Description of the Operational Mechanics of a Basel Regulated Banking System

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Abstract

This paper presents a description of the mechanical operations of banking as used in modern banking systems regulated under the Basel Accords, in order to provide support for a verifiable and complete description of the banking system suitable for computer simulation. Feedback is requested on the contents of this document, both with respect to the operations described here, and any known national, regional or local variations in their structure and practice.

1 Introduction

There appears to be considerable confusion surrounding the precise operation of the modern banking system, in particular with respect to the regulation of lending and deposit creation, the handling of loan defaults, and the relationships between holdings at the central bank and the bank clearing system and the rest of the system.

Simulation of the aggregate behaviour of the banking system is well within current computing capabilities, and would be highly beneficial both in exploring the impacts of different regulatory frameworks on the behaviour of the system, and to provide a scientific foundation for economic understanding of the monetary system. However for simulation efforts to be successful an accurate description of the mechanical operations used by banks in their day to day operations is required and this does not appear to be currently available either within economic theory, or from the regulatory authorities. The descriptions that are currently provided by economic textbooks such as Mankiw [1], and McConnell [2], are notably deficient, with important aspects of the system such as the precise handling of loan repayments and loan defaults omitted.

This paper aims to provide a clear and verifiable description of the fundamental operations of the banking system, which can then be used to build accurate simulations of its behaviour. We present these operations following the example of late 19th and early 20th century bookkeeping manuals on banking such as Shand [3], by providing detailed descriptions of the fundamental bookkeeping operations performed by a bank as it processes deposits, lends money, receives repayment on loans, and handles loan defaults in a banking system that consists of two banks, A and B, and a central bank.

2 Double Entry Bookkeeping.

Banking as we understand it today has emerged over several centuries from a set of practices first established in Northern Europe by medieval goldsmiths and traders [4]. It initially developed as a form of statistical multiplexing whereby access to physical money in the form of gold was managed through day to day bookkeeping practices, operated under the assumption that only a fraction of the underlying liabilities (customer deposits) would be requested at any one time. Based on this assumption, goldsmiths would make short term loans of gold to other customers, and as the chits used to represent gold deposits began to be exchanged directly a bank based monetary system developed. Over time this system has mutated into today’s almost entirely electronic transfer based system, however it still retains the bookkeeping practices of the original system, in particular with respect to the relationship between customer deposits, and interbank liabilities both in the form of reserves at the central bank, and deposits held with other banks in the system. The historical antecedents of the system are significant, as several of its current features can probably only be appreciated within that context.
The mechanical operations used by banks in their day to day processing of money and loans, are in large part a creation of the double entry bookkeeping procedures that evolved to track the customer deposits of physical money, and the associated lending activities of the banks. Double entry bookkeeping is based on the principle that a general ledger of assets, liabilities and shareholder equity is constructed from a series of separate accounts or individual ledger books (commonly referred to as T-accounts when presented formally). The system of accounts for any bookkeeping entity is deliberately structured so that a separate and opposite entry must be made into two T-account simultaneously for each action that occurs. That is for each debit in one T-Account there must be a separate matching credit in a different T-account, and vice versa. The practice was developed by the Florentines in the 13th century, initially as an anti-fraud measure, since the separate updates to two separate books could be structured to require different people to maintain the entries in each book.

In accounting assets are generally the resources owned by a company, and liabilities are resources that the bank owes to another separate entity. Customer deposits at a bank for example, are classified as liabilities, but when physical cash is deposited at the bank this is classified as an asset, with the corresponding liability being the customer deposit that was created by the deposit of physical money. The terms debit and credit have very specific meaning within bookkeeping that are tied to the type of account being operated on. For example, debits to accounts classified as dividends, expenses, assets and losses cause the account’s balance to increase, whilst credits to accounts classified as income, revenue, liabilities and stockholder’s equity cause these accounts to be increased. Debits are listed for all accounts in the left hand column, and credits in the right.

| Cash     | Deposit | Balance |
|----------|---------|---------|
| Debit    | Credit  | Debit   | Credit  | Debit   | Credit  |
| 100      |         | 100     | 100     |         | 100     |

Table 1: Example of T-Account Cash Handling

The balance sheet of assets, versus the liabilities and equity of a bank is built up from the set of individual T-accounts. In order to maintain this balance, each T-account is classified as either an asset or a liability. Increases to an asset T-account are then recorded on its debit side, and decreases as credits; whilst increases to a T-account classified as a liability are recorded as credits and decreases as debits. Table 1 shows an example of this when physical cash is deposited at a bank. Two entries are made, a debit into the bank’s vault cash account which is classified under assets, and a credit into the customer’s deposit account as a liability. The balance of both T-accounts consequently increases, maintaining equality in the balance book.

