on 20 June. The YC is telling us that the rates shown in Table 3.1 were recorded at 4pm on that day. Note: they are read from the YC.

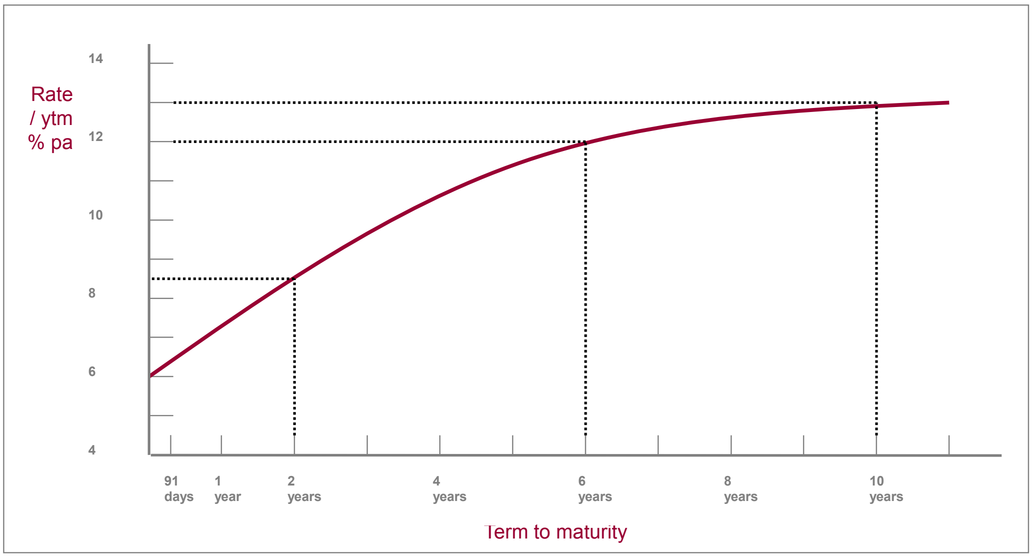


Figure 3.1: Normal yield curve

Maturity of security	Rate
1-day (TB)	6.0%
91-days (TB)	6.5%
1 year (government bond)	7.5%
2 years (government bond)	8.5%
3 years (government bond)	9.65%
4 years (government bond)	10.60%
5 years (government bond)	11.42%
6 years (government bond)	12.00%
7 years (government bond)	12.32%
8 years (government bond)	12.50%
9 years (government bond)	12.81%
10 years (government bond)	13.00%
11 years (government bond)	13.11%

Table 3.1: Government security rates recorded on 20 june

Where did this YC come from? It was constructed from the rates that prevailed on government securities of various maturities at 4 p.m. on 20 June. Figure 3.2 depicts this.

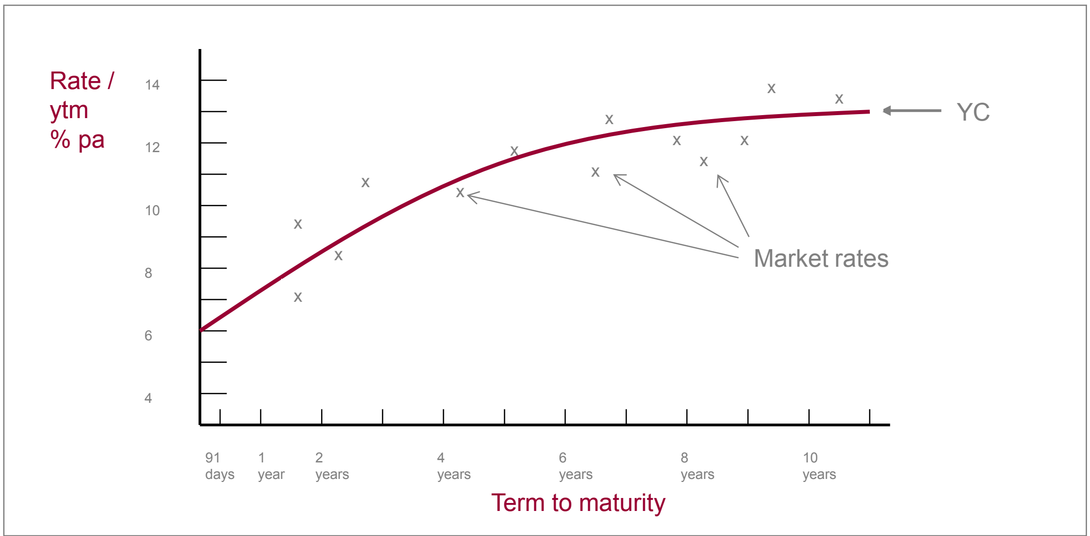


Figure 3.2: Market rates and constructed yield curve (YC) (normal YC)

The market rates on government securities of different maturities are represented by the x's and the YC is drawn with the use of a statistical technique. Thus, it will be apparent that the YC is a *graphical representation of the relationship between rate and term to maturity of bonds at a specific point in time.*

An YC is a useful tool:

- Rates (ytms) for year intervals can be derived for analysis purposes. For example, rates can be derived from the curve for 1 year, 2 years, 3 years, and so on. Thus, over a period a *time series* of rates for various terms is available. Recording the rate on a *specific* 10-year bond on month-ends of little use because each month the bond has one month less to maturity.
- Securities can be valued using the YC. The holder of a poorly traded bond is able to value the bond because the curve gives the "average" rate for all terms.
- The YC serves as a benchmark for both buyers of bonds and new issues of bonds.
- A government bond YC is a benchmark for the rates on non-government bonds.

It will be evident that in a sophisticated market the points (the x's) will not be as scattered as in the above example; they will be closer to the YC that is constructed from them.

It is to be noted that the above discussion was concerned with the *ytm YC*. It is the most familiar YC and is a representation of the relationship between yield to maturity and term to maturity of a group of homogenous securities (usually government).

3.3.2 Disadvantage of the ytm yield curve

However, there is a "problem" with the ytm YC. In the definition of ytm is the implicit assumption that coupon payments are reinvested at the ytm; this is rarely achieved (which can be called *reinvestment risk*). The only bond devoid of reinvestment risk is the zero coupon bond that has one payment at the end of its life.[19] For these reasons other YC types have been devised, such as:

- Par YC.
- Coupon YC.
- YC of "on-the-run treasury issues".
- Zero-coupon (a.k.a. spot) YC.

The ideal or "pure" YC is the *zero-coupon YC* (a.k.a. *spot YC*), i.e. a curve constructed from the rates on a series of central government zero coupon bonds and TBs. We do not have the space to take this issue further.

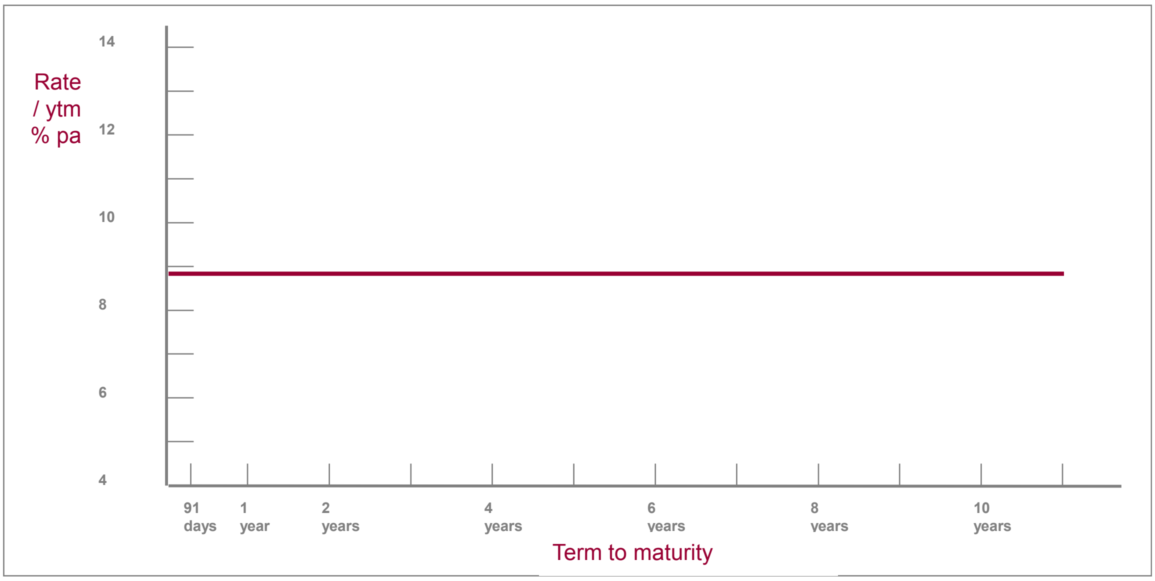


Figure 3.3: Flat YC

3.3.3 Shape of yield curve

Yield curves take on different shapes at different times. The normal YC is the one presented Figures 3.1–3.2, i.e. it is *positively sloped*, and it implies that the longer the bond the higher the return. Investors are rewarded for holding bonds of longer maturity. The other two basic shapes are the *flat YC* and the *inverted or negatively sloped YC*. The flat curve is portrayed in Figure 3.3.

The flat YC implies that there is no reward for the risk of a longer-term investment. Irrespective of term to maturity, all investors in government bonds earn the same rate (ytm). This curve usually represents the stage between normal and inverse.

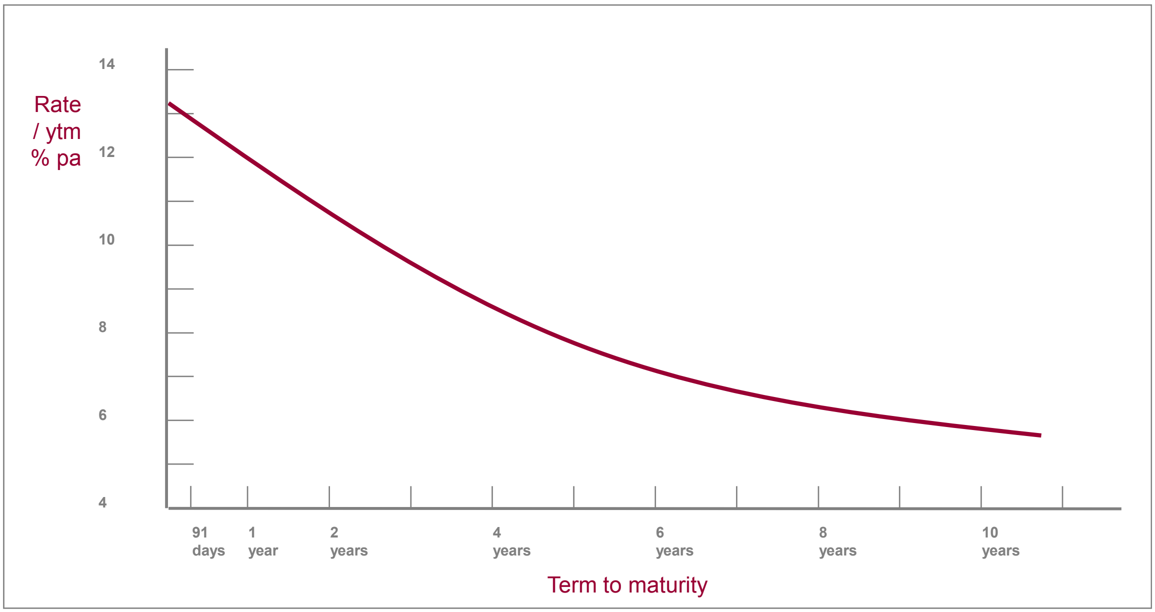


Figure 3.4: Inverse YC

The inverted or negatively sloped YC is illustrated in Figure 3.4. This curve tells us that investors are negatively compensated for holding long-term securities; they are "prejudiced" in relation to the holders of short-term securities – or so it appears. In reality, this YC normally comes about in periods of high rates when the monetary authorities are conducting a stringent monetary policy, driving up short-term rates. The long-term investors are content to accept short rates being higher than long rates because they *harbour strong expectations* that the shape of the YC is about to change to a normal shape and that the entire YC will shift downwards.

This means that the inverse YC is indicating that longer term investors are willing to accept lower rates now in exchange for large expected capital gains in the near future, i.e. the *income sacrificed will be more than compensated for by the capital gain*.

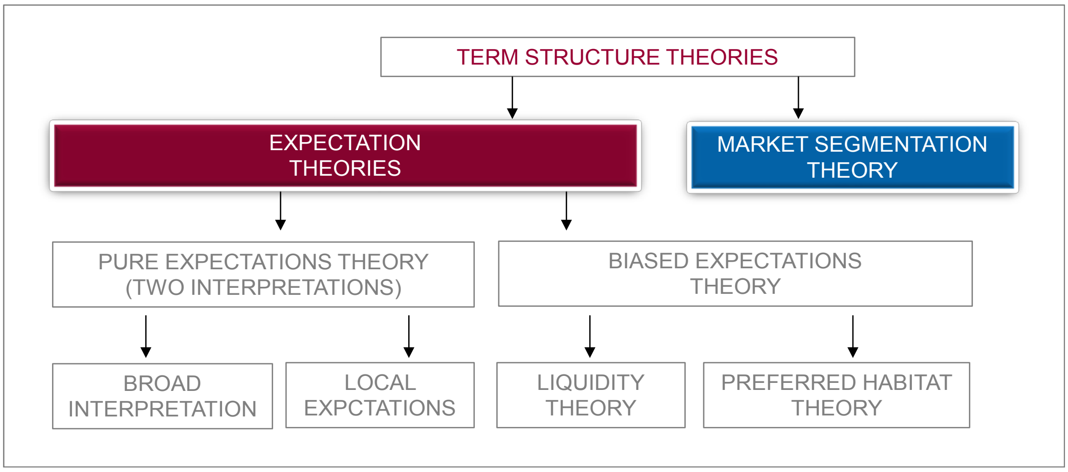
3.3.4 Theories of the term structure of interest rates

Two main theories have evolved to explain the YC, i.e. the expectations theory and the market segmentation theory. The former is categorised[20] into the pure expectations theory (of which there are two interpretations) and the biased expectations theory. There are two interpretations of the latter. Box 3.1 presents the term structure theories.

All these theories share a hypothesis about the behaviour of short-term forward rates and assume that the forward rates implied in current long-term bond rates are closely related to market participants' *expectations* about the future short-term rates.

The *pure expectations theory* postulates that the YC at any point in time reflects the market's expectations of future short-term rates. Thus, an investor with a 10-year investment horizon has a choice of buying a 10-year bond (and earn the current yield on his bond) or of buying 10 successive 1-year bonds. The return on the two investments will be the same, i.e. long-term rates are geometric averages of current and expected future short-term rates.

In terms of this theory, a positively shaped YC indicates that short-term rates will rise over the investment term, and a flat curve indicates that short rates are to be stable over the investment horizon.



Box 3.1: Term structure theories

As noted, there are basically *two broad interpretations* of this theory. The main criticism of this theory is that it does *not consider the risks* associated with investing in bonds.

The *liquidity theory* suggests that investors will hold longer term securities only if they are offered a long-term rate that is higher than the average of expected future rates by a risk premium that is *positively related* to the term to maturity (i.e. rises uniformly with maturity). Put another way: *the expected return from holding a series of short bonds is lower than the expected return from holding a long-bond over the same time period*. Thus, forward rates are not an unbiased estimate of the market's expectations of future rates, because they embody a liquidity premium.

The *preferred habitat theory* buys the theory that the term structure of interest rates reflects the expectation of the future path of interest rates and the risk premium. However, it rejects the notion that the risk premium must rise uniformly with maturity. Thus, the risk premium can be positive or negative and can induce investors to move out of their preferred habitat, i.e. their preferred part of the curve. It will be evident that in terms of this theory the YC can be positively sloping, inverse or flat.

The *market segmentation theory* holds that investors have preferred maturities of bonds dictated by their liabilities. Thus, banks will hold short-term securities and retirement funds / insurers will hold long-term securities. They will not shift from one sector to another to take advantage of opportunities. The YC reflects supply and demand conditions in the various maturity sectors of the YC.

3.4 Literature on the composition of interest rates

In the below analysis we assume a normal YC (i.e. a positively-sloped YC).

Prof Irving Fisher in his *Theory of interest* in 1930 was one of the first scholars to "split" the rate: the nominal interest rate. He postulated that the nominal interest rate (*nr*), i.e. the observed rate, is equal to, and is therefore comprised of, the real rate (*rr*) and the expected inflation rate ($e\pi$). At low levels of interest rates and low and stable inflation this may be expressed as:

$$nr = rr + e\pi$$

Essentially, Prof Fisher hypothesised that lenders demand a premium over the real rate of interest to compensate for the inflation-induced attrition of their monies lent. He asserted that nominal interest rates adjust in line with expected changes in the rate of inflation. Fisher did not state the term of asset he was referring to or its status in terms of risk.

Since then a number of economics and finance scholars have presented the elements that make up the nominal rate of interest. One example (Blake, 2000:86), which is largely representative, is presented in Figure 3.5. The starting point is the *real rate of interest* (*rr*), which is the rate of interest expected / demanded in a risk-free and inflation-free economic milieu. The *expected rate of inflation* (*e*π) is added to the *rr* arrive at the nominal rate of interest (*nr*).

According to Blake the third component is the *liquidity premium* (*lp*), which increases with term to maturity. This is so because lenders prefer to lend short, since short-term securities are more liquid than long-term securities, and the latter are more subject to losses in capital value. Borrowers, on the other hand, prefer to borrow long, because of *rollover risk*, that is, the risk of rolling over borrowings on unfavourable terms. Hence, borrowers are prepared to pay a liquidity premium to lenders. The preferences of lenders and borrowers in combination bring about the upward sloping YC (Yield Curve 1).

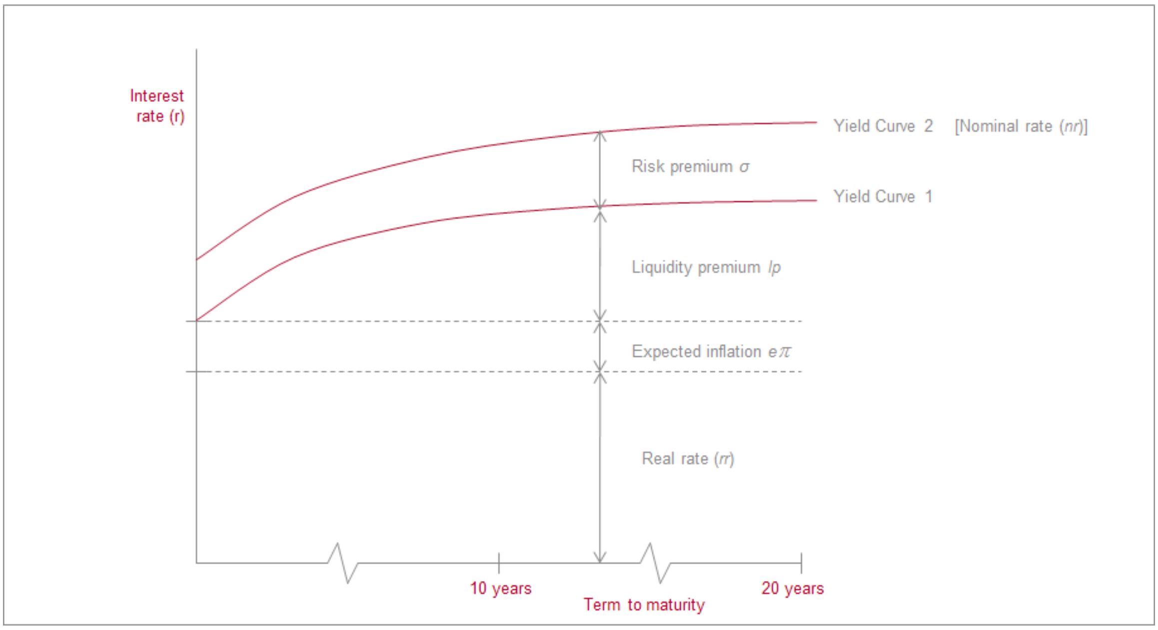


Figure 3.5: Composition of nominal rates

The fourth component, according to Blake, is the *risk premium* (σ), made up of *specific risk* (a.k.a. *unsystematic risk* and *diversifiable risk*) and *market risk*. Specific risk has four dimensions: management risk, business / operating risk, financial risk and collateral risk. Market risk (also known as *systematic risk* and *undiversifiable risk*) is the risk of default of the issuer, the risk of changes in capital value (which increases with term to maturity), and reinvestment risk (the risk of reinvesting coupon payments at lower than expected rates). Thus, every point on Yield Curve 2 has components as follows:

$$nr \quad = rr + e\pi + lp + \sigma.$$

3.5 Composition of interest rates: an alternative analysis

The above analysis is useful indeed. However, it makes no reference to the *risk-free rates* and *non-risk-free* (or *risky*) rates. In this section we offer a refinement to the analysis, which has as its starting point the *1-day real risk-free rate* (*rrfr*) (see Figure 3.6). By *risk-free* is meant *credit-risk-free*. This is the rate on a 1-day unexpired maturity TB or government bond in an inflation-free environment.[21]

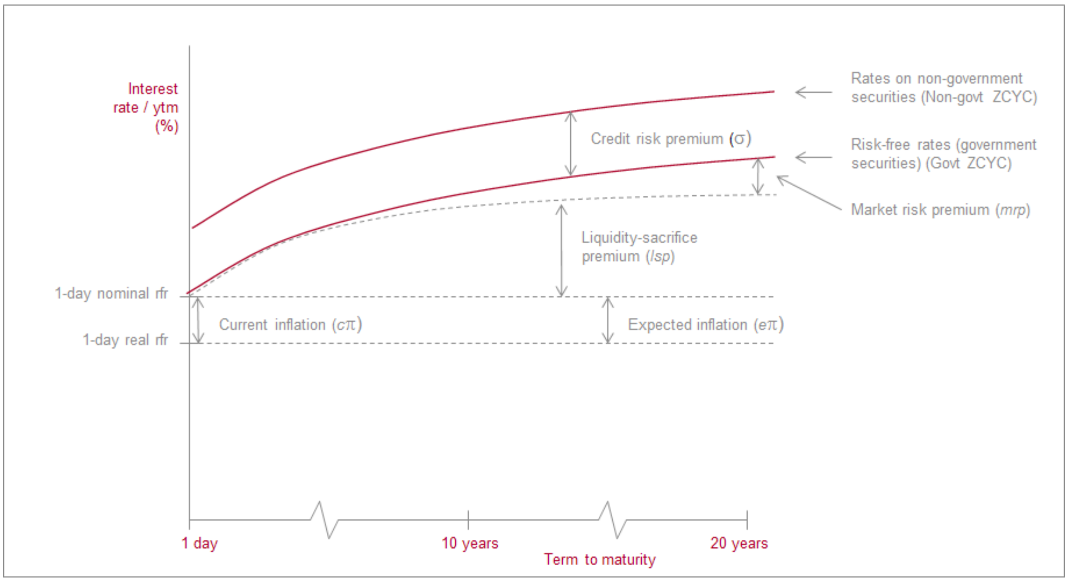


Figure 3.6: Composition of nominal rates (alternative)

The *1-day rrfr* is the lowest rate in the debt market in an inflation-free environment. However, such an environment rarely exists, and the *current rate of inflation* ($c\pi$) is taken into account in arriving at the *1-day nominal rfr* (*nrfr*):

$$\textit{1-day nrfr} \quad = \textit{1-day rrfr} + c\pi.$$

The *current* inflation rate in a low and stable inflation environment is relevant to the analysis. Market participants tend to use in their pricing behaviour the last published inflation rate, which at worse is six weeks old and at best two weeks old[22]. Also, in a low and stable inflation environment, it is unlikely that the next published inflation rate will differ much from the last one (it may differ by a few decimal points, for example, change from 2.2% to 2.4%).This is small enough to disregard.

The *1-day nrfr* is the lowest rate in the debt market. It contains no *liquidity-sacrifice premium* (*lsp*) (note the change from the previously used terminology: *liquidity premium*) because it has one day to maturity, that is, the investor has an investment with the shortest possible term to maturity. The *lsp* applies from the 2-day term to maturity and it rises as term to maturity increases, for the reasons described earlier: lenders prefer to lend short and borrowers prefer to borrow long. We need to question whether an *lsp* exists where the government bond market is liquid. The answer is that one is never 100% certain that a market will remain liquid.

As the term to maturity increases the component current inflation ($c\pi$) gives way to *expected inflation* ($e\pi$), because there is no certainty that the current low and stable inflation environment will prevail. The fourth component is the *market risk premium* (*mrp*). Market risk here is regarded as having two components: (1) the risk of *changes in capital value*, which increases with term to maturity, and (2) *reinvestment risk*, that is, the risk of reinvesting coupon payments at lower than expected rates.

Thus, after the 1-day term to maturity, which we give as:

$$\textit{1-day nrfr} \quad = \textit{1-day rrfr} + c\pi,$$

we are in the domain of the *government security YC,* which we call the government zero-coupon YC (Govt ZCYC[23]) in Figure 3.6. Thus, the components of all government security interest rates beyond 1-day are:

$$\textit{nrfr} \quad = \textit{1-day rrfr} + e\pi + \textit{lsp} + \textit{mrp}.$$

The rates of interest on government securities are the lowest in the debt markets because they are credit-risk-free. In the financial markets, the rates of interest on the debt instruments of non-government issuers are benchmarked against the equivalent-term rates on government securities. For example, the 10-year bonds of prime-rated ABC Company may trade at 200 basis points (bp) over the 10-year government bond rate. This is the *credit risk premium* (σ) demanded by the lenders.

The credit risk premium (by which is meant the risk of default), and the YC for corporate securities, depicted as "Non-govt ZCYC", are included in Figure 3.6. It is assumed that the YC is also a ZCYC and that the rates apply to AAA-rated borrowers (that is, homogenous corporate bonds in terms of risk).

The non-government ZCYC is depicted as running parallel to the government bond ZCYC, indicating that the credit risk premium is the same for all terms to maturity. This may not be the case: the premium may increase with maturity if corporate bonds are not as easily marketable as government bonds, which is usually the case.

With the addition of the credit risk premium (σ) to the equation, we are now "explaining" the nominal rates of AAA-rated companies (*nrc*). Each point on the corporate ZCYC is composed as follows:

$$nrc \quad = 1\text{-}day\ rrfr + e\pi + lsp + mrp + \sigma.$$

It should be clear that the above was not an attempt to explain the slope of the YC (the theories do that). It is merely an attempt to "build" interest rates from the logical starting point (the *1-day rrfr*) to the longer-term rates.

3.6 Literature on the risk-free rate

The *nrfr* (from here on referred to as the *rfr*) has a celebrated role in finance. It is the lowest debt interest rate in the monetary system; it is a benchmark rate; it is a significant input in models such as the Black-Scholes options pricing model, arbitrage pricing theory, capital market theory, the valuation of equities, the valuation of futures (cost of carry model), and many others. Despite its significance, there still exists some confusion as to its identity and even to its very existence.

Every author on the financial markets, economics of finance and finance makes reference to the *rfr,* and has a view on its somewhat blurred identity or nonentity status. We mention a few.

Reilly and Norton (2003:275) state that:

> "…the nominal risk-free rate [is the rate on] risk-free securities such as government T-bills."

Similarly, Gitman (1997:389) states:

> "The risk-free rate…is the rate of return…on a virtually riskless investment such as a US Treasury bill."

Adams et al. (2003:342) state that:

> "The risk-free rate of interest is the yield on a notional default-free bond…"

Cecchetti (2006:97) states that:

> "…a risk-free security is an asset whose future value is known with certainty and whose return is the risk-free rate" and that "no truly risk-free asset exists, so the risk-free rate is not directly observable."

Rose and Marquis (2006:116) maintain that:

> "…the pure or risk-free rate of interest exists only in theory" and that "the closest real-world approximation to this pure [risk-free] rate of return is the market interest rate on government bonds."

Bodie, et al. (1999:181) state that:

> "…it is common practice to view Treasury bills as 'the' risk-free asset. Their short-term nature makes their values insensitive to interest rate fluctuations."

Pilbeam (1998:92), under a discussion on bonds, asserts that:

> "Government bonds have the advantage of being risk-free in the sense that the purchaser…can be sure that the government will pay the coupon payments and the maturity value. Ultimately the government could just print money if it had to."

Mayo (2003:365) states that:

> "…no exact measure of the real risk-free rate exists."

In a similar vein, Bailey (2005:88) mentions:

> "A risk-free asset, if one exists…"

3.7 The risk-free rate: an alternative view

We present the view that there are as many *rfrs* as is the length of the government bond ZCYC, and that the relevant *rfr* is the one that corresponds to the application. For example, if a 180-day futures contract requires valuation, the applicable *rfr* is the 180-day point on the government bond ZCYC. The same applies to options. In the case of the valuation of shares as offered by the capital asset pricing model (CAPM), the applicable *rfr* should a longer term *rfr,* such as the 5-year *rfr*, and not the TB rate as proposed by some authors.

