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Liquidity Risk

Managing Asset and Funding Risk

Erik Banks

LIQUIDITY RISK

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Managing Asset and Funding Risk

ERIK BANKS

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Acronyms

ALCO	asset–liability committee
bps	basis points
CMO	collateralized mortgage obligation
CP	commercial paper
ECP	Euro commercial paper
EMTN	Euro medium-term note
EVT	extreme value theory
FRN	floating rate note
GAAP	generally accepted account principle
IO	interest only
LAVAR	liquidity-adjusted value-at-risk
LBO	leveraged buyout
LC	liquidity committee
LCMT	liquidity crisis management team
LR	liquidity risk
MAC	material adverse change
MBS	mortgage-backed security
MTN	medium-term note
NFR	net funding requirement
NIF	note issuance facility
OTC	over-the-counter
PO	principal only
RSA	rate sensitive asset
RSL	rate sensitive liability
RUF	revolving underwriting facility
SPE	special purpose entity
VAR	value-at-risk

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PART I

Elements of Corporate Liquidity

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CHAPTER 1

Liquidity Risk Defined

Liquidity, which we define broadly as the availability of cash or equivalent resources, is the lifeblood of every commercial and sovereign entity. Liquidity allows expected and unexpected obligations to be met when needed so that daily business affairs can proceed uninterrupted. In the absence of sufficient cash resources activities may be jeopardized; more importantly, the probability of encountering more severe financial distress increases. Liquidity is therefore a vital element of financial management and must be considered and managed with care. In this introductory chapter we begin our review of liquidity by examining definitions of liquidity risk, and considering liquidity risk in relation to general corporate operations and other dimensions of financial exposure. We also outline key themes we intend to explore in the balance of the text.

DEFINITIONS OF LIQUIDITY RISK

It is well known that the modern corporation must cope with a broad range of risks in the pursuit of business. The same is true, though sometimes to a lesser degree, of municipal, quasi-governmental and governmental entities. Risk, which we define as any source of uncertainty impacting business operations, comes in various forms. Although any taxonomy of risk is subjective, we begin by segregating risk into *financial risk*, or the risk of loss arising from financial variables that impact balance sheet and off-balance sheet activities, and *operating risk*, or the risk of loss arising from variables that impact the physical characteristics and operations of a business. While operating risks (including exposure to non-financial inputs/outputs, property and casualty losses, environmental liability, fiduciary liability, workers' health, safety, and compensation, and so forth) are crucial to understand and manage, we shall not consider them in further

detail, except in the context of how they might lead to cash flow pressures. Instead, we focus on financial risks, decomposing them first into three broad classes: market risk, credit risk and liquidity risk.

Market risk is the risk of loss due to adverse changes in the market prices/variables of a transaction or business. *Credit risk* is the risk of loss due to failure by a counterparty to perform on its contractual obligations. We can provide further granularity by considering financial exposure variables such as volatility risk, curve risk, directional risk, and basis risk (all subsets of market risk), and default risk, credit spread risk, contingent credit risk, sovereign risk, and settlement risk (subsets of credit risk). Both dimensions are essential to proper corporate risk management, but detailed discussion is out of the scope of this book. We shall therefore limit our discussion of market and credit risks to areas where they directly impact aspects of our main focus: liquidity risk, the last of the three broad classes of financial risk. Although liquidity risk is sometimes classified as a subset of market risk, we believe that it is more helpful to consider the category separately. This ultimately allows for more accurate measurement and management.

If liquidity is the availability of cash or equivalents, then we can define *liquidity risk* as the risk of loss arising from a lack of cash or equivalents or, more specifically, the risk of loss arising from an inability to obtain funding at economically reasonable levels, or sell[1] or pledge an asset at carrying prices, in order to cover an expected or unexpected obligation. Liquidity risk is, in essence, the risk of economic loss suffered in attempting to secure the cash that is so vital to continuing business operations.

We can also develop more detailed definitions of liquidity risk. It is helpful, for instance, to distinguish between funding (or liability) liquidity, asset liquidity, and joint liquidity. Funding liquidity focuses on the availability of unsecured liabilities that can be drawn on to create cash, including short-term and long-term debt facilities. *Funding liquidity risk* is, therefore, the risk of loss stemming from an inability to access unsecured funding sources at an economically reasonable cost in order to meet obligations. Asset liquidity focuses on the availability of assets, such as marketable securities, inventories, receivables, and plant and equipment, which can be sold or pledged to generate cash. *Asset liquidity risk* is thus the risk of loss arising from an inability to convert assets into cash at carrying value in order to meet obligations. In certain instances asset and funding liquidity join together to produce an incremental degree of risk, which we term *joint asset/funding liquidity risk* – the risk of loss that occurs when funding cannot be accessed and assets cannot be converted into cash in order to meet obligations. It is important to stress that cash-sensitive off-balance sheet commitments and contingencies often supplement cash flow

risks generated through balance sheet operations. Indeed, we shall note at various points in the text the crucial role off-balance sheet contracts play in liquidity risk management.

We can also consider liquidity risk in the context of internal and external forces. Some aspects of asset and funding liquidity are specific to an institution, its financial position, and its scope of operations, and are largely or entirely within its direct control. The liquidity features of the firm are not necessarily impacted by, nor do they impact, what happens in an industry or system context; this characteristic is commonly referred to as *endogenous liquidity*. In some cases, however, liquidity has a broader reach, affecting many institutions in a sector, or contracts in a marketplace; this *exogenous liquidity* is outside the direct control of any single institution, although in certain instances the actions of individual firms can contribute to the exogenous pressures.

For additional perspectives on liquidity and liquidity risk we summarize in Box 1.1 sample definitions from a number of regulators and industry bodies. Some of these are specific to financial institutions, and others applicable more generally to the marketplace at large.

Box 1.1 Sample definitions of liquidity and liquidity risk

American Academy of Actuaries (USA)

Liquidity is the ability to meet expected and unexpected demands for cash. Specifically, it is a company's ability to meet the cash demands of its policy and contract holders without suffering any (or a very minimal) loss. The liquidity profile of a company is a function of both its assets and liabilities. Liquidity risk is inherent in the financial services industry and one must understand, measure, monitor, and manage this risk.

(AAA, 2000, p. 4)

Bank for International Settlements (Supranational)

A liquid market is a market where participants can rapidly execute large volume transactions with a small impact on prices.

(BIS, 2000, p. 5)

Canadian Institute of Actuaries (Canada)

Liquidity risk is the inability to meet financial commitments as they fall due through ongoing cash flow or asset sales at fair market value. Liquidation risk is the potential loss when the sale of an asset is urgently required, which may result in the proceeds being below fair market value. The loss is the difference between the fire sale price and the fair market value.

(CIA, 1996, p. 4)

Box 1.1 continued

Federal Deposit Insurance Corporation (USA)

Liquidity represents the ability to efficiently and economically accommodate a decrease in deposits and other liabilities, as well as fund increases in assets. A bank has liquidity potential when it has the ability to obtain sufficient funds in a timely manner, at a reasonable cost.

(FDIC, 1998, p. 1)

Financial Services Authority (UK)

Liquidity risk is the risk that a firm, though solvent, either does not have sufficient financial resources available to it to meet its obligations when they fall due, or can secure them only at excessive cost. It is a basic business risk faced to some degree by most (if not all) firms, though clearly it is more significant for some than others.

(FSA, 2003, p. 3)

HM Treasury (UK)

Liquidity is the ease with which one financial claim can be exchanged for another as a result of the willingness of third parties to transact in the assets.

(HM Treasury, 1999)

International Association of Insurance Supervisors (Supranational)

The risk emerging when the insurer fails to make investments (assets) liquid in a proper manner as its financial obligations fall due.

(IAIS, 2000)

International Organization of Securities Commissioners (Supranational)

The risk to [an institution's] ability to meet commitments in a timely and cost-effective manner while maintaining assets, and in the inability to pursue profitable business opportunities and continue as a viable business due to a lack of access to sufficient cost-effective resources.

(IOSCO, 2002, p. 3)

Office of the Comptroller of the Currency (USA)

Liquidity risk is the risk to a bank's earnings and capital arising from its inability to timely meet obligations when they come due without incurring unacceptable losses.

(OCC, 2001, p.1)

Office of the Superintendent of Financial Institutions (Canada)

Liquidity is the ability of an institution to generate or obtain sufficient cash or its equivalents in a timely manner at a reasonable price to meet its commitments as they fall due.

(OSFI, 1995, p. 2)

Figure 1.1 summarizes the general taxonomy of risks we have outlined above.