As a consequence the structure surrounding the classification of T-accounts as liabilities or assets can be somewhat unintuitive. Revenue and capital for example are typically treated as liabilities, with the justification that capital and profits are `owed` to the shareholders, although more prosaically this treatment is also required to maintain the balance of bookkeeping operations. Similarly the handling of loan defaults by banks uses a “contra-asset” account, which allows income to be reserved on the Asset side of the ledger against expected losses. As a result money is removed from the income accounts, that would otherwise be evaluated to determine profits and paid as dividends to shareholders.

3 Bank Model

Economic models of bank operations are frequently presented at the annual balance sheet level, following the basic accounting identity:

\[ Assets = Liabilities + Stockholder's Equity \] (1)

However, correct analysis of banking behaviour requires a consideration of the details of monetary flows within the banking system in their day to day operations, particularly with respect to the handling of loan defaults, which are hidden by this `identity`. The expanded versions of equation (1):

\[ Assets = Liabilities + Common Stock + Retained Earnings \] (2)

and

\[ Assets = Liabilities + Common Stock + (Income - Expenses) - Dividends \] (3)

1 American and English accounting practices reverse the credit/debit convention, in the English system increases to an asset account are recorded as a credit. In this document we follow the American conventions.

2 There are potential order of evaluation issues with this equation if bracketing is not treated strictly. It perhaps might also be observed that units are not being correctly treated by the equality in the equation, and this may cause issues for superficial analyses based on it. For example,
show the breakdown within the Stockholder’s Equity of the bank’s day to day monetary flows and its capital holdings. Of particular significance is the definition of expenses, which for a bank includes its provisions for loan write-offs. A mistake sometimes found in the economic literature is to simply deduct losses from Stockholder’s Equity in the basic accounting equation rather than consider the flow implications of the (Income - Expenses) term in the expanded equation which indicate that banks can write-off loans against income with no effect on stock or capital reserves as long as they remain profitable. As stockholder’s equity is part of the regulatory capital for a bank, and in part determines its lending limits, this can lead to incorrect assumptions about the system’s stability.

Analysis of the banking system is further complicated by the increasingly abstract nature of money, as the banking system continues its evolution away from physical money to a completely electronic system. The system was originally based on empirically derived but known ratios between physical money, the price of precious metals, and the quantity of bank loans made at each local bank, regulated by the requirement that a fixed percentage of reserves against deposits was required to be held at the central bank. While it is not completely correct to equate bank deposits with physical money, if for no other reason than accounting treatment of the two differs significantly, it is equally invalid to fail to acknowledge the role bank deposits play as the de facto money supply in determining the general price level, and indeed have done for over a century.

The original role of bank deposits as a form of multiplexed access to physical money that is in day to day use remains embedded in the book keeping accounts, and now creates a feature of the system that is generally referred to as liquidity, that is the money available to the bank on the asset side of its balance sheet, to satisfy its day to day demands for cash and transfers within the system through its holdings with the central clearing system and other banks.

4 Bank Operations

4.1 Initial Position

| Central Bank | Bank A | Bank B |
|--------------|--------|--------|
| Assets       | Liabilities | Assets | Liabilities | Assets | Liabilities |
| 400          | Loans 10,000 5,000 Deposit A.C1 |
|              | Reserves 200 | 5,000 Deposit A.C2 |
|              | Cash 800 | 1,000 Capital |
|              | Total 11,000 | 11,000 |
| 200          | Loans 10,000 5,000 Deposit B.C3 |
|              | Reserves 200 | 5,000 Deposit B.C4 |
|              | Cash & Eq 800 | 1,000 Capital |
|              | Total 11,000 | 11,000 |

Examples in this document are based on a banking system consisting of two Banks, A and B, and a simplified Central Bank. The general ledgers of the two banks are shown together with their reserve account relationship with the central bank. The other holdings of the central bank are not shown. The starting position used for the examples shown here is shown in Table. For the examples shown here, the 2% reserve required of European

the majority of assets in the banking context are loans which represent contractually committed flows of money, stock is usually represented in financial instruments that are priced in monetary units, whilst income, expenses and dividends typically represent money as it is generally understood.