An important issue here is that the bottom end of the government security YC is closely related to and influenced by the PIR. This is discussed more fully in the next section.

3.8 Relationship of interest rates revisited

Figure 3.7 is the same as Figure 3.6, except that the rrfr has been removed, and the other short-term nominal rates have been superimposed, to show further relationships. This has been discussed, but we would like to add a few points:

- The rates on short-term prime debt (CP, BA's and PNs) will run along the YC for prime non-government securities (up to one year, because this is the maximum maturity).
- PR (which can be regarded as a 1-day rate – as discussed earlier) will be higher than the rate on prime CP, BA's and PNs because it is non-marketable debt.
- The rate on bank credit (overdrafts) to non-prime customers is shown at the point PR+2%.
- The NCD YC (a.k.a. the money market YC) is shown, with its starting point being similar to the rate paid on call deposits.

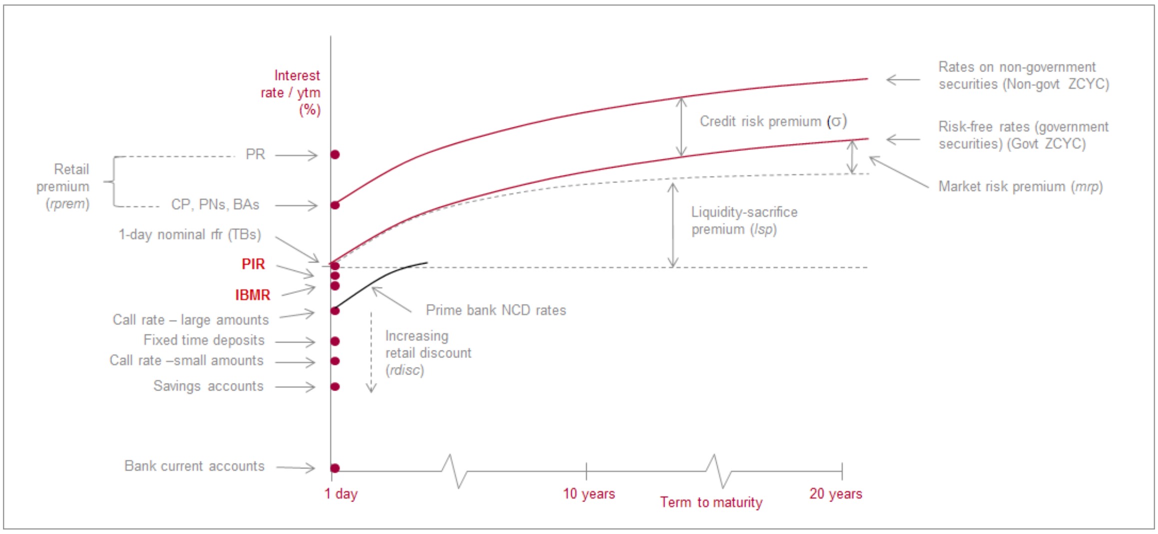


Figure 3.7: PIR, YC & money market rates

The most significant point to make here relates to the genesis of interest rates: the starting point of the *nrfr* YC is the PIR, that is, the lending rate of the central bank for borrowed reserves. As we have seen, in most countries (in normal times) the central bank, through open market operations, ensures that the banks are indebted to it at all times. This takes place in the central bank-to-bank interbank market (cb2b IBM).

The central bank levies the PIR on the borrowed reserves. Consequently, the PIR becomes the ceiling rate in the interbank market and for wholesale call money (one-day) deposits. In their endeavours to avoid borrowing from the central bank, the rate in the market-driven bank-to-bank interbank market (b2b IBM) is driven up to close to the PIR, as is the call deposit rate. This is borne out in practice, as we have seen, and show again in Figure 3.8. It shows the PIR (the ceiling rate) with the wholesale call money rate and the b2b IBM rate for a particular country[24] for a period of eleven years (monthly data). Recall that the R^2 of PIR and wholesale call money rate = 0.98, and the R^2 of PIR and IBMR = 0.97.

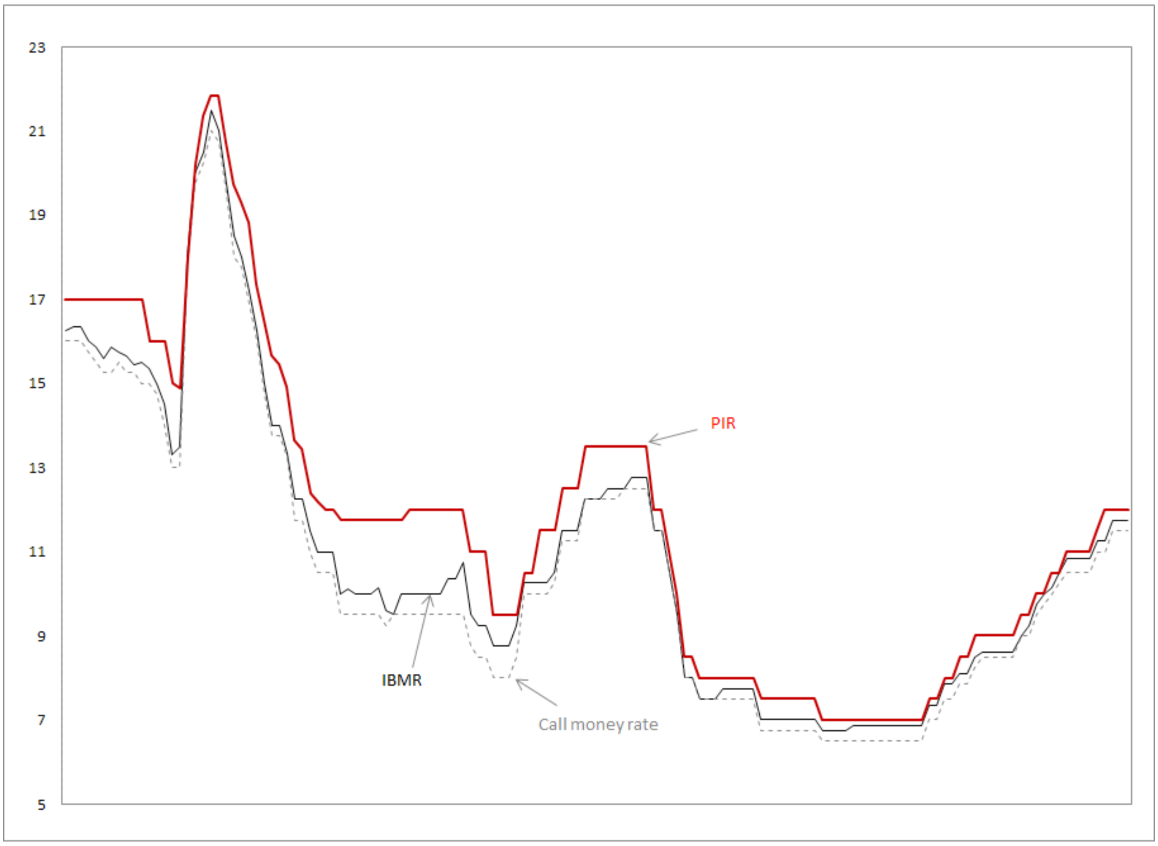


Figure 3.8: PIR, call money rate & IBMR

The ultimate objective of monetary policy is to "set" the PR (the benchmark lending rate) of the banks, and thus influence the demand for bank credit (the main determinant of money stock growth). This is achieved via the jealously-guarded bank margin. By "setting" the rates on banks' liabilities via the PIR, the central bank "sets" the prime rate of the banks. Figure 3.9, showing the relationship between PIR and PR, is repeated for the same country for a period of over 50 years (monthly data). Recall that R^2 = 0.98.

A final word: the reader will have noted the differences in the levels of debt instrument interest rates, deposit interest rates, and IBM rates in Figure 3.7. We point these out clearly in Figure 3.10. It is evident that the IBM rates are key in terms of influencing the bank deposit rates and, via the "sticky" bank margin, the lending rates.

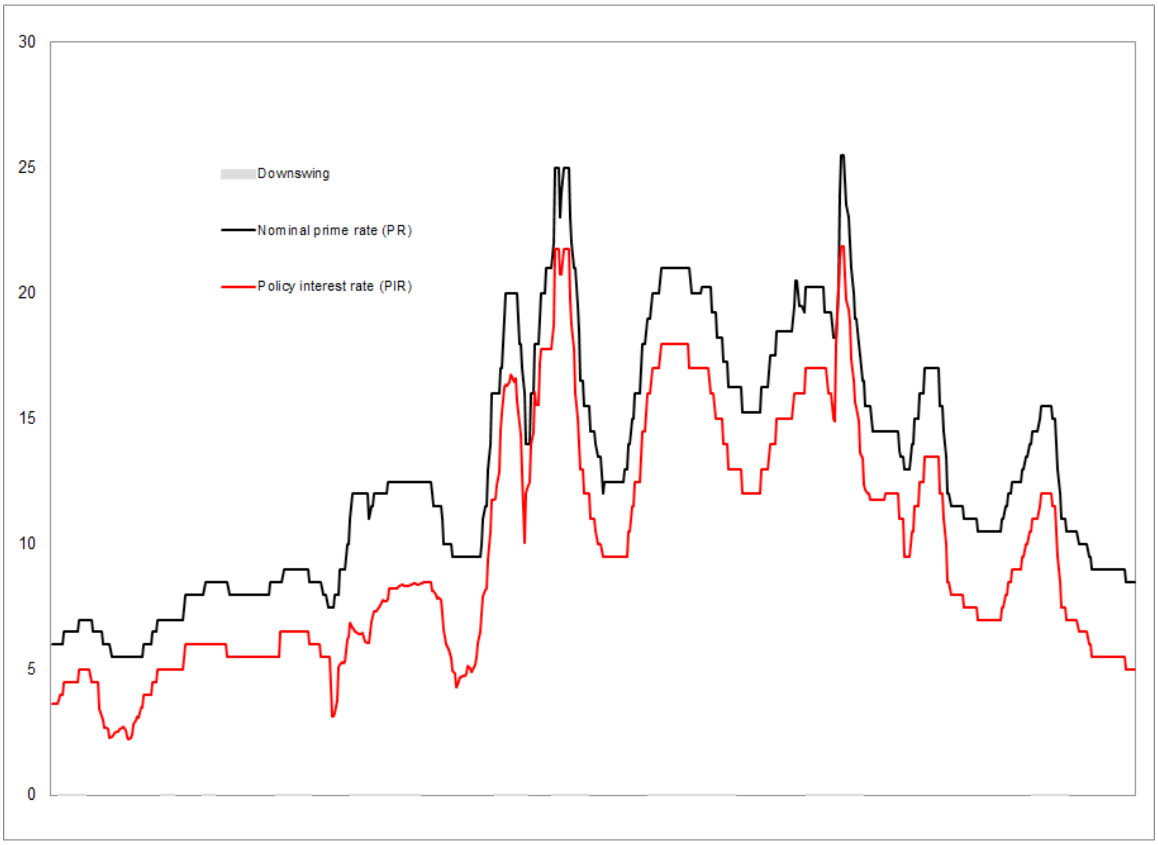


Figure 3.9: PIR & PR

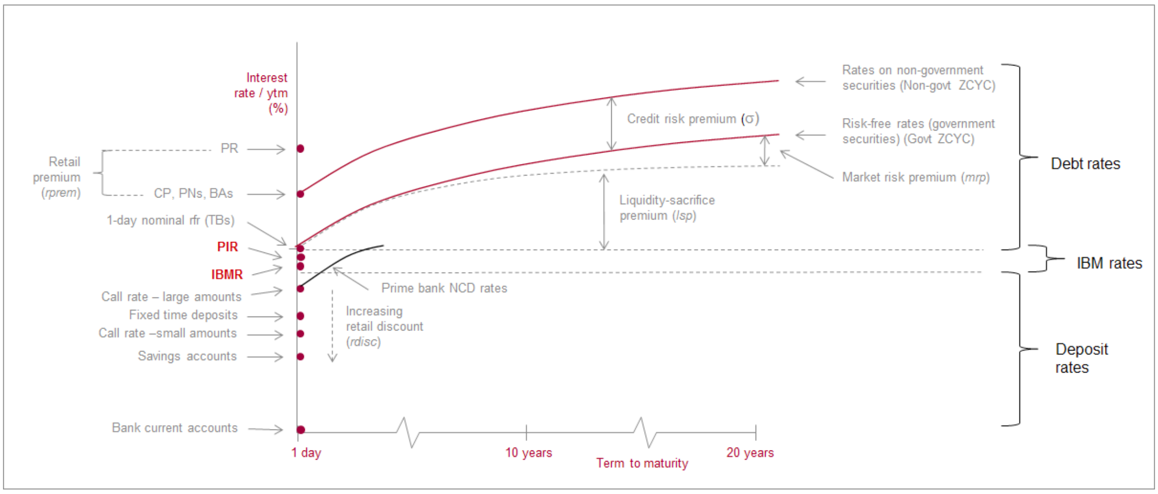


Figure 3.10: PIR, YC & money market rates

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4 Interest rate discovery

4.1 Learning outcomes

After studying this text the learner should be able to:

1. Elucidate the difference between price and valuation, and the markets to which this applies.
2. Describe the organisational structure of financial markets.
3. Discuss the role of the secondary markets.
4. Confer on interest rate discovery in the debt and deposit markets.
5. Deliberate on the factors which impact on price discovery.

4.2 Introduction

All economics scholars are familiar with the term *price discovery*. It is the process of "finding" or "determining" the price of a financial market security or commodity through the actions of buyers and sellers in the secondary market. In the primary market it is the actions of an issuer and buyers, both of whom rely on information emanating from the secondary market for the relevant security (if it exists, such as in the case of an equity rights issue, or a similar security if it does not).

These terms also apply to interest rates which, as we have seen, are inversely related to their prices. We discuss the important issue of interest rate discovery under the following headings:

- Interest rate discovery and security valuation.
- Organisational structure of financial markets.
- Role of the secondary markets.
- Interest rate discovery in the debt and deposit markets.
- Factors which impact on price discovery.

4.3 Interest rate discovery and security valuation

It is important to state at the outset that in the case of price discovery in the share / equity / stock market, there usually is a difference between the price discovered of a share and its valuation. The price discovered of a share is the outcome of all buyers' and sellers' market sentiments at a point in time. This is different to its valuation, which is the result of analysis of three approaches: balance sheet valuation, discounted cash flow valuation, and relative valuation. Thus, the outcome of valuation analysis may be a price which is higher than, equal to, or lower than, the market price discovered.

This is not the case with debt and deposit securities (ignoring a minuscule proportion of securities – floating rate securities[25]). In the overwhelming majority of cases the maturity values (MVs) and future cash flows (FVs) are fixed. In these cases, when an interest rate is discovered, its exact price can be derived.

4.4 Organisational structure of financial markets

4.4.1 Introduction

As we know, interest rate discovery takes place in the financial markets. As such, we need to cover the microeconomics of financial markets: the types, forms, nature, trading driver, secondary market, etc., of financial markets, and how they operate or work in the real world. The terms "types", "forms, "nature", "trading driver", "secondary market", etc., are part of the financial market jargon that can be confusing. A sub-aim of this section is to create some logical order in this regard. It is organised as follows:

- Spot and derivative markets.
- Primary and secondary markets.
- Market form: exchange-traded and OTC markets.
- Issuing methods.
- Trading driver: order or quote.
- Trading system.
- Trading form: single and dual capacity.

Note that this is a general discussion and as such does not focus only on the debt and deposit markets. The focus on the debt and deposit markets comes in a later section.

4.4.2 Spot and derivative markets

The first distinction we need to make is between spot and derivative markets. A *spot* deal (a.k.a. a *cash* deal) refers to a transaction / deal, which is a contract, that is settled at the earliest opportunity possible. For example (see Figure 4.1), in the money market a spot deal is where securities are exchanged for payment (also called *delivery versus payment*) on the day the deal is transacted (T+0) or the following day (T+1). In most bond markets a spot deal transacted on T+0 is settled after 3 working days (T+3). In most share / equity markets spot means T+5.

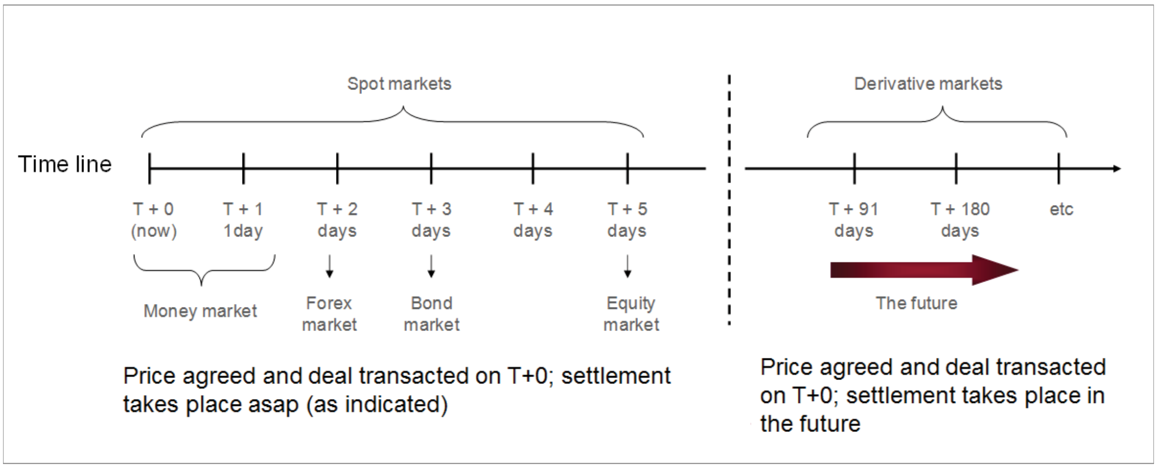


Figure 4.1: Settlement in the spot / cash and derivative markets

The issue that determines the number after the "+" sign is essentially convenience. In the money market it is convenient to settle now or tomorrow, whereas in the share market many individuals are involved who are spread across the county; therefore, it takes time for the securities to be posted to the exchange. This of course changes with security dematerialisation / immobilisation[26].

The difference between a spot deal and a derivative deal [forwards, futures, swaps, options and "other" (weather, credit, etc.)] is *only* the settlement date. Spot and derivatives deals are transacted on T+0 at a price agreed then, but settlement tales place on days other than spot deal days, that is, on days in the future, such as T+90.

4.4.3 Primary and secondary markets

The next level of distinction in the spot markets is *primary and secondary markets*, which we call *market type*. We have discussed this briefly, and take it a little further here. With the market types we are able to make a start with our illustration which is designed to demystify the jargon (see Figure 4.2).

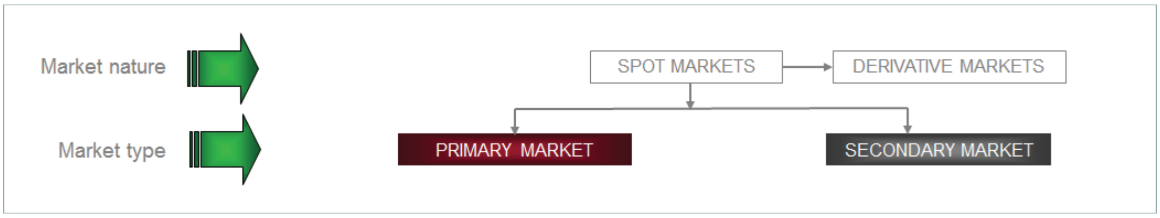


Figure 4.2: Organisational structure of spot financial markets (1)

The *primary market* is the market for the issue of new securities (debt, deposits and shares). It will be evident that the markets in non-marketable securities, such as mortgage loans, savings deposits and life policies, are entirely primary markets, while NCDs and bonds (for example) are *issued* in the primary market, but are *traded* in the secondary market.

Secondary market is the term used for the markets in which previously issued financial securities are traded. Broker-dealers usually facilitate these secondary market transactions. In the primary market the issuer receives funds, whereas in the secondary market the original issuer does not receive funds; only the seller does. The primary and secondary markets can be portrayed as in Figure 4.3.

Secondary markets play a significant role in the financial system, and specifically in interest rate discovery. This is covered in the following main section.

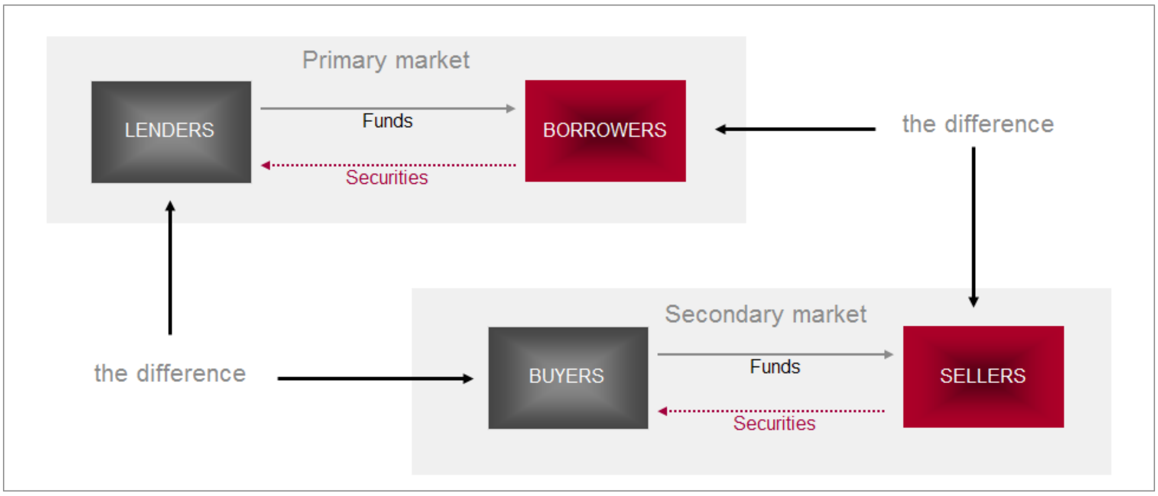


Figure 4.3: Primary and secondary markets: The difference

4.4.4 Market form: exchange-traded and OTC markets

Markets may be of the form over-the-counter (OTC), which are not usually legislated, or of the form exchange-traded (a.k.a. *formalised*). These fit into our growing financial markets illustration as portrayed in Figure 4.4.

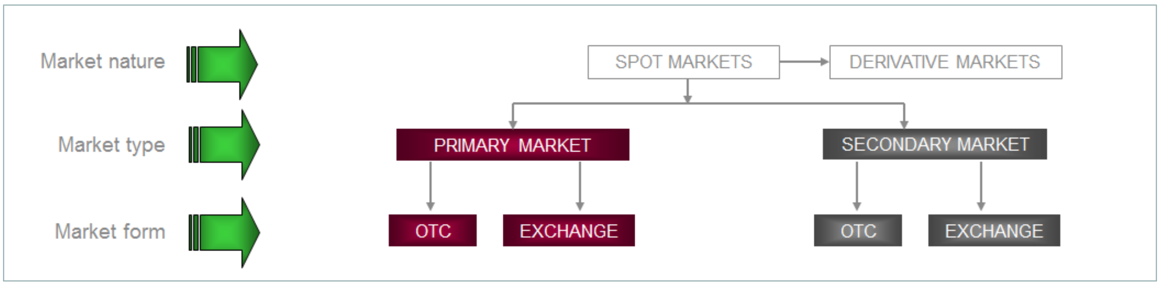


Figure 4.4: Organisational structure of spot financial markets (2)

Most markets in an economy are OTC, and examples are the labour market, the vegetable market, the fish market, and the market for elephants. In the case of the financial markets, however, all the markets start out as informal and some progress to formalised markets. For example, the forward markets are extremely useful markets and some have progressed into futures markets, not because the authorities want them so, but because the participants want them to be well-functioning, liquid and safe markets.

Some of the markets, such as the spot money market and the spot and forward foreign exchange markets may never become formalised, and the reasons are straightforward: they work well as they are (i.e. without official intervention) and because they are the domain of intermediaries (banks) who themselves are robustly regulated.

4.4.5 Issuing methods

4.5.1.1 Introduction

Figure 4.5 shows that here are four methods of primary issue: public issue, private placement, auction, and tap issue.

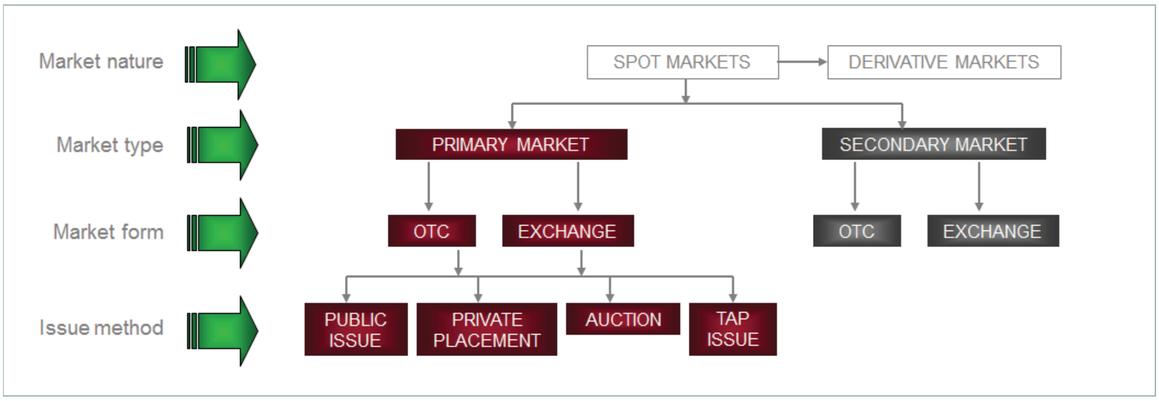


Figure 4.5: Organisational structure of spot financial markets (3)

4.5.1.2 Public issue

Public issue (also called public offer / offering) is the *process of offering securities to the general public*. This is done through the issue of a *prospectus* or *placing document*, i.e. an offer for the public to subscribe for the securities at a stipulated price. When shares are offered to the public for the first time it is called an *initial public offering* (IPO).

4.5.1.3 Private placement

Private placement is the placement of securities by the issuer or an *originator* with a single investor, or with a small group of investors, such as a selected number of "institutions"[27]. This may also be termed a *limited public offer*. Some countries use the terminology *book-building* to describe the activity of the placement of securities with a small group (in terms of numbers, not funds) of investors.

A form of private placement is an *underwriter* (usually an investment / merchant bank) taking up all the securities at a specific price and then on-selling them to investors at a higher price. The difference between the two prices is called the *underwriting spread*.

4.5.1.4 Auction

Many issuers make use of the auction method. There are various forms of auction:

- *Dutch auction*: where the seller starts at a high price and continuously lowers the price until a buyer "takes" securities at this price.[28]
- *English auction*: where a party starts the auction by bidding a price, and then others follow with bids at ever-increasing prices. When the bidding ceases, the last highest price is the price paid. There are variations to this auction method.
- *Descending price sealed auction* (a.k.a. *first-price sealed auction*): sealed bids are ranked from highest to lowest price and allocation takes place in descending price order, until all securities are allocated. This means of course that the highest prices bid receive full allocations and bidders lower down the price scale receive partial allocations on a pro rata basis.

The majority of TB issues in the world are done according to the latter method. In many countries this is the preferred method of issue of bonds, and is executed exclusively with the *market makers*. The central bank usually conducts the auction tenders on behalf of Treasury for specific amounts of government bonds, and the market makers are obliged to tender for a specified minimum amount.

Bidder	Price bid	Amount bid	Allocation	Allocation %
Bank A	LCC 97.125%	LCC 20 million	LCC 20 000 000	100%
Bank B	LCC 97.120%	LCC 50 million	LCC 50 000 000	100%
Insurer A	LCC 97.115%	LCC 10 million	LCC 10 000 000	100%
Insurer B	LCC 97.110%	LCC 25 million	LCC 4 762 000	23.810%
Broker-dealer A	LCC 97.110%	LCC 50 million	LCC 9 524 000	47.619%
Broker-dealer B	LCC 97.110%	LCC 30 million	LCC 5 714 000	28.571%

Table 4.1: Example of descending price sealed auction

An example of the *descending price sealed auction* method is presented in Table 4.1 [assumption: LCC 100 million TBs offered; Treasury bill auctions are executed in prices, not rates; in the case of the bond market it is usually rate (ytm)]. The first three tenders (bids) are allocated in full (LCC 80 million), leaving LCC 20 million to be distributed amongst the other bidders on a pro rata basis (percentage of total remaining bids, i.e. 25/105, 50/105 and 30/105).

4.5.1.5 Tap issue

The tap issue method of issuing securities is where the issuers are open to the bids of buyers at all times for their securities. They of course reserve the right accept or reject bids according to their view of the markets and need for funds. Most banks issue NCDs (as well as commercial paper on behalf of corporate issuers) according to this method, as do state-owned enterprises (SOEs).

