

7. Public finance and the monetary authorities

7.1 INTRODUCTION

The ban on *riba*, if interpreted as a ban on conventional interest, poses a problem for the fiscal and monetary authorities. Alternatives for conventional bonds as a means of borrowing money have to be found. In the early days of the ideas on an Islamic economy its advocates advanced ideas that in their naiveté were only equalled by Chilean President Dr Allende's belief that under his *Unidad Popular* rule (1970–73) people would not work simply because they receive money in return, but from an innate urge to contribute to the wellbeing of society as a whole (Allende 1973). In the same vein, Maulana Maududi (1999, p. 206) thought that in order to meet emergencies, non-productive national expense and war expenditure, an Islamic government could be assured of voluntary donations. The proscription of interest and the establishment of the system of *zakat* would result in such prosperity that people would not feel such donations as a burden. In addition, people would be glad to provide charitable (*quard hasan*) loans. But Maududi must have had an inkling that this was a bit starry-eyed after all, as he adds that if more money is needed than is collected in these ways, the government cannot only use capital levies such as the *zakat*, but also force people to lend part of their bank deposits to the government or even, if the worst came to the worst, resort to inflationary finance.

The ban on *riba* not only makes financing the government's budget more complicated, it also calls for creative thinking in monetary policy. In conventional monetary systems the central bank manipulates interest rates in its attempts to stimulate commercial banks to increase or reduce lending. For a government that is under pressure to avoid paying and receiving interest, the question is how to find a sharia-compliant equivalent. A similar problem presents itself when the central bank has to act as lender of last resort.

Monetary authorities not only are responsible for monetary policy, but also for supervision of the financial sector, including the sub-section that is Islamic. The rules and standards that apply to conventional financial institutions may require modifications before they can be used for supervision of Islamic ones.

In many of these areas both thinking and practice are still in an experimental phase; developments have not yet crystallized.

7.2 PUBLIC FINANCE

In so far as taxes, fees and property income can be used for financing a government's expenditure, there is no need for specific Islamic solutions. Budget deficits may, however, cause headaches, as interest-bearing bonds and private placements are out of the question if financing is to observe the ban on *riba* (assuming that *riba* is considered to be synonymous with interest). The easy way out is to force the central bank to provide free credit, but that makes the money supply grow and, if done on a large scale, fuels inflation.

Financial institutions can offer PLS finance to private companies and they can do the same with the government as their client. This works fine for government-owned companies or other activities that promise an income. It has been resorted to in Iran and Sudan (M.F. Khan 2007, pp. 292–3). For financing other government expenditure PLS is less suitable. One would be hard put to calculate the rate of return on such expenditure, though ingenious solutions have been proposed. In Iran the National Participation Certificates or National Participation Paper (NPP) recommended by Ul Haque and Mirakhor (1998) were designed to solve the calculation problem by linking the rate of return to returns in the private sector. The proposal has been under consideration for a decade or so. So far, it does not seem to have gone off the runway (Sundararajan et al. 1998; M.F. Khan 2007, p. 292). In other Muslim countries the chances for such a project would certainly be slim, as *fiqh* scholars outside Iran generally reject the idea.

For financing buildings or means of transport, *ijara* offers a solution. If *ijara wa iqtina* is chosen, the government agrees to buy the good at the end of the lease period for a given price and the lease payments then provide the financier with a steady income stream, possibly linked to LIBOR or EURIBOR (M.F. Khan 2007). Under a simple *ijara* contract, by contrast, the rate of return is not known beforehand, as the residual value of the object of the lease would be uncertain. *Murabaha* loans are of course another possibility. These are, however, at a disadvantage compared with PLS and *ijara* finance in that the banks cannot easily resell them on the secondary market. They are for all practical purposes illiquid because they are debt. *Musharaka*, *mudaraba* and *ijara* financing by contrast represent ownership of physical goods and can thus be traded on the secondary market.

For financing a government budget deficit that is not attributable to specific projects, one solution is to borrow in the form of *quard hasan* loans at zero per cent and offer gifts, at the discretion of the issuer, in recompense. In Malaysia the 2003 Government Investment Issues (GII) scheme was based on this principle, as was an earlier version, the Government Investment Certificates scheme introduced by a law passed in 1983. Investors buying government debt under these schemes formally provided a benevolent, or *quard hasan*, loan to the government, and the government gave a return in the form of a dividend, formally a gift. The committee setting the dividend made it dependent on such variables as inflation, real growth and yields on other financial instruments. These schemes, however, were developed not so much with the government budget deficit in mind as with a view to making liquid instruments available to the Islamic banking sector (at times consisting of one bank only). The sector could hold them as required liquidity or for investing excess reserves (Sundararajan et al. 1998; M.F. Khan 2007, p. 297).