3The description commonly found in economic textbooks such as Mankiw, which appears to have been derived from the 1931 Macmillan Report to the British Parliament, probably authored by Keynes, incorrectly shows a reserve being withheld from the total customer deposits at the bank, rather than as additional funds owned by the bank and maintained in a fixed relationship to the quantity of money represented as deposits.
Banks on accounts with notice periods up to 2 years is used. It is assumed all deposit accounts at both banks fall within this classification[4]. Reserve accounts held by banks at the central banks are treated as deposit accounts by the central bank, and are consequently classed as liabilities of the central bank. A matching amount of central bank assets is shown for completeness.

Cash, cash equivalents and reserves represent the bank’s own money, its 'liquidity'. Although originally this would have involved significant holdings of physical cash, today these holdings are predominantly electronic, and their significance derives from their position in the system of ledger books in maintaining receipts as funds flow between banks, rather than directly from customers. Money paid into or out of the bank is funnelled through its cash asset journal, with a matching credit or debit in the account the money is processed for. In an era of electronic operations, this part of the bank’s operation can be classified as a vestigial structure derived from gold standard era operations, but one with significant implications for the behaviour of the larger system.

4.2 Fundamental Operations

The following list of bookkeeping operations describe the fundamental mechanical actions that any bank must perform to maintain its day to day operations. Potentially some of these actions, such as transferring money between accounts can be performed differently when done at the same bank, than when done between banks as opposed to at the same bank, and consequently both possibilities are described.

1. Transfer between accounts at different banks, i.e. cheque or EFT
2. Transfer between accounts at the same bank.
3. Lend money to a customer.
4. Lend money to a customer at a different bank.
5. Borrow from another bank (or central bank)
6. Payment of interest and capital on a bank loan
7. Write off a loan
8. Increase Capital Holdings
9. Increase Reserve Holdings
10. Central Bank Operations
   - Borrow from the Central Bank (Lender of last resort)
   - Payment of interest on reserves at the Central Bank

In the examples below, we first show the set of (credit, debit) tuple operations that are performed using the American convention (increases in assets are debits), and then a worked example following the initial position in Table[2].

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[4]Source: European Central Bank, [http://www.ecb.int/mopo/implement/mr/html/calc.en.html](http://www.ecb.int/mopo/implement/mr/html/calc.en.html)
4.3 Transfers between Bank Accounts

4.3.1 At the same Bank

When money is transferred between two accounts at the same bank it is a debit to one account, and a credit to the other, with no change to the aggregate liability for the bank shown on the balance sheet.

Operations
1) debit customer account (A.C1)  credit customer account (A.C2)

|        |       | Bank A        |       |       |
|--------|-------|---------------|-------|-------|
| Assets | Liabilities | Loans 10000 | 4000  | Deposit A,C1 |
|        |       |             |       | Deposit A,C2 |
|        |       | Reserve 200 |       |             |
|        |       | Cash & Eq 800| 1000  | Capital |
| Total  |       | 11000        | 11000 |       |

|        |       | Bank B        |       |       |
|--------|-------|---------------|-------|-------|
| Assets | Liabilities | Loans 10000 | 5000  | Deposit B,C3 |
|        |       |             |       | Deposit B,C4 |
|        |       | Reserve 200 |       |             |
|        |       | Cash & Eq 800| 1000  | Capital |
| Total  |       | 11000        | 11000 |       |

This is in contrast to the procedure used when money is explicitly transferred between different banks shown in section 4.3.2, which could also be applied to a transfer occurring between customers at the same bank. While it may seem unlikely that there would be such dramatically different treatment, the potential certainly appears to exist, and this would have systemic implications if allowed.

It is also not known what if any differences in treatment occur when transfers are performed between branches of the same bank. It seems distinctly possible that both forms of accounting could be in use by different institutions within the same banking system.

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5Banks that operate unified bookkeeping across all branches would be able to source larger loans, and could also be expected to cause higher monetary expansion rates as they take advantage of a larger liquidity channel with the central bank’s clearing mechanisms.
4.3.2 Transfer between different Banks

Transfers between the main commercial banks, (clearing banks in the English system) take place through the central bank’s clearing operations. Smaller banks may use accounts at larger banks, rather than direct access to the central clearing systems. In the example below we will show a transfer through the reserve accounts held at the central bank.

For a transfer from customer A.C1 of 1000 at Bank A, to customer B.C3 at Bank B:

Operations
1) debit cash ledger credit reserve ledger
   credit reserve at central bank debit central bank cash account
2) debit reserve account Bank A credit reserve account bank B
   debit customer account A.C1 credit customer account B.C3

The operations are shown in more detail in Tables 4 and 5, which show a transfer of 20 from customer A.C1 at Bank A to customer B.C3 at Bank B.