LIQUIDITY, RISK, AND THE CORPORATION

A company requires liquidity in order to operate successfully. Liquidity can be viewed as the essential resource that permits a company to replace its liabilities, meet contractual obligations, and fund growth, all at a reasonable price, when needed. Liquid resources allow planned principal and interest payments, supplier, customer or lease payments, committed capital investments, dividends, and other obligatory cash flows to be met on schedule. Equally important, liquidity allows unanticipated obligations to

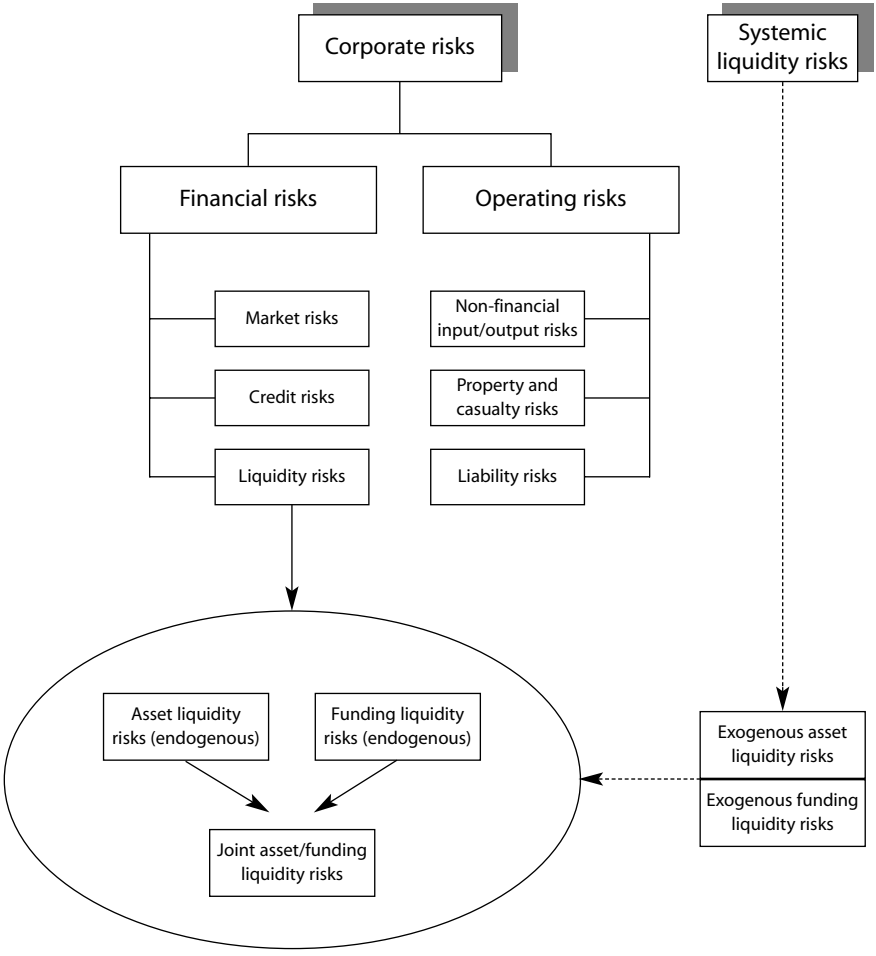

Figure 1.1 A general taxonomy of risks

be met with ease, and at a reasonable economic cost. This is important, because cash flow surprises are quite common in the corporate world: a company might be called on to make emergency payments to suppliers, provide customer restitution in the event of product problems, acquire a competitor when a sudden opportunity arises, or quickly repay contingent obligations when a lender or investor exercises a repayment option. Since unanticipated obligations cannot, by definition, be predicted, a company must maintain access to enough resources to cover such eventualities.

Failure to meet expected or unexpected payments on a timely basis can have serious ramifications. In particular, when a company cannot cover its obligations, it might jeopardize access to external sources of funding and become a forced seller of assets at unfavorable prices; it might also damage its reputation in the marketplace, create investor and creditor unease, and attract regulatory scrutiny. Any of these events can lead to instances of financial distress, some culminating in bankruptcy. A company might appear to be perfectly sound from a capitalization perspective (with sufficient capital and reasonable leverage) but if it lacks the cash to meet obligations, it might actually be forced into default. Preventing such an event through active management of liquid resources is thus powerful motivation for a firm's leadership.

Liquidity is also necessary in order to fund asset growth. Although capital is the essential ingredient in long-term investment, expansion, and research and development, liquid resources make possible the initial and periodic payments that are necessary to put plans into motion. Since companies depend on growth to build enterprise value, an ability to properly finance such expansion is imperative.

Endogenous liquidity risk can arise for a number of reasons, as we shall note in subsequent chapters. Broadly speaking, liquidity risks are induced by operating risks, credit and market risks, management/reputational problems, and legal/regulatory/compliance difficulties. Actual exposure and risk of loss can intensify dramatically when several of these forces are combined. Operating risks, including disruptions in daily business flows (such as sourcing, acquisition, extraction, transportation, and so forth) can impact cash flows and generate liquidity losses. Although the prudent company typically has some type of pre-loss financing in place – through insurance, contingent capital, or other forms of risk mitigation – access might be delayed or coverage might prove inadequate. Those that lack any pre-loss financing at all can face even more severe problems.

Credit risks can lead to liquidity problems if a counterparty fails to perform on a contracted transaction, such as a derivative or loan. The party (perhaps a bank or another company) expecting its counterparty to supply a cash flow will not receive what it should, and might experience a liquidity deficit as a result. Market risks can create losses in a firm's trading and

investment portfolio, again leading to a cash flow shortfall. Although this mainly impacts companies following mark-to-market accounting policies, it can also affect companies that have experienced a permanent impairment in asset value. Management, reputational, regulatory, and compliance problems can also cause, or intensify, liquidity risk. A firm that has damaged its reputation through particular behaviors (such as financial mismanagement, fraud, or product liability/recall) might lose customers and business revenues, causing investors and creditors to re-evaluate their willingness to supply funds. Regulatory sanctions, lawsuits, or other forms of legal action or penalty can exacerbate the situation and create even more pressures through forced compensatory payments.

Exogenous forces, such as a systemic market dislocation, a cyclical credit crunch, or a sovereign event (such as capital controls or a debt moratorium), can also play a role in firm-specific and sector liquidity pressures. Financial and economic stability are not characteristics of the modern corporate world. Even in an era of sophisticated products, markets, and conduits, leading-edge computational processes, deregulation, competition, and external and self-regulatory oversight, market stability cannot be guaranteed – meaning that the influence of external forces on liquidity access must always be considered. This becomes particularly critical during periods of economic weakness: regional or global economic slowdowns, credit deterioration, and real asset depreciation can intensify liquidity problems at the micro and macro level.

Although certain regulations exist to help dampen the possibility of large-scale illiquidity, they are not foolproof. (Indeed, we shall note later in the book instances where regulatory directives have actually intensified liquidity risks.) We can consider several basic examples of external liquidity pressures. For instance, if the banking sector is suffering from an excess of bad loans and reducing its corporate lending, individual companies (including those that are good credits) might have difficulty accessing or renegotiating debt facilities on favorable terms, leading to an increase in the cost of funding and inducing liquidity-related losses. If the global equity or fixed income markets are unstable, causing panic selling into thin trading volume, the prices of assets might plunge dramatically. Companies needing to sell or pledge assets in order to secure liquidity will be doing so under very unfavorable market circumstances, again suffering losses. Liquidity-related losses can therefore come from internal as well as external sources. Although the degree of intensity can vary by firm, industry, country, and market, the specter of loss is always present.

The nature of liquidity risk and risk management is, of course, industry-specific. Although all industries must take account of liquidity, some must focus more heavily on active liquidity management than others. This is true

when the functions they perform and businesses they run are based on accepting and providing liquidity. For instance, financial institutions essentially act as liquidity conduits; they feature fluid and often unpredictable assets, liabilities, and contingencies that must be revalued every day, meaning they must devote considerable effort to managing the internal liquidity process as precisely as possible. The collective balance sheet of the financial sector – which includes banks, securities firms, broker/dealers, insurers, and asset management companies – is characterized by a high degree of liquid and transferable assets (and very little in the way of fixed assets), a large amount of volatile, short-term funding, and significant off-balance sheet contingencies.

Industrial companies hold a much greater portion of their assets in inventory, property, plant, and equipment – the semi-fixed and fixed assets used to create computers, cars, jet engines, steel bars, and other durable and non-durable goods. They allocate a smaller percentage of their balance sheets to short-term assets and short-term liabilities, and are far less active in off-balance sheet transactions. In addition, most follow accounting conventions that allow the bulk of their operations to be valued at the lower of cost or market value, meaning they have no need to fund any losses or shortfalls that might arise through use of the mark-to-market accounting process. As a result, such companies tend to place less emphasis on the daily, active management of liquidity risk.