Sukuk, developed by the government of Malaysia in conjunction with HSBC, provide an elegant way of borrowing to finance general expenditure. The *ijara* securities issued by the Bahrain Monetary Authority (BMA, now Central Bank of Bahrain) in 2000 are close cousins (*Euromoney* 2001). Like *sukuk*, which may also be based on *ijara*, these are quite similar to fixed-interest debt, but are at least formally interest free and, moreover, backed by real assets. Also from Bahrain is a scheme that looks like *bai'salam* combined with elements of *tawarruq*. It works like this: BMA sells short-term government bonds, or bills, in the form of *sukuk al-salam*, certificates of pre-paid forward sales. Officially, investors pay for the future purchase of some commodity. They are not, however, required to take delivery of the commodity on the bill maturity date, as BMA arranges to sell the commodity on the investors' behalf at a pre-determined price. This price equals the purchase price of the bills plus interest, based on LIBOR plus a spread (El-Gamal 2005a). All this implies that BMA first buys and then sells commodities before it can repay the investors, a time-consuming and costly way just to formally comply with the religious requirements. Before BMA pays for the commodities, the funds can be used to finance a government deficit. The paper is not tradeable, as goods cannot be sold before they are delivered, according to *sharia* law. With a 91-day maturity, these securities are still sufficiently attractive for the banks with an eye to liquidity management.

If some governments go out of their way to obey the ban on *riba*, at least formally, the Islamic Republic of Iran hardly bothers to keep up the façade. The Iranian government requires the private sector to eschew *riba*, but it saw no opportunity to completely do without interest-based financial

transactions itself. As the owner of the state banks, it thinks itself justified in neglecting the ban on *riba* in its dealing with those banks. Its reasoning is built up of two elements. First, it argues that when borrowing from state-owned banks, it really borrows from itself. Second, it has defined *riba* in such a way that it does not include cases where the debtor and the creditor are not separate legal bodies. Big business is catered for in the same way: for intra-group business loans an identical reasoning applies (Lewis and Algaoud 2001, pp. 103–4).

7.3 MONETARY POLICY

7.3.1 Monetary Policy Instruments

The ban on *riba* severely restricts a central bank's grip on the economy and may lead to harmful consequences. A central bank that cannot use interest-based measures to control the commercial banking sector's lending activities and money creation may easily be tempted to resort to measures that undermine the efficiency of financial markets, in particular direct credit controls. However, it is not entirely without indirect instruments, as variable cash and liquidity ratios can still be applied (Chandavarkar 1996, ch. 9).

How did the countries that fully Islamized their financial system deal with the problem? The Central Bank of Iran (CBI) is authorized to impose ceilings on the banks' loan and credit volumes, not only in a global sense but for individual economic sectors as well. It may also use required reserve ratios, with different rates for different liabilities and for different fields of activity. Open-market operations are possible through the issuance of CBI Participation Papers, which pay a profit rate, and banks may deposit their excess liquidity in an open deposit account, which again pays no interest but promises a profit rate (CBI 2008). The Iranian authorities apparently are loath to leave things to the market. The banks, in so far as they are government-owned, are not fully free to set the payments on their deposits. The CBI imposes a minimum 'profit' rate which the banks must pay deposit holders (Kia 2006, p. 887).

In Sudan the central bank, the Bank of Sudan, has maintained direct instruments for regulating the money supply. It mainly relied on quantitative controls by fixing a random credit ceiling along with an across-the-board cash ratio on all types of deposits. This has not proven to be an effective way of controlling money supply and neither has it been conducive to economic development. The central bank has, however, developed instruments to conduct open-market operations. Central Bank