Some issuers approach potential investors and offer securities to them at offer prices, i.e. they "tap out" their own securities in this manner. Issuers of securities that make markets in their own securities also "tap out" their securities by being net sellers.

4.4.6 Trading driver: order or quote

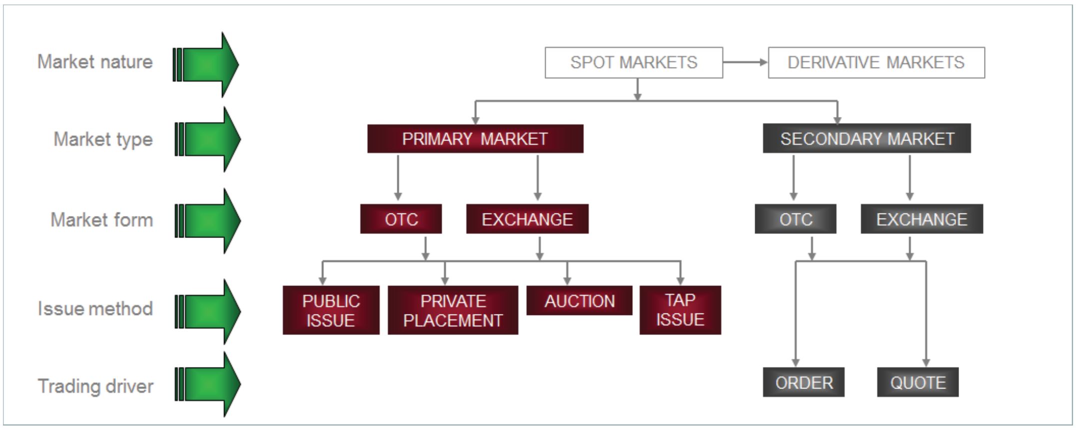


Figure 4.6: Organisational structure of spot financial markets (4)

Secondary financial markets are driven by one of two different kinds of trading: *order* and *quote* (see Figure 4.6). *Order-driven markets* are where clients place *orders* with their broker-dealers and the latter execute the order on the market. The orders may be:

- Market orders.
- Limit orders.
- Day orders.
- Good-until-cancelled orders, etc.

The *etc.* is added because many financial markets have different types of orders or different terms for the main ones mentioned here.

Market orders (a.k.a. *at-best orders*) are those that are placed with broker-dealers with the request that the broker-dealer executes the deal at the best current market price. The client is banking on the broker-dealer's intimacy with the market to execute when she thinks the price is "best".

Limit orders are buy orders (sell orders) where the client states a price or price-range below (above) the current price. The broker-dealer executes when the price falls (rises) to the limit price / range. Variations on market and limit orders are *day orders* (orders are live until the end of the day) and *good-until-cancelled orders* (orders are live until the client cancels them).

Quote-driven markets (a.k.a. *professional markets* or *market-made markets*). Essentially this means that certain participants (usually the large investment / merchant banks) quote firm buying and selling rates / prices simultaneously, after the client has disclosed the size of the deal, and the client is permitted to deal on either side of the quote. A subset of market makers is *primary dealers.* The large issuers (or their agent/s) appoint primary dealers, as in the case of government bond issues, and the primary dealers are obliged to adhere to certain rules (such as bidding for a stipulated minimum amount, and making a market in these securities).

There are two prices in market-made markets: *bid* and *offer* (or bid and *ask* in some countries). The *bid price* is the price that buyers are prepared to pay and the *offer price* the price at which holders of securities are prepared to sell. The bid price is always lower that the offer price (the opposite applies in the case of interest rates), and the difference between the two rates / prices is called the *spread*.

The *spread* is a valuable piece of information, for two main reasons. Firstly, it represents the cost of trading, i.e. it is a transaction cost. Secondly, the spread is a reflection of marketability / liquidity. If the spread is narrow, the relevant market is said to be *liquid* (some use the word *thick*, but we will not use it because of its uncharitable connotation), and if the spread is wide the market is *illiquid* (some say *thin*). We will return to this issue later.

It will have been noted that we have used the term *broker-dealer*. The reason is that there exist *brokers,* which can be defined as members of exchanges that execute deals *on behalf of* clients, *dealers*, which may be defined as members of exchanges and banks that deal for own account, and *market makers* (usually the banks) that operate as explained above. The latter two we refer to as *dealers* for the sake of simplicity, and to all three as *broker-dealers*. The term also encompasses the brokers who may act as dealers at times and the dealers and market makers who also act as brokers (on behalf of clients) in certain deals or markets.

4.4.7 Trading system

As seen in the final illustration (see Figure 4.7), there are essentially four types of trading systems:

- Floor trading.
- Telephone-screen trading.
- Screen-telephone trading.
- Automated trading [on an automated trading system (ATS)].[29]

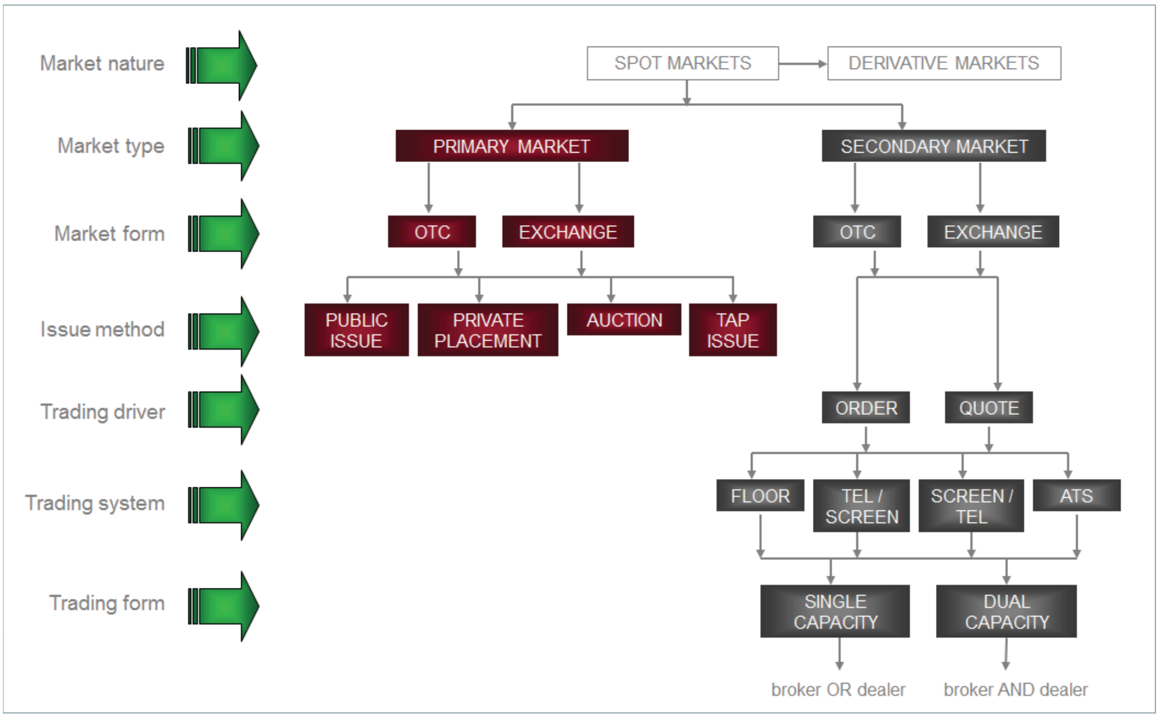


Figure 4.7: Organisational structure of spot financial markets (5)

Floor trading involves the physical presence of broker-dealers (i.e. members of the exchanges) in a large room (a room has a *floor*) and they *cry out* (a.k.a. *open-outcry trading*) or *hand signal* (in case of some derivative markets) the orders they have from their clients (or their own orders in the case of dealers) to other members in the hope that their orders match those (opposite orders) of the other members. Orders are amended in the case of market orders until orders are matched.

Floor trading usually implies an order-driven market (in which dual capacity trading is allowed), and a formalised market – because rules of trading and behaviour by members are required to make the market credible.

Telephone-screen trading is where negotiation by broker-dealers of deals takes place over the telephone, and where a screen (communications system such as Bloomberg's, Reuters) is used to advertise prices / rates. Deals are consummated on the telephone. The screen prices / rates are usually indication rates, i.e. not binding. This trading system implies that the relevant market is an OTC market, but this market may also be formal.

Screen-telephone trading involves the advertising by broker-dealers of firm prices / rates for specified maximum amounts of securities on a trading system or a communications system, and the deals are also consummated on the telephone. Quite often the trading system is used to communicate deals struck to a clearinghouse (within an agreed period of time), meaning that this type of trading system is used in exchange-driven markets and that the trading is quote-driven.

The *automated trading system* (ATS) is an electronic system (only available to the members, but not always so) where all *orders* of clients (indicating an order-driven market) are placed in the *central order book* of the ATS by the member broker-dealers and the system matches the orders when they coincide in price. Orders are price-time prioritised, and may be partly fulfilled. ATS systems are usually found in exchange-driven markets.

4.4.8 Trading form: single and dual capacity

Trading in dual capacity or single capacity (see Figure 4.7) was covered earlier under different terminology. *Single capacity* means that a broker-dealer deals only as a broker on behalf of clients *or* as a principal for own account (but not both). *Dual capacity* means that the exchange member or broker-dealer at a bank in the case of the informal markets trades as both a broker and a dealer for own account (which may lead to a conflict of interests: called an *agency-principal problem*[30]). In exchange-driven markets there are usually strict rules in this respect, the most important of which is that a client's order must always be executed first. Strict surveillance by the exchange ensures this.

4.5 Role of secondary markets

4.5.1 Introduction

The economic functions of secondary markets may be summarised as follows:

- Price discovery.
- Liquidity and borrowing cost reduction.
- Support of primary market.
- Implementation of monetary policy.

4.5.2 Price discovery

Price discovery (we use "price" here as this is a general financial markets discussion) is the central function of secondary markets. It is the route through which securities markets arrive at prices for the securities traded. (As we know, *prices* in the fixed-interest markets are *inversely related* to *interest rates*.) The "route" refers to the method of trading, and there are various trading methods, as seen.

Price discovery is important because it provides information that influences economic decisions, for example whether a company will expand production and finance this with long-term borrowing, or the issue of new shares (rights offer) or bonds. Price discovery provides important clues as to the prices that need to be offered on new primary issues of securities.

4.5.3 Liquidity and borrowing cost reduction

Liquidity (or *marketability*) refers to the ability to trade a security with ease, i.e. without impacting significantly on its price. It will be apparent that in liquid markets, prices are not adversely affected by large orders, whereas in thin markets prices may be shifted markedly by small orders. It may be said that a liquid market is more likely to create a *state of equilibrium* in the market. By this is meant that if the buyers and sellers are equally matched in terms of orders, the price will not be affected adversely (up or down), i.e. the price is a market-clearing price. As indicated, in a thin market, the market may clear at a vastly different price, depending on whether buyer orders outweigh sell orders (higher price), or vice versa (lower price). Equilibrium is disturbed in thin markets.

Liquidity is significant for two main reasons. Firstly, it enables investors to rapidly adjust their portfolios in terms of size, risk, return, liquidity and maturity. This in turn has a major influence of the *liquidity discount* (in terms of rate) or *liquidity premium* (in terms of price) investors place on liquid (i.e. highly marketable) securities. This of course means that the issuer is able to borrow at a *lower cost* than in the absence of liquidity. It is for this reason that many issuers of bonds attempt to create their own markets by acting as market makers (quoting buying and selling prices simultaneously) in their own securities, or by outsourcing this function to an investment / merchant bank/s. It is notable that central governments usually jumpstart the bond market by market making in their own securities (they usually outsource this function to the central bank).

An important question is how to enhance liquidity? The answer is, firstly, the active participation of the role-players in the financial markets, secondly, the existence of market makers and, thirdly, the existence of arbitrageurs and speculators (which seek out market rate and mispriced opportunities and act thereon).

4.5.4 Support of primary market

The secondary market plays an important role in terms of *supporting the primary market*. We noted above that price discovery in the secondary market assists the primary markets in terms of providing clues as to the *pricing of new issues*. In addition to this important function, the secondary market provides clues as to the *receptiveness of market for new issues* (which is reflected in the spread). Clearly, a liquid market improves the ability of issuers to place securities, and increases the price / lowers the rate.

4.5.5 Implementation of monetary policy

An active secondary market enables the central bank to buy and sell securities in order to influence the liquidity of the banking system, with a view the ultimately influencing interest rates. This is termed OMO, as we have seen, which means that the central bank buys and sells securities in the *open market*. In essence OMO is an adjunct to the primary central bank monetary policy weapon: interest rate manipulation. We discuss bank liquidity and its role in interest rate discovery later in this text.

4.6 Interest rate discovery in the debt and deposit markets

4.6.1 Introduction

With the foregoing as useful background, we move on to interest rate discovery in the debt and deposit markets. A reminder:

- The money market is the market for short-term debt and deposits (the overwhelming term to maturity of deposits is short-term), marketable and non-marketable, and it includes the interbank market. (See Figure 4.8.)
- The bond market in the marketable part of the long-term debt market (LTDM). (See Figure 4.9.) Non-marketable long-term debt is a small part of the LTDM, and we will ignore it here (rates will be benchmarked on the prime corporate bond rate).

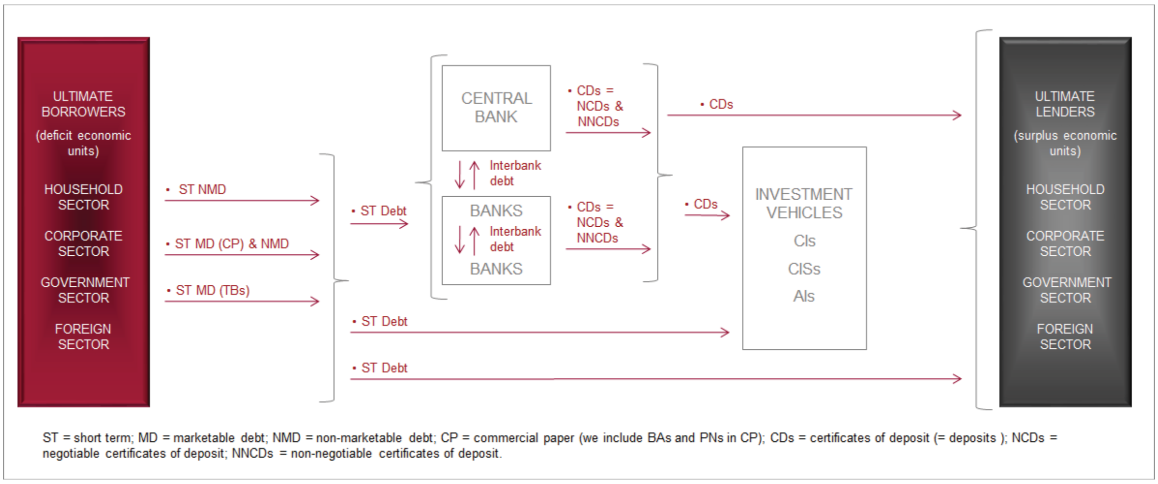


Figure 4.8: Money market

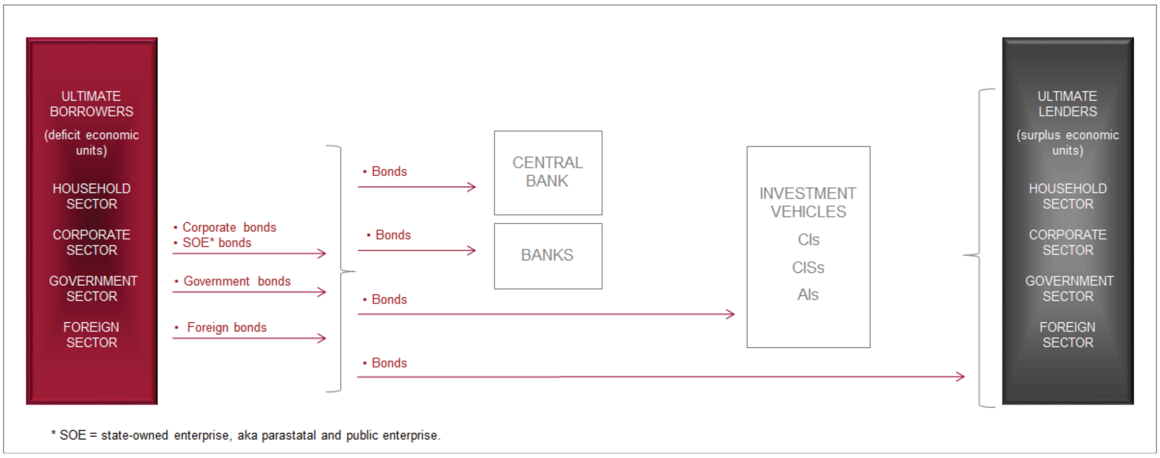


Figure 4.9: Bond market

In this section we cover:

- Interest rate discovery in the interbank market.
- Why is it necessary for the central bank to control interest rates?
- Interest rate discovery in the deposit part of the money market.
- Interest rate discovery in the debt part of the money market.
- Interest rate discovery in the bond market

4.6.2 Interest rate discovery in the interbank market

As we have seen, the IBM has three sub-markets:

- Bank-to-central bank interbank market (b2cb IBM).
- Central bank-to-bank interbank market (cb2b IBM).
- The bank-to-bank interbank market (b2b IBM).

The b2cb IBM is the one-way market representing the *reserve requirement* (RR; this also denote *required reserves*). In most countries no interest is paid on the RR. The b2b IBM is the market in which interbank claims are settled, a result of deposit shifts, and it is a zero sum game (if the central bank does no transactions on the day). The cb2b IBM represents the (usually overnight) *loans* of the central bank to the banks, which is forced upon them (in normal times). Through OMO the central bank is able to ensure a *borrowed reserves* (BR) (a.k.a. liquidity shortage – LS) condition and charges the banks the *policy interest rate* (PIR) on the loan/s. The PIR becomes the ceiling rate because the supply of reserves in unlimited (theoretically).

The IBM rate (IBMR) established in the IBM is directly influenced by the PIR. The PIR and IBMR influence all other rates. The causation path of interest rates is:

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

How does interest rate discovery work in the b2b IBM? We have discussed this issue and present another example to concretise the knowledge. Bank A and Bank B are not indebted to the central bank (i.e. there is no BR condition and no ER condition (many central banks operate on the basis of a "threat" of imposing a BR condition to make the PIR effective). The PIR is 6% pa. Bank B is expecting to lose deposits during the day. It offers Company A call money rate of 5.95% pa (i.e. just below the PIR – in order to avoid borrowing at the PIR) for LCC 100 million. Company A, which is being paid 5.90% pa by Bank A on call, withdraws LCC 100 million of its call money deposits from Bank A and deposits it with Bank B. Balance Sheets 4.1–4.4 elucidate the story (CB = central bank).

BALANCE SHEET 4.1: COMPANY A (LCC MILLIONS)			
Assets		Liabilities	
Deposit at Bank A Deposit at Bank B	-100 +100		
Total	0	Total	0

BALANCE SHEET 4.2: BANK A (LCC MILLIONS)			
Assets		Liabilities	
Reserve account at CB	-100	Deposits (Company A)	-100
Total	-100	Total	-100

BALANCE SHEET 4.3: BANK B (LCC MILLIONS)			
Assets		Liabilities	
Reserve account at CB	+100	Deposits (Company A)	+100
Total	+100	Total	+100

BALANCE SHEET 4.4: CENTRAL BANK (LCC MILLIONS)			
Assets		Liabilities	
		Reserve accounts: Bank A Bank B	 -100 +100
Total	0	Total	0

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

This is the only transaction that takes place during the day and it is now the close of business: 5 p.m. 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 million 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 two banks find one another in the IBM, which is a telephone based OTC market. The broker-dealer on the funding desk at Bank A puts on a show of not sounding desperate for LCC 100 million in reserves, while Bank B does not easily give the game away that it has LCC 100 million ER. Haggling takes place and they agree on an IMBR of 5.975% pa.

Bank B is thrilled because it has not ended up with ER (on which no interest is paid). Remember it paid 5.95% pa for the money that led to the ER situation. Bank A is also delighted, but because it does not have to borrow from the central bank at the PIR (6.0% pa). Instead, it paid 5.975%.

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 4.5–4.6.

BALANCE SHEET 4.5: BANK A (LCC MILLIONS)			
Assets		Liabilities	
		Deposits (Company A) Loan (Bank B)	-100 +100
Total	0	Total	0

BALANCE SHEET 4.6: BANK B (LCC MILLIONS)			
Assets		Liabilities	
Loan to Bank A	+100	Deposits (Company A)	+100
Total	+100	Total	+100

This explains why the IBMR remains closely related to the PIR. It is interest rate discovery and the genesis of 1-day market interest rates, and the anchor of all other rates.

The b2b IBM is an OTC primary market, and the trading driver is "quote" – but with a difference: one-way bid and offer rates are made by different banks. If one were to illustrate the negotiation process in the b2b IBM, that is, the bids for and the offers of central bank reserves [assuming that (1) there are many banks involved, (2) there is no LS, and (3) the PIR is 6.0% pa], it would appear as in the right pane in Figure 4.10. The left pane presents the usual demand and supply curves; it will be evident that the curves on the left of the equilibrium point cannot exist.

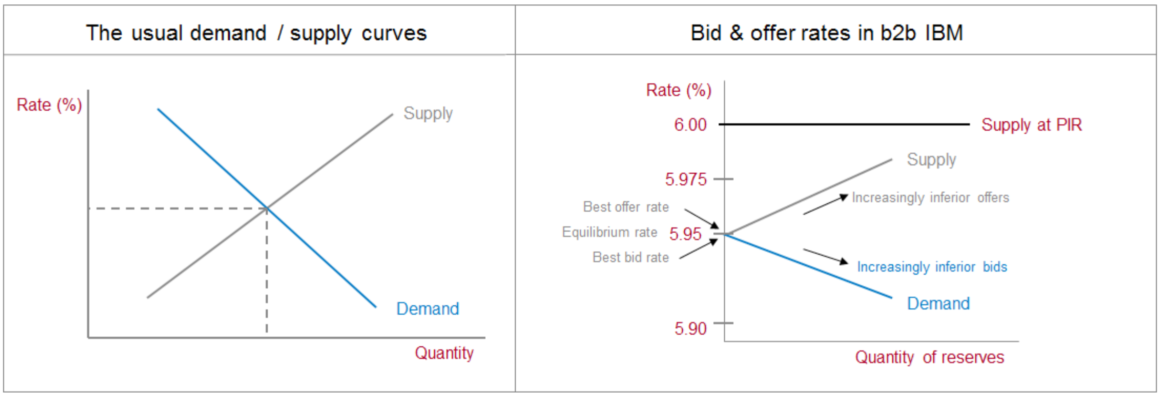


Figure 4.10: Bid & offer rates in the IBM

4.6.3 Why is it necessary for the central bank to control interest rates?

We need a reminder: why is it necessary for the central bank to control interest rates? It is so because money in the main is bank deposits (BD) (the other part is N&C[31]), liabilities of banks. This means that banks are able to create BD at will by providing bank credit (if there is demand for credit). In practice credit is extended based on the ability of the borrower to repay. But banks are in competition with one another to "grow their books" (grow their liabilities and assets), and this makes them inherently unstable. In addition, a high rate of BD growth [which represents new demand for goods and services (ΔGDP_N)] is inflationary because the economy cannot supply additional goods, requiring new capacity, quickly. High and unstable inflation is not conducive to economic growth and employment creation.

Thus, there has to be a referee in the system, which is the central bank. A central bank has one tool: interest rates. By creating a liquidity shortage condition (BR / LS) and charging PIR for the BR, the central bank controls the PR of the banks, and therefore the demand for credit. It exercises discretion in setting the rates, because it desires economic growth (as reflected in bank credit growth) on behalf of the country, but is needs the growth rate to be sustainable, that is, to ensure a low and stable rate of inflation. The rate of inflation recognised worldwide as ideal / desired is 2.0% pa. Why is it not 0.0% pa? Because at 0% pa, there is a danger of deflation, and deflation has its own set of economic problems.

Thus, the 1-day rate is determined by the central bank, and all other longer rates are related to this rate.

4.6.4 Interest rate discovery in the deposit part of the money market

We know that the KIR and the IBMR impact directly on the wholesale call money rate. How does this work? We present an example which is similar to the last one presented above, with the difference that Bank A and Bank B both have a BR condition (which is the model followed in many countries).

The PIR is set at 6.0% pa. Bank B would like to reduce its indebtedness to the central bank (which is costing it 6.0% pa) and offers cash-rich Company A a rate of 5.95% pa for LCC 100 million call money. It will not offer 6.0% pa because it is equal to the central bank's rate, and it can get an unlimited (in theory) supply of reserves from the central bank at this rate. There is no point to this action.

Company A is being paid a rate of 5.90% pa by Bank A. Company A withdraws LCC 100 million of its call money deposits from Bank A and deposits it with Bank B. Balance Sheets 4.7–4.10 elucidate the story.

BALANCE SHEET 4.7: COMPANY A (LCC MILLIONS)			
Assets		Liabilities	
Deposit at Bank A Deposit at Bank B	-100 +100		
Total	0	Total	0

BALANCE SHEET 4.8: BANK A (LCC MILLIONS)			
Assets		Liabilities	
Reserve account at CB	-100	Deposits (Company A)	-100
Total	-100	Total	-100

BALANCE SHEET 4.9: BANK B (LCC MILLIONS)			
Assets		Liabilities	
Reserve account at CB	+100	Deposits (Company A)	+100
Total	+100	Total	+100

BALANCE SHEET 4.10: CENTRAL BANK (LCC MILLIONS)			
Assets		Liabilities	
		Reserve accounts: Bank A Bank B	 -100 +100
Total	0	Total	0

Bank A is now short of RR by LCC 100 million, and therefore does not comply with the RR (TR < RR). If it does not find the funds in the IBM, its BR will increase. Bank B now has surplus reserves (TR > RR or TR–RR = ER = LCC 100 million), meaning it is in a position to repay part of its BR at the central bank.

The IBM starts up, that is, Bank A phones the other banks and bids a rate of 6.975% pa (just below the PIR) for funds. Bank B can repay part of its BR at 6.0% pa, and it not interested in Bank A's offer. Bank B instructs the central bank to use its ER to repay part of its BR. Bank A has no option to increase its BR. The balance sheets end up as indicated in Balance Sheets 4.11–4.13.

BALANCE SHEET 4.11: BANK A (LCC MILLIONS)			
Assets		Liabilities	
		Deposits (Company A) Loans from CB (BR)	-100 +100
Total	0	Total	0

BALANCE SHEET 4.12: BANK B (LCC MILLIONS)			
Assets		Liabilities	
		Deposits (Company A) Loans from CB (BR)	+100 -100
Total	0	Total	0

BALANCE SHEET 4.13: CENTRAL BANK (LCC MILLIONS)			
Assets		Liabilities	
Loans to Bank A Loans to Bank B	+100 -100	Reserve accounts: Bank A Bank B	 ~~-100~~ ~~+100~~
Total	0	Total	0

The LS does not change; there is just a shift between banks. The point of this exercise is to show how important the PIR is. Banks are in a continuous battle to repay the central bank, and this makes the PIR the ceiling rate for 1-day money.