Within the extremes of the financial and industrial sectors lie non-financial service companies, including those focused on transportation, retailing, hospitality, entertainment, beverages, foodstuffs, and so on. Their assets are not as liquid as those of financial institutions, but most carry a reasonably high proportion of inventories, receivables, payables, and short-term funding, and they may also be active in off-balance sheet transactions. They are far more likely than industrial firms to employ an active approach to liquidity management.

Municipalities and sovereigns must also manage their liquidity carefully, balancing inflows from taxes and grants with a variety of outflows, including those related to infrastructure, capital works, education, and transportation.

Since it is known that cross-industry differences exist, it is no surprise that each industry takes a different approach to the liquidity risk analysis and management process. While it is tempting to say that active liquidity risk management is most important for financial institutions – and in some respects it is, because financial institutions are liquidity providers to all other industries and are subject to greater systemic pressures – liquidity risk can prove devastating for firms from a range of non-financial industries. It cannot be considered to be of "secondary importance" in the management of corporate affairs. Indeed, some large non-financial

corporations have discovered just how critical is access to liquidity, as we shall discover later in the book. While we shall devote a reasonable portion of this book to considering liquidity risk for financial institutions, much of our discussion is equally appropriate and relevant for the corporate treasurers and CFOs running non-financial service and industrial companies, and for government officials managing sovereign/municipal cash flows. The need for an adequate supply of cash resources crosses industry boundaries.

Allowing for the obvious differences that can arise as a result of industry or sector specialization, a company generally attempts to manage liquidity through its assets and liabilities, and by taking account of its off-balance sheet activities. Although we shall explore this topic in detail in subsequent chapters, we introduce several key thoughts at this point.

After taking account of net cash inflows from operations, funding liquidity is the traditional domain of liquidity risk management – it is considered to be the "first line of defense" in meeting obligations. Effective funding liquidity management is based on determining how the firm's primary funding sources – from the most committed, reliable, and stable, to the most volatile and unpredictable – can be used to meet demands. Indeed, funding remains the mainstay of many corporate liquidity risk management programs, particularly for firms operating outside the financial sector. Assets, however, have become a more important part of the liquidity risk process in recent years. Management of asset liquidity is based on understanding how assets can be used to supplement the cash position generated through core operations and funding. The process is based on analyzing the composition of the primary asset accounts to determine how much cash value they might yield, and understanding the extent and value of any unencumbered assets that can be used as collateral to generate cash. Off-balance sheet activities have also received much greater attention in the liquidity process over the past decade. Off-balance sheet business can take many forms, including loan commitments, guarantees, contingencies, leases, and payments/receipts under derivative transactions.[2] Since these contracts often translate into real cash inflows and outflows, they must form part of any liquidity management program. Indeed, to be comprehensive and accurate, liquidity risk management must be viewed across all three dimensions.

MARKET RISK, CREDIT RISK, AND LIQUIDITY RISK

We have indicated above that the broad class of financial risks – market, credit, and liquidity risks – is often considered jointly. This is particularly

true of market risk, which is sometimes said to include liquidity risk as a specific subset.[3] As we explore the theme of liquidity risk, it is important to consider how and why these risks are related, and how effective management of one can affect the others.

Market risk, or the risk of loss due to adverse changes in the market prices/variables of a transaction or business, has a direct impact on a firm's cash inflows and outflows. Market risk positions that produce realized or unrealized gains create cash, while those generating losses absorb cash and require funding. Furthermore, the actual amount of liquidity characterizing an asset, liability, or off-balance sheet contract has a direct bearing on its value. The more liquid it is (that is, the more readily saleable at its carrying value), the greater its worth (all other things equal), and the more rapidly it can be sold without affecting the bid–offer spread. Thus, an asset with a small amount of market risk will generate cash with greater ease than an asset with considerable market risk.

Credit risk is the risk of loss due to failure by a counterparty to perform on its contractual obligations. A safe credit risk is one that performs as expected and, where relevant, provides a firm with a planned cash flow; a poor credit risk is one that either delays or defaults on its obligations, creating a cash flow disruption. Although virtually all firms are exposed to some amount of credit risk, financial institutions, which are in the business of extending credit risk through lending, bond underwriting, securities trading, and securities warehousing, are particularly susceptible to problems – especially if they are not diligent in applying proper credit standards. Indeed, many global bank failures of the past few decades have been attributable to problems arising from the combined effects of credit risk and liquidity risk.

A firm that is highly exposed to market and/or credit risk is almost certainly exposed to a great deal of liquidity risk. The very value and performance of the market and credit risk positions will determine the firm's own liquidity profile, and indicate whether it will have the liquid resources it expects (at the value it expects) or experience a shortfall and be forced to sustain a liquidity-induced loss. The firm that suffers a very large loss on its market risk portfolios may have to finance the resulting shortfall at a higher cost or through the disposal of assets on less favorable terms – crystallizing a loss. The firm that suffers an unexpected credit loss will have to cover the loss of anticipated cash inflows through similar means, again experiencing a shortfall. Given these relationships, the management of liquidity risk must be considered in the context of broader financial risks. A firm with significant market and credit risks cannot expect to have a small amount of liquidity risk, while a firm with negligible market and credit risks may indeed be exposed to a smaller amount of liquidity risk.

OVERVIEW OF THE BOOK

As we embark on our analysis of liquidity risk, we shall consider the topic from a number of theoretical and practical perspectives.

- **Part I:** In the balance of Part I we shall expand on aspects of corporate liquidity, first by considering the nature of liquidity and financial operations in the modern corporation, and then by examining traditional sources of asset, liability, and off-balance sheet liquidity.
- **Part II:** In Part II we analyze the nature of liquidity risks. In Chapter 4 we examine funding liquidity risk, in Chapter 5 we follow with asset liquidity risks, and in Chapter 6 we explore the combination of joint asset/funding liquidity risks and the theoretical nature of liquidity spirals, distress, and bankruptcy. We supplement these discussions with a number of "real life" case studies of liquidity crises in Chapter 7.
- **Part III:** In Part III we shift from an examination of liquidity-induced problems to methods of management and control. In Chapter 8 we focus on practical mechanisms of measuring liquidity risk, in Chapter 9 we describe methods of managing and monitoring liquidity exposures, and in Chapter 10 we discuss the nature and benefits of liquidity-based crisis planning. We summarize our thoughts and provide some guidance on future challenges in Chapter 11.

CHAPTER 2

Liquidity and Financial Operations

With some background on liquidity and its associated risks, we are now prepared to review the role of liquidity in financial operations. By examining concepts related to the operating environment we come to understand the importance of liquidity from an internal and systemic perspective, which will be useful when we consider liquidity-induced problems in Part II of the book. In this chapter we explore liquidity operating requirements, the liquidity risk/return trade-off, liquidity characteristics across industries, and endogenous versus exogenous liquidity.

LIQUIDITY OPERATING REQUIREMENTS

During the 1950s and 1960s companies relied primarily on operations to generate the cash necessary to meet their short-term obligations, and supplemented this with conventional bank funding arrangements. With the arrival of more significant volatility in the 1970s (fuelled by deregulation, floating interest/currency rates, inflation, and mobile capital), and the advent of new funding and asset management products/solutions in the 1980s and 1990s, firms started becoming more active and creative in their liquidity management practices. Efforts have strengthened into the millennium as companies strive to maximize enterprise value by utilizing their financial resources as efficiently as possible.

Ample liquidity is necessary in order for a company to meet its financial imperatives and satisfy regulatory rules and credit rating agency requirements. Liquidity is not the only corporate or external imperative, of course; solvency, which we define as a sufficiency of capital resources, is just as critical to ongoing corporate operations, and individual firms and regulatory authorities devote considerable effort to ensure capitalization levels are at all times adequate.

While liquidity and solvency are related, they are driven by different factors and are used to achieve different goals. Liquidity, as we know, relates to maintaining access to cash and equivalents to meet obligations as they come due. Solvency, in contrast, relates to preserving enough capital resources to fund a firm's ongoing operations and absorb unexpected losses. Both are needed if a firm is to operate as a going concern, but they are still separate and unique: a firm that is technically solvent can fail from lack of liquidity, while a firm that is liquid may become technically insolvent.[1] The two concepts are drawn closer together when severe lack of liquidity, coupled with demands to meet large obligations, forces wholesale disposal of assets at prices that are well below carrying value; in extreme situations, such actions can lead to negative net worth (that is, technical insolvency). Generalizing, we might therefore say that liquidity is primarily concerned with short-term resources and obligations and is thus an essential tactical operating requirement; solvency is focused on the "disaster scenario," often over the long term, and is an essential strategic operating requirement.