Musharaka Certificates (CMCs) have been introduced, following their approval by the High Sharia Supervisory Council of the Bank of Sudan. A special company, Sudan Financial Services Co., was established to hold the shares of the government and the Bank of Sudan in commercial banks and CMCs were issued against their value. These CMCs allow the central bank to conduct open-market operations (Sundararajan et al. 1998, pp. 12–13). CMCs can be issued with or without maturity date. The return on the certificates presumably follows the yield on the shares held by the Sudan Financial Services Co. Under an earlier plan, which was under consideration by the Bank of Sudan's High Sharia Supervisory Council in 1998, CMCs would promise investors a negotiable rate of return linked to developments in government revenue, that is, investors got a claim on a share of government revenue. This method had a long history, as it was, according to Sundararajan et al. (1998, pp. 15–16), a modern version of *qabala*, or tax farming, though the government would not now leave tax collection to its creditors.¹ Arguably, the CMCs that eventually have been adopted deal in a more straightforward way with the ban on *riba*.

Like the central bank of Sudan, other central banks have also found ways to mimic conventional money market instruments with unconventional methods. The Indonesian Central Bank, Bank Indonesia, for instance, allows banks to deposit funds according to *wadia* (safekeeping) principles. Formally, the funds are kept in custody by the central bank for 7, 14 or 28 days and the depositor has no right to any remuneration. Bank Indonesia, however, may pay out a bonus, or gift, at its discretion (Bank Indonesia 2004). In Kuwait the central bank has introduced *tawarruq* as an instrument for open-market policy (Solé 2007). If the central bank wants to tighten the money market, it approaches Islamic banks and asks them to purchase some commodity on its behalf. The banks will contact commodity brokers and purchase the commodity. The central bank agrees to pay the purchase price plus a mark-up to the banks at a future date. The banks make no payment to the brokers. Next the central bank asks the banks to sell the commodities back to the brokers at the same price. The banks pay the central bank. The brokers receive no funds and make no payments (presumably they receive a fee). The end result of this circuitous way is a temporary fall in the banks' liquidity. The central bank can, conversely, pump liquidity into the system by making immediate payments to the banks for the purchase of the commodities and agreeing to receive payment for the sale of the commodities later.² The most innovative central bank, however, has been Bank Negara Malaysia, the Malaysian central bank. It allowed in its guidelines on the Islamic Interbank Money Market of 1993, effective as per January 1994, a number of instruments (Hakim 2007):

- The Government Investment Issues (GII), mentioned in Section 7.2. The Malaysian central bank also opened a window to purchase and sell GII on the secondary market, at prices set by them.
- Rahn agreements. These resemble GII and repurchase agreements. The lender provides a *quard hasan* loan against collateral and the borrower may, at his discretion, provide the lender with a gift. The central bank resorts to Rahn agreements to regulate liquidity on the money market.
- Wadia interbank acceptance. This instrument is used to absorb excess liquidity from the banks. The banks place the money in the custody of the central bank. Custody, or *wadia*, means that the central bank is not seen as the owner of the funds and is not required to pay something in return. The central bank may, however, pay depositors a return at its own discretion. This is seen as a bonus, or a gift. An Islamic central bank may resort to this method as an alternative to conventional interest-bearing required reserves or open-market policies.
- Bank Negara negotiable notes, created through *bai inah* (commercial banks grant credit to Bank Negara through a *bai inah* operation and receive the notes in return). The notes are traded on the secondary market and can be used for open-market operations. They resemble Treasury bills. Prices are set by the central bank on a discount basis.
- Sale and buy-back agreement. Under this agreement one party sells an asset and agrees to buy it back later at a predetermined higher price.

7.3.2 Lender of Last Resort

The ban on *riba* severely constrains a commercial bank's room of manoeuvre and requires it to safeguard its liquidity, as the conventional interbank money market is out of bounds for a sharia-compliant bank. No interest can be paid by Islamic commercial banks, and other banks will hardly be willing to part with liquidity and receive nothing in return. Consequently, Islamic banks have an incentive to concentrate on investing in short-term assets (El Qorchi 2005). Still, situations may occur where the central bank has to act as lender of last resort. Most countries with Islamic banks are still without provisions for providing liquidity *riba* free to banks facing liquidity shortages (Graiss and Pellegrini 2006b, p. 13). Only a few have central banks that can tide over the banks following the principles of Islamic finance.