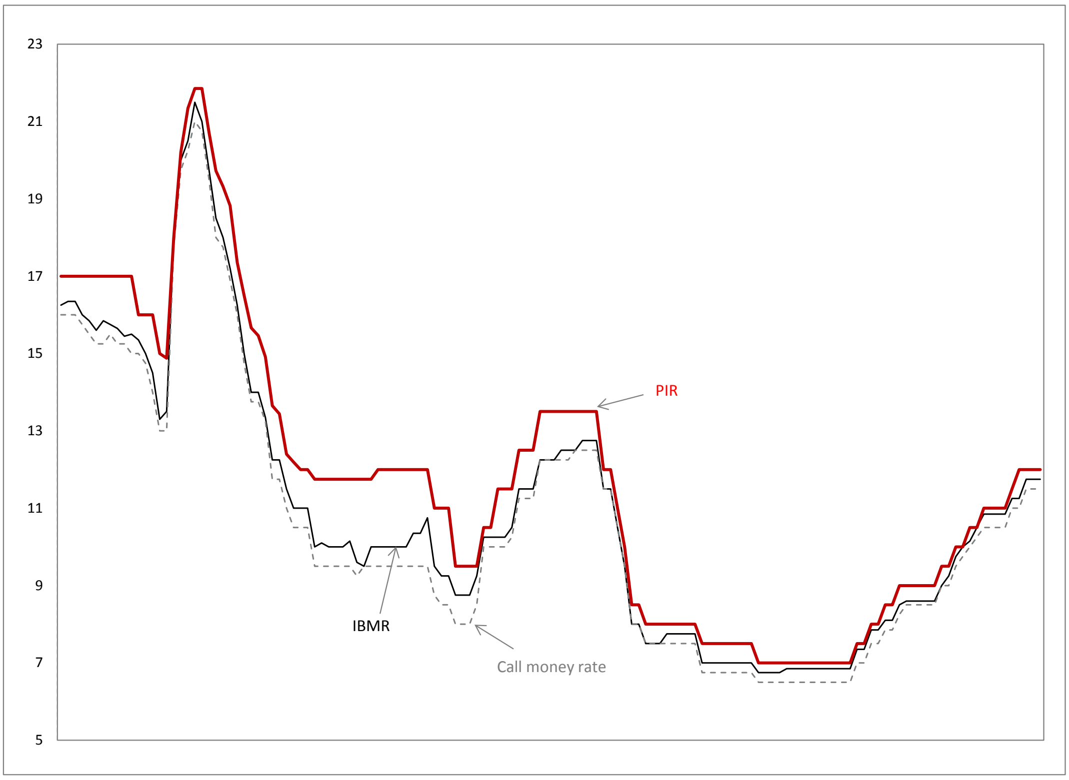


Figure 4.11: PIR, call money rate & IBMR

This is the starting point of interest rate discovery in the deposit market, and it will be evident that 1-day deposit rates cannot be equal to or above the PIR. In the case of the wholesale call money market the rate is just below the PIR and is usually a little lower than the IBMR (as a reminder see Figure 4.11). Term deposit rates can be higher that the PIR, because the liquidity sacrifice premium (*lsp*) comes into play – the *lsp* as the term to maturity increases. Thus, in the case of NCDs (which are wholesale, i.e. of large denomination), the interest rate discovery route is:

NCD rate = *call deposit rate (wholesale) + lsp (for the term to maturity).*

In the case of NNCDs (assuming retail, i.e. of small denomination):

NNCD rate = *NCD rate – retail discount (rdisc).*

An attempt to illustrate the above is presented in Figure 4.12. Note that the credit risk premium (σ) is absent. This is because the bank has no risk with deposits. However, some banks pay higher rates than others, because of a credit risk premium attached to the relevant banks.

In conclusion: the market form of the deposit market in the case of NNCDs is *OTC*, and it is entirely a primary market. The issue method of the banks is *tap*; depositors ask for a *quote*, and compare it to the quotes of other banks. In the case of NCDs, they are issued in the primary market (on *tap*), and traded in the secondary market. The trading driver is *quote*, but a one-way quote via broker-dealers, some of which trade (trading form) in dual capacity and some in single capacity.

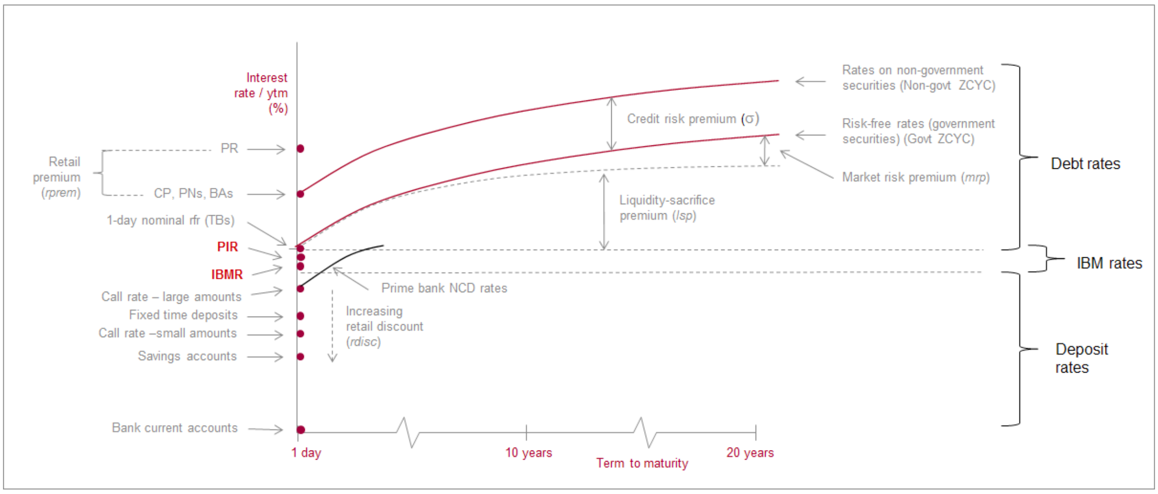


Figure 4.12: PIR, YC & money market rates

4.6.5 Interest rate discovery in the debt part of the money market

It will be evident that the starting point of interest rate discovery in the debt part of the money market is the 1-day TB rate (which has the PIR as its anchor). Thus, the interest rate discovery route in the case of 1-day CP (which are the obligations prime-rated companies, and wholesale) is:

$$\text{1-day CP rate} = \text{1-day TB rate} + \sigma.$$

In the case of longer-dated CP:

$$\begin{aligned} \text{CP rate} &= \text{1-day TB rate} + \sigma + lsp \\ &= \text{1-day CP rate} + lsp. \end{aligned}$$

We know that TBs and CP are marketable. In the case of retail non-marketable debt (NMD), the interest rate discovery route is:

$$\text{1-day NMD rate} = \text{1-day TB rate} + \sigma + \text{retail premium } (rprem)$$

In the case of longer-dated retail NMD:

$$\begin{aligned} \text{NMD rate} &= \text{1-day TB rate} + \sigma + rprem + lsp \\ &= \text{1-day NMD rate} + lsp. \end{aligned}$$

In the case of wholesale NMD for prime companies, the rate will be a little lower.

In conclusion: the market form of the short-term debt market (STDM) is *OTC*, and in the case of ST-NMD it is a primary market. The issue method is *tap* via the banks. Investors ask for a *quote* and compare it to the quotes of other banks. In the case of marketable debt (CP) they are issued in the primary market, via the banks, and traded in the secondary market. The trading driver is *quote*, but a one-way quote via broker-dealers, some of which trade (trading form) in dual capacity and some in single capacity.

4.6.6 Interest rate discovery in the bond market

We know that the bond market is the marketable arm of the LTDM. We also know that government bond rates (recall that they are all nominal risk-free rates – *nrfr)* are discovered by the route:

$$nrfr \quad = 1\text{-}day\ rrfr + e\pi + lsp + mrp$$

and in the case of prime corporate bond rates (nominal rates for corporates – *nrc*):

$$\begin{aligned} nrc \quad &= 1\text{-}day\ rrfr + e\pi + lsp + mrp + \sigma \\ &= nrfr + \sigma. \end{aligned}$$

In the case of the non-marketable long-term debt, a premium is added for non-marketability (*nmp*)

$$nrc\ (non\text{-}marketable) = 1\text{-}day\ rrfr + e\pi + lsp + mrp + \sigma + nmp$$
$$= \text{nrfr} + \sigma + nmp.$$

Bonds are issued in the primary market and traded in the secondary market. The market form is *exchange*, i.e. they are traded on a regulated and supervised exchange. The trading driver is *quote* (in the pure sense), meaning that there are market makers (or a subset, primary dealers – the large banks) which quote two-way rates simultaneously once the client (buyer or seller) has disclosed the size of the deal (but not whether he is a buyer or seller). The trading system in most countries is *telephone-screen*, i.e. the system where a screen (communications system such as Bloomberg / Reuters) is used to indicate rates, but negotiation by clients of deals takes place over the telephone. Consummated deals are reported to the exchange.

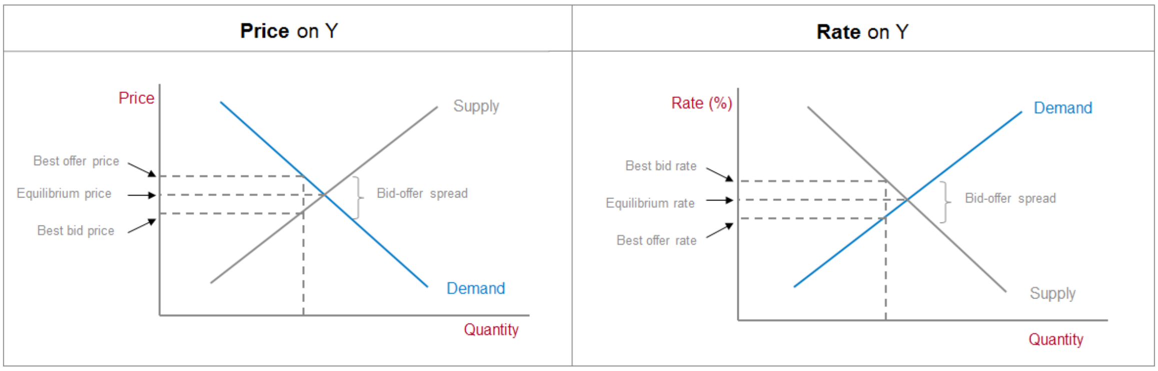


Figure 4.13: Demand & supply curves (price & rate)

In a number of financial market texts[32] the bid-offer spread is illustrated as indicated in the left pane in Figure 4.13. If one places "rate" on the Y-axis, the curves are swapped, as are the best bid and offer rate legends.

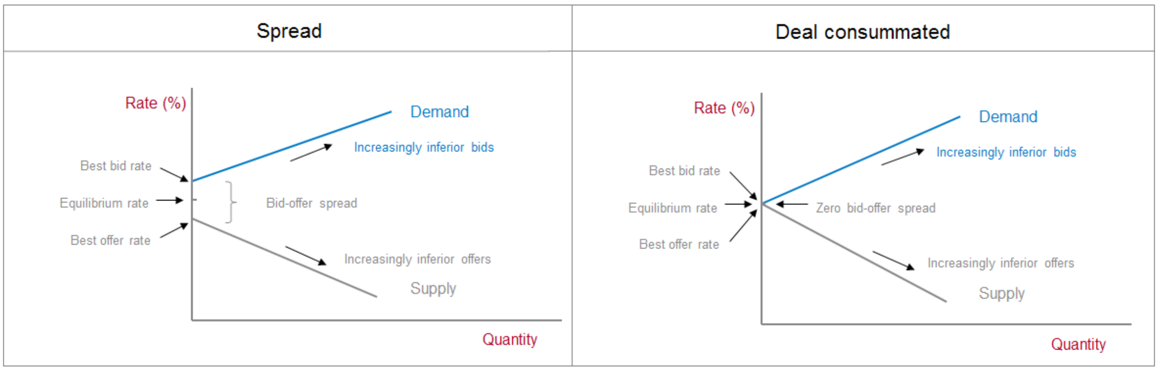


Figure 4.14: Demand & supply curves (two-way quote, bond market)

However, we do not believe this is the best way of portraying the two-way quote bond market. We offer an alternative depiction in Figure 4.14, and an explanation as follows (we do repeat a few basic terms in the interests of concretising the knowledge):

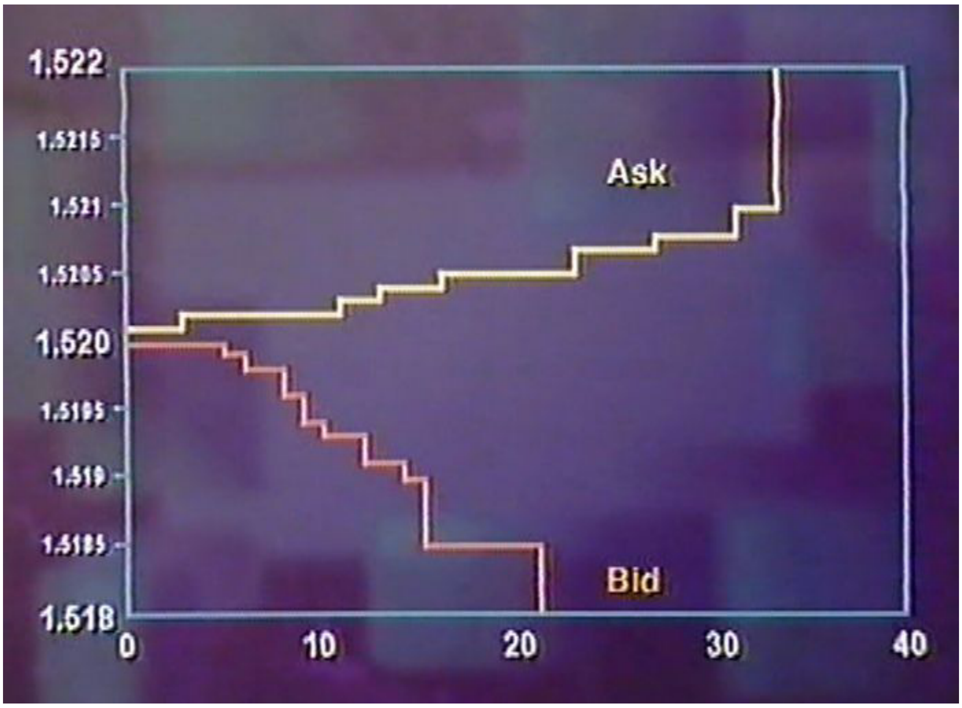
What are bid and offer rates? The *bid* rate (a.k.a. *buy* rate) is the rate at which the market maker will buy a quantity of a particular bond. The *offer* rate (a.k.a. *ask* or *sell* rate) is the price at which the market maker will sell the bond. It will be evident that buyers and sellers will approach more than one market maker and that buying clients will seek to deal at the highest quoted offer rate (= lowest price) of the market makers. On the other hand, selling clients will seek to deal at the lowest quoted bid rate (= highest price) of the market makers.

What is the spread? It is the differential between the best bid and offer rates, and can be seen as the dealing profit of the market maker (assuming it is "hit" on "both sides" of the quote, which is highly unlikely, because there is a better rate available). It is the remuneration for the capital employed and risk inherent in holding an inventory of bonds and being prepared to sell from it or add to it. The size of the spread provides information on the breadth and depth of the market (but we will not discuss this interesting issue here as it is not relevant to the discussion).

What is the equilibrium price? It is presented as the mid-point between the bid and offer rates, and it is a theoretical price in the absence of a consummated deal. When bid and offer rates coincide, a deal is consummated and we have a true equilibrium rate. The equilibrium rate fluctuates constantly because the bond market is a *dynamic* (a.k.a. *continuing* or *continuous*) market.

In the Figure 4.14 depiction the demand and supply curves to the left of the best bid and offer rates (the equilibrium rate), do not exist. Why?

- No market maker will offer a higher rate that the best bid rate.
- No market maker will bid a lower rate that the best offer rate.



Box 4.1: Live quotations at a point in time (USD/DEM)

In many of the bond markets of the world there also exist interdealer brokers. They offer a pure broking service to the market makers to relay their quotes to other market makers via an electronic information service (such as Reuters). Market makers use interdealer brokers in cases where they prefer to remain anonymous in a particular deal. Interdealer brokers are paid a commission on deals.

Does the above exposition exist in reality? It does. Some years back Prof CAE Goodhart and colleagues of The Financial Markets Group, London School of Economics produced a video[33] on the foreign exchange market in which they presented foreign exchange quotes (note: in prices) and consummated deals in real time. A frame-grab of a particular time is shown in Box 4.1. The bid-offer (bid-ask in the frame grab) curves and spread are clearly visible.

4.7 Factors which impact on price discovery

We know that interest rates have their genesis in the IBM, and that monetary policy in the form of the administratively-set PIR is the starting point (assuming a LS / BR condition which makes the PIR effective – under normal circumstances). As we move along the yield curve, the rates reflect various premia / discount factors and the bank margin, but, macroeconomically-speaking, longer rates are a function of short rates and expectations in respect of the level of short rates in the future.

What are the micro-economic factors that play a role in small movements in interest rates, in the spread, and so on? They may be summarised as follows:

- Number of buyers and sellers.
- Size of deals.
- Market capitalisation of issues (i.e. size of issue of, for example, a particular bond).
- Market mechanism.
- Information dissemination.
- Existence of debt and deposit derivative markets.

All of these factors impact ultimately on the liquidity of and the "spread" in markets, which is a reflection of the depth and breadth of the market. Figure 4.15 illustrates this.

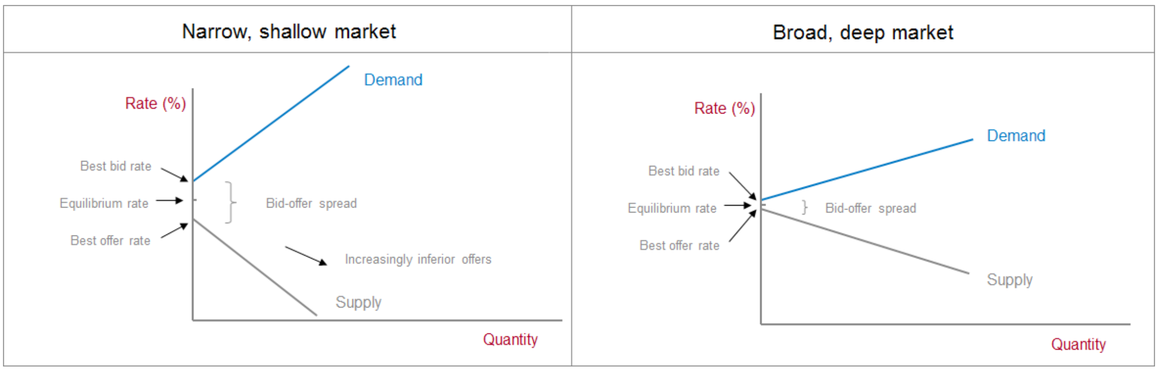


Figure 4.15: Bid-offer spread

4.8 References

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5 Bank liquidity & interest rate discovery

5.1 Learning outcomes

After studying this text the learner should be able to:

1. Elucidate the monetary policy models.
2. Explain the concept of quantitative easing in terms of bank liquidity.
3. Confer on the concept of bank liquidity, the balance sheet sources of change, and the underlying sources of change.
4. Describe how a central bank is able to influence bank liquidity.

5.2 Introduction

The state of bank liquidity can be measured: as the banks' net excess reserves (NER) with the central bank. It is a critical element of the successful implementation of monetary policy: controlling short-term interest rates and significantly influencing other rates.

Central banks have absolute control over NER and manipulate it to bring about a positive NER in abnormal – quantitative easing (QE) – periods in order to drive interest rates down, or a negative NER in order to have absolute control over short-term interest rates. The latter condition aims at influencing the exogenous ("from outside") force, the demand for bank credit, via the policy interest rate (PIR) and its influence on the banks' benchmark short-term lending rate, prime rate (PR), and therefore on other rates related to PR. Satisfaction of the demand for bank credit has the simultaneous outcome of deposit money creation. This text has the following sections:

- Monetary policy models.
- A bank liquidity analysis.
- Quantitative easing.
- Quantitative easing and interest rates.

5.3 Monetary policy models

There is no such thing as exogenous money; only endogenous ("from inside") money creation exists. A central bank is able to exactly control the extent of money creation, under the monetary base-focused monetary policy model (it is a theoretical model – see below), but money creation which takes place under this model is still endogenous: new bank credit extended create new bank deposits (that is, money). A demand for bank credit must exist for a bank to grant credit, which is an exogenous force.

The money stock is comprised of two parts: notes and coins (N&C) and bank deposits (BD) held by the domestic non-bank private sector (NBPS):

M = N&C + BD (held by the NBPS).

There are two monetary policy models:

- Monetary base-focused monetary policy.
- Interest rate-focused monetary policy.

The former is a theoretical model, and it rests on the money multiplier ($m = 1 / r$) [r = the reserve requirement (RR) ratio applied to bank deposits]. The growth in BD money is related to r, in that it can only increase up to the extent of excess reserves (ER) created by the central bank (CB) times m:

$$\text{Money growth} = \text{ER} \times m = (1 / r).$$

Thus, if the central bank creates ER[34] to the extent of LCC 10 billion (see Balance Sheets 5.1–5.2) by purchasing government bonds from the banks, the banks may make loans / provide credit (assume to the NBPS), which create deposits (money) simultaneously, to the extent of (see Balance Sheets 5.3–54):

$$\begin{aligned}\text{Money growth} &= \text{ER} \times (1 / r)\\ &= \text{LCC 10 billion} \times (1 / 0.1)\\ &= \text{LCC 100 billion.}\end{aligned}$$

BALANCE SHEET 5.1: BANKS (LCC BILLIONS)			
Assets		Liabilities	
Bonds Reserves (total reserves – TR) (ER = +10) (RR = 0)	-10 +10		
Total	0	Total	0

BALANCE SHEET 5.2: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
Bonds	+10	Deposits: Banks (TR) (ER = +10) (RR = 0)	+10
Total	+10	Total	+10

BALANCE SHEET 5.3: BANKS (LCC BILLIONS)			
Assets		Liabilities	
Credit to private sector Reserves (TR) (ER = -10) (RR = +10)	+100 0	Deposits: Private sector (M3)	+100
Total	+100	Total	+100

BALANCE SHEET 5.4: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
		Deposits: Banks (TR) (ER = -10) (RR = +10)	0
Total	0	Total	0

Note the shift from ER to RR in Balance Sheets 5.3–5.4, and the fact that the banks now exactly comply with the RR, and can lend no further. Note also that deposit money creation took place endogenously, as a result of an exogenous force: the demand for bank credit (which was assumed above).

As noted earlier, this model is a theoretical monetary policy model. It was applied briefly in the distant past, with dire consequences in terms of volatile interest rates. It was abandoned for this reason – interest rates are a significant input in business decision-making.

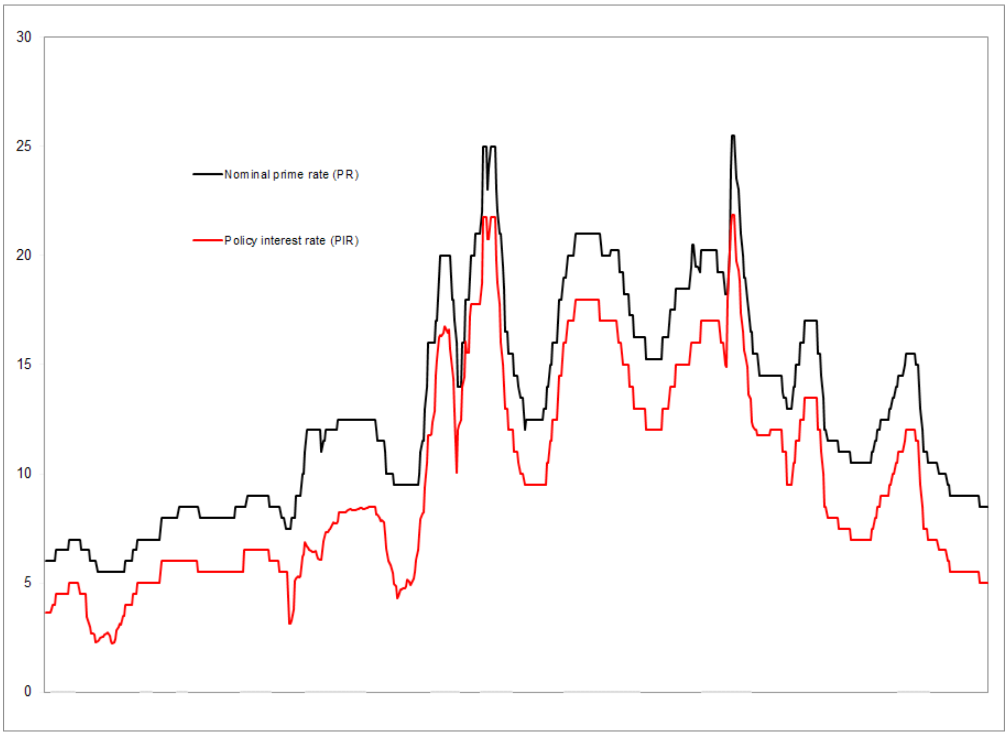

Figure 5.1: PIR & PR

The vast majority of countries adopted the *interest rate-focused monetary policy model* many decades ago. In a nutshell, it amounts to control of the banks' prime lending rate (PR) (and other lending rates which are usually benchmarked on PR), which is achieved by the creation (in normal, non-QE-policy times) of a liquidity shortage (LSh) (a.k.a. BR) in order to make the central bank's PIR effective.

An effective PIR affords the central bank control over PR and, therefore, the demand for bank credit (as discretion is exercised it is not an exact science). The control a central bank has is demonstrated in the relationship between PR and PIR for a particular country[35] for a period of over 50 years (see Figure 5.1, which we repeat for the sake of convenience; the R^2 is 0.98). This country ensures that the banks are in a BR condition at all times – to ensure that the PIR remains effective.

The reserves required by banks, as they provide credit and create deposits, are accommodated by the central bank, as part of its control over the LSh (= BR). An example of central bank accommodation (in the form of on-demand loans – BR – from the central bank, which is the case in reality in normal times) is presented in Balance Sheets 5.5–5.6 (banks provide credit of LCC 1 000 billion to the NBPS, which creates LCC 1 000 billion of new deposits; the RR ratio is 10% of deposits):

BALANCE SHEET 5.5: BANKS (LCC BILLIONS)			
Assets		Liabilities	
Credit to NBPS Reserves at CB (TR) (ER = 0) (RR = +100)	+1 000 +100	Deposits of NBPS (money) Loans from CB (BR) @ PIR	+1 000 +100
Total	+1 100	Total	+1 100

BALANCE SHEET 5.6: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
Loans to banks (BR) @ PIR	+100	Bank reserves (TR) (ER = 0) (RR = +100)	+100
Total	+100	Total	+100

The central bank is accommodative, that is, supplies the BR on demand, as part of its policy to ensure that the BR condition is on-going.

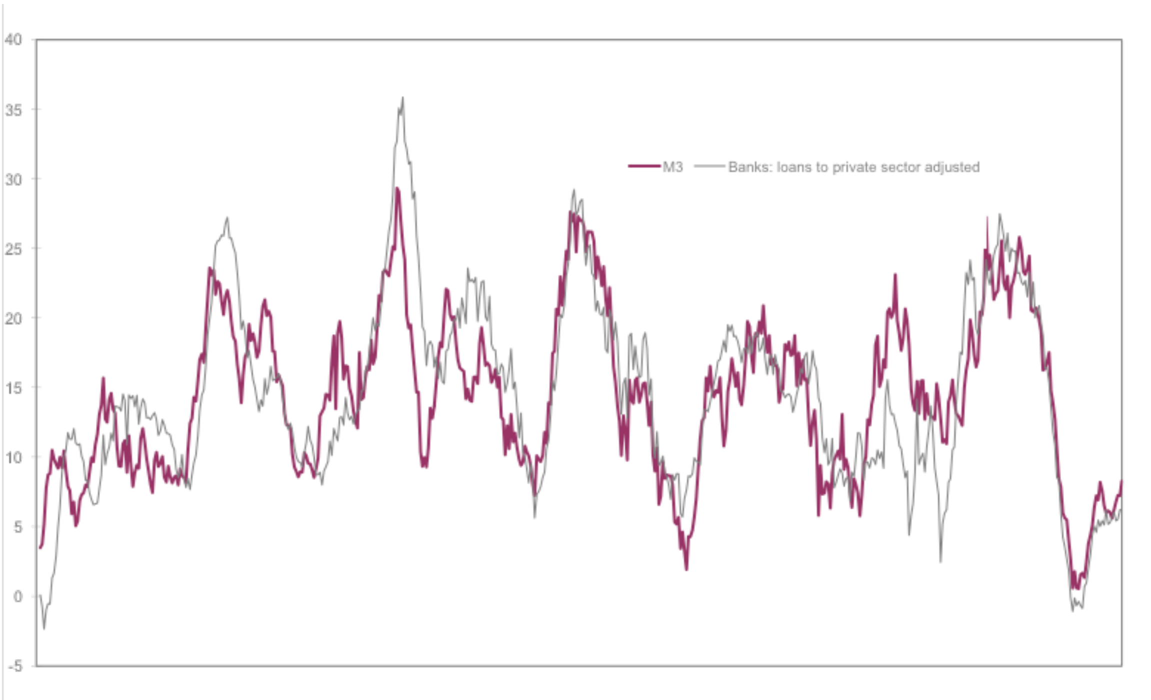

Figure 5.2: M3 and bank loans to private sector (yoy%)

The above is an example of where bank liquidity is kept "short", that is, when the banks collectively are indebted to the central bank (a BR condition exists). This policy exists (in slightly different forms in some countries) in normal times – when the money stock is increasing (the outcome of bank credit extension) and the central bank controls PR via its PIR, as indicated in Figure 5.1. Through this mechanism, it influences the exogenous force, the demand for bank credit, and therefore the growth rate in the money stock. The relationship between the growth rates in bank credit to the NBPS and M3 (for a period of over 50 years) is shown for a particular country[36] in Figure 5.2. The R^2 (0.999) (raw figures) is presented in Figure 5.3.