Liquidity management is a dynamic process, because the cash position of a firm changes, quite literally, every day. At any point in time a liquidity position that appears adequate can become inadequate, and vice versa – the passage of time, the movement of markets, the inflow and outflow of cash, and the expansion or contraction of business activities ensure that this is the case. Dynamic liquidity management, not surprisingly, is concentrated heavily in the short term, up to a maximum of 30 or 60 days. While liquidity issues can also affect a medium or long-term financial position, the degree of sensitivity is much smaller: actions taken today, that will only come to fruition in 6, 12, or 24 months, can often be reshaped during the intervening period – although they will eventually impact the firm's liquidity profile and requirements.

Since liquidity changes continuously, it is helpful to consider cycles of cash inflows, outflows, and requirements. Firms obviously do not have the same demand for liquidity at all points in time – either seasonally or structurally – so a proper plan must be developed. Consider, for instance, Company A, which operates in a very predictable corporate environment, plans ahead for seasonal variations in cash flow, and keeps a liquidity buffer to cope with unexpected payments; A's demands for incremental liquidity under any scenario are likely to be negligible. Company B operates in a seasonal business with cash inflows and outflows occurring at regular intervals during the cycle. When B is in the "cash flow positive" portion of the cycle, it does not need extra liquidity and can accumulate a buffer for unexpected payments, or for the cash outflow part of the cycle. When B moves into the "cash flow negative" portion it needs access to liquidity. If B has planned ahead it might have accumulated enough of a buffer to meet requirements, otherwise it will have to turn to alternative

sources, intensifying liquidity pressures. Finally we have Company C (operating in the same cycle), which is periodically impacted by unexpected payments (regardless of the phase of the cycle), and has not established a buffer to cover emergencies. C always requires external liquidity and thus suffers from more serious liquidity pressures. The primary point to emphasize is that companies, regardless of industry, face different liquidity profiles and needs over time, and must deal with a range of internal and external forces when creating a management process. Figure 2.1 illustrates this discussion.

Although dynamic management of liquidity is essential for virtually every organization with fluid operations, it may be of less concern for a very small subset of institutions we classify as "hold to maturity" firms. While this theory is applicable across industries, in practice it is associated with certain investment management operations. The theory states that a firm that is properly match-funded (for instance, asset and liability durations are approximately equal) and is permitted to hold assets and liabilities until maturity faces no liquidity risk. This occurs because maturing assets provide the funds needed to repay liabilities as they come due. It is, however, an "ideal world" that is based on several key factors:

- The firm can hold all assets and liabilities until maturity.
- Assets and liabilities are properly matched; liabilities, in particular, cannot be presented for early repayment.

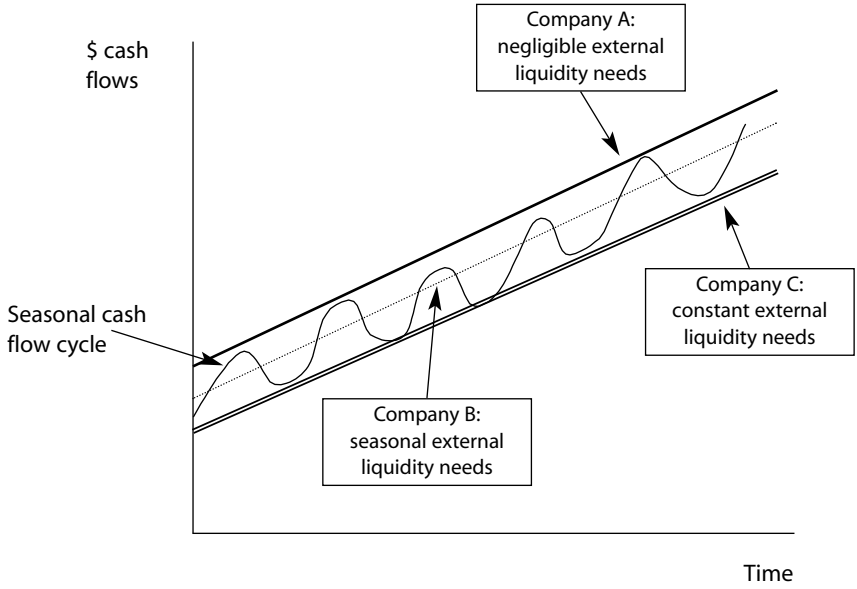

Figure 2.1 Corporate liquidity needs

- No unexpected payments arise (or those that arise can be met with an extra buffer of liquidity).
- Accounts are not marked-to-market.
- Assets are not subject to default, and yield a defined value at maturity.

If these conditions exist, a firm arguably faces no liquidity risk. However, since very few organizations operate in this theoretical state, the prudent approach says that liquidity risk is an exposure that every firm must consider and manage.

GENERAL APPROACHES TO LIQUIDITY MANAGEMENT

Management of liquidity risk is a vital, sometimes complex, function – regardless of industry. In practice, the liquidity management process can be divided into three broad segments: daily management of cash flows, medium-term (6–24 month) management of business operations (including realignment of assets and liabilities), and crisis management of stress/disaster events. In the large corporation, liquidity can be managed at a business unit/legal entity/regional level, and a consolidated level. This is especially helpful if particular units are subject to regulations or restrictions that influence access to cash resources. For instance, a subsidiary might be restricted from passing cash to a sister company or even the parent, or might have better access to competitive sources of funding. Knowledge of such costs and benefits is integral to effective management. Ultimately, of course, consolidated management of liquidity is most critical.

In many organizations the task of managing liquidity has historically been the exclusive, or primary, responsibility of the corporate treasury function, with little (and sometimes no) participation by others. In the firm of the millennium, however, it is common for more groups to be directly and indirectly involved in the process: treasury, financial control, risk management, operations/settlements, business units, and product development teams all have a stake in the process and are often actively involved. This means the management process requires robust communication and coordination. To avoid confusion and problems, some companies manage their liquidity on a formalized basis, through a structure that assigns specific responsibilities to different groups. Although we will consider detailed approaches to governance and liquidity management in Part II, we note at this juncture that a general liquidity plan might focus on the following steps:

- Matching cash flows: laddering cash inflows/outflows assets and liabilities as closely as possible in order to keep the funding gap tight. This may involve lengthening liabilities in order to avoid instances of simultaneous redemption.
- Diversifying assets and liabilities: ensuring that portfolios of assets and liabilities are diversified across maturities, markets, sectors, and providers in order to reduce over-reliance on any single source.
- Creating a liquidity warehouse: developing a portfolio of securities that can easily be pledged as collateral or sold in order to raise new funds.
- Developing committed funding sources: obtaining bank facilities that are truly committed, and that will not be withdrawn under any circumstances.
- Purchasing liquidity options: using financial resources to acquire contracts that will provide cash injection when needed.

By creating a plan based on such techniques a firm assumes greater control of its liquidity profile and can actively manage the inflows and outflows that drive daily operations.

FINANCIAL IMPERATIVES

A firm faces certain financial imperatives when conducting business, including maximizing enterprise value and minimizing the possibility of financial distress.[2] From a liquidity perspective a firm's executives must be keenly aware of the cash position and be prepared to manage it under both normal market conditions and stress scenarios. Daily operations drive the majority of a firm's liquidity requirements and are the foundation of any liquidity plan; expected cash inflows and outflows form the liquidity baseline, representing resources generated in the normal course of business. A firm with robust, positive operating cash flow, proper access to funding, and correctly structured asset and off-balance sheet portfolios can manage its liquidity under normal market conditions with relative ease.

But financial imperatives related to liquidity must extend beyond the normal course of business. Some allowance must be made for the onset of unexpected obligations or payments – events that represent deviations from the baseline, when cash outflows are larger than expected. These can impact companies from any sector at virtually any time, so the prudent firm must prepare by arranging suitable *ex ante* resources and market access. Thus, a bank must be ready to respond to the cash pressures imposed by an unexpected wave of deposit withdrawals or the absence of buyers for particular assets that it needs to sell. A steel company has to be ready to respond to

emergency repairs to plant and equipment that are not suitably covered by insurance, or a lack of investor interest in rollovers of its commercial paper. As noted, this means that a firm must understand in detail the nature of its cash inflows and outflows, the structure of its assets, liabilities, and off-balance sheet contracts, and any potential surprises that might arise and consume cash resources. If it can, then it is well positioned to manage its liquidity in a prudent manner and meet its financial imperatives under all conditions.