Table 4: Transfer: Step 1: Move money to reserves

| Central Bank | Bank A | Bank B |
|--------------|--------|--------|
| Assets       | Liabilities | Assets | Liabilities |
| Loans        | 10000   | 5000   | Deposit A.C1 |
|             | 220     | 220    | Deposit A.C2 |
| Reserves     | 420     | 420    |
| Cash & Eq    | 780     | 1000   | Capital |
| Total        | 11000   | 11000  |

Clearing operations today are usually performed through a real time transaction based system, but historically depended on an end of day exchange and balancing approach. The exact implementation of the clearing operation, particularly with respect to its tolerance or otherwise for negative balances during the day, may have some systemic implications.
Table 5: Transfer: Step 2 transfer money to customer A.C1

| Central Bank | Bank A |
|--------------|--------|
| Assets       | Assets | Liabilities | Liabilities |
| Loans        | 10000  | 4980         | Deposit A.C1 |
|              |        |              | 5000         | Deposit A.C2 |
| Reserves     | 200    |              |              |              |
| Cash         | 780    |              |              |              |
| Total        | 10980  | 10980        |              |              |

| Bank B       |        |
|--------------|--------|
| Loans        | 10000  | 5020         | Deposit B.C3 |
|              |        |              | 5000         | Deposit B.C4 |
| Reserves     | 220    |              |              |              |
| Cash & Eq    | 800    |              |              |              |
| Total        | 11020  | 11020        |              |              |

4.4 Lending Money

Similar issues with liquidity considerations and activity that takes place between banks as opposed to those at the same bank can be seen with bank lending. Although banks have to assume that the money they loan may end up on deposit at another bank, and manage their liquidity exposures appropriately, many banks express a clear preference for lending to their own rather than other bank’s customers, a preference that is also recommended in early banking literature. Both alternatives are detailed below.

4.4.1 A loan of money to its own customer.

Manuals on bank bookkeeping from the early 20th century indicate that the practice then was to enter the loan and the deposit simultaneously in the ledger books as shown here and there is no evidence that this practice has ever changed.

"If a loan is granted, an entry is made in a Customers’ loan register, and passed for entry in the Current Accounts Credit Analysis book. Against the credit so placed to his Current Account, the customer draws in the ordinary way.

Bank Bookkeeping and Accounts, Meelboom (p35-p36) [9]."

For a loan of 500 made by Bank A to its own customer A.C1 the operation proceeds as follows:

Operations
1) debit loan ledger  credit customer account (e.g. A.C1)
2) credit cash ledger  debit reserve ledger

Besides adding to both the loan and customer deposit accounts, the bank may also need to adjust its reserve provisions with respect to the new level of customer deposits. In this case 10 is transferred from the bank’s cash holdings to the reserve account at the central bank. We assume in this example that the bank is still within its risk weighted capital multiple, and does not need to adjust its capital holdings.

Banks lend money against their asset holdings, with the total amount they can lend regulated by reserve requirements at the central bank, capital requirements and in the case of loans made to customers of other banks, or directly to other banks (interbank lending), their cash holdings.

There are restrictions on the total amount of its loans that a bank can maintain. Under the Basel accords, it must be within its risk weighted capital restrictions, and it must also be able to meet the reserve requirement on its new level of deposits. To lend to another bank’s customer, the bank must additionally have available liquidity for the transfer of money for the loan, and in practice since the bank must assume that its funds may be transferred to other banks, these considerations also apply to loans to its own customers.
Table 6: Loan to Bank’s own customer

| Central Bank | Bank A |
|--------------|--------|
| Assets       | Liabilities | Assets | Liabilities |
| Loans 10500  | 5500 Deposit A.C1 |
| Reserves 210 | 210 |
| Cash 790     | 1000 Capital |
| Total 11500  | 11500 |

| Bank B |
|--------|
| Loans 10000 | 5000 Deposit B.C3 |
| Reserves 200 | 200 |
| Cash & Eq 800 | 1000 Capital |
| Total 11000 | 11000 |

4.4.2 Lend to another Bank’s Customer

Lending to a customer at a different bank by contrast requires use of the interbank transfer mechanisms and follows a different sequence of operations, as shown below.