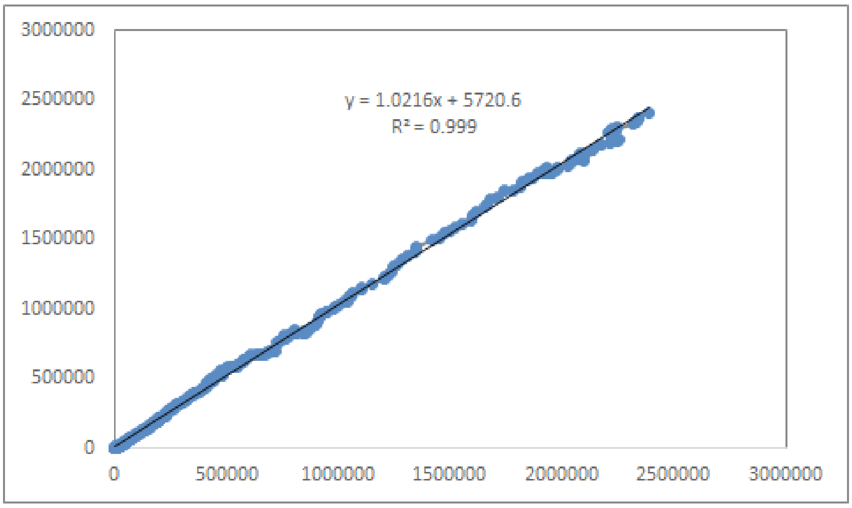

Figure 5.3: M3 and bank credit (raw monthly data)

Conditions do arise when central banks wish to drive interest rates to the lowest levels possible. These periods usually arise at the end of recessions and continue into low-growth periods, and the policy (QE) is designed to drive interest rates down to the lowest levels possible and encourage bank credit extension / money creation. We discuss this further after attention is given to the bank liquidity analysis.

5.4 A bank liquidity analysis

It should be evident that the RR is only one of many factors which influence bank liquidity. In order to elucidate, we present the simplified (we have left out unimportant items such as *other assets*, *other liabilities* and *capital and reserves*) balance sheet of the central bank in Balance Sheet 5.7.

BALANCE SHEET 5.7: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
		A. Notes & coins (N&C)	2 000
		B. Deposits:	
D. Foreign assets (FA)	1 800	1. Government sector	1 000
E. Credit to government (CG)[37]	2 100	2. Banks (TR)	500
F. Loans to banks (BR) at PIR	100	(a. ER = 0)	
		(b. RR = 500)	
		C. Loans: Foreign sector	500
Total	4 000	Total	4 000

From this balance sheet we can create what can be called a *bank liquidity analysis* (BLA). On the left of the identity we have the net excess reserves (NER) of the banking sector, an indicator of bank liquidity (as far as CBM is concerned). This is made up of the ER of the banking sector (item B2a) less the extent of loans to the banking sector (at the PIR), that is, the liquidity shortage (LSh = BR = item F):[4]

$$\text{NER} = \text{B2a} - \text{F}.$$

On the right hand side of the identity we have all the remaining liability and asset items:

$$\text{NER} = \text{B2a} - \text{F} = (\text{D} + \text{E}) - (\text{A} + \text{B1} + \text{B2b} + \text{C}).$$

If we group the related liability and asset items we have:

$$\text{NER} = \text{B2a} - \text{F} = (\text{D} - \text{C}) + (\text{E} - \text{B1}) - \text{A} - \text{B2b}.$$

Using the numbers in Balance Sheet 5.7, we have NER and its counterparts (in LCC billions) as follows:

$$\begin{aligned} \text{NER} &= \text{B2a} - \text{F} && = (\text{D} - \text{C}) + (\text{E} - \text{B1}) - \text{A} - \text{B2b} \\ &= 0 - 100 && = (1\,800 - 500) + (2\,100 - 1\,000) - 2\,000 - 500 \\ &= -100 && = 1\,300 + 1\,100 - 2\,000 - 500 \\ & && = -100. \end{aligned}$$

It will also be evident that from one date to another the changes (Δ) as well as the balance sheet sources of changes (BSSoC) can be calculated:

$$\Delta NER = \Delta(D - C) + \Delta(E - B1) - \Delta A - \Delta B2b.$$

Thus, a change in the NER of the banking system is *caused* by changes in the remaining balance sheet items (that is, the BSSoC):

ΔNER =
Δ(D – C) = net foreign assets (NFA)
+ Δ(E – B1) = net credit to government (NCG)
– ΔA = N&C in circulation
– ΔB2b = required reserves (RR).

The actual sources of changes (ASoC) are the transactions that underli.e. the BSSoC. It will be evident that the instruments of open market operations (OMO) are NFA (usually forex swaps), NCG (purchases / sales of government securities in the main) and that the RR ratio (r) can also be used (rarely so in practice) to also manipulate bank liquidity (NER). For example, the sale of forex to a bank (a forex swap) will decrease NER [(increase the LSh (item F)]. The BSSoC is a decrease in NFA. Similarly, the sale of TBs to the banks will decrease NER (increase the LSh). The BSSoC is a decrease in NCG. Thus, the central bank has total control over bank liquidity (assuming efficient markets).

BALANCE SHEET 5.8: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
		A. Notes & coins (N&C)	2 000
		B. Deposits:	
D. Foreign assets (FA)	1 800	1. Government sector	1 000
E. Credit to government (CG)[38]	2 300	2. Banks (TR)	600
G. Loans to banks (BR)	0	(a. ER = 100)	
		(b. RR = 500)	
		C. Loans: Foreign sector	500
Total	4 100	Total	4 100

It will also be evident that in a recessionary period (assuming the above numbers to be in place) the central bank can change the NER condition of the banking sector at will [to a liquidity surplus (LSu) under a QE policy] by, for example, purchasing LCC 200 billion bonds from the banks (see Balance Sheet 5.8). This will result in (in LCC billions):

ΔNER = +200 billion
BSSoC = ΔNCG = +200 billion.

The *outstanding* NER condition will be (in LCC billions):

NER = B2a – F
= 100 – 0
= 100.

Is this a robust analysis? Obviously, because a balance sheet balances, one can create an identity for any item. It is robust because it is based on the fact that all interbank settlement takes place over the accounts which banks are required to maintain with the central bank. For example, when the central bank sells government bonds (CG in its balance sheet) to the banks, the banks' accounts with the central bank will be debited (= a decline in TR). If the banks have no ER, they are obliged to take loans (BR = item F) from the central bank at the PIR (assuming the bond sale = LCC 100 million):

NER		= B2a – F
		= 0 – 100
		= – LCC 100 million
BSSoC	= ΔNCG	= – LCC 100 million.

The ASoC is the OMO sale.

The above demonstrates that bank liquidity (NER) is firmly under the control of the central bank. Most countries' monetary policy approach (that is, the interest rate-focused monetary policy) rests on creating and maintaining a liquidity shortage (LSh) (in normal circumstances) in order to make the PIR effective. But, as discussed earlier, in abnormal times, when a QE policy is required, the central bank is able to bring about a liquidity surplus (LSu) condition, rendering the PIR irrelevant, thus driving down interest rates to low levels.

We give attention to the influence of a QE policy on interest rates in the following section, while at the same time tackling an widespread misconception: that QE creates new money.

5.5 Quantitative easing

5.5.1 Introduction

There is a profound misconception amongst certain commentators on money and banking: that QE creates new money. The misconception is either: (1) that new money is injected into the economy; (2) newly created ER can be used by the banks to provide new credit. Neither of these is correct. QE, that is, the purchase of securities by the central bank from the banks (usually), may *lead to* money creation in the future (that is the objective of the policy), but it *does not* create money when the purchases are made. The purchases create ER for the banks, and these reserves cannot be loaned by the banks.

The only way that the excess reserves can be employed by banks is by providing new credit (underlying which lies the objective of the policy: economic activity), which creates new deposits (money), which carries a reserve requirement, thus shifting the dividing line between ER and RR in favour of the latter. This process is helped along by the immediate outcome of ER creation: the lowering of bank lending rates to a level approximating the cost of banking (the bank margin).

QE has become an almost "normal" policy for persons newly introduced to economics at the end of and following the recession of 2007–09. QE amounts to the purchase by the central bank of securities, usually government bonds, but sometimes other riskier securities, with the purpose of creating ER for the banks, and encouraging them to lower interest rates across the yield curve.

The purpose of this section is to point out the "technical" aspects of the QE policy, and its influence on interest rates. It is ordered as follows:

- Literature review.
- Does quantitative easing create money?
- Quantitative easing creates excess reserves.
- Can excess reserves be loaned out by banks?
- Concluding remarks: the money multiplier is dead.

5.5.2 Literature review

We present a literature review in Appendix 1. A summary:

- It is common in the media that reference is made to a QE policy leading to the creation of money ("pumping money into…", "printing money", "injecting money into…").
- Central banks and academics make no reference to money; only to bank reserves. This is correct.

5.5.3 Does quantitative easing create money?

We know that the money stock (M) is comprised of notes and coins (N&C) and bank deposits (BD) held by the domestic non-bank private sector (NBPS):

M = N&C + BD (held by NBPS).

We also know that the main source of change is bank credit to the NBPS. We take this further now and present what can be called a monetary analysis[39], which is an analysis of *all* the BSSoC in M.

The stock of M, as well as the BSSoC, is calculated by central banks, usually monthly, by consolidating the collective balance sheets of the private sector banks with that of the central bank (CB). It is called the consolidated balance sheet of the monetary banking sector (MBS). A simple example is presented in Balance Sheets 5.9–5.11. Note that in a consolidation interbank claims (RR, ER, BR, and N&C) are netted out.

What is the stock of money in this example? Assuming we are focused on the money stock measure M3 (total NDPS deposits), it is LCC[40] 4 600 billion:

M3 = N&C + BD
= A + B2
= 600 + 4 000
= 4 600.

BALANCE SHEET 5.9: BANKS (LCC BILLIONS)			
Assets		Liabilities	
Foreign assets (FA)	300		
Credit to government (CG)[41]	900		
Credit to private sector (CPS)[42]	2 000		
Central bank money (CBM):		Deposits: Private sector	4 000
Notes & coins (N&C)	600	Loans from central bank (BR)	200
Reserves (Total reserves – TR)	400		
(ER = 0)			
(RR = 400)			
Total	4 200	Total	4 200

BALANCE SHEET 5.10: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
		Notes & coins (N&C)	1 200
		Deposits:	
Foreign assets (FA)	1 600	Government sector	800
Credit to government (G)[43]	1 000	Banks (TR)	400
Loans to banks (BR)	200	(ER = 0)	
		(RR = 400)	
		Loans: Foreign sector	400
Total	2 800	Total	2 800

BALANCE SHEET 5.11: CONSOLIDATED BALANCE SHEET OF MBS (LCC BILLIONS)			
Assets		Liabilities	
		A. Notes & coin	600
D. Foreign assets (FA)	1 900	B. Deposits:	
E. Credit to government (CG)	1 900	1. Government	800
F. Credit to private sector (CPS)	2 000	2. Private sector	4 000
		C. Loans: foreign sector	400
Total	5 800	Total	5 800

The BSSoC (= M3) are:

$$= D + E + F - (B1 + C).$$

If the related items (D and C; E and B1) are grouped, we get (LCC billions):

M3 = A + B2 = $\underline{4\ 600}$ (600 + 4 000)

= (D – C) = 1 500 (1 900 – 400)
+ (E – B1) = 1 100 (1 900 – 800)
+ F = $\underline{2\ 000}$
TOTAL = $\underline{4\ 600}$

Thus, the counterparts of the M3 money stock on a particular date are:

Net foreign assets (NFA) (D – C)
Net credit to government (NCG) (E – B1)
Credit to private sector (CPS) (F).

It also tells us that from a date to another date (in practice month-end to month-end) the BSSoC of changes (Δ) in M3 can be calculated as follows:

$$\Delta M3 = \Delta NFA + \Delta NCG + \Delta CPS.$$

When a QE policy is adopted and implemented, the central bank purchases securities (usually government bonds, but corporate bonds as well at times). As we know, government bonds are credit to government which are marketable, and are therefore part of CG in Balance Sheets 5.9–5.11, and of course part of NCG in the monetary analysis presented above. Corporate bonds held by the private sector banks are marketable credit to the corporate sector and are therefore part of CPS in the banks' balance sheet. Thus, it will be clear that when a central bank buys bonds from the banks they will simply shift from the banks' balance sheet to the central bank's balance sheet. The counterbalancing balance sheet items (bank reserves) will be elucidated in the following section.

The conclusion is thus that when QE is implemented and the bonds are forthcoming from the banks, there is no change in the stock of money. In practice this is overwhelmingly the case. However, to the extent that bonds are forthcoming from non-bank financial intermediaries (such as retirement funds, insurers, unit trusts, etc.), the money stock will increase, as indicated in Balance Sheets 5.12–5.14 [we assume retirement funds (i.e. private sector) sell government bonds to the central bank to the extent of LCC 100 billion] (we ignore the effect on bank reserves here in the interests of simplicity, but introduce it later).

BALANCE SHEET 5.12: RETIREMENT FUNDS (LCC BILLIONS)			
Assets		Liabilities	
Bonds Deposits at banks	-100 +100		
Total	0	Total	0

BALANCE SHEET 5.13: BANKS (LCC BILLIONS)			
Assets		Liabilities	
Reserves at CB (TR)	+100	Deposits of retirement funds	+100
Total	+100	Total	+100

BALANCE SHEET 5.14: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
Credit to government (CG)	+100	Bank reserves (TR)	+100
Total	+100	Total	+100

In terms of the analysis presented above:

ΔM3		= +LCC 100 billion
BSSoc	= ΔNCG	= +LCC 100 billion.

It must be quickly pointed out that the non-bank financial intermediaries are not keen to dispose of bonds under a QE policy, because they will be aware that the prices of bonds will rise and the yield curve will move down, bringing with it large capital profits. They will be exchanging high yielding bonds for bank deposits (with almost zero rate of interest).

The QE policy not is designed for this outcome, but for the effect on bank reserves, to which we now turn.

5.5.4 Quantitative easing creates excess reserves

It is assumed that the banks are not indebted to the central bank (which is the case – obviously – under a QE policy), and that they are complying with the reserve requirement (RR). The purchase of LCC 100 billion bonds by the central bank will lead to the creation of additional ER to the extent of LCC 100 billion, as indicated in Balance Sheets 5.15–5.16.

BALANCE SHEET 5.15: BANKS (LCC BILLIONS)			
Assets		Liabilities	
Bonds (CG) Reserves at CB (TR) (ER = +100) (RR = 0)	-100 +100		
Total	0	Total	0

BALANCE SHEET 5.16: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
Bonds (CG)	+100	Bank reserves (TR) (ER = +100) (RR = 0)	+100
Total	+100	Total	+100

It is sometimes mistakenly believed that banks, now having abundant ER, are in a position to loan these funds to borrowers. This is not so.

5.5.5 Can excess reserves be loaned out by banks?

This is not so because no bank is able to create or destroy central bank money (CBM, that is, bank reserves[44]). This can only be achieved through bank credit extension, which creates new deposits (money), which on which the RR is based.

Assuming the central bank creates an ER condition in the banking sector of LCC 100 billion by buying bonds (as in Balance Sheets 5.15–5.16) the banks can only reduce their ER by extending credit to the extent of LCC 1 000 billion (assuming the RR[45] ratio = 10% of deposits), that is ER × 1 / 0.1 (see Balance Sheets 5.17–5.18).

BALANCE SHEET 5.17: BANKS (LCC BILLIONS)			
Assets		Liabilities	
CPS (or CG assuming funds spent) Reserves at CB (TR) (ER = -100) (RR = +100)	+1 000 0	Deposits of the NBPS (M)	+1 000
Total	+1 000	Total	+1 000

BALANCE SHEET 5.18: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
		Bank reserves (TR) (ER = -100) (RR = +100)	0
Total	0	Total	0

Note the shift in the dividing line between RR and ER in favour of the former. If we combine Balance Sheets 5.15–5.16 with 5.17–5.18, we get the entire picture: in Balance Sheets 5.19–5.20.

BALANCE SHEET 5.19: BANKS (LCC BILLIONS)			
Assets		Liabilities	
CPS (or CG assuming funds spent) Bonds (CG) Reserves at CB (TR) (ER = 0) (RR = +100)	+1 000 -100 +100	Deposits of the NBPS (money)	+1 000
Total	+1 000	Total	+1 000

BALANCE SHEET 5.20: CENTRAL BANK (LCC BILLIONS)			
Assets		Liabilities	
Bonds (CG)	+100	Bank reserves (TR) (ER = 0) (RR = +100)	+100
Total	+100	Total	+100

It will be evident that a demand for bank credit must exist for this situation to come about – and this is a function of a robust economic environment (amongst myriad other factors), a most important element of which is interest rates, specifically (in a QE policy environment) low interest rates. However, such an environment is not a panacea for growth, as it amounts, to use the common idiom, to "pushing on a string", referred to as a *liquidity trap* by Prof JM Keynes.

5.6 Quantitative easing and interest rates

A QE policy is designed to create ER for the banks, which drives interest rates down to the lowest level possible. A QE policy is accompanied with a PIR of close to 0.0% pa (in practice 0.25–0.5% pa). What does this mean? In essence, the low PIR is a central bank monetary policy message that they want interest rates to be as low as possible. The PIR is totally ineffective because the banks have ER (and – obviously – no BR). The banks are "on their own" under a QE policy: ER and an ineffective PIR.

What is the outcome of a QE policy for market interest rates? It is that deposit rates will be close to zero and bank lending rates (PR) will be approximately equal to the cost of banking, as reflected in the bank margin. PR can be no lower than this level. The YC is positively shaped under a QE policy, with the west-end reflecting the PIR / 1-day TB rate, and it "drags" down the east-end, that is, long term interest rates, by simply having made the alternative to bonds (i.e. deposit rates) most unattractive. The other major factor that impacts on the long end of the YC is of course the demand for bonds by the central banks, coupled with the lower supply of bonds, reflecting investors' propensity to hold on to their bonds for revenue / income purposes.

In essence the policy is designed to encourage borrowers to borrow from the banks (which creates new money) and the non-bank financial intermediaries, which will prompt, in time, new equity funding, and therefore higher aggregate demand and supply (GDP growth). In conclusion we present charts (Figures 5.4 and 5.5) on the relationship between bank credit (to the government and the NBPS, which is called domestic credit extension, DCE) and nominal GDP for the US and Japan (non-smoothed, raw World Bank data, 1960-2012): $R^2 = 0.98$ and 0.99, respectively.

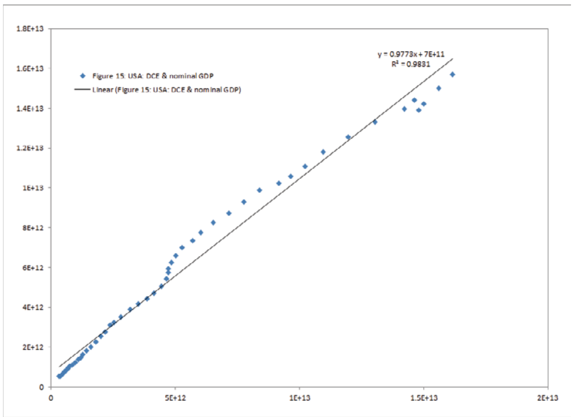

Figure 5.4: DCE & GDP_N: USA: $R^2 = 0.98$

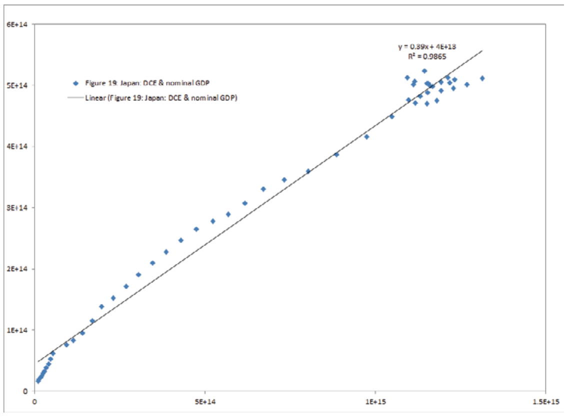

Figure 5.5: DCE & GDP_N: Japan: $R^2 = 0.99$

5.7 Appendix 1: quantitative easing literature review

5.7.1 Literature review: media

QE began in the US in 2008, and from there spread to other countries, including the UK and Japan, and the policy has been extended in many cases. The popular media, almost without exception, displays misinterpretation of the QE policy. Some examples follow (italics are the author's).

The New York Times (2012):

> "…central banks turn to what economists call 'quantitative easing'…methods of *pumping money into an economy* and working to lower the long-term interest rates… The most usual approach is large-scale purchases of debt. The effect is the same as *printing money in vast quantities*, but without ever turning on the printing presses. The Fed buys government or other bonds and writes down that it has done so – what is called 'expanding the balance sheet.' The bank then *makes that money available for banks to borrow, thereby expanding the amount of money sloshing around the economy* thereby, it hopes, reducing long-term interest rates."

BBC (2013):

> "Usually, central banks try to raise the amount of lending and activity in the economy indirectly, by cutting interest rates. Lower interest rates encourage people to spend, not save. But when interest rates can go no lower, a central bank's only option is to *pump money into the economy directly*. That is quantitative easing (QE). The way the central bank does this is by buying assets – usually government bonds – using money it has simply created out of thin air. The institutions selling those bonds (either commercial banks or other financial businesses such as insurance companies) will then have 'new' money in their accounts, which then boosts the money supply."

Financial Times (2013):

> "When interest rates are close to zero there is another way of affecting the price of money: Quantitative Easing (QE). The aim is still to bring down interest rates faced by companies and households and the most important step in QE is that the *central bank creates new money for use in an economy*. Only a central bank can do this because its money is accepted as payment by everybody. Sometimes dubbed incorrectly "printing money" a central bank simply *creates new money* at the stroke of a computer key, in effect increasing the credit in its own bank account. It can then use this new money to buy whatever assets it likes: government bonds, equities, houses, corporate bonds or other assets from banks."

US News (2013):

> "…quantitative easing, a process in which the government purchases assets from banks and private companies in order to *add a set amount of money into the economy*."

Wikipedia (2013):

> "Quantitative easing (QE) is an unconventional monetary policy used by central banks to stimulate the national economy when standard monetary policy has become ineffective. A central bank implements quantitative easing by buying financial assets from commercial banks and other private institutions, thus *creating money and injecting a pre-determined quantity of money into the economy*."

Independent.ie (2013):

> "Massive quantitative easing by central banks around the world *has created huge amounts of new money in the economy.* Much of that cash is being pushed into equity markets, helping push up valuations despite doubts about the underlying health of the global economy."

5.7.2 Literature review: academia and central banks

On the other hand, academics and central banks (which implement QE policy) obviously comprehend the policy, its channels of transmission, its possible outcomes, its shortcomings, etc. As said earlier, this text focuses on the technical aspects of QE. As such, the following extracts from academic and central bank papers are selected for their expositions on the first effect of QE: on bank reserves) (italics are the author's).

Federal Reserve Board of Governors (Bernanke, BS, 2009):

> "Our approach – which could be described as 'credit easing'- resembles quantitative easing in one respect: It involves an expansion of the central bank's balance sheet. However, in a pure QE regime, the focus of policy is the *quantity of bank reserves*, which are liabilities of the central bank; the composition of loans and securities on the asset side of the central bank's balance sheet is incidental."

Bank of England (Benford et al., 2009):

> "…the Monetary Policy Committee (MPC) decided to reduce Bank Rate to 0.5% and to undertake what is sometimes called 'quantitative easing'. This meant that it began purchasing public and private sector assets using *central bank money*."

Bank of Japan (Shiratsuka, 2010):

> "The BOJ provided ample *excess reserves* by using various tools for money market operations, including an increase in the outright purchase of long-term government bonds."

Bank of England (Joyce et al., 2010):

> "…the Committee also announced that…it would ease monetary conditions further through a programme of asset purchases funded by the issuance of *central bank reserves*."

Blinder, AS (2010):

> "The most obvious approach is to buy one of the risky and / or less-liquid assets, paying either by (i)…or (ii) creating *new base money*, which would increase the size of its balance sheet."

Krishnamurthy and Vissing-Jorgensen (2011):

> "The QE strategy involves purchasing long-term securities and paying by increasing *reserve balances*."

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6 Role of interest rates

6.1 Learning outcomes

After studying this text the learner should be able to:

1. Elucidate the role: primary tool of monetary policy.
2. Explain the role: bridge between present and future consumption.
3. Discuss the role: advancing consumption / investment with debt.
4. Describe the principle underlying the inverse relationship between interest rates and asset prices.
5. Discuss the essence of the wealth effect.
6. Expound upon the role of interest rates in derivative instrument pricing.
7. Discuss the role of interest rates in respect of the foreign sector.

6.2 Introduction

The interest rate is one of the most significant prices in the economy. The following are the roles of interest rates:

- Primary tool of monetary policy.
- Part of bridge between present and future consumption.
- Advancing consumption and / or investments with debt.
- Inverse relationship with asset prices and the wealth effect.
- Interest rates and derivative instrument pricing.
- Interest rates and the foreign sector.

6.3 Primary tool of monetary policy

In 1930 Prof Iriving Fisher, famous for many issues in economics, including the quantity theory of money and the theory of interest, wrote:

> "Prof. Knut Wicksell was one of the first to recognize the influence of interest rates upon prices. See his book, *Geldzins und güterpreise;* Prof. Alfred Marshall, Prof. Gustav Cassel, Rt. Hon. Reginald McKenna, chairman of the Midland Bank of London, Mr. R.G. Hawtrey, of the Treasury of Great Britain, and many other well known economists, bankers, and business men have emphasized that business activity is influenced and may be largely controlled by manipulation of the discount rate."

The role of interest rates in monetary policy has been covered on many occasions in this text. Thus, we will not repeat it. However, we offer a synopsis:

- In normal circumstances the central bank, through open market operations (OMO), creates a liquidity shortage (LS) and, in most countries, maintains it permanently. This means it "forces" the banks to borrow from it at all times. The borrowing term is short (usually 1 day to 7 days).
- It levies its PIR on these borrowed reserves.
- The bank-to-bank interbank rate (b2b IBM), the market in which banks settle interbank claims on one another) takes its cue from the PIR.
- The b2b IBM rate has a major impact on the banks' deposit rates (wholesale call money rates in the first instance and other short-term deposit rates in the second, and so on).
- As the banks maintain a jealously guarded margin, deposit rates impact on bank lending rates.
- Thus the PIR impacts on the banks' PR (an R2 of close to 1.0 is not unusual).
- The level of PR (especially in real terms) influences the NBPS's demand for bank credit. Responsible governments tend to be interest rate sensitive, but many are not.

- Interest rate changes also have a major impact on asset prices which through the "wealth effect" influence consumption and investment (C + I = GDE; GDE + net exports = GDP) behaviour (discussed further below).
- The growth in bank credit (to the NBPS and government) is the main counterpart of growth in M3, i.e. M3 growth is largely the outcome of growth in bank lending.
- The growth rate in aggregate demand (Δnominal GDP, GDP_N), financed to a large degree by Δbank credit, and reflected in ΔM3, has a major impact on price developments (inflation).
- The inflation rate is a major input in business decisions.
- Business decisions impact on economic growth and employment.

Figure 6.1 illustrates the monetary policy route and its objectives.

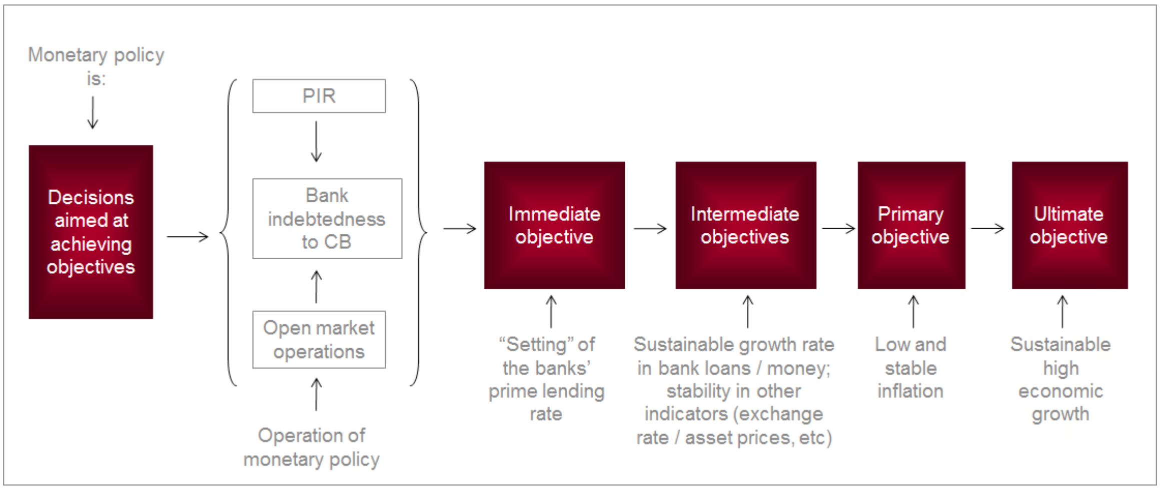

Figure 6.1: Route of monetary policy and objectives

The latter bullet points deserve a few more words. As we have seen, there is a close correlation between ΔDCE and ΔM3 (close to 1.0), because ΔM3 is (largely) the outcome of ΔDCE. The ΔDCE represents new spending; consequently one would expect a close correlation between ΔDCE and ΔGDP_N. This is shown for the US and Japan in Figures 6.2–6.3.

