Chapter Eight

Financial Markets

Introduction

8.1. This chapter covers market-based FSIs required for assessing the health of the financial system. The chapter is divided into two sections: interest rates and security market indicators. The interest rate FSIs provide information on the interest rates charged by and to deposit-takers, so providing an indication of profitability and competitiveness in the banking sector, along with information on the spread in inter-bank rates that can provide early indications of credit risk concerns among deposit-takers. The security market FSIs provide information on the liquidity of the security markets in which deposit-takers are active, and on which they can partially rely to help manage their liquidity.

I. Interest rates

Introduction

8.2. To support the monitoring of the financial health and soundness of deposit-takers, the *Guide* encourages the compilation of two interest-rate based FSIs: the spread between reference lending and deposit rates (SLDR), and the spread between the highest and lowest interbank rate (SIR).

8.3. Spreads between lending and deposit rates can serve as indicators of trends in deposit-takers' net interest income, and hence of *profitability*. The interest spread can also provide information on deposit-takers' *pricing behavior*. However, further information would be required to understand the causes of such behavior, such as a sectoral disaggregation and a peer group analysis of spreads.

8.4. Interest rate spreads such as those between borrowers with different credit risk profiles, can serve to indicate the level of *perceived risk* within the financial system. So, the

spread between the highest and lowest interbank rate would help to capture banks' *own* perception of problems and risks facing banks with access to the interbank market.[160]

Measuring the spread between reference lending and deposit rates (SLDR)

8.5. There is no standard definition of reference or representative rates. To measure the spread between lending and deposit rates (SLDR), the *Guide* recommends as a minimum the calculation of the weighted average of all lending and deposit interest rates on loans and deposits (excluding inter-deposit-takers' loans and deposits) during a reference period in the portfolio of resident deposit-takers. The interest rate spread could also be calculated on a domestically controlled, cross-border consolidated basis, so providing an indication of profitability, but it would be combining activity in different markets. Using loan and deposit amounts as weights, the spread between the weighted average lending and deposit rates gives the ***overall interest spread*** (in basis points) between loans and deposits.

8.6. Inter-deposit-takers loans and deposits are excluded because the focus of this FSI is on the profitability of the deposit-taking sector as a whole, and on its pricing behavior in intermediating the savings of other sectors. While the *Guide* recommends compilation of an aggregate interest spread at a minimum, more disaggregated information on spreads could be compiled as needed, such as for nonfinancial corporations and households.

8.7. A preferred method of calculating the weighted-average interest rate data is to divide the accrued amount of interest income on loans, and interest expense on deposits, reported by deposit-takers for a given period (numerator), by, respectively, the average position in loans,

[160] In discussions on the draft *Guide* it was suggested that other measures of deposit-takers' credit risk could be monitored, including spreads of bank paper over sovereign debt and spreads on subordinated debt. See also *Equity and bond market signals as leading indicators of bank fragility*, Reint Gropp, Jukka Vesala and Giuseppe Vulpes, ECB, (2001). The credit derivatives market is also a potential source of market information on the credit risk of individual entities. Such measures go beyond the agreed FSIs.

and deposits (denominator), for the same period.[161] Positions should be averaged using the most frequent observations available.

8.8. In concept, using this method, the weighted average interest rate for a portfolio of *n* loans for example can be constructed as follows:

$$\text{Weighted Average Interest Rate} = \sum_{i=1}^{n} RiLi \Big/ \left(\sum_{t=0}^{T} St \Big/ T\right) \quad [162]$$

Where, Ri = Interest Rate for Loan i that is outstanding during the period [163]
Li = Loan i
St = Stock of loans observed at time t
T = Total number of observations during the period

8.9. This method of calculation compilation should minimize the reporting burden on deposit-takers because data on accrued amounts of interest on loans and deposits should be readily available from the accounting systems of deposit-takers, while typically data on deposit-takers positions in loans and deposits are regularly reported to central banks in balance sheet reports required for the compilation of monetary statistics.

8.10. Another approach to calculating average weighted interest rates for a given reference period is to use contracted interest rates (i.e., price data), using the loan amounts as weights. The weights are determined by dividing the outstanding value of each loan at the end-of-the period by the outstanding value of all loans at the end of the period. Two steps are involved (i) multiply each weight (which can be derived for a single loan at a time or for a group of loans with the same contracted interest rate) by the contracted rate for each loan (or

[161] Islamic instruments that are classified as deposits or loans but do not provide capital certainty nor a prefixed positive return should be excluded from the denominator.