EXTERNAL REQUIREMENTS

Not all of a firm's liquidity management process is driven by internal goals. Some is guided or required by regulatory authorities and rating agencies, which have overarching goals of their own.

Regulators are interested in preserving market stability and reinforcing investor and creditor confidence; by promoting minimum standards of liquidity (as well as capitalization, asset quality, and so forth) they can help achieve these goals. In the normal course of affairs regulators are thus concerned with:

- maintaining systemic stability (particularly in industries that supply liquidity to others, intermediate in the origination and allocation of capital funds, or create liabilities that are due and payable to others)
- creating investor, depositor, and lender confidence (which can help strengthen capital flows and participation in government securities markets, including benchmarks used to price other capital instruments and derivative contracts)
- ensuring conditions are conducive to monetary policy activities (including open market operations, which rely heavily on active trading in government securities and repurchase agreements).

In fact, regulatory involvement occurs on an *ex ante* and *ex post* basis. *Ex ante*, the regulator develops appropriate rules and regulations regarding maintenance of liquidity, and *ex post* it may provide a liquidity injection, restructuring, or rescue. *Ex post* involvement must necessarily be limited to instances where systemic stability is truly at risk. If it is applied too liberally, instances of moral hazard are almost certain to become more prevalent.

Regulators naturally focus considerable attention on financial institutions. In order for the system at large to remain stable, financial institutions must manage liquidity flows properly, providing borrowers, depositors,

creditors, policyholders, and investors with funds when desired or contractually required. Regulators can ill afford liquidity-related problems in any portion of the financial sector, as dislocation can soon feed into other sectors of the macro-economy. For instance, problems in the banking sector can disrupt funding availability in the corporate sector, causing broader economic woes. In order to help protect against systemic liquidity problems, regulators may attempt to influence institutions by penalizing activities that are illiquid or create illiquidity. Thus, banks or insurance companies choosing to hold very illiquid securities may be required to allocate more capital in support of the positions, or discount their value more heavily. Or financial holding companies that rely on other group companies or subsidiaries for liquid funds (for example through intracompany loans, or dividend upstreaming) might be restricted in their ability to source such funds so that the broader group structure is not placed at risk.

Rating agencies also factor into the process. The major credit rating agencies are responsible for assigning ratings to individual firms and sovereign entities. These debt ratings are a reflection of the ability of individual entities to repay their contractual obligations – the greater the financial strength, the greater the likelihood of timely repayment, the higher the resulting credit rating. Although many factors are used in determining a rating (earnings, capital, asset quality, management, leverage, competition, and so forth), liquidity is an essential ingredient. All other factors equal, a firm that is illiquid will receive a lower rating than one that is liquid. Accordingly, firms must be cognizant of the perspective and requirements of rating agencies as related to financial strength generally, and liquidity strength specifically. Expectations regarding minimum thresholds of acceptable liquidity must be incorporated into overall management plans. Failure to take account of this external dimension can directly impact on the cost of a firm's funding and its ability to access specific types of financing.

The consideration of liquidity can thus be seen as a combination of internal financial imperatives and external recommendations or requirements. While best practices or minimum standards are a good starting point in creating a management framework, companies may find it helpful to consider processes that go beyond such minimum standards, as we shall note in Part III.

THE LIQUIDITY RISK/RETURN TRADE-OFF

If ensuring an appropriate amount and type of liquidity in order to minimize, or eliminate, the prospect of financial distress is a key imperative, then it would seem logical for directors and executives to want to create a company that is as liquid as possible. At first glance it would appear bene-

ficial for a firm to try to maximize the liquidity in its asset portfolio, arrange access to a broad range, and large amount, of committed funding, and ensure ongoing ability to enter into contingent transactions that provide further financing options.

While these seem like sensible choices, we must recall that corporations are risky entities, and suppliers of risk capital demand returns that are commensurate with the capital they allocate. Creating a truly liquid corporation comes at a price that detracts from returns: a sacrifice in yield on the asset side of the balance sheet, or a rise in all-in funding costs on the liability side or via off-balance sheet contingencies. For instance, in order to maintain a portfolio of liquid assets (such as short-term government securities or very high quality corporate or agency securities) that can be converted into cash quickly, with no discount to carrying value, a company must accept a lower yield. The return on liquid assets is lower because the liquidity premium commanded is small compared with assets that are less saleable. The creation of readily liquefiable assets therefore detracts from the company's overall returns, and translates into a lower return for risk capital investors.

The same occurs with funding. For example, a company that wants to make certain it has undoubted access to financing will have to pay commitment and arrangement fees to its bank for backup revolving credit facilities – a cost of ensuring that liquidity is preserved, and one that detracts from investor returns and decreases enterprise value. The same applies to the banking institution. A bank relies heavily on short-term interbank and demand deposits to fund its loan business; these are notoriously unstable, particularly in difficult or competitive market scenarios. Lengthening liability maturities to match asset maturities and eliminate any gap seems like a reasonable solution. Once again, however, there is a price, this time in the form of an increased cost that must be paid for medium-term funding (in a normal positive yield curve environment). The cost compresses the bank's net interest margin, reduces earnings, and leads to a lower earnings valuation. The marginal cost of ensuring liquidity must therefore factor into the corporate analysis. Again, it is relatively simple for a company to remain completely liquid in order to meet any possible liquidity claims – but this will not maximize shareholder value. Naturally, this liquidity risk/return trade-off concept is consistent with other aspects of financial theory: firms and investors seeking greater returns must accept more risk – in this case liquidity risk.

If the goal of directors and executives is to maximize enterprise value, the determination of optimal liquidity is complex: it is possible to create a perfectly liquid firm that will never suffer financial distress, but will generate inadequate shareholder returns, or an illiquid firm that may indeed suffer from financial distress under certain scenarios, but will otherwise

provide superior investment returns. In fact, the optimal answer is likely to lie between the two extremes: most firms balance the liquidity risk/return decision by attempting to create a liquidity risk profile that allows for prudent management of risk – particularly for extreme events that can create devastating losses – while still delivering adequate returns to investors.

The liquidity trade-off can be evaluated in a standard cost/benefit framework, just as a firm might weigh other financial and operating risks. The costs include lower yield on earning assets and/or payment of commitment fees to ensure the availability of standby facilities. The benefits include less (or no) chance of having to arrange funding at a very high rate of interest or sell assets at a distressed level in order to cope with a liquidity crisis. When determining these costs and benefits it is important for the firm to consider that holding liquid assets is equivalent to purchasing liquidity insurance; if a firm seeks such liquidity insurance from a third party it will pay a cost in the form of a premium. Thus, to be accurate in the assessment of costs and benefits it is unfair simply to view the holding of liquid assets as a gross cost – an estimate of the implied benefit must be factored into the analysis.

Table 2.1 highlights the costs and benefits of a company with varying degrees of liquidity, and Figure 2.2 summarizes the risk/return trade-offs facing firms that seek to eliminate all, a portion, or none, of their liquidity risk, and face no other financial or operating risks (for example the only source of potential risk is from a liquidity-induced loss). Excess returns are those above the risk-free rate.

LIQUIDITY PROFILES ACROSS INDUSTRIES

We have already mentioned that liquidity risk impacts industries to different degrees. In this section we consider some of the general characteristics of liquidity and liquidity risk across four general sectors: financial institutions, non-financial service industries, capital industries, and municipal and

Table 2.1 Costs and benefits to a firm under various liquidity scenarios

	Perfectly liquid firm	*Partly liquid firm*	*Perfectly illiquid firm*
Cost	Lower investment returns	Possible financial distress	Likely financial distress
Benefit	No financial distress	Reasonable investment returns	Higher investment returns

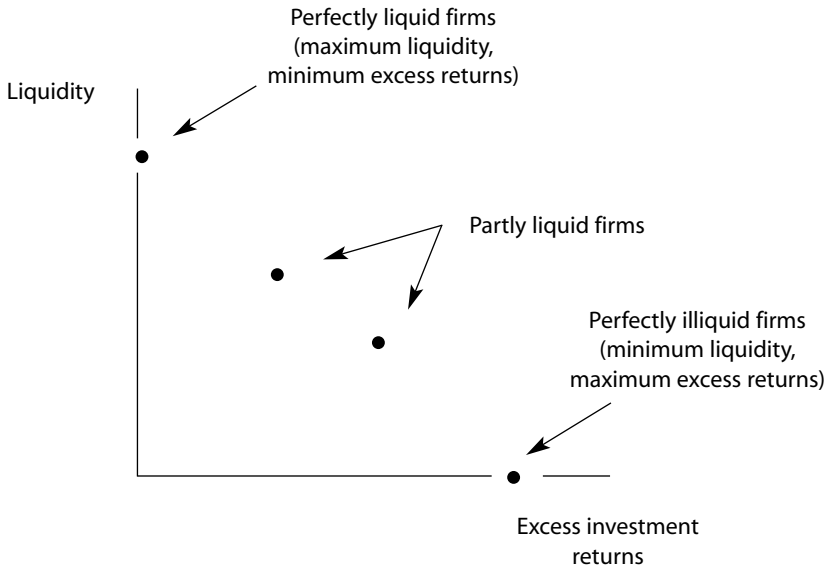

Figure 2.2 Liquidity/return trade-off

sovereign entities. Given its importance in the provision of liquidity, we devote a considerable portion of this section to the financial sector.