Operations
1) credit cash holdings at Bank A debit reserve holdings at Bank A
   credit reserve account at Central Bank debit assets at Central Bank
2) credit reserve account at Bank A debit reserve account at Bank B
debit loan ledger at Bank A credit customer account at Bank B

Table 7: Loan to another Bank’s Customer

| Central Bank | Bank A |
|--------------|--------|
| Assets       | Liabilities | Assets | Liabilities |
| Loans 10000  | 5000 Deposit A.C1 |
| Reserves 700 | 700 |
| Cash & Eq 300 | 1000 Capital |
| Total 11000  | 11000 |

| Bank B |
|--------|
| Loans 10000 | 5000 Deposit B.C3 |
| Reserves 200 | 200 |
| Cash & Eq 800 | 1000 Capital |
| Total 11000 | 11000 |

This example also illustrates another feature of the system, that the creation of money in the form of customer deposit entries is independent of the money on deposit at the central bank (base money) and within the clearing system unless the system is operating at the limits of its reserve requirements.

7 In any banking system where accounts exist that do not carry reserve requirements (only Net Transaction Accounts require a reserve in the US system, while time deposits of greater than two years do not require reserves in the euro-zone), reserve limits effectively only throttle the system’s deposit expansion rate, and do not set absolute limits on expansion.
Table 8: Loan to another Bank’s customer

| Central Bank | Assets | Liabilities | Bank A | Assets | Liabilities |
|--------------|--------|-------------|--------|--------|-------------|
|              |        |             |        |        |             |
|              |        | Loans       | 10500  | 5000   | Deposit A.C1 |
|              |        |             |        | 5000   | Deposit A.C2 |
|              |        | Reserves    | 200    | 200    |             |
|              |        | Cash & Eq   | 300    | 1000   | Capital     |
|              |        | Total       | 11000  | 11000  |             |

| Bank B | Assets | Liabilities |
|--------|--------|-------------|
|        | Loans  | 10000       |
|        |        | 5500 Deposit B.C3 |
|        | 200    |              |
|        | Reserves| 200         |
|        | Cash & Eq| 1300       |
|        | Total   | 11500       |

5 Interbank Loan

A loan to another bank is similar to a loan to a customer at a different bank, with side effects involving liquidity availability. It is accounted as a liability at the bank receiving the loan, and as an asset at the bank making it.

Operations

1) credit cash holdings at Bank A debit reserve holdings at Bank A
   credit reserve account at Central Bank debit assets at Central Bank

2) credit reserve account at Bank A debit reserve account at Bank B
   debit loan ledger at Bank A credit loan liability at Bank B

Table 9:

| Central Bank | Assets | Liabilities | Bank A | Assets | Liabilities |
|--------------|--------|-------------|--------|--------|-------------|
|              |        |             |        |        |             |
|              |        | Loans       | 10000  | 5000   | Deposit A.C1 |
|              |        |             |        | 5000   | Deposit A.C2 |
|              |        | Reserves    | 700    | 700    |             |
|              |        | Cash & Eq   | 300    | 1000   | Capital     |
|              |        | Total       | 11000  | 11000  |             |

| Bank B | Assets | Liabilities |
|--------|--------|-------------|
|        | Loans  | 10000       |
|        |        | 5000 Deposit B.C3 |
|        | 200    |              |
|        | Reserves| 200         |
|        | Cash & Eq| 800        |
|        | Total   | 11000       |
6 Loan Repayment

Loan repayment is broken into two parts, repayment of the principal outstanding on the loan, and repayment of the interest. Repayment of the principal is a balanced operation, with a simple deduction from both sides of the balance sheet in the event that the loan is made to a customer of the same bank which made the loan. Interest is received as income by the Bank holding the loan, however its accounting is more complex. Strictly, GAAP requirements are that interest is accrued on a daily basis, rather than when it is actually paid, but to simplify the presentation this step is not shown.

Income is accounted for as a liability, as it nominally represents revenue that will be paid to the shareholders. In reality, this is a requirement for the double entry bookkeeping operations surrounding it to remain balanced, which carries implications for the treatment of expenses, and in particular loan defaults or write-offs which are treated as an expense in bank accounting. Outside the artificial constraints of bookkeeping practices, income received by the bank has asset like properties, and in particular can be transferred to the asset side when needed to compensate for loan losses. This element of bank liquidity is systemically interesting for a number of reasons, in particular loan defaults that can be covered from income do not impact the quantity of bank lending that is regulated by the capital requirement. Consequently, when a loan is written off purely against income, the bank is able to extend new loans on its existing capital base, and subject to liquidity availability the total amount of lending it can perform is not affected.