[162] For instance, if during the period of the first quarter there are end-month observations for end-December (200), end-January (100), end-February (200), and end-March (300), then St is the sum of the four observations (800) and T is the number of observations (4), so the denominator in the equation would be 800/4 = 200.

[163] The amount of accrued interest in the numerator depends on the time over which the associated loans are outstanding. For instance, for a loan that is issued mid-way through the quarter, the numerator should capture accrued interest over 1 1/2 months only.

group of loans) and (ii) sum the result to get the overall weighted interest rate. Thus, an overall average weighted interest rate can be constructed as follows:

$$\sum_{n=1}^{N}\left(rate_n \times \frac{Value\ of\ \ loan_n}{Total\ \ value\ of\ \ loan\ book} \right)$$

Key definitions

8.11. Under accrual accounting, interest costs accrue continuously on debt instruments, so matching the cost of funds with the provision of funds. The rate at which these costs accrue is known as the **interest rate**, and for deposit and loans is typically established by contractual arrangement. Interest rates may be fixed or variable. Charges such as fees that reflect payments for the provision of services should be excluded from the interest rate calculation. For compiling the SLDR, annualized interest rates should be calculated.[164] **Loans and deposits** are defined in Chapter 4. The reporting population is the **deposit-taking sector** as defined in Chapter 2, on a resident basis (although data could also be compiled on domestically controlled, cross-border consolidated deposit-taker basis)

End- and average-period interest rates

8.12. The *Guide* prefers that average-period interest rates be calculated for use in compiling the SLDR (see paragraph 8.7). Average period interest rates are more closely related to profitability and pricing behavior than end-period rates, and are not subject to the possibility of exceptional daily observations.

8.13. However, an SLDR based on end-period rates, with appropriate metadata, is acceptable. Such an spread between lending and deposit rates would be calculated as the difference between the weighted averages of end-period interest rates for the different types of loans and the different types of deposits (i.e., 3-month, 6-month, etc). The weights for

[164] For instance, to produce an the annualized rate per annum, interest rates per quarter should be compounded to the power of four. So, an interest rate of 3 percent per quarter is an annualized rate of 12.55 per cent = $(1.03)^4$.

each type of loan and deposit would be calculated using end-period position data (see paragraph 8.10).

Outstanding and new business

8.14. The *Guide* recommends as a minimum the compilation of an SLDR for outstanding business, as this is directly related to profitability. For the purposes of this FSI, outstanding business is the stock of deposits placed with deposit-takers and the stock of loans extended by deposit-takers, excluding deposits from, and loans to, other resident deposit-takers. The stock of loans is measured after specific provisions. The interest rate on outstanding business thus covers all business that has been agreed in all periods prior to the reference date and is still outstanding.

8.15. To reflect more closely current market developments rather than outstanding business, countries could also compile an SLDR for new business, particularly if the necessary data are readily available. New business is defined as deposits placed with deposit-takers and loans extended by deposit-takers during the reference period. New business includes "rolled over" or renewed loans and deposits. Interest rates on new business allows for the monitoring of deposit-takers' pricing behavior in response to current financial market developments, such as changes in central bank intervention rates.

Nonperforming loans (NPLs)

8.16. In Chapter 4, the *Guide* recommends that interest should no longer accrue on nonperforming loans resulting in an implicit interest rate of zero. While there might be some analytical benefit in excluding NPLs from the SLDR calculation (see ahead), the *Guide*'s preferred approach is to include such loans in the calculation. In other words, when compiling the interest rate on loans, positions in NPLs (less specific provisions)[165] should be included in the denominator and zero interest in the numerator. By widening the spread,

[165] Specific provisions have already reduced profits, and capital and reserves, and so are deducted from the denominator.

excluding such positions would give a misleading—overstated—indication of profitability. Indeed, movements overtime in the SLDR could be analyzed with the help of data on outstanding NPLs.

8.17. However, if NPLs are significant in deposit-takers portfolios, to provide additional information on deposit-takers' pricing behavior, another SLDR could be calculated that excludes the position in NPLs from the denominator in the compilation of the loan interest rate.

Lending at prescribed interest rates

8.18. In some economies, a certain amount of lending by deposit-takers can be directed to priority sectors at prescribed interest rates for the purpose of economic development. Similarly to the discussion above on NPLs, the *Guide* prefers that such loans, and the interest that accrues, are included in the calculation of an SDLR on outstanding business because excluding such business could give a misleading indication of profitability. Nonetheless, if significant, another SLDR could be calculated that excludes such prescribed lending and the average interest rate received. In such circumstances, there may be analytical interest in information on the aggregated amount of such lending.