In Indonesia Islamic banks may borrow funds from the central bank for periods ranging from 1 to 90 days against collateral. Bank Indonesia

demands a return based on the rate of profit of the borrowing bank, for which the realized rate of return on *mudaraba* time deposits held in that bank acts as a proxy (Bank Indonesia 2003). In Iran commercial banks could at first borrow at a fixed interest rate from the central bank, which clearly conflicts with Islamic principles (Iqbal and Mirakhor 1987, p. 14). With nationalized banks, the *hiyal* of not considering interest payments between entities belonging to the same owner to be *riba* could be applied, but the Iranian central bank in the end decided to provide uncollateralized overdraft facilities and it has been extending interest-free short-term loans under a lender-of-last-resort facility (Errico and Farahbaksh 1998, p. 22). Uncollateralized loans imply that the central bank assumes the risk of default. If those loans are not freely available, or if banks doubt whether they can count on it, this further implies that the banks have to hold a high level of unremunerated reserves with the central bank, which according to figures from the 1990s they indeed did (Sundararajan et al. 1998, p. 9). Such reserves eat into the profits of the banks and force them to demand a relatively high remuneration for the funds they supply, which may lead to disintermediation.

7.3.3 Interbank Money Market

Clearly, banks have a need for an interbank money market. Creating sharia-compliant money market instruments is a tall order, but several attempts have been made. In addition to the measures discussed in Section 7.3.1, Bank Negara Malaysia introduced in 1994 the following instruments:

- *Mudaraba* interbank investment. This facility is called *Skim Perbankan Tanpa Faedah (SPTF)*, literally ‘Bank Scheme Without Advantage’ (Sundararajan and Errico 2002, p. 7). Periods of investment run from overnight to 12 months. These investments earn a share of the profits for investment of one year of the investee bank, at a negotiable profit-sharing ratio. *Mudaraba* interbank investments replace Certificates of Deposit and are issued and traded by the banks.
- The *GII* mentioned above. The Malaysian central bank also opened a window to purchase and sell *GII* on the secondary market, at prices set by them.
- *Islamic Accepted Bills*. These resemble banker’s acceptances and are based on *murabaha* (mark-up). A bank selling a good under a *murabaha* contract draws a bill of exchange on its client and may sell the bill to a third party in a *bai’al-dayn* sale at an agreed

price. *Bai'al-dayn* is debt financing by way of sale/purchase of trade documents and papers. In the case of exports, the exporter sends documentation as required under a letter of credit to the importer's bank and draws a bill of exchange which is bought by the bank. Outside Malaysia, *bai'al-dayn* is not universally accepted as sharia-compliant.

The instruments mentioned in Section 7.3.1 that are traded on the secondary market, CMCs and Bank Negara negotiable notes, can of course also be used by the banks for purposes of liquidity management.

Ways to provide credit that are nominally linked to goods transactions have been developed for the benefit of the non-bank private sector and these could be applied in the interbank sector as well, provided one deems these methods not too much at variance with the precepts of sharia. Banks could thus make use of *bai inah* and *tawarruq* for attracting and placing funds among themselves. Bank A, needing funds, might approach bank B and ask it to buy some commodity and sell it (with a mark-up) to itself (that is, bank A). A sells the commodity immediately back to the original seller or the commodities broker. Bank B pays the broker or seller spot and the broker or the seller channels the funds immediately to bank A. A pays B in instalments. This of course is a very cumbersome and circuitous way to generate funds, which would force banks into the role of commodities traders and may conflict with the demands of financial sector regulators. For short-term investment, *sukuk* are probably much more attractive, and for relieving a liquidity shortage, securitizing *ijara* loans might be a solution.

7.4 SUPERVISION OF THE FINANCIAL SECTOR

Central banks are not only responsible for monetary policy, but often also for regulating and supervising the banking sector. Alternatively, a separate Financial Sector Authority may have been set up to this end. As for supervision on Islamic financial institutions, it is early stages yet and there clearly still is a long way to go. A few points call for special attention when setting up supervision on an Islamic financial sector.