GDP_N translates into real GDP and inflation:

$$GDP_N = GDP_R \times P$$

and therefore:

$$\Delta GDP_N = \Delta GDP_R + \Delta P.$$

Economists, government, business, etc., are interested in the level of ΔGDP_R, because this aggregate influences income and employment. Central banks are aware that there is a trade-off between the two: low and stable ΔP brings about a higher ΔGDP_R and high and unstable ΔP dissipates the contribution of ΔGDP_N to ΔGDP_R.

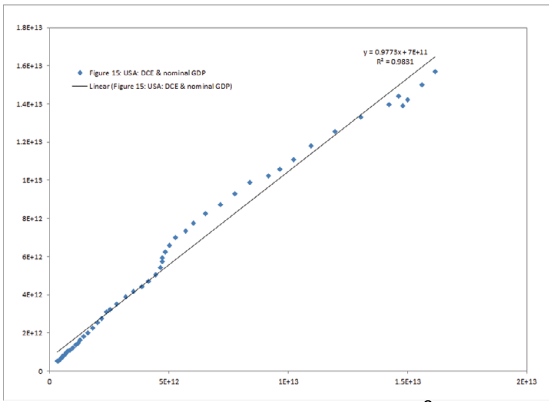

Figure 5.4: DCE & GDP_N: USA: R^2 = 0.98

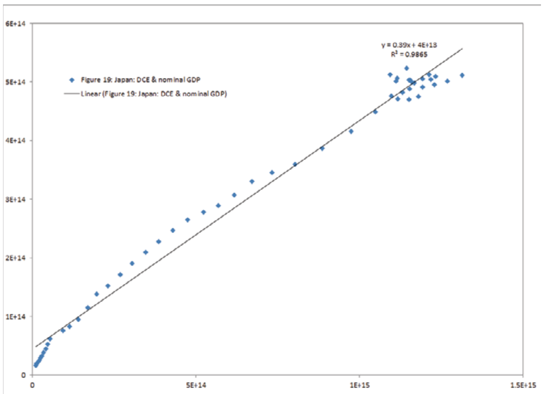

Figure 5.5: DCE & GDP_N: Japan: R^2 = 0.99

In conclusion we need to ask: is there an optimal rate of interest? The answer is yes. It is called the natural rate of interest or, more usually, the natural rate (NR), but it is a hypothetical rate. It is the rate that brings about the ideal economic situation: achievement of low and stable inflation and potential real output. It may also be seen as the ideal division of:

$$\Delta GDP_N = \Delta GDP_R + \Delta P.$$

However, it is non-measurable and therefore elusive. This does not detract from its significance and the need for central banks and academics to hunt for it. Great strides have been made, for example, the advent of inflation targeting and the almost universal agreement that a ΔP of 2.0% pa is ideal. The ideal division of GDP_N is one of the most imperative topics in economics. We discuss the NR in more detail later.

6.4 Part of bridge between present and future consumption

6.4.1 Introduction

Assets (i.e. financial and real assets) can be seen as the bridge between present and future consumption. What does this mean? It means that there is a trade-off between present and future consumption: the household and corporate sectors continually make decisions regarding spending (consuming) all income now and consuming less now and saving – in the form of assets – for consumption in the future, i.e. delaying spending now for future spending.

Prof Irving Fisher (1930) described this role in 1930:

> "The rate of interest expresses a price in the exchange between present and future goods…the rate of interest, or the premium on the exchange between present and future goods, is based, in part, on a subjective element, a derivative of marginal desirability; namely, the marginal preference for present over future goods. This preference has been called time preference, or *human impatience*. The chief other part is an objective element, *investment opportunity*."

What are the assets referred to above? Usually they are categorised as follows (a.k.a. "investment asset classes"):

- Financial assets:
    - Money market (mainly short-term debt and bank deposits).
    - Bonds.
    - Equity.

- Real assets:
    - Property (developed and undeveloped).
    - Commodities (gold coins, maize, cattle, etc.).
    - Other (furniture, rare books, rare stamps, art, etc.).

These are the forms in which households and companies are able to delay consumption. The rate of return on financial and real assets plays a role in these decisions. Interest on debt financial assets is part of this equation (the other parts are: dividends on shares, rent on property, expectations of capital gains). The higher the rate of return the higher is the incentive to delay consumption. We cover this issue under the following brief sub-sections:

- Household sector.
- Corporate sector.
- Government sector.
- Concluding remarks.

6.4.2 Household sector

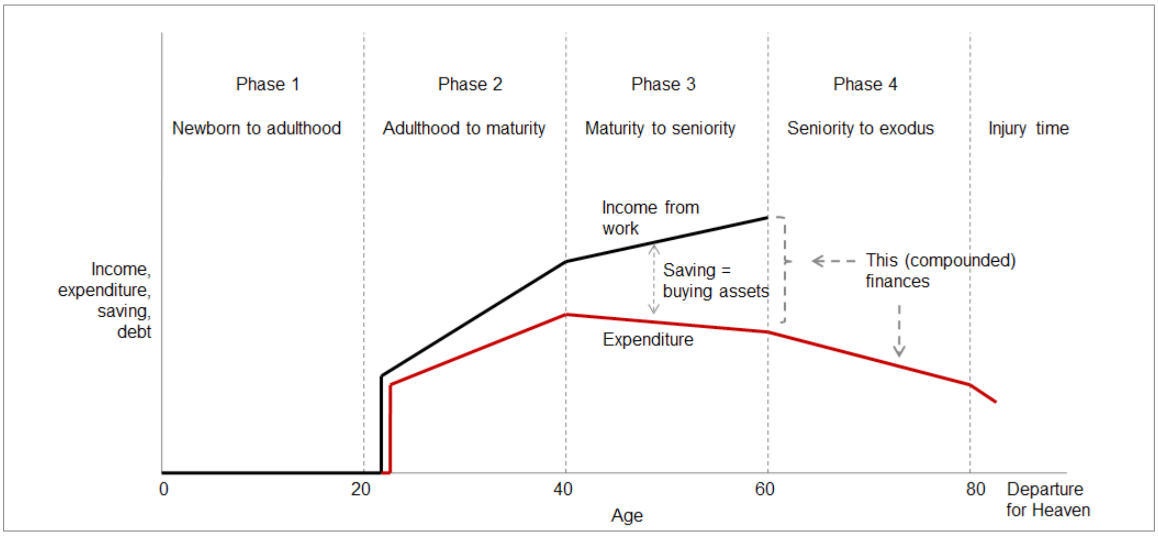

Figure 6.4: Ideal financial life cycle: income, expenditure, and saving

If we divide an individual's life into four phases and indicate income, expenditure, and saving (investment in assets), it will appear as in Figure 6.4. Obviously the working start and end dates will differ from person to person. This is the ideal situation, but few achieve it according to numerous studies. A discussion on the financial life cycle issue is provided in: http://bookboon.com/en/investments-an-introduction-ebook.

6.4.3 Corporate sector

The way in which the corporate sector delays consumption may not be obvious. The shareholders of a company (or their agents – in the form of non-shareholder directors and management) may choose present consumption over future consumption in the form of paying out large dividends. On the other hand, they may choose to delay consumption – by retaining profits in the company (in the form of "retained earnings" = equity) and investing the funds in new plant and equipment in order to make larger profits and pay out larger dividends in the future.

6.4.4 Government sector

Do central governments delay consumption? The answer is no and yes. The vast majority of governments run permanent budget deficits, and they fund the deficit by issuing securities, meaning that they borrow in order to advance consumption (see next section). They pay a rate of interest for this privilege, which is for the account of taxpayers (meaning that it will influence future deficits). The rates of interest on bonds do (or should) affect decisions in this respect.

When a government has a surplus, it will usually repay debt. This is equivalent to delaying consumption. The reduction in government debt alters the supply of government bonds, and it changes the size of future deficits (in that interest payments reduce), both of which have an interest rate reduction consequence.

6.4.5 Concluding remarks

Delaying consumption / investment (residential in the case of households and, in the main, in plant and equipment by companies) is effected in assets, mainly financial assets (i.e. lending). The rate of interest is the reward for doing so; it is a significant variable in the choice in decisions to delay consumption.

What is the other side of the coin? It is borrowing, i.e. the issue of financial securities, by those who wish to advance consumption. We cover this next.

6.5 Advancing consumption / investment with debt

6.5.1 Introduction

The converse of postponing consumption is advancing consumption: households, corporate entities and central government do so by issuing financial obligations (debt and equity[46]; the latter applies only to companies) in order to advance consumption (C) and / or investment (in plant and equipment) (I). Recall that: C + I = GDE; GDE + NE = GDP (NE = net exports), and that there is a close relationship between DCE and GDP_N, meaning that borrowing (from banks, the outcome of which is bank deposit money creation) reflects additional demand for goods and services (GDP_N growth). As we are interested in interest rates, we ignore equity and focus on debt. This section has 3 sub-sections:

- Household sector.
- Corporate sector.
- Government sector.

6.5.2 Household sector

Members of the household sector have assets (loans by them) and liabilities (loans to them), and astute older members just have assets. A typical balance sheet of a young member of the household sector (in phase 2 of life: 20–40) appears as in Balance Sheet 6.1, and that of an older astute member (in phase 4: 60-80+) in Balance Sheet 6.2.

BALANCE SHEET 6.1: YOUNG MEMBER OF HOUSEHOLD SECTOR (LCC)			
Assets (A)		Liabilities (L)	
Deposits (current account) Property (residential) Furniture Motor vehicle PI[1] (retirement fund)	1 000 200 000 25 000 60 000 110 000	Bond (on residence)	150 000
Total	396 000	Total	150 000
Negative net worth (when L > A)	0	Net worth (when A > L)	246 000
Total assets	396 000	Total liabilities + net worth	396 000
1 PI = participation interest.			

BALANCE SHEET 6.2: OLDER MEMBER OF HOUSEHOLD SECTOR (LCC)			
Assets (A)		Liabilities (L)	
Deposits: Current account Savings account Property (residential) Furniture Motor vehicle PI[1] (retirement fund) Shares Bonds (government bonds)	 5 000 10 000 400 000 50 000 60 000 900 000 150 000 100 000		
Total	1 675 000	Total	0
Negative net worth (when L > A)	0	Net worth (when A > L)	1 675 000
Total assets	1 675 000	Total liabilities + net worth	1 675 000
1 PI = participation interest.			

Most educated young people when in phase 2 ensure a budget condition of $I > E = S+$ (income = I; expenditure = E; increased savings = $S+$), in order to have the funds as a deposit on a residence (inter alia). This enables them to raise a mortgage loan from a bank, as indicated in Figure 6.5. The budget condition, $I > E = S+$, alters in that the rate of interest on the bond becomes part of E. The rate of interest on the mortgage, which is benchmarked on PR, plays a major role in the decision to borrow.

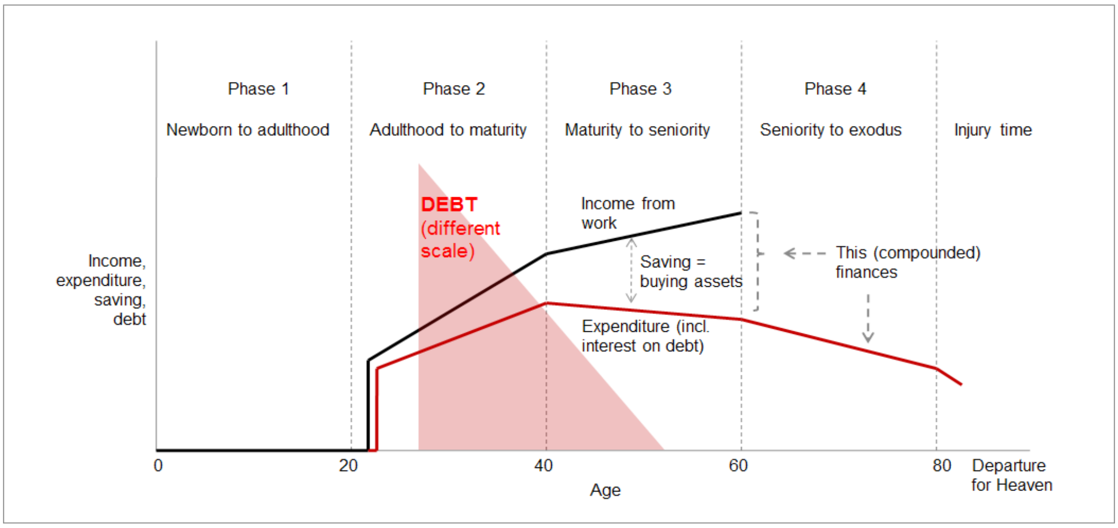

Figure 6.5: Ideal financial life cycle: income, expenditure, debt, and saving

Figure 6.6 shows DCE (bank credit to NBPS and government) growth and the real prime rate (PR_R) for a period of almost 60 years[47] (monthly data). It will be evident that DCE growth never becomes negative (except for one short period); just the growth rate varies. It is clear that interest rates (in real terms) play a role after some time (in this case PR_R has been forwarded by 24 months). The expected inverse correlation is not good but it does show that interest rates do influence DCE. As we know, interest rates are largely controlled by the central bank.

The lack of a robust inverse correlation should not cloud the issue, because the levels of PR_R were perhaps at times not optimum in this particular country. We discuss the issue of the optimal rate of interest (the natural rate) later.

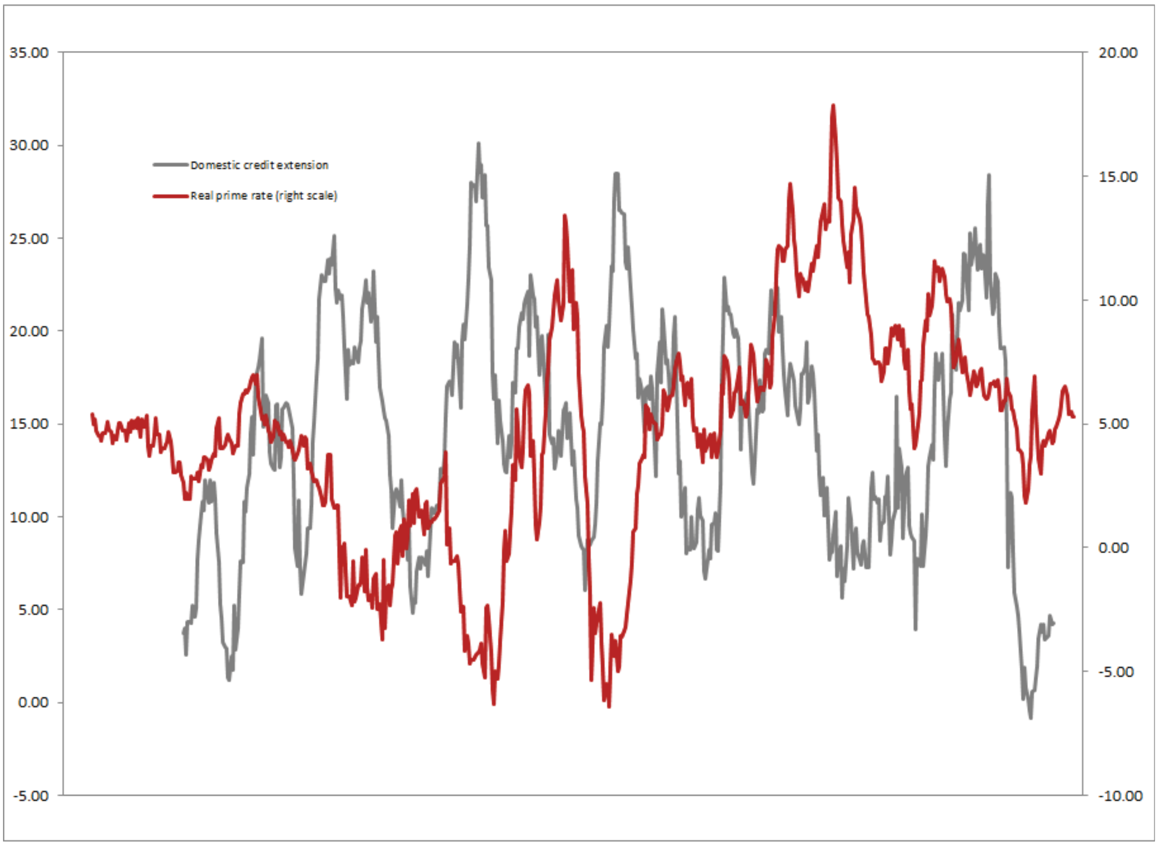

Figure 6.6: Real prime rate (+24 months) & DCE

Figure 6.7 shows the relationship between credit to the NBPS and household debt to disposable income (yoy% growth) for over 5 decades. As household debt rises, debt service costs rise (see Figure 6.8), and disposable income falls, leading eventually to a cut-back in expenditure, which leads to a recessionary period.

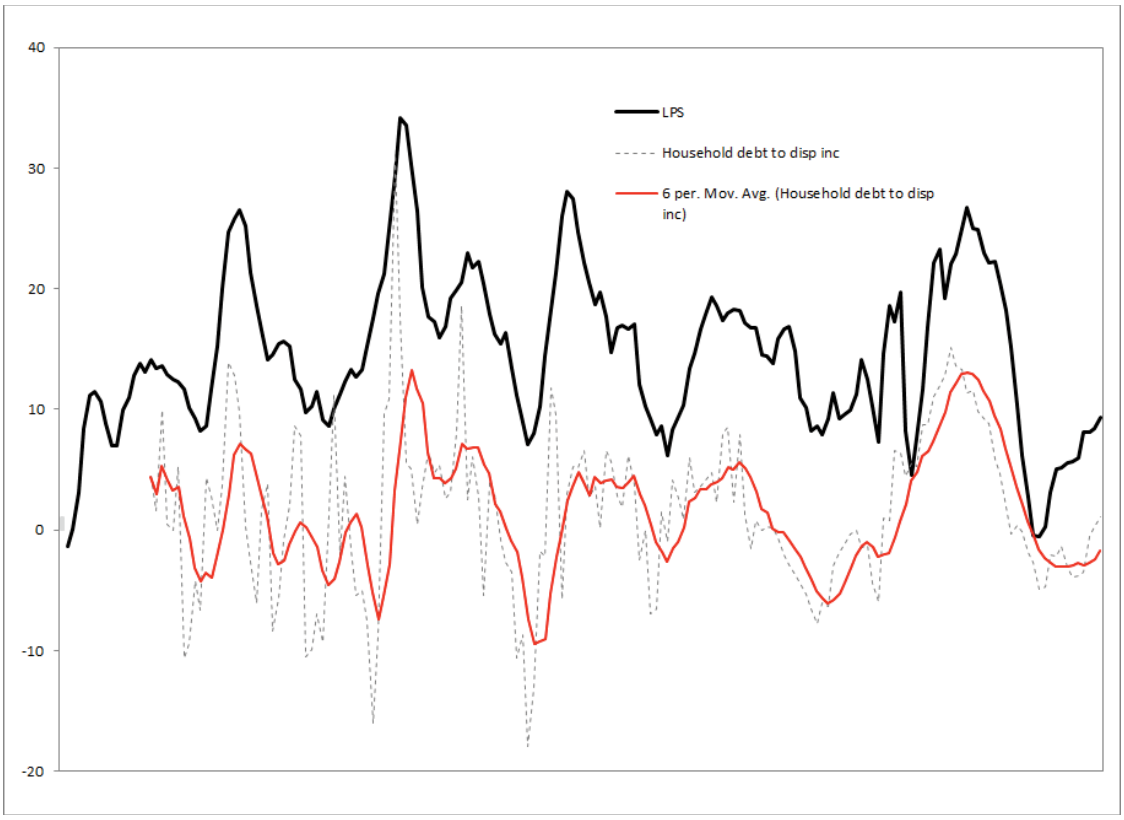

Figure 6.7: Change (yoy%): Bank credit to NPBS & household debt to disposable income

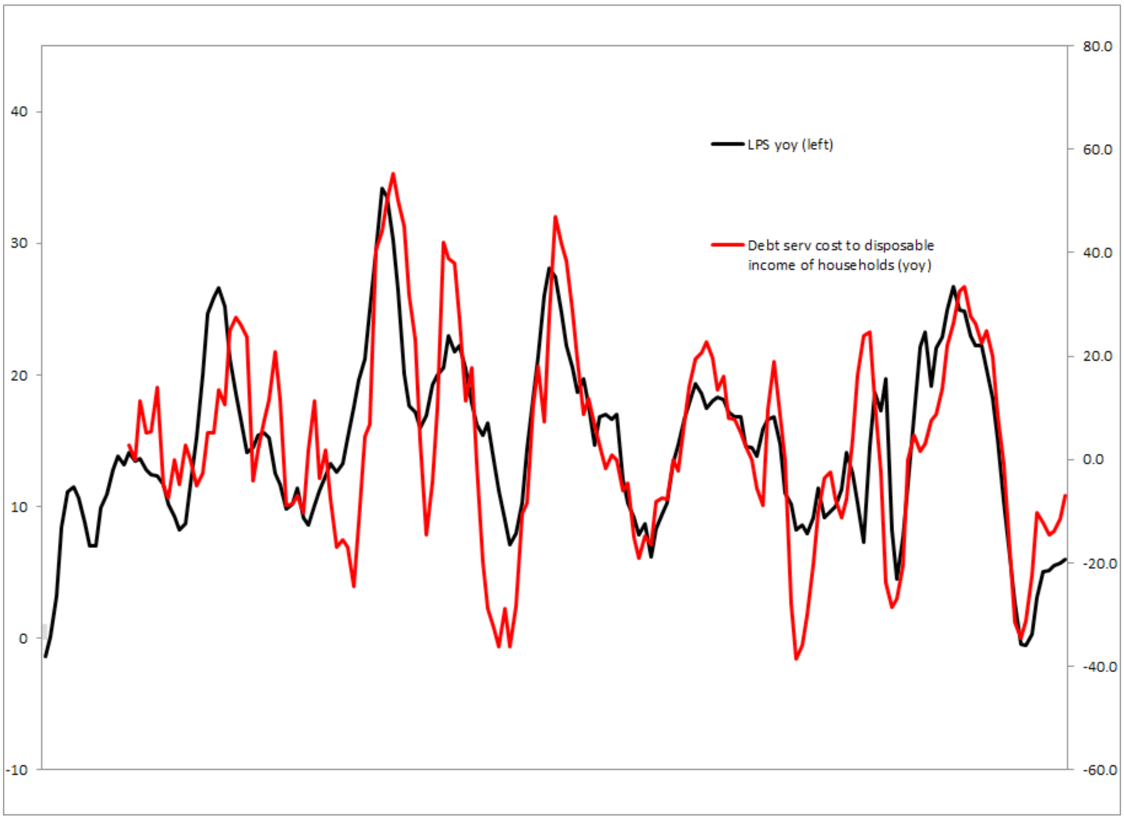

Figure 6.8: Change (yoy%): Bank credit to NBPS & debt service cost to disposable income (households)

6.5.3 Corporate sector

As we saw earlier, companies can delay consumption by increasing retained profits which can be used for additional investment in plant and equipment in order to reap higher profits for consumption purposes in the future. Companies also have a choice, when capital is limited, to borrow, by the issue of new debt securities, for this purpose. The rate of interest on debt plays a major role in the choice to borrow or not.

If a company decides to fund a new project which has a lifespan of 5 years by the issue of 5-year bonds (projects have a lifespan of 10-30 years, but we use this term for illustration purposes), the net present value (NPV) and internal rate of return (IRR) concepts are employed to determine the project's financial viability. A planned project has an estimated outlay cost (OC = the cost of a factory and required equipment) and future cash flows or profits (FVs). As we know from the PV-FV discussion, the PV is:

$$PV \quad = FV / (1 + ir / not)^{y.not}.$$

The NPV is the same, except for the OC: it is the PV of future cash flows minus the OC [CF_1, CF_2, etc. = annual future cash flows (FVs)]:

$$NPV \quad = - OC + [CF_1 / (1 + ir)^1] + [CF_2 / (1 + ir)^2] + [CF_3 / (1 + ir)^3] + [CF_4 / (1 + ir)^4] + [CF_5 / (1 + ir)^5].$$

The bond interest rate (ir = ytm) to be paid by the company is (recall: rp = risk premium):

ir = 5-year rfr + rp.

If we assume:

- the 5-year rfr = 4.0% pa, and the market demands an rp of 2.0% pa (ir = 6.0% pa);
- the forecast cash flows are (pa, LCC millions): 20, 25, 30, 35, and 40;
- OC = LCC 120 million,

the NPV of the project is:

$$\begin{aligned} NPV &= - OC + [CF_1 / (1 + ir)^1] + [CF_2 / (1 + ir)^2] + [CF_3 / (1 + ir)^3] + [CF_4 / (1 + ir)^4] + [CF_5 / (1 + ir)^5]. \\ &= - 120 + (20 / 1.06^1) + (25 / 1.06^2) + (30 / 1.06^3) + (35 / 1.06^4) + (40 / 1.06^5) \\ &= - 120 + (20 / 1.06) + (25 / 1.12360) + (30 / 1.19102) + (35 / 1.26248) + (40 / 1.33823) \\ &= - 120 + 18.868 + 22.250 + 25.188 + 27.723 + 29.890 \\ &= +3.919 \\ &= +\text{LCC } 3\ 919\ 000. \end{aligned}$$

The project is viable at this corporate bond funding rate. It delivers a cash flow higher than the OC. At 8.0% it is not:

$$\begin{aligned} NPV &= - 120 + (20 / 1.08^1) + (25 / 1.08^2) + (30 / 1.08^3) + (35 / 1.08^4) + (40 / 1.08^5) \\ &= - 120 + (20 / 1.08) + (25 / 1.16640) + (30 / 1.25971) + (35 / 1.36049) + (40 / 1.46932) \\ &= - 120 + 18.519 + 21.433 + 23.815 + 25.726 + 27.223 \\ &= -3.284 \\ &= -\text{LCC } 3\ 284\ 000. \end{aligned}$$

The IRR is the discount rate which makes the NPV = 0, that is, the PVs of the cash flows (FVs) of the project are equal to its OC. The IRR of the project is higher that 6.0% pa and lower than 8.0% pa.

It will be clear that, in a tight monetary policy environment when interest rates are increased by the central bank, more and more new projects become non-viable and are put on ice.

Often, companies decide to fund a project by issuing bonds, but regard bond funding as part of their funding mix: ordinary shares, preference shares, bonds, etc. The interest rate on debt then becomes part of a company's *weighted average cost of capital* (*wacc*). If we assume simply that a company has two sources of funding, shares and bonds, the inputs are as follows (assume the project has a life of 5 years):

(1) Cost of equity (rrr) = rfr + rp

where

rrr = required rate of return
rfr = risk-free rate (the rfr is known; assume 4% pa)
rp = risk premium (the rp is "arbitrary"[48]; assume 5% pa).

Cost of equity (rrr) = rfr + rp
= 4.0 + 5.0
= 9.0% pa.

(2) Cost of bond debt (ir) (ytm) (% pa) = rfr + rp
= 4.0 + 2.0 (assumed)
= 6.0% pa.

With these inputs, the wacc can be established:

$$\text{Wacc} = \{[D / (D + E)] \times ir\} + \{[E / (D + E)] \times rrr\}$$

where

D = total bond debt = LCC 100 million
E = shareholder equity (issued + retained income) = LCC 200 million.

$$\begin{aligned} \text{Wacc} &= \{[D / (D + E)] \times ir\} + \{[E / (D + E)] \times rrr\} \\ &= \{[100 / (100 + 200)] \times 0.06\} + \{[200 / (100 + 200)] \times rrr\} \\ &= [(100 / 300) \times 0.06] + [(200 / 300) \times 0.09] \\ &= (0.33333 \times 0.06) + (0.66666 \times 0.09) \\ &= 0.02 + 0.06 \\ &= 0.08 \\ &= 8.0\% \text{ pa.} \end{aligned}$$

As we saw above, the NPV is the same as the FV-PV calculation, except that there is an OC:

$$NPV = -OC + [CF_1 / (1 + wacc)^1] + [CF_2 / (1 + wacc)^2] + [CF_3 / (1 + wacc)^3] + [CF_4 / (1 + wacc)^4] + [CF_5 / (1 + wacc)^5].$$

Example [with CF numbers as above (LCC millions): 20, 25, 30, 35, 40]:

$$NPV = -OC + [CF_1 / (1 + wacc)^1] + [CF_2 / (1 + wacc)^2] + [CF_3 / (1 + wacc)^3] + [CF_4 / (1 + wacc)^4] + [CF_5 / (1 + wacc)^5].$$
$$= -100 + (20 / 1.08) + (25 / 1.16640) + (30 / 1.25971) + (35 / 1.36049) + (40 / (1.46933)$$
$$= -100 + 18.52 + 21.43 + 23.82 + 25.73 + 27.22$$
$$= +16.72$$
$$= +\text{LCC } 16\ 720\ 000.$$

As we saw above, this means that the project is viable: it delivers a positive NPV, and the IRR of the project is higher than 8.0% pa.