Subcategorization

8.19. As noted above, while the *Guide* recommends as a minimum the compilation of the SDLR on all outstanding business (excluding among deposit-takers), this SDLR could be supplemented with subcategory detail. This is because the SDLR might change for a variety of factors, such as changes in the composition of business, the introduction of new competition, etc., which are not apparent by considering the overall spread alone. For instance, the overall interest spread may increase if (1) the sectoral concentration of the loans becomes more heavily weighted towards the household (consumer loans) instead of the corporate sector, since the interest rates offered by deposit-takers on consumer loans tend to be higher than those on corporate loans, or (2) the portfolio of loans becomes more weighted towards longer term loans, given a normal yield curve. Deposit rates can be similarly

affected. Indeed, only limited judgments could be drawn about the factors influencing changes in profitability and/or pricing behavior in the financial system from the use of the SDLR for all outstanding business alone.

8.20. As such, the SDLR for all outstanding business could be supplemented with SDLRs for:

- both the nonfinancial corporations sector and for the household sector.
- both short-term and long-term (original maturity) interest rates.
- peer groups, to ascertain the pricing behavior of different subgroups within the total resident deposit-takers.
- both domestic and foreign currency business.

Frequency of compilation

8.21. The *Guide* recommends quarterly compilation, and encourages monthly compilation. It is recognized that the accrued interest data on deposits and loans needed to compile average interest rates information may often be reported in deposit-takers' income and expense statements only on a quarterly basis.

Measuring the spread between the highest and lowest interbank rates (SIR)

8.22. Interbank rates measure the cost of funds to deposit-takers in the domestic interbank market—the cost of borrowing the excess reserves of other deposit-takers. The source of these data is usually interbank dealers or brokers.

8.23. Deposit-takers may be charged different rates depending upon their size or financial strength. An increasing spread between the highest and lowest interbank rate could indicate an increasing risk premium being charged on the deposit-taker facing the highest rate—that is, deposit-takers would themselves be perceiving increasing risk of lending within the banking system—which may be limited to the weakest deposit-taker or may turn out to be more systemic in nature.

8.24. However, there can be limitations with this indicator. For instance, in an economy with government-owned deposit-takers, they might continue to obtain the best interbank rates even if they are close to insolvent. Also the framework through which central banks provide liquidity to money markets influences the overall liquidity of these markets and the extent to which individual banks under stress are able to maintain access to liquidity, while one outlier can change the value of the indicator substantially.[166] In addition, a perceived increase in risk might also be reflected in informal limits on the quantities (rather than price) of funds that a deposit-taker could borrow in the interbank market.

8.25. Interbank rates are usually short-term in nature. Since this FSI provides information on deposit-takers' own perceptions of risks facing other banks, and perceptions can change very quickly, the *Guide* encourages weekly compilation of SIRs, using end-period rates for loans of the same maturity (overnight or weekly).[167] While the agreed FSI is a spread, there might also be analytical interest in the dissemination of the highest and lowest interest rates themselves; for instance, these rates could be compared with others in the financial markets.

II. Security markets

Introduction

8.26. Security markets can support financial stability by diversifying the channels of financial intermediation, and allowing perceived risks to be monitored on a continuous basis. For these reasons, while beyond the agreed FSIs, the *Guide* encourages the compilation of security market data, including information on the total outstanding value of domestic security market issuance, at a minimum, by sector.

[166] Thus, it might be analytically useful to also look at the spread excluding the high and low rates.

[167] The credit derivatives market is also a potential source of market information on the credit risk of individual entities.

8.27. However, conditions in financial markets may not always be conducive to raising funds through borrowing, and experience has shown the necessity for maintaining prudent levels of liquid assets. Moreover, the liquidity of assets depends on how quickly and with what certainty they can be sold in the market. So, to supplement the core indicator on the liquidity of banks' assets, the *Guide* encourages the compilation of indicators on market *depth* and *tightness*. [168]