- Deposit guarantees. Conventional bank deposits benefit from deposit guaranty schemes. These partly conflict with sharia, as investment deposits are formally *mudaraba* investments, which share in profits and losses, by their very nature excluding any guarantee of the principal. PLS (investment) accounts can therefore in principle not

be included in deposit guarantee schemes. However, the sharia board of the Islamic Bank of Britain (IBB), the first wholly Islamic bank in Britain, established in 2004, decided not to sacrifice the whole project for an unattainable ideal and accepts that in the real world compromises have to be made. It had to accept that the definition of 'deposit' as applied by the Financial Services Authority (FSA) was incompatible with the PLS (*mudaraba*) character of the 'savings deposits' they offered customers. The solution agreed between IBB and the FSA was that IBB would inform customers that they were legally entitled to full repayment, but had the right to refuse deposit protection and choose sharia-compliant sharing not only of profits but also of losses (Chiu and Newberger 2006; Ainley et al. 2007). There don't seem to be such strictures against insurance of demand deposits, though a guarantee system where member banks pay premiums that are invested in interest-bearing instruments would not be acceptable. The Dutch system, where no premiums are paid but banks provide guarantees among themselves, is not tainted with interest payments. It would probably meet with less resistance from the *fuyaha*. In Jordan demand deposits of Islamic banks are covered by deposit insurance but if banks fail, investment account holders are treated like shareholders, which means that their deposits are not protected. Turkey, in 2003, allowed Islamic banks to create an Islamic deposit *takaful* that covers holders of demand deposits, whereas investment account holders receive protection only when it is fraudulent mismanagement that brings a bank down (Grais and Pellegrini 2006b; Solé 2007). Most countries with Islamic banks, however, have no explicit deposit insurance scheme. Some provide an implicit guarantee from the conventional insurance system, but that is not satisfying from an Islamic point of view, given that the funds of such a system may be invested in interest-bearing assets. Malaysia is preparing a scheme where premiums collected from Islamic banks will be invested separately from the premiums from conventional banks. However, they are designed to cover PLS accounts as well, which not only exacerbates the moral-hazard problems associated with such forms of finance, but also runs counter to the fundamental idea of risk sharing. The authorities appear to sacrifice religious purity for a lower risk of bank runs (Solé 2007).

- Speculation. As speculation, in the sense of attempting just to make a quick profit without caring for the underlying real asset, is seen as *maysir* and considered *haram*, stock market supervisors have to ask themselves whether they should interfere in case of high volatility. Regulators are known to impose limits on price volatility in

practice. Limits on the daily movement of stock prices are used in Korea, Malaysia and Japan, in order to prevent speculators pushing prices up or down too fast. Institutions such as the Australian Stock Exchange and the New York Stock Exchange may interrupt trading in individual stocks, for instance, when price-sensitive news is about to be released. The New York Stock Exchange also has ‘circuit-breakers’ that interrupt trading in the event of large price declines (Naughton and Naughton 2000). Supervisors of Islamic stock markets may draw inspiration from these examples.

- Zakat payments. Zakat payments are due on Islamic deposits. Opinions differ, however, whether it is the financial institution or the depositor who should pay zakat tax (KPMG 2006). It is up to Islamic standard-setting bodies themselves to solve this question, but if zakat is paid by the bank, supervisors understandably want to know where the money goes. After all, as we saw in Section 3.2, there are widely differing views on who should be the beneficiaries of zakat disbursements, ranging from the needy in the immediate environment of the taxpayer to bodies that defend the faith against any foe. The wide interpretation might include organizations that some governments find suspect.
- Sharia boards. Not all firms offering Islamic financial products disclose the powers of their boards and they are not in the habit of publishing the fatawa of these boards on the sharia-compliance of their products. Authors associated with the Dutch supervisory bodies (the central bank and the Autoriteit Financiële Markten, or Netherlands Authority for the Financial Markets) foresee reputational and even legal risks if clients of Islamic financial institutions start to doubt the Islamic character of their products. They also note that qualified potential members of sharia boards are not in abundant supply and they are concerned that conflicts of interest might arise with the same people manning a relatively large number of sharia boards (Verhoef et al. 2008).
- PLS lending. It has been noted that an Islamic bank, when providing funds according to PLS principles, may be considered a fund manager as much as a commercial bank. Some supervisors seem to prefer to treat them as such, though usually PLS takes up a minor share of a bank’s activities (El Qorchi 2005).
- The classification of Islamic financial instruments. What conventional instrument do they resemble most, and analogous to what conventional instrument should they be regulated? In the case of *mudaraba sukuk*, for instance, the British supervisor FSA notes that in each individual case it has to be decided whether they should

be seen as a Collective Investment Scheme, which is unregulated, or as debt instruments, which are regulated (Ainley et al. 2007, pp. 25–6).