The example shown in Table 10 shows a loan repayment of 100, split into two parts, a 40 principal repayment and a 60 interest payment made by customer A.C1 at Bank A. The two payments are processed separately to illustrate the different handling for interest versus capital repayment, and also that while interest repayment is money supply neutral, principal repayment removes the deposit from the system that was originally created by the loan.

| Operations | 1) debit principal from customer deposit | credit principal from loan |
| 2) debit interest from customer deposit | credit interest account for Bank |

| Central Bank | Loans | 10500 | 5000 | Deposit A.C1 |
| Liabilities | Liabilities | 5000 | 200 | Deposit A.C2 |
| Reserves | 200 | Cash & Eq | 300 | Capital | 1000 |
| Total | 11000 | 11000 |

| Bank A | Loans | 10000 | 5000 | Deposit B.C3 |
| Liabilities | Liabilities | 5000 | 200 | Deposit B.C4 |
| Reserves | 200 | Loan from Bank A | 500 | Capital | 1000 |
| Cash & Eq | 1300 | 1000 |
| Total | 11500 | 11500 |
### Table 11: Principal Repayment

| Central Bank | Bank A | Assets | Liabilities |
|--------------|--------|--------|-------------|
|              |        | Loans  | Deposit A.C1 |
|              |        | 9960   | 4960         |
|              |        | 200    | 5000         |
|              |        | Reserves | Deposit A.C2 |
|              |        | 200    | 200          |
|              |        | Cash & Eq | 800         |
|              |        |        | 1000         |
|              |        | Total  | Capital      |
|              |        | 10960  | 10960        |

| Bank B | Assets | Liabilities |
|--------|--------|-------------|
| Loans  | 10000  | Deposit B.C3 |
| 200    | 5000   | Deposit B.C4 |
| Reserves | 200    |
| Cash & Eq | 800    |
| Total  | 11000  | Capital     |
|        | 11000  |             |

### Table 12: Interest Repayment

| Central Bank | Bank A | Assets | Liabilities |
|--------------|--------|--------|-------------|
|              |        | Loans  | Deposit A.C1 |
|              |        | 9960   | 4900         |
|              |        | 200    | 5000         |
|              |        | Reserves | Deposit A.C2 |
|              |        | 200    | 60          |
|              |        | Cash & Eq | 800         |
|              |        |        | 1000         |
|              |        | Total  | Capital      |
|              |        | 10960  | 10960        |

| Bank B | Assets | Liabilities |
|--------|--------|-------------|
| Loans  | 10000  | Deposit B.C3 |
| 200    | 5000   | Deposit B.C4 |
| Reserves | 200    |
| Cash & Eq | 800    |
| Total  | 11000  | Capital     |
|        | 11000  |             |

### 7 Loan Default

Losses on loans are initially treated as an expense for banks, and are effectively deducted from income, but there are several stages to this process. Additional and potentially systemic complexities can occur if the capital reserve becomes involved. In general loan write-offs are a fairly predictable occurrence, several payments have to be missed before a loan can be treated as impaired. Banks are required to provision against potential losses on a loan at the same time it is made, and to continuously monitor and adjust loss provisions to match their anticipated losses. Banks also have some freedom on how impaired loans are treated, and may elect to write off all or some of the loan, or refinance it.

If loan losses and other expenses significantly exceed income, then the capital reserve is used to cover the write-off. With respect to the Basel Accord Tier 1 and Tier 2 capital lending provisions, the bank may be over capitalised, in which case there is a buffer of capital that can be used for this purpose without any impact on its ability to lend with respect to its risk weighted capital reserve multiplier. However, since banks must maintain a limit on their lending that is a multiple of their Tier 1 & 2 reserve funds, if losses are sufficiently high they can push the bank out of regulatory compliance, since it will no longer meet its capital requirement. This last situation is rarely recoverable without external intervention.

The bookkeeping arrangements that are used to represent the first part of this process use a contra-asset account for loan losses, which is then subtracted from gross loans. In the example below, we will begin with showing

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8 A contra-asset account is an asset account which has a credit balance, normally asset accounts maintain a debit balance. The contra-asset...
the creation of a loan loss account from income received, and then assume that its contents are sufficient to cover losses from the loan write down of 50 for Bank A. The significance of the contra-asset designation of the loss provisions account becomes clearer when the transfer from the interest income account is examined. The funds are credited to the loss provisions account, but as it is a contra-asset account they act to reduce the total asset balance.

When the bank then writes off part of its loan book (50 in the example shown in Table 13, the loss provision account is reduced by the amount of the write-off, as is the loan book. Strictly, the loss provision account is debited, reducing its balance, and the loan account is credited, also reducing its balance, since it as an Asset account. The net balance of the Assets is unchanged as a result, since the loss provision account has already accounted for the write off [10].