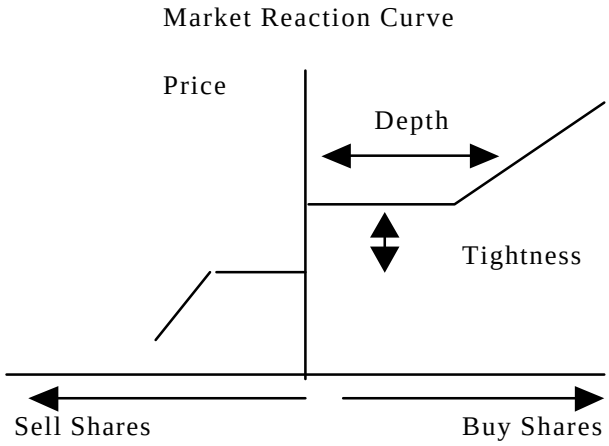
Market depth and tightness

8.28. While liquidity is difficult to define, two important dimensions are market depth and tightness. *Market depth* relates to the ability of a market to absorb large trade volumes without a significant impact on market prices, and can be proxied by the average daily turnover ratio—the ratio of average daily number of trades to the outstanding stock of securities. A higher turnover ratio typically indicates a more liquid market. *Market tightness* indicates the general cost incurred in a transaction irrespective of market price, and is measured by the average bid-ask spread—the difference between prices at which market participants are willing to buy (bid) and sell (ask) assets. Bid-ask spreads tend to be narrower in more liquid and efficient markets.[169]

[168] To further supplement the analysis of the core indicator, through an analysis of the distribution of option prices, financial derivative markets can be a source of information on the implied probability distribution of a future asset price that is, provide an indication of the likelihood that a particular price might be realized . For instance, see the Bliss and Panigirtzoglou, "Testing the Stability of Implied Probability Density Functions", Bank of England Working Paper 114, May 2000.

[169] Bid-ask spreads may reflect: (i) the cost of processing orders; (ii) costs arising from asymmetric information among potential transactors; (iii) the cost for the dealer of holding the asset (inventory) in order to meet potential demand (so-called carrying cost); and (iv) oligopolistic market structure. The price volatility of the asset can also be a factor.

Figure 1: Market Depth and Tightness[170]



8.29. Figure 1 illustrates the concepts of market depth and market tightness. The demand and supply curves to left and right of the price axis represent the price a seller or buyer faces when trading various numbers of shares. A buyer of shares faces a higher price in the market than a seller of shares. Market tightness is graphically depicted by the vertical distance between the buy and sell price. The horizontal distance between the vertical axis and the demand/supply response represents the depth of the market at a particular price. The short flat segment at the bid and ask price is the posted quote depth.

Immediacy and Resilience

8.30. In addition to market depth and tightness, other important dimensions of market liquidity include immediacy and resiliency.[171] *Immediacy* represents the speed with which orders can be executed and settled, and thus reflects, among other things, the efficiency of trading, clearing, and settlement systems. *Resilience* is the speed with which

[170] Source: The report on *Market Liquidity* by the Committee on the Global Financial System of the central banks of the Group of Ten countries (BIS, May 1999).

[171] See also Sarr and Lybek, *Measuring Liquidity in Financial Markets*, IMF Working Paper (2002), for a fuller discussion of market liquidity.

price fluctuations arising from trades are dissipated or the speed with which imbalances in orders (such as more buy than sell orders, or vice versa) are reversed with new orders. In short, it is a measure of the speed by which "transitory" price movements are corrected. Measures of resilience are described later in the chapter.

Market structure

8.31. Being aware of the institutional micro structure of markets can be important when using liquidity indicators, as different structures can complicate analysis of liquidity indicators across countries, across markets in the same country, and across time.

8.32. Particularly relevant is whether a market is quote- or order-driven. In an *quote-driven* (dealer) *market*, dealers quote bid and ask prices and may take positions, while in a pure *order-driven* (auction) *market* potential buyers and sellers submit orders and brokers or an electronic system match them in a central order book. In a quote-driven system, dealers provide immediacy and can even accommodate large orders by holding securities (inventory) to help match temporary imbalances between buyers and sellers. In a pure auction market liquidity is supplied through limit-orders[172]—orders placed with a broker to buy or sell a predetermined number of shares at a specified price or better than the specified price. In practice, many auction markets rely on market-makers[173] to supply additional liquidity to the market. Bid-ask spreads and turnover during periods of stress might differ between quote- and order-driven markets.

8.33. Other market structure features that can influence liquidity include the extent of *market transparency*, such as the timing of the disclosure of traded prices and quantities, and the efficiency and cost of *clearing and settlement systems*.[174]

[172] Limit orders also allow an investor to limit the length of time an order can be outstanding before cancelled.

[173] Agents that make publicly disclosed quotes for unrelated parties.

[174] Sarr and Lybek, *Measuring Liquidity in Financial Markets*, (page 38), IMF Working Paper (2002) provide a list of micro and macro factors affecting asset and market liquidity.