Financial institutions

Financial institutions, which we define to include banks, securities firms, investment funds (that is, unleveraged mutual funds and leveraged hedge funds) and insurance companies, are in business to supply investment, financial, and risk management services – all of which have an element of liquidity risk. Indeed, virtually every financial transaction arranged by, or flowing through, a financial institution carries some element of liquidity transfer. Through their intermediation duties financial institutions match depositors with loan borrowers, and investors with capital markets borrowers; in exchange for capital they provide investment returns, and in exchange for *ex ante* premiums they provide *ex post* loss financing.

Most financial institutions act as principals rather than agents, which has a direct impact on their own liquidity profiles. For instance, a bank accepts deposits, invests the funds in securities until needed, and makes loans to borrowers. If depositors want to withdraw money the bank may be obliged to pay on short notice. Since it is unlikely that loans granted to borrowers will fall due at the same time (indeed they will not, as demand or short-sight deposits feature uncertain time horizons), the bank will have to repay depositors through alternative funds – meaning it must access other sources of liquidity. The same is true for capital markets dealing. Banks and securities

firms regularly make markets in assets as principals, purchasing securities from clients in the secondary market, holding them for time, and then reselling them to others. This business provides selling clients with liquidity, and must be financed by accessing liquidity (for instance, pledging securities for cash in the repurchase agreement market).

A similar process exists in the insurance industry. An insurer might be required to pay expected or unexpected claims to policyholders, providing them with post-loss liquidity, and can only do so by accessing its own internal and external sources of liquidity. In the investment fund industry investors may redeem fund shares at any time, meaning the fund must be able to liquidate enough of the assets in the underlying portfolio to deliver capital back to investors – access to liquidity is essential. Liquidity claims can also appear through off-balance sheet activities, including those generated by contingent liabilities, commitments, and derivative contracts; all represent important business and risks sources for financial institutions. By warehousing risks, transforming maturities, and providing investment or risk-based cash flows, financial institutions are able to provide liquidity insurance to risk-averse depositors, borrowers, investors, and insureds; in order to be able to perform this function properly, the typical financial balance sheet might feature more than 90 percent of assets in truly liquid form.

To decrease reliance on lower yielding stored liquidity, financial firms manage their liabilities closely. A bank's liability position is generally built on very short-term borrowing, such as deposits, interbank funds, and repurchase agreements. Incremental asset growth is then managed through either asset conversion or liability liquidity management. Under the asset conversion scheme a bank issues additional savings and time deposits, floats bonds, or accesses non-deposit funding sources, and stores the proceeds in a liquidity warehouse until opportunities arise to lend at a higher rate. Through the liability liquidity management approach a bank originates higher yielding loans, then attempts to fund the loans by actively raising new liability contracts. The asset conversion approach is more conservative because a bank that cannot raise liabilities at a reasonable rate need not expand its balance sheet; a bank that has already granted a loan and cannot secure deposit funding will either have to secure more expensive funding from alternative sources or sell the loan to another bank . Either represents a cost. In practice, there is evidence to suggest that many banks follow the liability liquidity management strategy in order to reduce opportunity costs – but this generates additional liquidity pressures.

Financial institutions supplement their liability management with active asset management. For example, a bank might hold primary reserves (assets that are available immediately at no loss in carrying value but generate no earnings, such as cash, deposits at correspondent banks, and deposits at the central bank or monetary authority) and secondary reserves (short-term

assets that are convertible quickly near carrying value and generate earnings, such as treasury bills and purchased interbank funds) in order to meet reserve requirements and fluctuations in the liability account. The core lending business and other investments – which generate much greater earnings but impose liquidity constraints – supplement these reserves.

Financial institutions are also heavily focused on gap management, or management of the mismatch between assets and liabilities. In fact, managing the gap is a key mechanism for generating earnings, and a great deal of effort goes into understanding how portfolios can be optimized during particular interest rate cycles. In general, institutions operating in a positive yield curve environment where long-term rates are rising (or short-term rates are falling) want to widen the gap: this allows them to fund on a short-term basis and lend on a long-term basis, maximizing the spread between the two. Conversely, those operating in a positive yield curve environment where long-term rates are declining (or short-term rates are rising) want to narrow the gap in order to take advantage of a new interest rate environment. The reverse scenarios hold true for negative yield curve environments.

More than any other economic sector, financial institutions must actively deal with the liquidity risk/return trade-off mentioned earlier. While many financial firms are aware of the need to maintain adequate access to cash or equivalents in order to respond to liquidity calls, they still strive to keep liquid balances to a minimum in order to maximize returns.

To consider the unique and critical role of financial institutions in the liquidity process, it is helpful to examine the liability claims of banks, securities firms, and insurance companies in terms of the amount and timing of cash flows – two dimensions that illustrate why liquidity management can be complex. To begin, we note that the value and timing of a contract may be certain or uncertain. When certain, cash flows can be predicted with confidence and can easily be factored into the funding plan; as uncertainty is introduced, the degree of confidence declines and accurate planning grows more difficult.

Consider, for example, a bank deposit, fixed with respect to maturity and rate. Both dimensions are certain, meaning there is no unpredictability regarding the magnitude or timing of cash outflow: the bank will repay the depositor a certain sum on a certain date. The same is true with an insurer writing a guaranteed investment contract (GIC): it will deliver to the GIC investor a specified amount of cash on a pre-determined date. We now inject uncertainty into the timing dimension by considering an insurance company that has written a life insurance policy for a specified amount (that is, a valued, rather than indemnity, contract). When the policyholder dies, the beneficiary makes a claim on the insurance company: although the amount is fixed in advance the timing is, of course, unknown. This extra dimension of uncertainty makes it more difficult for the insurer to plan for

cash outflows (which can be estimated, though never precisely, through actuarial processes). Insurers and reinsurers face similar time and quantity uncertainties in other aspects of their business, including policy surrenders, guarantee provisions, liquidity backstops, and so forth. Next we alter the process by fixing the timing but varying the amount: a bank accepting a floating rate deposit with a defined maturity date faces a known time horizon but is uncertain as to the amount it will be required to pay, as the obligation varies with movements in interest rates. This again injects some uncertainty into the bank's cash flows. And in the final stage we can vary timing and amount, introducing a maximum amount of uncertainty. For instance, an insurer may write an indemnity-based property and casualty contract with no policy cap and an expiry date extending many years into the future; it will thus be liable for paying out an unknown amount of money if a loss event strikes at some unknown time. Two dimensions of uncertainty combine to create a much more challenging liability management exercise. Table 2.2 highlights these examples.

We can extend time and amount certainty/uncertainty to the assets and off-balance sheet contracts of financial institutions: the process is the same, meaning some contracts are well defined and highly predictable, while others are not. Tables 2.3 and 2.4 provide further examples. The point of this discussion is to illustrate that liquidity providers, primarily those from the financial sector, face a considerable amount of uncertainty in attempting to manage the cash inflows and outflows of their businesses. If they fail to manage the process properly, they will damage their own operations and

Table 2.2 Liability amount and timing variations

Liability amount	*Liability timing*	*Example*
Certain	Certain	Fixed rate, fixed maturity deposit
Certain	Uncertain	Valued life insurance contract
Uncertain	Certain	Floating rate, fixed maturity deposit
Uncertain	Uncertain	Indemnity P&C insurance contract

Table 2.3 Asset amount and timing variations

Asset amount	*Asset timing*	*Example*
Certain	Certain	Fixed rate, fixed maturity loan
Certain	Uncertain	Fixed rate, callable bond (investment)
Uncertain	Certain	Floating rate, fixed maturity loan
Uncertain	Uncertain	Floating rate, callable bond (investment)

Table 2.4 Off-balance sheet amount and timing variations

OBS amount	*OBS timing*	*Example*
Certain	Certain	Lease payment
Certain	Uncertain	Surety bond, financial guarantee
Uncertain	Certain	European exercise option
Uncertain	Uncertain	Revolving credit facility

perhaps even impact their ability to offer non-financial firms the liquidity that they require.