As a result, the impact of the write-off on the balance sheet usually precedes the actual write-off. As long as the loss can be covered from income, then the overall state of the balance sheet (with respect to the reduction in assets caused by the write-off) can be restored by new lending. Nor are there any accompanying money supply considerations, since the money removed from the system by the loan write-off is replaced by the new loan. Some degree of loan losses can consequently be absorbed by the system with no systemic repercussions for the money supply. There may be implications for the larger economic debt supply, depending on the subsequent treatment of the loan, which although removed from the bank’s balance sheet, may be sold on for collection. Local practices surrounding the handling of bankruptcy and recourse and non-recourse lending will play a part there.

| Operations | 1) debit interest account | credit loss provisions account |
| 2) credit loan amount | debit loss provisions account |

![Table 13: Loan Writeoff - Initial Conditions](image)

| Central Bank | Assets | Liabilities |
|--------------|--------|-------------|
| Bank A       |        |             |
| Loans        | 9960   | 4900 Deposit A,C1 |
|             | 5000   | 5000 Deposit A,C2 |
|              | 60     | 60 Interest income |
| Reserves     | 200    | 200          |
| Cash & Eq    | 800    | 1000 Capital |
| Total        | 10960  | 10960        |
| Bank B       |        |             |
| Loans        | 10000  | 5000 Deposit B,C3 |
|              | 5000   | 5000 Deposit B,C4 |
| Reserves     | 200    | 200          |
| Cash & Eq    | 800    | 1000 Capital |
| Total        | 11000  | 11000        |

account is itself linked to an asset account, and the book value is the net value of the two accounts. It is effectively a way of carrying an offsetting allowance forward for loss provisions or depreciations, linked to specific ledgers for tracking purposes.
### Table 14: Loan Writeoff - Creation of Loss Reserve Account

| Central Bank | Bank A |
|--------------|--------|
| **Assets**   | **Liabilities** |
| Loans       | 9960   |
| Deposit A.C1 | 4900   |
| Deposit A.C2 | 5000   |
| Loss provision | (50) |
| Reserves    | 200    |
| Interest income | 10 |
| Cash & Eq   | 800    |
| Capital     | 1000   |
| **Total**   | 10910  |

| Bank B |
|--------|
| Loans | 10000 |
| Deposit B.C3 | 5000 |
| Deposit B.C4 | 5000 |
| Reserves | 200 |
| Cash & Eq | 800 |
| Capital | 1000 |
| **Total** | 11000 |

### Table 15: Loan Writeoff - Writeoff against loss provisions

| Central Bank | Bank A |
|--------------|--------|
| **Assets**   | **Liabilities** |
| Loans       | 9910   |
| Deposit A.C1 | 4900   |
| Deposit A.C2 | 5000   |
| Loss provision | (0) |
| Reserves    | 200    |
| Interest income | 10 |
| Cash & Eq   | 800    |
| Capital     | 1000   |
| **Total**   | 10910  |

| Bank B |
|--------|
| Loans | 10000 |
| Deposit B.C3 | 5000 |
| Deposit B.C4 | 5000 |
| Reserves | 200 |
| Cash & Eq | 800 |
| Capital | 1000 |
| **Total** | 11000 |
8 Increase Capital

The capital holdings of a bank are initially the shares purchased by its stockholders when the bank is founded. The money received by the bank for this purpose becomes its asset cash holdings. Although the tradable price of shares varies with stock market conditions, the book value used for common stock held in the bank’s capital is the money received by the bank and initially entered into its cash asset ledger.

Under Basel, capital holdings are divided into two Tiers with regulated definitions for the financial instruments that can be held in the different tiers, and separate ratios for the loans that can be extended against their capital holdings. Broadly, Tier 1 consists of common stock and disclosed reserves or retained earnings. Tier 2 holds undisclosed reserves, revaluation reserves, additional reserves for loan losses (holdings additional to the loss provisions described above), and subordinated debt. (Subordinate debt is money that has been borrowed by the bank, but is subordinate to the claims of the depositors on bank funds.)

Basel 2 included a Tier 2 category of “hybrid capital instruments” which are financial instruments having qualities of both debt and equity. The category has proved somewhat controversial, with a number of such instruments being explicitly forbidden by the regulators, and appears to be being removed in Basel 3.