Measuring market depth and tightness

8.34. Indicators of market depth and tightness can be compiled for a wide range of traded financial assets. Because of the link between market-based liquidity indicators and the indicator on deposit-takers' liquid assets, turnover ratios and bid-ask spreads should, at a minimum, be compiled for financial instruments included in the wider measure of liquid assets. The natural starting point is to compile indicators for domestic government or central bank bills that are used by the national authorities to influence liquidity conditions in their domestic economy. Depth and tightness indicators for corporate securities may also be useful, particularly if they are within the definition of liquid assets. Similarly, the depth and tightness of the local foreign exchange markets are also relevant if foreign-exchange denominated securities qualify as liquid assets.

8.35. A breakdown of turnover and bid-ask indicators between on-the-run and off-the-run securities can also be useful in monitoring market liquidity conditions.[175] Empirical evidence suggests that liquidity differentials that typically exist between on-the-run and off-the-run securities may become more acute prior to and during periods of financial stress.[176]

8.36. Major exchanges located in the domestic economy can be used as a source of data for compiling market turnover ratios and bid-ask spreads. Other sources can include dealer associations, central banks, and commercial databases.[177] While high frequency data on the volume of trades and bid-ask prices are usually available from most exchanges, it is recognized that in some economies data may be infrequently collected centrally, and periodic and consistent data may be limited to certain types of securities.

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[175] On-the-run securities are the most recently issued security of a given original maturity. All other securities are defined as off-the-run.

[176] See for example, Reinhart and Sack, *The changing information content of market interest rates*, and Furfine and Remolona, *What's behind the liquidity spread? On-the-run and off-the-run US Treasuries in Autumn 1998*, BIS Quarterly Review, June 2002.

[177] Compilers who approach a commercial database vendor will need to make their own judgments about whether the product being offered meets their needs.

8.37. To the extent that deposit-takers hold securities issued by nonresidents, or hold so-called international securities that are listed on local and overseas exchanges, it is relevant to also monitor depth and turnover indicators for key foreign financial asset markets, especially if liquidity conditions differ across markets for the same asset.

8.38. Coverage of all market makers may not be necessary for capturing trends in turnover ratios and bid-ask spreads because in highly liquid markets, price and size quotes tend to converge across market makers. Nevertheless, market liquidity can vary across assets and through time. The top five market makers, or at least those accounting for a minimum of 75 percent of market turnover, should therefore be covered. Automated electronic market making can also be covered.

8.39. While the transaction price and transaction size might be used to capture realized prices and volumes in the market, bid and ask deals may be undertaken at different times, biasing the resulting "spread." For this reason, quoted bid-ask prices and volume data are preferred.

Turnover ratio

8.40. The *Guide* recommends that the turnover ratio for securities be calculated as the number of securities bought and sold during a trading period divided by the average of the number of securities outstanding at the beginning and the end of the trading period:

$$T = \frac{N}{[(S_t - S_{t-1})/2]},$$

where N is the number of securities bought and sold during the periods and S is the number of securities outstanding.

8.41. The *Guide* encourages the compilation of the turnover ratio on a daily basis or, at a minimum, weekly basis.

8.42. While the turnover ratio might also be calculated using the value of securities traded and outstanding in the period, the *Guide* prefers the above approach because it facilitates cross-country and cross-market comparisons. Nevertheless, to gauge market size, collection of information on the total value of securities outstanding on instruments for which turnover data are presented is encouraged.

8.43. The number of trades executed during official trading hours of the markets should be captured.[178]

8.44. There is a lack of data on foreign exchange market turnover except for the triennial central bank survey of foreign exchange (and derivative market activity) conducted by the BIS. [179] This survey defines foreign exchange turnover as the gross value of all new deals entered into during a given period, measured in terms of the nominal amount of the contracts. However, information on bid-ask spreads is more readily available.

Bid-ask spread

8.45. The simplest measure of the bid-ask spread is the difference between the best (highest) bid and the best (lowest) ask price in the market. So, XYZ security with a best bid price of 120.375 and a best ask price of 120.5 has a bid-ask spread of 0.125. It is recommended that both the bid and ask prices be collected. To facilitate comparison of bid-ask spreads across assets of differing value, the *Guide* recommends that bid-ask spreads be expressed as a percentage of the mid-point of the buy and sell price of the asset. For example, ABC security with a bid price of 10.375 and ask price of 10.5 has a bid-ask spread of 0.125, the same as for XYZ security. But, the bid-ask spread for ABC security is larger relative to the value of the security:

[178] The increasing prevalence of trading outside of official exchange hours, as well as the use of off-hours futures for securities suggests there may be an increasing need for supplemental statistics on off-hours trading, especially since liquidity conditions in those markets may differ substantially from conditions during regular trading hours.