Given these cash flow uncertainties, the balance sheet of a typical bank, fund, securities broker or insurer is liquid – certainly when compared with that of an industrial company. Financial institutions keep a larger portion of their assets in the form of cash and marketable securities, and a much smaller portion in long-term illiquid investments or fixed assets. Even banks with core long-term loan portfolios regularly attempt to reshape their commitments through syndications, loan participations, securitizations, and other "liquefying" techniques, as we shall discuss later in the book. Liabilities are generally short-term and often volatile. Although many financial institutions might prefer to concentrate them with a base of stable depositors/fund providers, the realities of modern finance are often quite different – particularly for those seeking to maximize value in a positive yield curve environment. Financial liabilities can often be withdrawn, transferred, or presented for repayment on very short notice. Indeed, over the past few decades the funding of many institutions has migrated from a stable base of retail and non-optionable liabilities to unpredictable and optionable wholesale funds. This has added a greater dimension of cash flow uncertainty and exposed financial institutions to larger amounts of market and credit risk. Activity in off-balance sheet commitments – including derivative contracts, loan commitments, letters of credit, and so forth – injects additional uncertainty.

These factors, taken together, require diligent management of the liquidity profile. Failure to do so can lead to an increase in financing costs, reduced financial flexibility, and even instances of financial distress. Through differences in function, funding sources, leverage, asset composition, and regulatory schema it is possible to create a spectrum of liquidity sensitivity within the financial sector. Securities firms, for instance, are generally most susceptible to liquidity risks, primarily as a result of their high leverage and relatively unstable funding. Unlike banks and insurers, securities firms lack a base of core liabilities; their operations are financed primarily through repurchase agreements and short-term notes.[3] In addition, they lack access to a central bank discount window and have no official lender of last resort. Their

reliance on unstable sources of funding, the fluid nature of their asset portfolios (including some 80 to 90 percent centered in short-term, liquid, or saleable/marketable assets) and the depth and breadth of their off-balance sheet activities (particularly derivative contracts) mean they have greater concentrations of market and credit risks than other financial institutions – which, as we have noted earlier, can magnify liquidity exposures. Hedge funds share similar characteristics: they lack stable funding, speculate on a highly leveraged basis, and encumber their balance sheets (that is, they pledge assets in support of greater leverage). These factors intensify liquidity exposure and often leave little margin for error.

Banks typically feature greater funding stability than securities firms and hedge funds, and enjoy access to central bank facilities and a lender of last resort. That said, some banks have excessive exposure to very short-term and/or volatile liabilities that can be withdrawn very rapidly. If they use short-term institutional deposits to finance medium and long-term loans, they increase curve/mismatch risk and are prone to greater losses. In addition, banks are extremely significant providers of off-balance sheet facilities (such as revolving credits, guarantees and derivatives), and thus face a large amount of uncertain cash flows arising from contingent events.

Mutual funds, which are often not permitted to directly leverage their balance sheets, are exposed to liquidity risk primarily through redemptions. The fund management company must ensure that there are sufficient cash resources on hand to meet periodic redemptions, and enough liquefiable assets in the investment portfolio and contingent funding to meet more significant outflows. (Some funds are prohibited through their investment mandates from investing more than a certain amount of their portfolios in assets deemed to be illiquid; others, of course, face no such restrictions.)

Insurers are usually exposed to less liquidity uncertainty than banks or securities firms: most liability sources are quite stable and assets are conservatively managed. There are, however, instances where an insurer can face unexpected losses in its investment portfolio (through market or credit risks) or insurance operations (through extraordinary insurance claims, that is, those that are more severe, or occur more frequently, than actuarial expectations predict). These can create cash shortfalls and liquidity pressures. In addition, certain insurance liabilities contain features that allow investors to demand return of their capital within relatively short time frames. Some GICs have downgrade clauses allowing investors to put the liabilities to the insurer in the event of a credit downgrade. Other funding arrangements have embedded short-term put options, and some feature cash buildup values that allow policyholders to borrow against them. (If such borrowing occurs en masse, an insurer may be faced with short-term borrowing needs of its own.) Like securities firms and banks, insurers also

face contingent cash outflows through their participation in financial guarantees and liquidity backstops.

Non-financial service companies

Many non-financial service companies are exposed to a reasonably high degree of liquidity risk – less than most financial service firms, but often more than the average industrial company. Non-financial service companies, including those from retailing, foodstuffs, beverages, hospitality, computer services, consulting, pharmaceuticals, and so on, often derive a great deal of funding from short and medium-term note programs, trade payables, and revolving credit facilities. Some of these can prove volatile, particularly in times of general market stress or credit quality deterioration. Assets are also heavily concentrated in the short- to medium-term – perhaps 60–70 percent of total footings – primarily through receivables and inventories (which, as we have noted, can be considered liquid, though not as liquid as marketable securities). Challenges can thus arise in matching the cash flows of assets and liabilities. Non-financial institutions tend to be less active in off-balance sheet activities than financial institutions: they are often only modest users of derivative contracts or providers of guarantees, and therefore need not be as concerned about cash inflows or outflows from such sources.

Asset trading companies are a unique "hybrid" within the sector – they are neither financial institutions nor capital-intensive companies, although they exhibit characteristics of both. For example, commodity and merchant energy trading firms have active short-term trading operations, but often feature significant fixed plant and equipment associated with extraction, sourcing, refining, distribution, storage, and/or transportation. The degree of liquidity they require, and their ongoing exposure to liquidity risk, depends ultimately on their mix of revenues and business focus. An energy trading firm that derives 75 percent of its revenues and operating income from trading crude oil, natural gas, or electricity, relies very heavily on liquidity to conduct business: it will focus on maintaining a good credit rating, strong reputation, and robust access to cash to finance collateral calls and market-based profit and loss swings. An energy trading firm that obtains 25 percent of its revenues from trading and 75 percent from exploration, drilling, and refining, still requires good access to liquidity, but its needs are unlikely to be as strong and its daily management of the process will be less intense.

Capital-intensive companies

Companies in capital-intensive industries use the majority of their resources to produce or refine resources, produce hard assets, or create

durable goods. It is no surprise, therefore, that they invest primarily in property, plant, and equipment, including depreciable assets with lives of 5, 10, 30 or more years. Since these assets are long-term in nature, they are often funded with long-term capital; short-term liabilities are used primarily to balance short-term activities, such as receivables and inventories. The percentage of liquid assets found on the balance sheet of the typical capital-intensive company ranges from 5 to 20 percent (compared with 90 percent plus for an average securities firm, and perhaps 60 percent for a retailer). Capital-intensive companies do not exhibit the same fluctuation in asset values as they mark the bulk of their assets to the lower of cost or historical value (rather than current market value); this obviates the need to fund shortfalls arising from assets with a more volatile value profile. (Capital assets are, of course, depreciated on steady basis through non-cash charges to the accumulated depreciation account.)

The corporate sector is generally not very active in off-balance sheet activities. Accordingly, contingent future cash flows, such as might arise from derivative contracts or cross-guarantees, are the exception rather than the norm, and do not form a significant part of corporate risk management activities. The need for intensive liquidity management in the average industrial company is thus lower than it is for firms in other sectors. That said, it is still very important for industrial firms to manage their liquidity closely; as we shall note in Chapter 7, certain industrial firms have been at the center of significant liquidity crises in recent years, suggesting that the specter of liquidity-induced losses, or worse, is very real.

It is worth noting that a small number of global industrial companies have very significant financial operations that are involved in a wide range of financial transactions, including asset trading, leasing, derivatives dealing, group-wide funding, insurance, and factoring. The presence of sufficient short-term liquidity and the commitment to active liquidity risk management is of paramount importance to such financial subsidiaries, meaning the comments we presented above for energy and commodity trading companies are applicable.

Municipalities and sovereigns

While most of our discussion is geared toward liquidity risk management in the corporate sector, we would be remiss in excluding some reference to municipalities and sovereigns, as such sectors must also balance their liquidity profiles. In the normal course of affairs, municipalities and sovereign nations with taxing power gather the bulk of their funding from corporate, personal, real estate, and consumption taxes, and the issuance of public or private debt securities. Against these inflows they face a series of

outflows related to the provision of public goods and services, including education, health, transportation, welfare, medical care, retirement, infrastructure, law enforcement, and fire safety. In this sense they can be viewed as service providers, and must therefore be attuned to the nature and timing of their cash inflows and outflows. Inability to match these properly can lead to the same liquidity-induced losses that impact firms in the corporate sector, and may require the emergency issuance of debt or the liquidation of municipal or sovereign assets. Indeed, some public sector entities have been at the center of major liquidity crises in the past, as we shall discover later in the book.