There appear to be no restrictions or controls on increases to the capital reserve, which can be done from profits, but liquidity would be required for any purchase of financial instruments such as government treasuries. Since sales of bank stock add to liquidity, this restriction would not apply to that channel.

the deposit holder of account A.C1.

| Operations          |              |              |
|---------------------|--------------|--------------|
| 1) debit from A.C1  | debit reserves at Bank A |
| credit capital      | credit reserves at Bank B |

Table 16: Sale of Stock to increase Capital

| Central Bank | Bank A | Bank B |
|--------------|--------|--------|
| Assets       | Liabilities | Assets       | Liabilities | Assets       | Liabilities |
| Loans        | 10000  | 4950   | 10000  | 5000  | Deposit A.C1 |
|             | 5000   |        |        | 5000  | Deposit A.C2 |
| Reserves     | 150    |        | 150    |        | Capital      |
| Cash & Eq    | 800    | 1000   | 800    | 1050  | Capital      |
| Total        | 10950  | 10950  | 11050  | 11050 | Capital      |

| Bank B       | Assets | Liabilities |
|--------------|--------|--------------|
| Loans        | 10000  | 5000         | Deposit B.C3 |
|             | 5000   | 5000         | Deposit B.C4 |
| Reserves     | 250    | 250          | Capital      |
| Cash & Eq    | 800    | 1050         | Capital      |
| Total        | 11050  | 11050        | Capital      |
9 Borrow from Central Bank

Central bank operations are in principle no different to other bank operations, but operate from a privileged position in the system with respect to the other banks.

| Operations | 1) | debit Central Bank Assets (loan) | credit reserve account for Bank A debt reserves at Bank A | credit loan to Central Bank |
|------------|----|---------------------------------|--------------------------------------------------------|----------------------------|

Table 17: Loan from Central Bank

| Central Bank | Assets | Liabilities | Bank A | Assets | Liabilities |
|--------------|--------|-------------|--------|--------|-------------|
| Loans        | 10000  | 5000        | Deposit A.C1 |
| Reserves     | 400    | 200         | Loan from Central Bank |
| Cash & Eq    | 800    | 1000        | Capital |
| Total        | 11200  | 11200       |        |

| Bank B       | Assets | Liabilities |
|--------------|--------|-------------|
| Loans        | 10000  | 5000        | Deposit B.C3 |
| Reserves     | 200    | 200         | Deposit B.C4 |
| Cash & Eq    | 800    | 1000        | Capital |
| Total        | 11000  | 11000       |        |
10 Payment of interest on reserve holdings by Central Bank.

Payment of interest on the reserve holdings is a necessary feature of the system, otherwise systemic imbalances would result over time from the asymmetric flow within the system as central bank loans were repaid by the clearing banks. In the example in Table 10 it is assumed that 10 has been received by the Central Bank as interest payment on its loans, and this is now paid to Bank A as interest on its reserves.

Operations

1) debit Central Bank Assets (money) credit reserve account at Bank A
debt reserves at Bank A credit income received at Bank A

Table 18: Initial Position

| Central Bank | Bank A |
|--------------|--------|
| Assets       | Liabilities |
| Loans        | 10000  | 5000 Deposit A.C1 |
|              |        | 5000 Deposit A.C2 |
| Reserves     | 200    |                |
| Cash & Eq    | 800    | 1000 Capital   |
| Total        | 11000  | 11000          |

Table 19: Payment of Interest on Reserves

| Central Bank | Bank A |
|--------------|--------|
| Assets       | Liabilities |
| Loans        | 10000  | 5000 Deposit A.C1 |
|              |        | 5000 Deposit A.C2 |
| Reserves     | 210    | 10 Income       |
| Cash & Eq    | 800    | 1000 Capital   |
| Total        | 11000  | 11000          |

11 Reserve Holdings

Two forms of reserve holdings exert regulatory control within the system. The capital reserve regulates the total amount of loans that can be made by the bank, while the reserve held at the central bank, in principle at least regulates the amount of deposits that the bank may hold. Potentially, as lending is also linked to deposit creation the central bank reserve can exert some regulation over lending as well. For this to occur however, two conditions
have to be true. One is that the central bank reserve requirement is greater than the capital reserve requirement, otherwise the capital reserve requirement will dominate. The other is that the reserve requirement is applied to all deposits accounts without exception. Consequently the regulatory effect of the central bank reserve can be diluted in practice. A further consideration, with systemic implications, is also the mechanisms by which banks are allowed to increase their central bank reserves. In the USA it seems this can be done through the deposit of government treasuries, which in practice would remove systemic control over the quantity of reserves in the system.
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