[179] The most recent survey in 2001 collected data on turnover in foreign exchange markets from 48 central banks. See *Triennial Central Bank Survey 2001,* BIS, March 2002.

- Spread for ABC security as a percentage of price = (0.125) / (10.4375) = 1.20 percent of mid-price.
- Spread for XYZ security as a percentage of price = (0.125) / (120.4375) = 0.10 percent of mid-price.

8.46. More generally, the percentage spread can be calculated as follows:

$$S = [(AP - BP)/((AP + BP)/2)] \times 100,$$

where AP is the ask price and BP the bid price.

8.47. For traded debt securities such as bonds and bills, the bid and offer quotes can be in terms of yield rather than in terms of price. In such instances, the *Guide* recommends that the bid and ask yields are separately reported and converted into price terms so that the mid-point and spread in price can be observed. Methods of calculating bid and ask prices from yields can differ depending upon the maturity of the instruments and the specific market practices for quoting yields. However, the type of information required for conversion typically includes the par value, the quoted yield, and the maturity (or for longer instruments, the duration) for the instrument. Box 8.1 provides some conversion equations and numerical examples for calculating bid and ask spreads in price terms from yields.

8.48. The number of securities that can be traded at the best bid and best ask price provide an important context for interpreting the bid-ask spread, and the *Guide* encourages the dissemination of this information along with the best bid-ask spread. In particular, any asymmetry in the number of securities that can be bought and sold at the best bid and best ask prices should be collected along with the price quotes. For example, the number of securities that a market maker is willing to sell at 120.5 might be 1,200, while the number of securities that a market maker is willing to buy at 120.375 might be 500, indicating more sell than buy pressure in the market at the quoted price. Sustained over time, such asymmetries convey useful information about the speed and certainty with which deposit-takers' can dispose of their liquid assets.

8.49. For consistency with the turnover ratio, the bid-ask spread should be compiled on a daily basis or, at a minimum, on a weekly basis. The frequency of price observations can

be on a tick-by-tick basis, but preferably at least two quotes per day should be taken (for example at 10.30 a.m. and 2.30 p.m.). If price observations are taken on a less than hourly basis, care is needed to avoid biases related to systematic volatility of intraday price quotes. In particular, empirical work suggests that spreads are typically higher around open and close of the market, with sharp fluctuations immediately before and after the lunch break. The daily (or, weekly) bid-ask spread can be computed as the average of the bid price less ask price observations during the period.

8.50. Beyond the simple measure of the best bid-ask spread described above, there are two additional ways of calculating the bid-ask spread that take into account the quantity of securities that can be traded at the quoted prices.

- A "normalized" version of the simple bid ask spread can be calculated by taking the difference between bid and ask prices for the *same or similar quantity of securities*. For example, suppose the best sell price for XYZ securities is 120.50 for 1,200 in number. Suppose on the bid side that 1,200 XYZ securities can be sold only in two tranches as follows: 500 at 120.375, 700 at 120.125. The "normalized" bid-ask spread is 0.271.[180]

- A weighted average of all bid-ask prices, not just the best in the market, can also be calculated, using the bid-ask size as weights. For example, given the following bid and ask quotes:

Ask quotes			Bid quotes		
Total ask size = 6700			Total bid size = 2200		
Size	*%*	Price	Size	*%*	Price
1,200	*(18)*	120.50	500	*(23)*	120.375
2,000	*(30)*	120.625	700	*(32)*	120.250
3,500	*(52)*	120.750	1,000	*(45)*	120.125

[180] 120.50 – ((120.375*(500/1200)) + (120.125*(700/1200))) = 0.271

the weighted average bid-ask spread can be calculated as,

[(0.18 x 120.50) + (0.30 x 120.625) + (0.52 x 120.750)] – [(0.23 x 120.375) + (0.32 x 120.250) + (0.45 x 120.125)]

= [(21.58 + 36.01 + 63.08) – (27.36 + 38.26 + 54.60)]

= (120.67 – 120.22) = 0.45

More generally, the weighted average bid-ask spread can be calculated as:

$$\sum_{n=1}^{N}\left[\left(\frac{AS_n}{TAS}\times AP_n\right)-\left(\frac{BS_n}{TBS}\times BP_n\right)\right]$$

Where,

AP_n and AS_n are, respectively, the nth ask price and nth ask size,

BP_n and BS_n are, respectively, the nth bid price and nth bid size,

Total ask size, is given by $TAS = \sum_{n=1}^{N} AS_n$,

Total bid size, is given by $TBS = \sum_{n=1}^{N} BS_n$, and

N is the number of observations.