Note that the above is simplified. We have, for example, ignored taxes on profits, the important "hurdle rate" (an arbitrary minimum rate of return that a company will accept for a project), and the corporate finance-related disadvantages inherent in the analysis. We have done this to keep the exposition simple, in order to demonstrate the principle.

The principle is that new company projects have an estimated OC and future cash flows (CFs = FVs), and these cash flows are discounted to PV (total FVs – OC = NPV) by an interest / discount rate: wacc or bond rate. This wacc contains the rfr and the bond rate, and the bond rate is an interest rate (ytm). This means that when rates rise, projects have a lower value (NPV), and when rates fall the opposite is the case. Thus, interest rates have a significant influence on investment spending (I) by corporate entities. Recall that: C + I = GDE; GDE + NE = GDP.

6.5.4 Government sector

BALANCE SHEET 6.3: CENTRAL GOVERNMENT (LCC BILLIONS)			
Assets (A)		Liabilities (L)	
Deposits at central bank	10 000	Bonds in issue	150 000
Property	100 000	Treasury bills in issue	10 000
Buildings	50 000		
Shares in state-owned enterprises	30 000		
Salaries payable	100		
		Total liabilities	160 000
Total assets	190 100	Net worth	30 100
		Total liabilities + net worth	190 100

Governments also have a balance sheet (but few publish it). An example is presented in Balance Sheet 6.3. As we discussed earlier, most governments run a budget deficit and issue securities in the form of TBs and bonds to fund it, resulting in an outstanding amount of securities, as shown.

Interest rates do play a role in decisions with respect of borrowing. Higher rates do (or should) deter borrowing, mainly because the bonds carry fixed rates, which have to be paid in the future until the bonds mature.

6.6 Inverse relationship with asset prices and the wealth effect

6.6.1 Introduction

We have discussed the PV-FV concept at some length and the reader will know that the interest rates on, and the prices (PVs) of, fixed interest securities are inversely related: when rates increase the prices (PVs) of securities decrease. The reverse obviously also applies, and it applies also to non-financial securities, specifically rent-producing property. This means that any asset which has future cash flows is influenced by interest rates.

This does not only apply to assets, but also goods and services. Prof Irving Fisher (1930) puts it as follows:

> "Interest plays a central role in the theory of value and prices and in the theory of distribution. The rate of interest is fundamental and indispensable in the determination of the value (or prices) of wealth, property, and services…the price of any good is equal to the discounted value of its expected future service… If the value of these services remains the same, a rise or fall in the rate of interest will consequently cause a fall or rise respectively in the value of all the wealth or property. The extent of this fall or rise will be the greater the further into the future the services of wealth extend. Thus, land values from which services are expected to accrue uniformly and indefinitely will be practically doubled if the rate of interest is halved, or halved if the rate of interest is doubled. The value of dwellings and other goods of definitely limited durability will fall less than half if interest rates double, and will rise to less than double if interest is halved. Fluctuations in the value of furniture will be even less extensive, clothing still less, and very perishable commodities like fruit will not be sensibly affected in price by a variation in the rate of interest."

Our interest here is with the effect of interest rates on assets. The asset categories have future cash flows as shown in Table 6.1.

Financial assets	Cash flows
Money market	Usually one payment at maturity
Bonds	Multiple, regular, fixed future payments
Equity	Dividends
Real assets	Cash flows
Property	Rent in the case of rental properties
Commodities	None
Other	None

Table 6.1: Cash flows on assets

We discuss the following:

- The principle.
- Money market.
- Bonds.
- Equities.
- Property.
- Wealth effect.

6.6.2 The principle

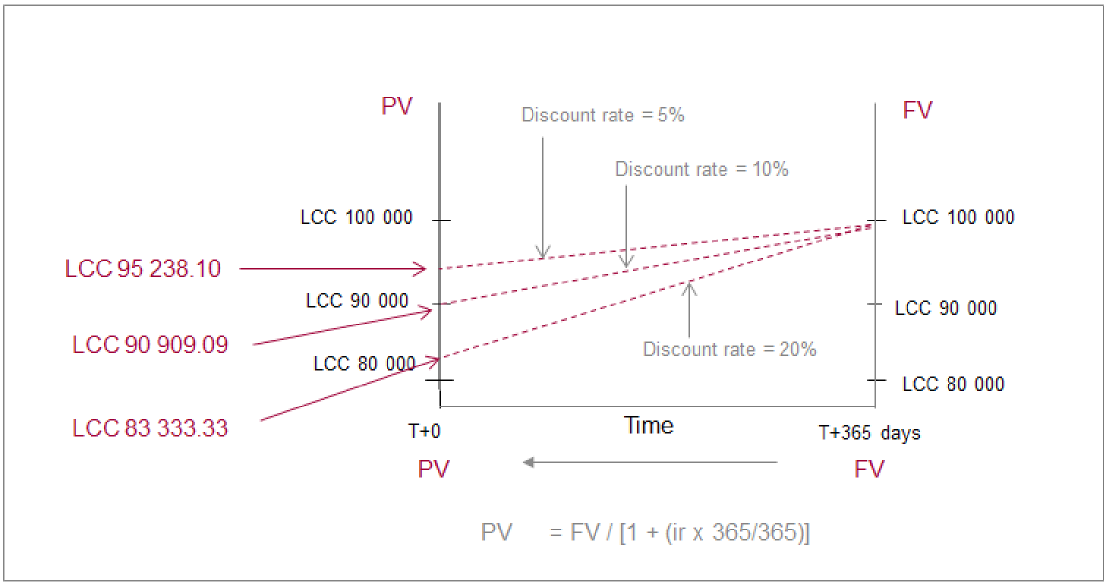

Figure 6.8: FV to PV

The principle is the time value of money: discounting from FV to PV at the relevant rate for the period:

One payment in a year:	PV	= FV / [1 + (ir / 365)]
Multiple payments over years:	PV	= FV / (1 + ir / not)$^{y.not}$.

The case of one payment in a year is shown clearly in Figure 6.8. The higher the rate the lower is the PV of the FV. If the FV of a financial asset that has 365 days to maturity is LCC 100 000, the following PVs apply at the rates shown:

FV = LCC 100 000	5.0% pa	PV = LCC 95 238.10
FV = LCC 100 000	10.0% pa	PV = LCC 90 909 .09
FV = LCC 100 000	20.0% pa	PV = LCC 83 333.33.

6.6.3 Money market

The best example is that of a newly issued short-term NCD: a buyer of a new NCD (i.e. a depositor) deposits at the bank LCC 1 000 000 at a rate of 8.25% pa for 182 days. The maturity value of the NCD is:

Maturity value (MV = FV) = PV × [1 + (0.0825 × 182 / 365)]
= LCC 1 000 000 × 1.04113699
= LCC 1 041 136.99.

If the rate on this NCD happens to rise to 16% pa on the day of purchase, its consideration (price, PV) will be:

PV = MV / [1 + (0.16 × 182 / 365)]
= LCC 1 041 136.99 / 1.0797808
= LCC 964 211.41.

The holder / depositor will make a capital loss of LCC 35 788.59 (LCC 1 000 000.00 – LCC 964 211.41). If the rate falls to 4.0% pa:

PV = MV / [1 + (0.04 × 182 / 365)]
= LCC 1 041 136.99 / 1.01994522
= LCC 1 020 777.36

The holder / depositor will make a capital gain of LCC 20 777.36 (LCC 1 020 777.36 – LCC 1 000 000.00). It will be clear that the FV is discounted to PV by the relevant market interest rate, and that interest rates are inversely related to prices.

6.6.4 Bonds

The relationship between rate and price is best demonstrated with an (unreasonable) example relating to perpetual bonds (which were issued in the distant past). A perpetual bond is one that has no maturity date and therefore no repayment of the principal amount, and it pays a fixed annual (or more frequent) coupon rate (cr). The price of such a bond is determined as follows:

$$\text{Price (PV)} = [cr / (1 + ytm)^1] + [cr / (1 + ytm)^2] + [cr / (1 + ytm)^3] + \ldots\infty$$

Because infinity is involved here, the formula simplifies to the following:

$$\text{Price (PV)} = cr / ytm.$$

It should be clear that when cr = ytm, the price is 1.0. For example, if the coupon rate is 10.0% pa and the ytm is 10.0% pa, the price is 10 / 10 = 1.0. If the market rate moves up to 20.0% pa, the price is 10 / 20 = 0.5. If the rate moves down to 5.0% pa, the price is 10 / 5 = 2.0.

The principle is clear: when the market rate falls from 10.0% pa to 5.0% pa, the buyers are prepared to earn 5.0% pa in perpetuity. This means that they are *prepared to pay a price* for the security that will yield them 5.0% pa (= 200%). On a 10.0% pa coupon LCC 1 000 000 nominal value perpetual bond the annual income is LCC 100 000. Thus, the buyers are willing to pay LCC 2 000 000 for the bond (LCC 100 000 / LCC 2 000 000 × 100 = 5.0% pa).

Bonds today have a fixed term to maturity; therefore infinity does not apply. Bonds have multiple but equal cash flows in future (coupons), plus a nominal value, both of which terminate / mature on a specified date in the future. These cash flows are discounted at the market rate (ytm) to PV and added. An example:

Settlement date:	30 / 09 / 2014
Maturity date:	30 / 09 / 2017
Coupon rate (cr):	9% pa
Nominal / face value:	LCC 1 000 000
Interest date:	30 / 09
Market rate (ytm)	8% pa (payable annually in arrears).

The cash flows and their discounted values (the ytm is used) are as shown in Table 6.2.

Date	Coupon payment (C)	Nominal / face value	Compounding periods (cp)	Present value $C / (1 + ytm)^{cp}$
30 / 09 / 2015	LCC 90 000	-	1	LCC 83 333.33
30 / 09 / 2016	LCC 90 000	-	2	LCC 77 160.49
30 / 09 / 2017	LCC 90 000	-	3	LCC 71 444.90
30 / 09 / 2017	-	LCC 1 000 000	3	LCC 793 832.24
Total	LCC 270 000	LCC 1 000 000		LCC 1 025 770.96
C = coupon payment. cr = coupon rate. cp = compounding periods (years).				

Table 6.2: Cash flows and discounted values

The value now of the bond is LCC 1 025 770.96, and the price of the bond is 1.02577096. The price is calculated according to:

$$\text{Price (PV)} = [cr / (1 + ytm)^1] + [cr / (1 + ytm)^2] + [cr / (1 + ytm)^3] + [1 / (1 + ytm)^3].$$

If the ytm fals to 4.0% pa, its value (PV) is:

Price (PV) $= [cr / (1 + ytm)^1] + [cr / (1 + ytm)^2] + [cr / (1 + ytm)^3] + [1 / (1 + ytm)^3]$
$= [90\ 000 / (1 + 0.04)^1] + [90\ 000 / (1 + 0.04)^2] + [90\ 000 / (1 + 0.04)^3] + [1\ 000\ 000 / (1 + 0.04)^3]$
$= (90\ 000 / 1.04) + (90\ 000 / 1.0816) + (90\ 000 / 1.124864) + 1\ 000\ 000 / (1.124864)$
$= 86\ 538.46 + 83\ 210.06 + 80\ 009.67 + 888\ 996.36$
= LCC 1 138 754.55.

Compare this to the LCC 1 025 770.96 when the ytm was 8.0% pa. When the ytm decreases, the denominator decreases, and the discounted value (PV) increases. The converse also holds.

6.6.5 Equities

Equities / shares pay dividends, which are often irregular. However, many companies have a policy of a healthy dividend which grows annually at the constant rate. These companies' shares can be easily valued. For the other companies, various other valuation methods (other than the one below) are used.

In the case of companies with a constant growth dividend policy the discounted cash flow technique, *Gordon constant-growth dividend discount model* (CGDDM), is generally used. There is another: the *free cash flow technique*, but we will discuss the former because it demonstrates the principle well and is easy to follow. The CGDDM formula is:

$$PV = \{[D_0 \times (1 + D_g)^1] / (1 + rrr)^1\} + \{[D_0 \times (1 + D_g)^2] / (1 + rrr)^2\} + \{[D_0 \times (1 + D_g)^3] / (1 + rrr)^3\} + \dots \infty$$

where

D_0 = past dividend
D_g = growth rate in dividends
rrr = required rate of return (= rfr + rp).

Because we have a condition of infinity, this formula simplifies to:

$$PV = [D_0 \times (1 + D_g)] / (rrr - D_g)$$
$$= D_1 / (rrr - D_g).$$

For example, if we have (share XYZ):

D_0 = LCC 6.0
D_g = 8.0% pa (based on past growth rates)
rrr = 14.0% pa = rfr + rp = 10.0% pa + 4.0% pa,

then

$$D_1 = D_0 \times 1.08 = \text{LCC } 6.0 \times 1.08 = \text{LCC } 6.48.$$

The fair value price (FVP or PV) of share XYZ is:

$$\begin{aligned} PV &= \text{LCC } 6.48 / (0.14 - 0.08) \\ &= \text{LCC } 6.48 / 0.06 \\ &= \text{LCC } 108.00. \end{aligned}$$

The role of interest rates is clear: the rfr is a major component of the rrr. If the rfr decreases from 10.0% pa to 8.0% pa (assuming the rp remains unchanged at 4.0% pa), the share's value rises:

$$\begin{aligned} PV &= D_1 / (rrr - D_g) \\ &= D_1 / [(rfr + rp) - D_g] \\ &= 6.48 / [(0.08 + 0.04) - 0.08] \\ &= 6.48 / (0.12 - 0.08) \\ &= 6.48 / 0.04 \\ &= \text{LCC } 162.00. \end{aligned}$$

As we have said before, the *rp* ingredient of the *rrr* is difficult to establish. There are models to establish it, such as the capital asset pricing model (CAPM). We will not discuss these here because the above sufficiently demonstrates the inverse relationship between interest rates and prices.

6.6.6 Property

In the case of rental property, rental flows (net after tax and costs) (= FVs) are discounted to PV at the so-called *capitalisation rate* (a.k.a. *cap rate*, *yield*, and *return*). Because property is a risky asset, the capitalisation rate is nothing else than a required rate of return (rrr):

$$rrr = rfr + rp.$$

Because property is a long-term asset the rfr used is the long-term bond rate, and the rp is usually made up of factors such as:

- Liquidity-sacrifice premium (+).
- Market risk premium (+).
- Potential for capital gain (-).

For example, in the case of a rental property with the following data:

net rental (NR) pa	= LCC 150 000
rfr	= 6.0% pa
rp	= 2.0% pa,

the PV (a.k.a. the *fair value price* – FVP) will be:

PV (FVP)	= NR / rrr
	= LCC 150 000 / (rfr + rp)
	= LCC 150 000 / 0.08
	= LCC 1 875 000.

It will be clear that if rates increase the PV will fall. For example, if the rfr increases to 8.0% pa, and the rp required by the investor remains unchanged:

PV (FVP) = NR / (rfr + rp)
= LCC 150 000 / 0.10
= LCC 1 500 000.

If a constant growth rate (g) in NR is expected, the CGDDM principle applies:

PV (FVP) = NR / (rrr – g).

In some cases, peer-related transactions are used to determine the rrr. For example, if a similar property to the one envisaged was recently sold for LCC 1 200 000 and it delivers a NR of LCC 85 000, the rrr is:

rrr = LCC 85 000 / LCC 1 200 000
= 0.0708
= 7.1%.

In the case of a farm, the PV / FVP is equal to the discounted value of the (net) production output of the land. Prof Fisher (1930) put it as follows:

> "The value to a farmer of the services of his land in affording pasture for sheep will depend upon the discounted value of the services of the flock in producing wool."

6.6.7 Wealth effect

What does this relationship mean for the real economy? It means that interest rate changes have an impact on asset prices. Assets are held by individuals and companies (and government, but government is not a factor here), and increases in asset prices lead to an increase in demand / expenditure [Δ(C + I + NE) = ΔGDP]. It is termed the "wealth effect". As there is voluminous literature supporting this contention, we will not discuss it further here.

6.7 Interest rates and derivative instrument pricing

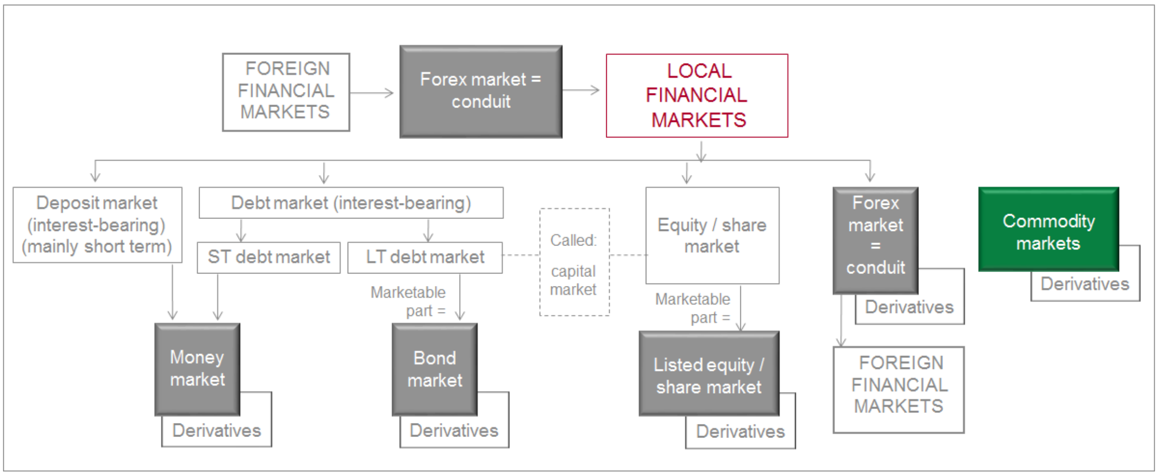

Figure 6.9: Financial (spot & derivative) markets

Earlier we explained the difference between spot and derivative markets: in both markets the transaction is done now (T+0) at a price agreed now (T+0), but the settlement dates are different. In spot markets transactions are settled as soon as is practically possible (T+0 to T+5), whereas in derivative markets transactions are settled in the future, usually way beyond T+5 (there are exceptions).

Figure 6.9 depicts the financial and commodity markets, as well as the derivative markets, i.e. all the markets have derivatives. Figure 6.10 depicts the categories of derivative instruments (pure and hybrid).

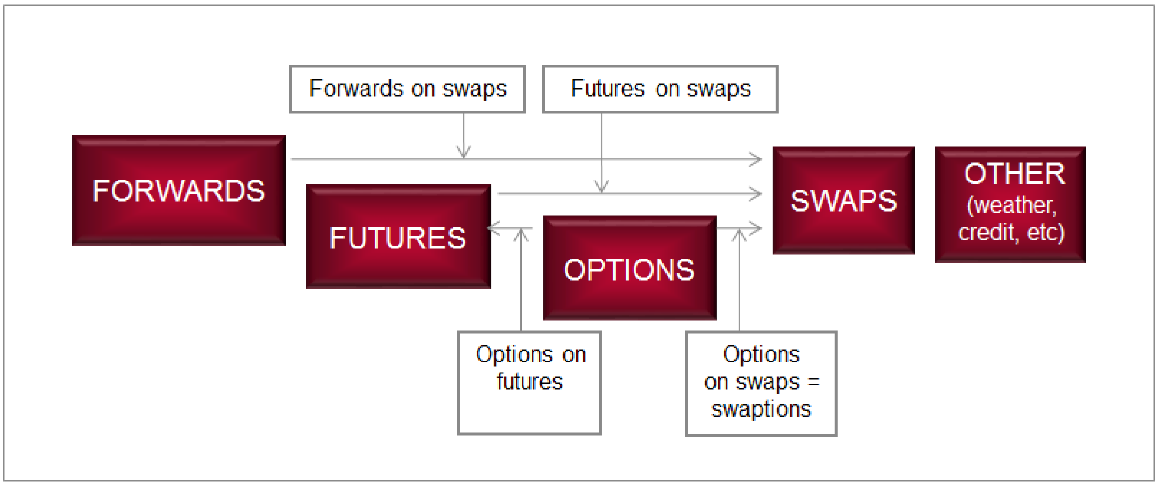

Figure 6.10: Derivative instruments / markets

Interest rates play the major role in the pricing of derivative instruments, because they deal with settlements in the future. Thus, the *fair value price* (FVP = PV) is equal to the spot price of the (financial market or commodity) “underlying instrument” plus the rate of interest for the relevant period. This requires further elucidation.

Derivatives are called as such because they are contracts that are "derived" from the spot rates on the "underlying instruments". An example of an underlying instrument is a specific share or bond or commodity such as gold. The underlying can also be a share index, such as the All Share Index, or a bond index, such as the Government Bond Index.

How is the FVP of a futures contract determined? There are four (or some of) factors involved:

- Current (or "spot") price of the underlying asset.
- Financing (interest) costs involved.
- Cash flows (income) generated by the underlying asset.
- Other costs such as storage and transport costs and insurance.

The FVP of a future is determined according to the *cost-of-carry model* (CCM): the FVP is equal to the spot price of the underlying asset, plus the cost-of-carry of the underlying asset to expiry of the contract:

FVP = SP + CC.

where:

SP	= spot price
CC	= cost of carry = {SP × [(rfr – I) × t]} + OC
rfr	= risk-free rate[49] (i.e. the financing cost for the period)
I	= income earned during the period (dividends or interest)
t	= days to expiry (dte) of the contract / 365
OC	= other costs (which apply in the case of commodities: usually transport, insurance and storage).

Thus, in the case of financial futures:

$$\begin{aligned} FVP &= SP + CC \\ &= SP + \{SP \times [(rfr - I) \times t]\} \\ &= SP \times \{1 + [(rfr - I) \times t]\}. \end{aligned}$$

An example will be useful: a 319-day futures contract on the All Share Index:

SP	= index value now	= 15357
t	= dte / 365	= 319 / 365
rfr	= assumed for 319 days	= 8.0% pa
I	= assumed dividend yield	= 2.0% pa

$$\begin{aligned} FVP &= SP \times \{1 + [(rfr - I) \times t]\} \\ &= 15357 \times \{1 + [(0.08 - 0.02) \times (319/365)]\} \\ &= 15357 \times [1 + (0.06 \times 0.873973)] \\ &= 15357 \times 1.052438 \\ &= 16162. \end{aligned}$$

It is clear that the difference between the spot price (15357) and the FVP of the futures contract is the rate of interest less the income for the period. This principle applies to all derivatives, except that options pricing contains other factors as well, such as volatility, and currency derivatives are priced using two interest rates: local and foreign (following the principle of covered interest rate parity).

We will not detail the pricing of all derivatives here, as they can be easily accessed at http://bookboon.com/en/derivative-markets-an-introduction-ebook.

Derivatives are used for (1) hedging a spot market position, (2) speculation (no spot market position) and, (3) investment (as an alternative to a spot market position). Is there a wealth effect attached to derivatives? Yes, in the case of speculation and investment.

6.8 Interest rates and the foreign sector

How does the foreign sector fit in with domestic interest rates? Domestic interest rates in relation to the rates prevailing in other countries has a major effect on foreign demand for domestic assets (inflows of capital) and domestic demand for foreign assets (capital outflows). We need to add here that capital flows do not necessarily affect the money stock or bank liquidity; this depend on whether the central bank or the private sector banks buy or sell foreign exchange. We do not have space to discuss this in detail.

Capital flows also have a major effect on the exchange rate, which influences the attractiveness or otherwise of exports and imports.

6.9 References

Faure, AP (2012–2013). Various which can be accessed at http://ssrn.com/author=1786379.

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7 An optimal rate of interest: the natural rate

7.1 Learning outcomes

After studying this text the learner should be able to:

1. Elucidate the Wicksell hypothesis.
2. Explain the significance and role of the natural rate.
3. Understand that there is a difference of opinion on the definition of the natural rate.
4. Discuss the essence of the Taylor rule and the place of the natural rate in the rule.

7.2 Introduction

Is there an optimal rate of interest? Before answering we need to make a diversion: and point out again the high correlation between DCE and GDP_N and the fact that it is an accepted fact in economics. It was covered in great detail in the seminal work of Friedman and Schwartz (1963 and 1982) (except that we see the link being between DCE and GDP_N – the effect on the money stock is the outcome of changes in bank lending / DCE):

> "…the movements in the level of [nominal] income and its rate of change parallel extraordinarily closely for more than a century the contemporaneous movements in the quantity of money and its rate of change, and this is equally true for the United States and the United Kingdom."

We show the relationship for yet another country[50] in Figure 7.1: the R^2 is 0.998. Why did we introduce this fact? It is because the division of GDP_N into its components real GDP (GDP_R) and inflation (P) is the most critical issue in economics. Friedman and Schwartz (1963 and 1982) paid much attention to it; in this regard they stated:

> "…the decomposition of nominal movements in money and income between prices and output. What determines this decomposition is one of the major unsettled questions in monetary theory; it has been the source of much of the dispute about the role of money in recent decades and is a key to the controversy between the quantity-theory framework and the Keynesian income-expenditure framework. It is the issue that generated the Phillips curve and all the opposing views that have peppered the economic literature. We do not, of course, settle these hotly debated issues, but we believe our data greatly clarify them."

The issue remains hotly debated and the final solution elusive, except that it is well-known that a low and stable ΔP is a propitious condition for achieving a ΔGDP_R at potential. The most favourable ΔP, based on extensive central banking experience and research, is 2.0% pa. As we know, 2.0% pa is the inflation target of most developed countries' central banks.

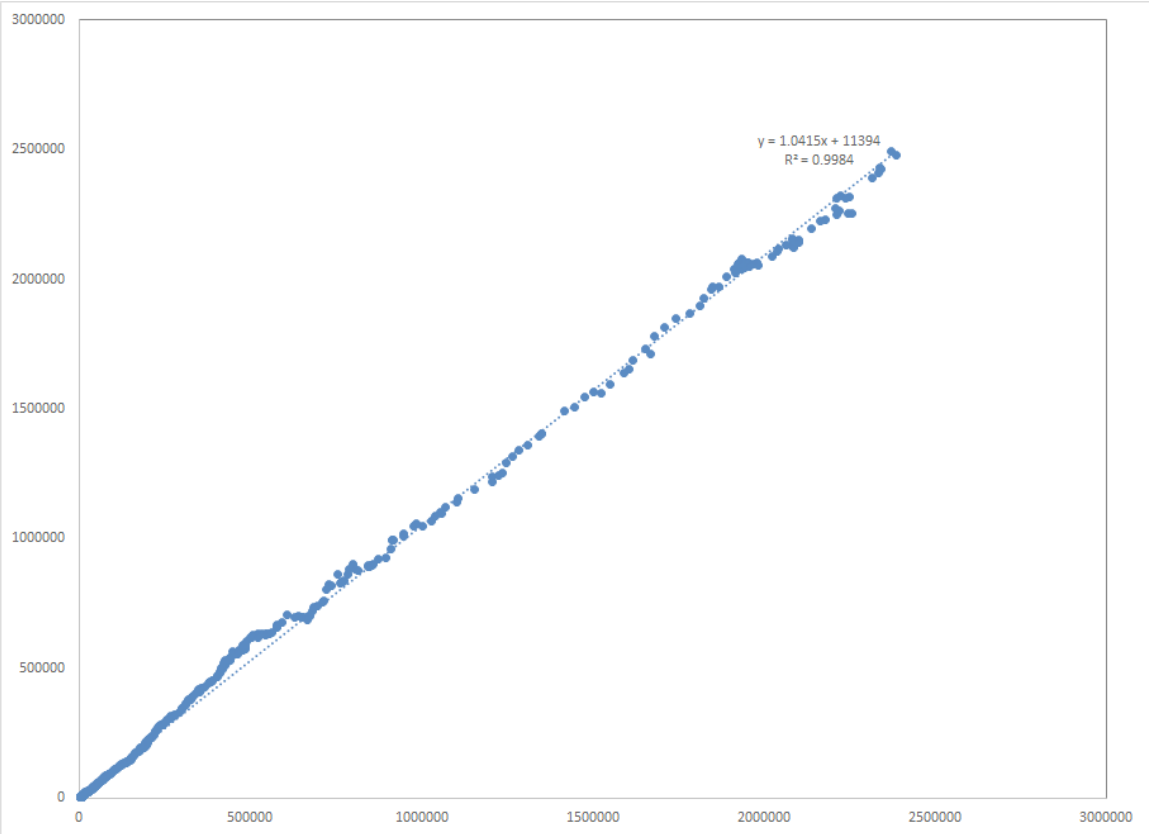

Figure 7.1: Scatter chart: M3 and DCE (raw monthly data)

With this as the backdrop, we are now able to answer the question: is there an optimal rate of interest? The answer is yes, and it is the "natural rate of interest", referred to here as the "natural rate" (NR), which can be defined as the equilibrium interest rate consistent with the optimal division of ΔGDP_N into its components ΔGDP_R and ΔP.