Then there are the normal risks that also confront conventional finance, but these may demand a slightly different application of the rules in the case of Islamic finance, in particular as regards capital-asset ratios (see Verhoef et al. 2008; Čihák and Hesse 2008):

- Credit risk, or the risk of default of a counterparty. PLS financing is, as we have seen in Chapter 4, beset with moral-hazard problems. In addition, Islamic financial institutions cannot profit from penalties imposed on debtors that have fallen into arrears and credit risk cannot be mitigated by the use of credit derivatives. Credit risk may therefore be higher than in comparable conventional banks and this may call for higher capital–asset ratios.
- Market risk, that is, the risk of price volatility of marketable assets. This risk is arguably somewhat higher with a portfolio made up of Islamic products, as there is less scope for diversification or for hedging risks with the help of derivatives.
- Financing risk, or the risk of insufficient funding. The ban on *riba* makes it difficult for Islamic financial institutions that face a lack of liquid funds to take recourse to the interbank money market. This might be a reason for supervisors to insist on a higher volume of own funds or on higher cash and liquidity ratios.
- The character of investment deposits. In so far as these deposits are on a PLS basis and share in the total risk of the financial institution, they are on a par with own funds, or tier-1 capital in the terminology of the Basel Capital Accords. If those deposits are matched by specific investments and depositors only share the risks of those investments, they should not be included in the institution’s risk capital. As Islamic financial institutions tend not to shift losses to their clients in practice, for fear that they would defect to competitors, either Islamic or conventional, the conclusion will often be that investment deposits are not comparable to own funds.
- Operational risk. This is the risk of losses resulting from inadequate or failed internal processes, people or systems or from external events. The legal and reputational risks mentioned above might be included under this heading, but another factor, as noted by Čihák and Hesse (2008), is that monitoring PLS arrangements cannot easily be standardized, which may make large Islamic banks in particular vulnerable (provided a large part of their financing is in PLS modes).

This squares with their finding that large Islamic banks are financially less solid than large conventional banks and than small Islamic banks, whereas for small Islamic banks it is the other way round. Financial solidity is measured by return volatility relative to equity capital and reserves plus average return.³ The authors also note that financial solidity tends to decline when small banks grow, but to increase when large banks grow. Apparently, there is something like a U-shaped relationship. Their hunch is that, when large banks grow, increased diversification and a larger share of income from non-lending activities compensate for the negative effects of the high monitoring costs.

One fundamental question that the monetary authorities have to solve when Islamic financial institutions are set up in their jurisdiction is what supervisory approach to take. Two main approaches can be discerned. One, followed by regulators in Malaysia and Yemen, for example, is that the supervision and regulation of Islamic financial institutions should be entirely different from that of conventional banks. The second approach is to treat the sector as a variant of the conventional one and putting them under the same central bank supervision and regulatory regime, with only slight modifications and special guidelines for which occasional central bank circulars suffice. This is the approach followed in, among others, Bahrain and Qatar (El Qorchi 2005). Institutions such as the IFSB and the IIFM (see Section 5.4.4) can help in developing and harmonizing standards and norms.

7.5 CONCLUSIONS

Banks and governments have proven to be very innovative in designing ways for financing the government. Still, governments that fully rely on sharia-compliant financial instruments face some restrictions that their colleagues using conventional instruments do not have to cope with. First, borrowing must, at least formally, be backed by real goods, which leads to cumbersome procedures. Second, rescheduling government debt will be difficult, as Islamic contracts cannot easily be renegotiated.

As for monetary policy, the options open to the central bank are far more restricted than under conventional finance, but there have been enough innovations to make monetary policy at least possible, be it probably at higher cost and in more complicated ways than under conventional finance. Setting up an Islamic interbank money market in particular is bound to be a laborious process.

Finally, financial sector regulators have to face the fact that their standards and norms cannot always be applied to Islamic financial products without taking the special character of these products into consideration.

NOTES

1. See Fritschy (2008) on the history of tax farming in the Ottoman empire.
2. Presumably this counts as *tawarruq* and not as *bai inah* because the brokers may sell the commodities to other parties than the original sellers.
3. More precisely, the authors calculate z scores using $z \equiv (k + \mu)/\sigma$, where k is equity capital and reserves as per cent of assets, μ is average return as per cent of assets and σ is standard deviation of return on assets as a proxy for return volatility. The z score measures the number of standard deviations the return over a period has to fall in order to deplete equity, under the assumption of normality of banks' returns. A higher z score means a lower probability of insolvency (Čihák and Hesse 2008, p. 7).