Measuring resilience

8.51. Going beyond the agreed FSIs, resilience and depth of markets can be measured by the *Hui-Heubel Ratio* (HHR). This ratio relates the volume of trades—as a proportion of the outstanding stock of the instrument—to their impact on prices. Thus, the larger the volume of trades relative to the percentage price change—that is, the lower the HHR—the more resilience and deep the market. The HHR is specified as follows:

$$HHR = \frac{\left[\left(P_{\max} - P_{\min}\right)/P_{\min}\right]}{\left[V/\left(S\times\overline{P}\right)\right]}$$

Where,

P_{max} = highest daily price over period

P_{min} = lowest daily price over period

V = total dollar (domestic currency) value traded over the period

S = number of instruments outstanding

$\overline{P}$ = average closing price of the instrument over period

8.52. Subject to data availability, the ratio could be calculated on a daily basis to capture very short-term price movements, or as an average of the 5-day periods in a specified period of time (such as 3 months) to smooth volatility.

8.53. If there is a lack of data, the numerator in the HHR can be measured as the percentage change in the price of the asset over the period chosen, while other measures of trading volume could be used, such as the number of securities traded.

Text Annex: Structural Indicators for Financial Markets

8.54. In different countries, financial markets are at different stages of development and this can affect analysis of FSIs, particularly for market-related indicators. While collection systems may not be sufficiently advanced to provide data on activity in the various types of financial markets, it may be beneficial to policy makers and analysts to be provided with some indication of the types of markets that exist and their stage of development.

8.55. For this reason, Table 8.1 is presented below; it goes beyond the agreed FSIs. The table is intended to provide a judgmental impression of the state of development in domestic financial markets. The extent to which national authorities consider the specific markets to be very important, important, or not is marked by an asterisk. Table 8.1 provides a hypothetical example. Overtime this table could be developed to include actual data. Additional information on whether the market is order or quote driven could be added.

8.56. Payment system information is not covered in Table 8.1. However, an example of the type of payment system information that could be made available is provided in the so-called “Red book” published by the BIS’s Committee on Payment and Settlement Systems.[181]

8.57. Table 8.2 provides examples of structural data requested on FSAP missions.

[181] The objective of the Red Book is to provide a clear and reasonably comprehensive description of a country's payment systems to a reader who has some familiarity with payment systems in general but who knows little or nothing about the particular arrangements in that country. The Red book published in 2001 is available at: http://www.bis.org/publ/cpss44.pdf#xml=http://search.atomz.com/search/pdfhelper.tk?sp-o=28,100000,0

Table 8.1: Stage of development in domestic financial markets

	Overall Evaluation (entries below are illustrative)	Comments
Money Markets		
Interbank	***	
Treasury bill	**	
Central bank bill	—	
Certificate of deposit	**	
Commercial paper	*	
Bankers acceptances	*	
Repurchase agreements	**	
Securities Markets		
Government bonds	**	
Corporate bonds	*	
Asset backed securities	*	
Equity	**	
Foreign Exchange Market		
Spot	***	
Forward	**	
Swaps	**	
Other Derivatives Markets		
Futures	*	
Options	*	
Swaps	*	
Other Financial Markets		
Commodities	—	

*** Very important
** Important
* Exists, not important
— Nonexistent

Table 8.2: Example of data request for an FSAP mission[182]

Markets: Describe the number and nature of financial markets (provide copy of pertinent rules and regulations) and list the instruments traded.

Foreign exchange market: Local currency versus U.S. dollar (spot, forwards, and derivatives, if any).

Money market
- Certificates of deposit with different maturities
- Repurchase agreements (repos) (including repos for intraday liquidity to support a Real Time Gross Settlement (RTGS) system)
- Treasury bills with up to one year maturity in local and foreign exchange
- Central bank bills with maturity up to one year in local and foreign exchange
- Commercial paper, if any
- Derivatives, futures, options, Forward rate agreements, etc.