The NR was first presented to us in 1898 by the Swedish economist, Prof Knut Wicksell. However, the NR is not directly observable; it is hypothetical. The NR is a critical concept in that it is the rate (PIR or PR? – see below) which central banks aspire to in their quest to effectuate their mandate: low and stable inflation and high and sustainable economic output. We discuss the concept of the NR under the following headings:

- The Wicksell hypothesis.
- Literature review.
- An alternative interpretation.

- Reconciliation of PR and PIR / IBMR.
- Taylor rule.
- A proposed Taylor-type rule.

7.3 The Wicksell hypothesis

Prof Knut Wicksell famously wrote in 1898:

> "There is a certain rate of interest on loans which is neutral in respect to commodity prices, and tends neither to raise nor to lower them."

It is clear that Prof Wicksell embraced the fact that new money ($\Delta M3 = \Delta BD$) is created by new bank credit extended (Δbank credit) (substantiated below), and that there is a rate of interest, which he called the "natural rate" (note: a lending rate), which can bring about a state of equilibrium in the economy. This state is one where the division between ΔGDP_R and ΔP is such that ΔP (Wicksell's "commodity prices", in other words, inflation) is optimal: ΔP is low and stable and, against this background, ΔGDP_R is at the level of its long-term sustainable potential. In New Keynesian economic terms, there is no "output gap" [the divergence of ΔGDP_R from potential GDP_R growth (ΔGDP_{RP})], or the economy is at full employment, and inflation is low and stable.

If the economy is expanding at higher than GDP_{RP}, reflecting that, in simple terms, aggregate demand (AD) is outstripping aggregate supply (AS) and that higher inflation is or will the consequence, it means that the market rate is below the NR. Under these conditions, monetary policy will have to be tightened, that is, the PIR must be increased. The opposite also applies.

7.4 Literature review

Generally, scholars have interpreted the NR to be referenced on the PIR in real terms (PIR_R) or to the real Fedfunds rate, which is the US interbank market rate ($IBMR_R$). As we know, the IBMR is closely related to the PIR, as are their real rate versions. In some cases the NR is termed a "short-term rate" which, presumably, refers to the IBMR or the PIR. In a few cases the NR is referred to as just a "rate" without reference to the term. We present a few examples:

Federal Reserve Bank of San Francisco (2003):

> "…the natural rate is defined to be the real fed funds rate consistent with real GDP equaling [sic] its potential level (potential GDP) in the absence of transitory shocks to demand. Potential GDP, in turn, is defined to be the level of output consistent with stable price inflation, absent transitory shocks to supply. Thus, the natural rate of interest is the real fed funds rate consistent with stable inflation absent shocks to demand and supply.

Federal Reserve Bank of Cleveland (Carlstrom and Fuerst, 2003):

> "The second factor is the 'natural' real, or inflation-adjusted, federal funds interest rate. This is the rate that is consistent with 'neutral' monetary policy. That is, if the real funds rate is equal to the natural real rate, then monetary policy will be consistent with both the inflation and output targets."

Amato (2005):

> "Broadly put, the natural rate of interest…can be defined to be the equilibrium real interest rate consistent with price stability.… In the light of the key role that the natural rate plays, explicitly or implicitly, in theories of the transmission mechanism subscribed to by many central banks, estimates of the natural rate could prove useful to policy makers. Moreover, since most central banks formulate monetary policy by setting a target for a short-term nominal interest rate (typically an overnight money market rate), the natural rate provides a convenient benchmark that policy rates can be measured against directly."

Bank of Spain (Manrique and Marqués, 2004):

> "…direct comparison of the interest rate set by the central bank with the natural rate of interest has taken on greater importance in assessing the monetary policy stance."

Canzoneri, Cumby, Diba (2011):

> "Inflation is brought to its target if the policy rate is brought to its natural rate. Intuitively, when an increase in aggregate demand, or a decrease in productivity, pushes inflation above its target, the policy rate should be raised above its natural rate for a period of time, raising the real rate of interest to curb the rise in inflation."

Bank of France (Mésonnier and Renne, 2004):

> "…the natural rate of interest equals the equilibrium real rate of return in an economy where prices are fully flexible, or in other words, it is the real short term rate of interest that equates aggregate demand with potential output at all times.

Cuaresma, Gnan, Ritzberger-Gruenwald (2004):

> "…it is useful to define the natural rate of interest in terms of the real short-term interest rate where output converges to potential and inflation is stable…"

Laidler (2011):

> "Natural rate of interest: The value of an economy-wide average of the real rates of interest at which agents transact that equates the economy-wide supply of savings to the economy-wide demand for investment, and hence ensures that the output gap is zero."

Sveriges Riksbank (Central Bank of Sweden) (Lundvall and Westermark, 2011):

> "The natural interest rate is the real interest rate that would prevail if resource utilisation in the economy was normal today and was expected to remain normal in the future."

Thus, according to the literature, the majority of scholars regard the NR as the ideal or optimal PIR_R or $IBMR_R$, that is, the rate level that is consistent with both low and stable inflation (ΔP) and potential output (ΔGDP_{RP}). It may be regarded as the optimal division of ΔGDP_N into its components.

The literature is ad idem on the issue of the NR not being a constant rate. It shifts with changing economic circumstances. Much attention has been devoted by many scholars to estimating the changing NR, called the "time-varying natural rate of interest" (TVNRI). One study (Cuaresma, Gnan, Ritzberger-Gruenwald, 2004) reported that for the euro area the NR: "…now fluctuates between 1 and 3½% between 1994 and spring 2002. The average over the full sample period is close to 3%."

Taylor, of Taylor rule fame (see below), estimated the average for the US at 2.0%.

7.5 An alternative interpretation

We are of the opinion that the scholars mentioned have misinterpreted Wicksell. In substantiation, we repeat the Wicksell quote from above (1898) (bold: the author's):

> "There is a certain **rate of interest on loans** which is neutral in respect to commodity prices, and tends neither to raise nor to lower them."

Further substantiation (Wicksell, 1898) (italics: sic; bold: the author's):

> "This does not mean that the **banks** ought actually to ascertain the natural rate before fixing their **own rates of interest**. That would, of course, be impracticable, and would also be quite unnecessary. For the current level of commodity prices provides a reliable test of the agreement or diversion of the two rates. The procedure should rather be simply as follows: *So long as prices remain unaltered the* ***banks' rate of interest*** *is to remain unaltered. If prices rise, the rate of interest is to be raised; and if prices fall, the rate of interest is to be lowered; and the rate of interest is henceforth to be maintained at its new level until a further movement of prices calls for a further change in one direction or the other.*"

We also add Wicksell's (1907) consideration of money creation resulting from bank credit extended (bold: the author's):

> "The **banks in their lending business** are not only not limited by their own capital; they are not, at least not immediately, limited by any capital whatever; by concentrating in their hands almost all payments, they themselves create the money required, or, what is the same thing, they accelerate *ad libitum* the rapidity of the circulation of money. The sum borrowed today in order to buy commodities is placed by the seller of the goods on his account at the same bank or some other bank… Emil Struck, justly says in his well-known sketc.h of the English money market: in our days demand and supply of money have become about the same thing, the demand to a large extent creating its own supply. In a *pure* system of credit, where all payments were made by transference in the bank-books, the **banks** would be able to grant at any moment any amount of **loans** at any…**rate of interest**."

Contemplation of the highlighted (in bold) parts will reveal that Wicksell was referring to the banks' lending rate/s, which we have called prime rate (PR), the benchmark bank lending rate. This is in line with our analysis presented above, that is, that the level of PR in real terms (PR_R) is the rate which, to a large degree, determines the demand for bank credit and its outcome, deposit money creation. Additional aggregate demand in nominal terms [$\Delta(C + I) + \Delta NE = \Delta GDP_N$] (NE = net exports) underlies the bank-satisfied demand for credit. It is axiomatic that households, companies and government borrow (and they do so to a large degree from the banks) to spend (C) or invest (I).

We presented the relationship (DCE and GDP_N) in the case of the US earlier ($R^2 = 0.98$), and present it for Japan ($R^2 = 0.99$) and Switzerland ($R^2 = 0.99$) in Figures 7.2–7.3 (World Bank data). (See also later for additional data.)

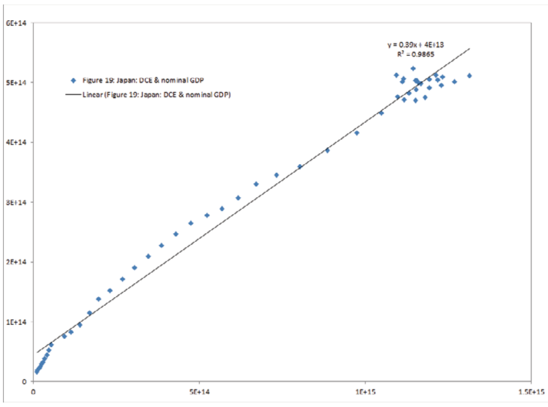

Figure 7.2: Japan: DCE & nominal GDP

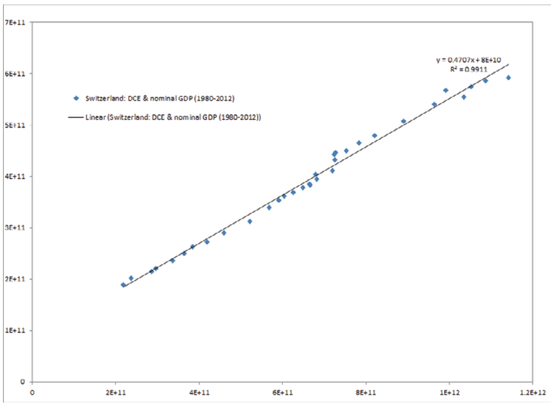

Figure 7.3: Switzerland: DCE & nominal GDP

Prof Wicksell's (1898) (bold: the author's) strong emphasis on inflation is notable and he speaks of an inflation-targeting monetary policy regime, much like we see today; while he did not specify the level of inflation, it is clear that he had a low rate in mind:

> *"…so long as **prices** remain unaltered the banks' rate of interest is to remain unaltered. If **prices** rise, the rate of interest is to be raised; and if **prices** fall, the rate of interest is to be lowered; and the rate of interest is henceforth to be maintained at its new level until a further movement of **prices** calls for a further change in one direction or the other."*

It can be safely assumed that Prof Wicksell was referring to the banks' *lending rate* (the modern day PR), and it can be surmised that he meant the level of PR_R. Thus, he was referring to the "optimal" PR_R as the NR, i.e. the hypothetical rate that would produce the best outcome in terms of inflation and real output. This ideal outcome has been grappled with by the best academic and central bank minds to this day.

7.6 Reconciliation of PR and PIR / IBMR

Thus, there is a difference of opinion with regard to the reference rate for the NR. However, we also know that there is (in most countries) a close correlation between the PIR / IBMR and the PR (as a reminder, see Figures 7.5–7.6). The data are monthly for a period of over 50 years for a particular country[51]. The R^2 is 0.98, and it is not a spurious one. Causation is (as discussed earlier):

> PIR → IBMR → call money rates (wholesale) → other deposit rates → [via the sticky bank margin] → PR.

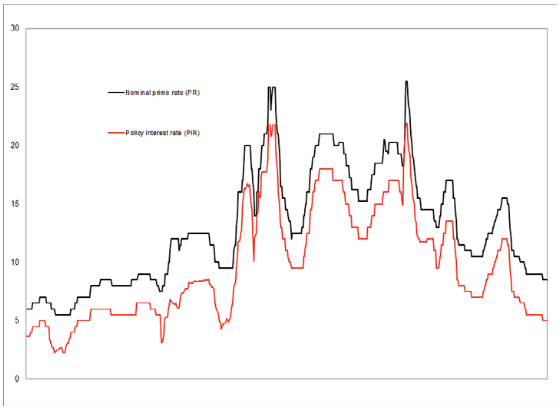

Figure 7.5: PIR and PR (50 years)

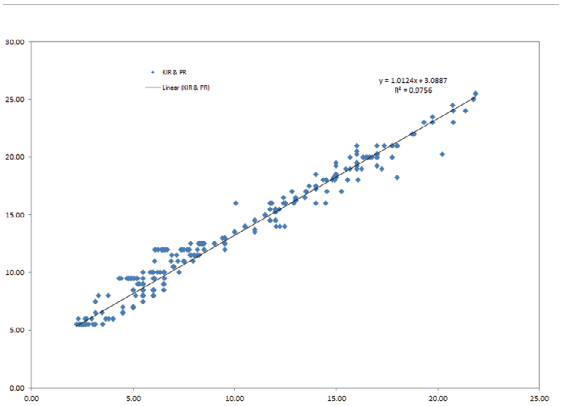

Figure 7.6: Scatter chart: PIR and PR (50 years)

The changes (PIR → PR) are one-for-one, as they are in real terms as well. However, there is a major difference in the *levels* of PIR and PR, and the level of PR is crucial in the influence on the demand for credit / money creation (when demand is satisfied), which, as we has said, reflects additional demand / output.

If we accept that:

(1) bank credit extended creates bank new deposits, i.e. money (which is axiomatic),
(2) that bank credit growth (ΔDCE) largely reflects the growth in aggregate demand (ΔAD),
(3) that, given (1) and (2), the PR is the reference rate for the NR,
(4) and that a static margin between PIR and PR exists (there is evidence that it does, and it is in the region of 3.0 percentage points),

then it is important for monetary policy to establish the PR, and thereby the PR_R, at the optimal level (= NR). It is clear that in order to do so, the PIR must be at a level that achieves this. As we know, central banks have the tools to do so.

If, at a particular level, the PR_R is consistent with the ideal division between ΔP and ΔGDP_R, then PR_R = NR. Then, if inflation moves above the target level (as said, the world seems to have accepted a 2% target as ideal), it will be recognised that, to a large degree, additional aggregate demand (ΔAD) was fuelled by credit / money creation, and that aggregate supply (ΔAS) could not adjust quickly enough (a low elasticity of supply). The bank credit / money creation data should reflect this.

Thus, it will be known that PR_R < NR and that PR and PR_R must be adjusted upwards, by adjusting the PIR upwards (to what extent we discuss in the following section on the Taylor principle). Conversely, if inflation is below target or deflation is foreseen, then PR_R > NR, and it must be adjusted downwards. Once again the PIR is the route to the PR.

In conclusion, it will be apparent that central banks have great difficulty in establishing when PR_R = NR. Their mandate is to keep inflation low and stable (in developed countries 2.0%) because history has shown that an inflation rate of 2.0% presents the ideal condition for achievement of potential $\Delta GDP_{R.}$ Non-achievement of PR_R = NR is a common occurrence with the majority of central banks, indicating the difficulty of establishing when PR_R = NR. There also exists the problem of a shifting NR.

This does not mean that the search for the NR should be abandoned. Rather, efforts to approximate it should continue with vigour.

7.7 Taylor rule

The Taylor rule is relevant to this discussion. It is a monetary policy rule which links mechanically the level of the PIR to:

- deviations of inflation from its target level, and
- deviations of output from its potential level (the output gap).

In other words it focusses on rectifying, through changes in the PIR, deviations from the optimal outcome of the NR: low and stable inflation and sustainable high real growth. The Taylor (1993) rule (Hofmann, Bogdanova, 2012 interpretation) is as follows:

$$PIR = (r^* + \pi^*) + 1.5(\pi - \pi^*) + 0.5(y - y^*)$$

where

PIR = target nominal policy interest rate
r^* = the long-run or equilibrium real rate of interest (i.e. the NR)
π^* = central bank's inflation target
π = current period inflation rate
y = current period GDP_R growth
y^* = long term GDP_R growth (= potential growth rate).

It will be clear that $(y - y^*)$ is the output gap, that is, the deviation of current GDP_R growth from the long-term average, which can be regarded as the potential growth rate.

An example where $\pi^* = \pi$, and $y = y^*$:

r^* = 2.0% (the rate favoured / assumed by Prof Taylor)
π^* = 2.0% (the rate favoured by central banks in developed countries)
π = 2.0% (assumed)
y = 2.5% (assumed)
y^* = 2.5% (assumed)

$$\begin{aligned} PIR &= (r^* + \pi^*) + 1.5(\pi - \pi^*) + 0.5(y - y^*) \\ &= (2.0 + 2.0) + [1.5 \times (2.0 - 2.0)] + [0.5 \times (2.5 - 2.5)] \\ &= 4.0 + 0 + 0 \\ &= 4.0\%\ pa. \end{aligned}$$

In other words, the $PIR_N = r^* + \pi^*$, that is, the NR + the current inflation rate. An example of a booming economy with inflation above target:

r^* = 2.0% (the rate favoured / assumed by Prof Taylor)
π^* = 2.0% (the rate favoured by central banks in developed countries)
π = 3.0% (assumed)
y = 3.5% (assumed)
y^* = 2.5% (assumed)

$$\begin{aligned} \text{PIR} &= (r^* + \pi^*) + 1.5(\pi - \pi^*) + 0.5(y - y^*) \\ &= (2.0 + 2.0) + [1.5 \times (3.0 - 2.0)] + [0.5 \times (3.5 - 2.5)] \\ &= 4.0 + 1.5 + 0.5 \\ &= 6.0\% \text{ pa.} \end{aligned}$$

It will be clear that the Taylor rule prescribes a "leaning against the wind" policy, that is, it "…implies that central banks aim at stabilising inflation around its target level and output around its potential. Positive (negative) deviations of the two variables from their target or potential level would be associated with a tightening (loosening) of monetary policy." (Hofmann, Bogdanova, 2012.) It will also be apparent that a change in inflation is met with a change in the nominal PIR that *exceeds* the change in inflation. This is referred to as the "Taylor principle".

The Taylor rule is a highly esteemed piece of work, but is not without limitations. Taylor himself accepts that circumstances do prevail (referred to as "shocks" in the literature) when central banks may be required to deviate from the rule. It is also well known that the rule involves assumptions about the non-observable NR, which is a shifting rate. It may at times therefore be incorrect and misleading.

7.8 A proposed Taylor-type rule

It is clear where the NR fits into the Taylor rule: r*. But, what about our view that the reference rate of the NR should be the PR_R and not the PIR_R? As such, we are of the opinion that the PR_N should be the target interest rate (it is in many countries) and that the PIR_N should be derived from it as follows:

$$PIR_N = PR_N - (\text{long-term differential: } PR_N - PIR_N).$$

Why do we believe this is significant? It is because:

- To a significant degree ΔDCE = ΔM3, and the latter is the outcome of the former. The R2 (World Bank data):
  - o Raw data: USA = 0.996, UK = 0.994, Canada = 0.97, Australia = 0.996, Japan = 0.981, Switzerland = 0.97, South Africa (monthly central bank data) = 0.9992.
  - o Yoy% changes: USA 0.7, UK = 0.64, Canada = 0.83, Australia = 0.7, Japan = 0.89, South Africa = 0.7.

- To a large degree ΔDCE reflects changes in ΔGDP_N, and therefore changes in aggregate demand (ΔAD). The R2 (World Bank data):
  - o Raw data: USA = 0.98, UK = 0.92, Canada = 0.91, Australia = 0.94, Japan = 0.99, Switzerland = 0.99, South Africa = 0.99.
  - o Yoy% changes: as in above case the numbers are lower but robust: USA = 0.5, UK (we suspect data problems), Canada = 0.4, Australia = 0.2, Japan = 0.6, Switzerland (data problems), South Africa = 0.23.

- The level of PR in nominal and real terms is the main ingredient in changes in ΔDCE,
- There is a one-to-one relationship between ΔPIR and ΔPR.

It is perhaps necessary to create a Taylor-type rule for PR:

$$PR_N = (r^* + \pi^*) + 1.5(\pi - \pi^*) + 0.5(y - y^*)$$

where

PR_N = target bank prime lending rate.
r^* = the long-run or optimal / equilibrium real PR (i.e. the proposed NR)
π^* = central bank's inflation target
π = current period inflation rate
y = current period GDP_R growth
y^* = long term GDP_R growth (= potential growth rate).

An example where $\pi^* = \pi$, and $y = y^*$:

r^* = 3.5% (based on a period in a developing country[52] when PR_R delivered a high and sustainably high ΔGDP_R = 5.5% and a low ΔP = 3.0%, i.e. an approximate NR in our opinion)
π^* = 3.0% (assumed target inflation rate favoured by central banks in developing countries)
π = 3.0% (assumed)
y = 5.5% (assumed)
y^* = 5.5% (assumed)

$$\begin{aligned} PR_N &= (r^* + \pi^*) + 1.5(\pi - \pi^*) + 0.5(y - y^*) \\ &= (3.5 + 3.0) + [1.5 \times (3.0 - 3.0)] + [0.5 \times (5.5 - 5.5)] \\ &= 6.5 + 0 + 0 \\ &= 6.5\% \text{ pa.} \end{aligned}$$

In other words, the $PR_N = r^* + \pi^*$, i.e. the NR + the current inflation rate. If the long-run differential between PR_N and PIR_N = 3.0 percentage points, then the derived PIR_N:

$$\begin{aligned} PIR_N &= PR_N - (\text{long-run } PR_N - PIR_N) \\ &= 6.5 - 3.0 \\ &= 3.5\% \text{ pa.} \end{aligned}$$

An example of a booming economy with inflation above target:

r^* = 3.5% (as above)
π^* = 3.0% (the rate favoured by central banks in developing countries)
π = 6.0% (assumed)
y = 6.5% (assumed)
y^* = 5.5% (assumed)

$$\begin{aligned} PR_N &= (r^* + \pi^*) + 1.5(\pi - \pi^*) + 0.5(y - y^*) \\ &= (3.5 + 3.0) + [1.5 \times (6.0 - 3.0)] + [0.5 \times (6.5 - 5.5)] \\ &= 6.5 + (1.5 \times 3.0) + (0.5 \times 1.0) \\ &= 6.5 + 4.5 + 0.5 \\ &= 11.5\% \text{ pa.} \end{aligned}$$

The PIR_N then becomes 11.5 – 3.0 = 8.5% pa.

It is notable that with this approach (NR = PR_R and not PIR_R), the translation into the PIR is amplified (compared with the Taylor rule outcome), and this is because a change to the PIR is not the same, percentage-wise, as a change in PR. For example if PIR = 4.0% pa and is increased to 4.5%, this = 12.5%. If PR = 8.0% and changes in line with PIR to 8.5%, this = 6.25%. This means that when, for example, inflation and output rise above the target levels, the monetary policy reaction (change in PIR) will be harsher than that dictated by the Taylor rule.

Let us conclude with an example of an underperforming economy with low inflation:

r^* = 3.5% (as above)
π^* = 3.0% (the rate favoured by central banks in developing countries)
π = 2.0% (assumed)
y = 2.5% (assumed)
y^* = 5.5% (assumed)

$$
\begin{aligned}
PR_N &= (r^* + \pi^*) + 1.5(\pi - \pi^*) + 0.5(y - y^*) \\
&= (3.5 + 3.0) + [1.5 \times (2.0 - 3.0)] + [0.5 \times (2.5 - 5.5)] \\
&= 6.5 + (1.5 \times -1.0) + (0.5 \times -3.0) \\
&= 6.5 - 1.5 - 1.5 \\
&= 3.5\% \text{ pa.}
\end{aligned}
$$

The PIR_N then becomes 3.5 – 3.0 = 0.5% pa. It is notable that this level fits with a QE-type policy.

In summary: the proposal is for the PR_R, not the PIR_R, to be the reference rate of the NR. If PR_R = NR, then monetary policy, as reflected in the derived PIR_N, is consistent with the output and inflation targets. It is recognised that times do arise when short-term deviations may be required.

7.9 References

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Endnotes

1. LCC is the currency code for a fictitious currency, the corona, of fictitious country, Local Country.
2. Not compounded for the sake of simplicity.
3. Saunders and Cornett (2001: 26).
4. The cents' numbers are the same when more decimals are used.
5. South Africa.
6. The term "prime" in PR is a little misleading in that in practice some customers are charged PR-1%. These are prime-prime customers.
7. South Africa.
8. South Africa.
9. South Africa.
10. South Africa.
11. The data span is six years, and is for South Africa, which has a good record in terms of the conduct of monetary policy.
12. South Africa.
13. In some countries the central bank does, but this takes place under extreme conditions of high bank liquidity when there is no other option. High liquidity renders monetary policy ineffective, and paying interest is an effort to make policy partially effective. This is a complicated story on which we will be silent in this book in the interests of our keeping the principles unfettered.
14. The singular is applicable because the banks always have the same PR – certainly in the vast majority of countries.
15. Except "self-imposed" creditworthiness-assessment in the case of individuals and scrutiny of viability in the case of the corporate sector.
16. In many countries central bank accommodation to the banks is granted on an overnight basis (i.e. 1 day). In the repo system adopted in many other countries 1-week auctions are usually held for the majority of the liquidity required, and overnight repos are executed for "fine-tuning" at the end of the final interbank clearing.
17. Note that this style on monetary policy execution is followed by many countries in normal circumstances, including the ECB, the Bank of England, the Bank of Canada, the South African Reserve Bank, and so on. Not all countries follow this style. Some countries follow a policy of not having a liquidity shortage or surplus, while others allow liquidity surpluses. The latter policy is deeply flawed – if the policy is to control interest rates.
18. It makes sense to use homogenous securities such as government securities in YC construction because they are comparable in terms of the major risk, credit risk (zero in this case).
19. In this regard see: Blake (2000).
20. See Fabozzi, 2000.
21. We are aware that not all government bonds are credit-risk-free. Some government bonds have been defaulted upon or been subject to a "haircut". However, the vast majority of government bonds are credit-risk-free, and are considered so because governments have the right to tax of raise revenue to mature them. An alternative denotation could be "Least-risky-rate" (*lrr*).

22. In many countries inflation numbers are usually published two weeks after a month-end for that month.
23. AS said, the Govt ZCYC is the purest form of yield curve, because it is comprised of the rates on government zero-coupon bonds (they have durations equal to their terms to maturity), as opposed to coupon bonds which are not homogenous in respect of duration.
24. South Africa, month-end data.
25. Floating rate securities which have frequent rate changes, such as call securities, are priced at 1.0.
26. *Dematerialisation* means that scrip (physical certificates) no longer exist, while *immobilisation* means that scrip exists but is placed in a scrip depository which holds them on behalf of the investors (usually this means one certificate).
27. A reminder: the "institutions" means the contractual intermediaries (insurers and retirement funds, CISs, and AIs.
28. See McInish (2000: 212)
29. Note that there may also be hybrids of these main trading systems.
30. This phrase is usually used by economists in respect of a moral hazard problem that arises with share ownership and the management of that company. It fits well here though.
31. N&C in fact are deposits – if one goes back to the goldsmith-banker days.
32. For example: Bailey, 2005:37, and Blake, 2003:23.
33. Goodhart, CAE, circa 2003. The data were obtained from Olsen & Associates of Zurich.
34. We ignore the fact that N&C also rank as reserves, in the interests of simplicity. Doing so does not detract from the principle. In some countries this does apply (South Africa is one).
35. South Africa.
36. South Africa.
37. Marketable (Treasury bills and bonds) and non-marketable (for example: loans to local authorities), but usually marketable only, for purposes of open market operations (OMO).
38. Marketable (Treasury bills and bonds) and non-marketable (for example: loans to local authorities), but usually marketable only, for purposes of open market operations (OMO).
39. Based on Van Staden, 1966.
40. LCC is the currency code for fictitious currency "corona" of fictitious country "Local Country".
41. Marketable (TBs and bonds) and non-marketable (for example: loans to local authorities).
42. Marketable (for example: commercial paper and corporate bonds) and non-marketable (for example: mortgage and overdraft loans to households and companies).
43. Marketable (TBs and bonds) and non-marketable (for example: loans to local authorities), but usually marketable paper only, for purposes of OMO.
44. We ignore N&C which in the big picture are irrelevant.
45. We assume that N&C do not rank as reserves – to keep the analysis simple. In reality N&C is minuscule in relation to total reserves. There are some countries where N&C do not rank as reserves (South Africa is one of them).
46. We do know that equity represents ownership, but we ignore the detail here in the interests of simplicity.
47. Monthly data for South Africa.

48. There are theories surrounding the rp, such as the CAPM. As we are dealing here with principles, we will assume an rp.
49. In most derivative formulae the risk-free rate (rfr) is used, and this is so because it is a well known and easily accessible rate. There is no standard definition for the rfr but most analysts / academics apply this term to the 91-day Treasury bill rate.
50. South Africa, approximately 50 years.
51. South Africa.
52. South Africa: part of 1950s and 1960s.