Government securities market:
- Notes (1-, 2-, and 5-year), both benchmarks and off-the-runs, and indexed notes, if available
- Bonds (10-, 15-, and 30-year), both benchmarks and off-the-runs, and indexed notes, if available
- Futures and other derivatives, if available

Equities: The number of listed companies and total market capitalization
- Ten most traded equities
- Derivatives, futures on indexes, etc.

Data: Provide data on respective markets the last three years, if available.

Frequency: Daily

Price: Bid and ask prices/interest rates if available
Minimum and maximum prices/interest rates during the day (or period of observation) if relevant
Average prices/interest rates, where relevant
Closing prices/interest rates, where relevant
Market indicators (market index if available)

Turnover: Turnover during period (value per day or month)
Average number of trades during day

Outstanding value: Value at market price of pertinent most traded issues
Value at market price of total market

[182] Source: Sarr and Lybek, *Measuring Liquidity in Financial Markets*, IMF Working Paper (2002)

Chapter 8: Financial Markets

Box 8.1

Converting bid-ask spreads from yield quotes into price terms

For traded debt securities such as bills and bonds, this box provides numerical examples of how to convert bid and offer quotes in yield terms into price terms. These examples are illustrative in that national market practices for quoting yields can differ.

Bills

On July 31, it is assumed that a bill has the following characteristics:

Maturity	Days to maturity	Bid Yield	Ask Yield
October 26, 2002	86	6.03	6.02

The discount yield on the bill maturing October 26 is 6.03% based on the bid price of the bill and 6.02% based on the ask price of the bill.[1] If the yields are quoted as *bank discount yields* such that $r_{bdy} = \frac{par\,value - market\,price}{par\,value} \times \frac{360}{n}$, then rearranging the equation the market price can be computed as follows:[2]

$$market\ price = par\ value \times \left[1 - r_{bdy} \times (n/360)\right]$$

Using the bid and ask yields as inputs, the bid and ask prices can be derived as follows:

Bid price = 10,000 x [1 – (0.0603 x (86/360))] = $9,855.95

[1] The bid price is the price at which a customer can sell the bill to a dealer in the security, whereas the ask price is the price at which the customer can buy a security from a dealer.

[2] The local method used for calculating the bid and ask yield may differ from the discount yield method, for example the bond equivalent yield might be used; in deriving the bid ask prices from yields, the formula relevant to local practices should be used.

Ask price = 10,000 x [1 – (0.0602 x (86/360))] = $9,856.19

The bid/ask spread as a percentage of the mid-price can be calculated as:

(9,856.19 - 9855.95)/ ((9,856.19 + 9855.95)/2) = 0.002%

If the bid and ask yields on bonds are quoted as *bond equivalent yields* rather than bank discount yields such that $r_{bey} = \frac{par value - market\ price}{market\ price} \times \frac{365}{n}$, then the market price can be computed as follows:

$$market\ price = \frac{par value}{1 + \left(r_{bey} \times \frac{n}{365} \right)}$$

Using the bid and ask yields as inputs, the bid and ask prices can be derived as follows:

Bid price = 10,000/ 1+ (0.0603x(86/365)) = 10,000/1.014207 = $9,859.91

Ask price = 10,000/1+(0.0602x(86/365)) = 10,000/1.0141841=$9860.14

The bid/ask spread as a percentage of the mid-price is 0.22/9860.03 = 0.002%

Bonds

It is assumed that a bond has the following characteristics,

Coupon	*Original Maturity*	*Remaining Maturity*	*Par Value*	*Bid/Offer (Yield to maturity)*
$60 annually	30-years	5-years	$1000	8.03/7.97

the value of the bond can be written as follows:

$$\Pr ice = \sum_{t=1}^{T} \frac{Coupon}{(1+r)^t} + \frac{Par value}{(1+r)^T},$$

$$=> \text{Price} = Coupon \times \frac{1}{r}\left(1 - \frac{1}{(1+r)^T}\right) + Par\ value \times \frac{1}{(1+r)^T} \ ,$$

where T is the number of periods to the maturity, and r is the interest rate for each period.

Accordingly, the bid and offer prices of the bond in the above example can be derived as follows:

$$Bid\ price = 60 \times \frac{1}{0.0803}\left(1 - \frac{1}{(1.0803)^5}\right) + 1000 \times \frac{1}{(1.0803)^5} = \$919.01$$

$$Ask\ price = 60 \times \frac{1}{0.0797}\left(1 - \frac{1}{(1.0797)^5}\right) + 1000 \times \frac{1}{(1.0797)^5} = \$921.28$$

The bid/ask spread as a percentage of the mid-price is 2.27/920.15 = 0.25%