Figure 2.3 depicts a stylized liquidity spectrum across a range of industries – from those that face the smallest amount of liquidity exposure and cash flow uncertainty (and thus have the smallest need for intensive daily risk management) to those with the greatest amount of liquidity exposure and cash flow uncertainty (and, by extension, the most significant need to manage their liquidity profiles very dynamically). The figure is generalized: there are certainly instances when a non-financial service company or capital-intensive firm has greater liquidity risk exposure than a mutual fund or an insurance company. However, the general classification holds true for the majority of cases.

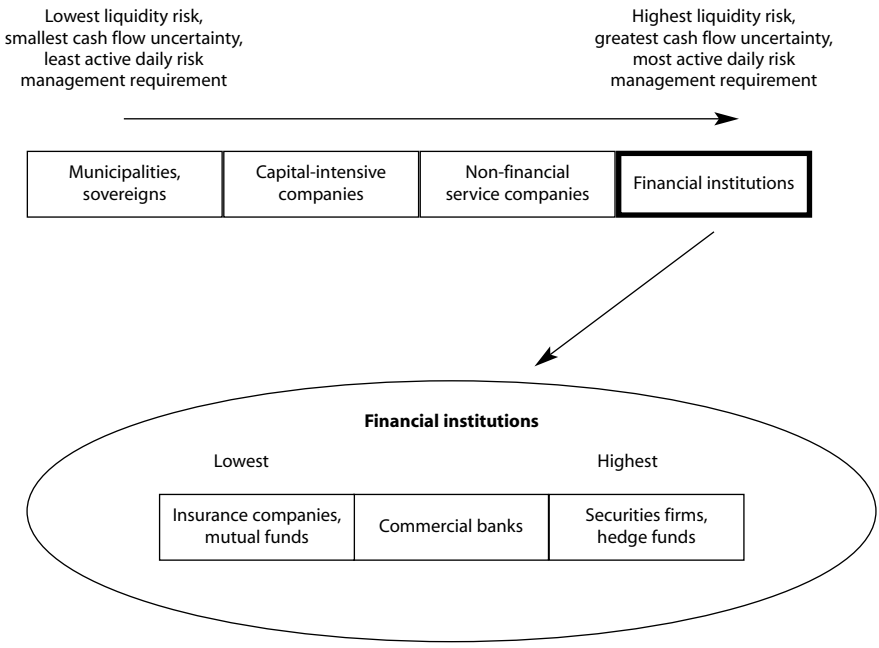

Figure 2.3 Industry-based liquidity spectrum

ENDOGENOUS VERSUS EXOGENOUS LIQUIDITY

In the last chapter we introduced the concepts of endogenous and exogenous liquidity. These require further exploration, as they are central to the liquidity risk management topic. Indeed, it is important to consider which factors are under the direct or indirect control of a company, and which factors are driven solely or primarily by external forces. While either can lead to liquidity pressures, the approach to analysis and management is often distinct.

A company can control endogenous liquidity by understanding its liquidity profile and taking all necessary internal actions to ensure the profile is managed prudently. This means maintaining a realistic, even conservative, approach to structuring the asset portfolio and securing liabilities – and sometimes means exchanging incremental return for the safety of a larger cash buffer or additional committed financing. It may mean sacrificing certain business opportunities (for instance, not accumulating a large market or credit risk position or expanding into a new area too rapidly) or refusing to take actions that might otherwise exacerbate risks (such as avoiding the rapid sale of an asset). The primary point is that a firm has a reasonable degree of control over these variables and can act as it sees fit; endogenous liquidity risks can thus be considered firm-specific.

A single company generally lacks the ability to directly control liquidity risk created by systemic forces that are imposed by the marketplace, regulatory rules, activities of competing firms, and the state of micro and macro-economic and financial indicators. A firm does not typically drive exogenous forces, but it must respond to them. (It is, however, worth noting that an extremely large firm with significant risks or an entire group of smaller institutions with similar risk positions and market expectations can influence such forces.)

Exogenous liquidity risk becomes particularly evident during times of stress, as market and regulatory actions introduce behaviors that exacerbate price shocks and illiquidity. In more serious instances external factors may induce widespread withdrawal of funding, forcing firms to sell assets at distressed prices in order to reinforce their cash positions. Certain stress events can lead to a flight-to-quality, which we define as the sale of risky assets and the purchase of those deemed to be "safe" (such as assets with low risk of default and/or lower price volatility than competing alternatives). They may also lead to a flight-to-liquidity, or the purchase of assets that are supported by two-way flows, even during times of extreme stress (which might be a subset of the flight-to-quality asset pool). These movements mean that assets deemed to be "less favorable" are liquidated, sometimes in large quantity, leading to sharp price declines, volatility spikes, and the onset of illiquid conditions.

Exogenous forces can quickly sweep through entire industries, regions, or countries, impacting many firms – often without much discrimination. When lenders and investors refuse to differentiate among institutions, strong, intermediate, and weak credits within a particular sector may all suffer liquidity problems. (This happened with Asian banks and companies in the crises of 1997–8, US energy firms in the millennium, and so forth.) In the face of such forces it is easy to see how a single firm can lose control over its own exposures.

Let us consider a simple example of a stress event that creates liquidity difficulties. In the early part of a speculative phase, economic growth leads to credit extension through the banking sector, inflating the prices of real and financial assets. When the peak of the cycle is reached, a tightening of interest rates leads to a "bursting" of the speculative asset bubble, the withdrawal of credit, and a plunge in asset prices. The collapse may be fueled, in part, by sales of assets by companies eager to repay unsecured debt that cannot be rolled over, and sales of collateral held by banks against credit extensions. The sale of illiquid assets, or assets sold into an illiquid market, magnifies the downward price movements and generates even larger losses. In addition, financial institutions holding leveraged market risk positions may decide to liquidate; the endogenous decision by each firm to sell or hedge such positions (or perhaps a requirement by regulators that they do so) forces all financial institutions to take similar actions: individual actions exacerbate exogenous forces.

These events may be compounded by a pullback in funding by institutional investors, who might grow nervous over the instability; financial and non-financial institutions must then contend with lack of robust funding. Under this type of market dislocation scenario, exogenous forces dominate. While an individual institution may believe that its asset positions and funding plan are prudent, external forces may prove otherwise. This is not, of course, a theoretical premise – it has occurred several times in recent years, for example the global stock market crash of 1987, the Japanese asset deflation and bad loan crisis of the 1980s and 1990s, the Nordic banking crisis of the early 1990s, the Mexican peso crisis of 1994, the Asian collapse of 1997, the Russian/hedge fund debacle of 1998, the Turkish and Argentine banking crises of 2000, and the technology-media-telecom (TMT) asset burst of 2001. Awareness of the impact exogenous risks can have on individual corporate operations is therefore an important dimension of internal risk management.

In some cases regulatory authorities attempt to manage, reduce, or prevent exogenous liquidity risk by creating safeguards and enhancing market structures to promote liquidity and stability; this is particularly true within the financial sector. Regulatory safeguards can take different forms, and we provide only a few examples that illustrate the point. For instance,

in order to reinforce trading in government securities (which often serve as benchmarks for other corporate instruments), some systems adhere to the concept of primary dealerships, which give approved institutions the ability to bid on a primary basis for new government securities issues and deal actively in the secondary market with full quote transparency. Those granted primary dealer status are entitled to certain monopoly rents not available to other institutions; that rent can be regarded as *de facto* payment for the market-making and liquidity services they provide. As part of the process, governments regularly attempt to issue their own sovereign securities at various points on the yield curve in order to build a robust curve that can be used for corporate pricing and hedging, thus promoting more issuance and trading in the corporate sector.

Some systems allow short selling, meaning that firms (and individuals) can borrow and then sell securities freely. A marketplace that allows short selling promotes more activity, as both sides can be reflected and dealing can occur under virtually any type of market scenario. The same is often true for "when issued" trading: if authorities permit dealers to trade newly announced, but not yet settled, securities in a gray market, they are permitting liquidity to build in advance of final settlement.

Regulators may aid in establishing and deepening associated markets such as listed futures and options and over-the-counter derivatives.

Although there are instances when derivative instruments act as "competitors" to underlying cash assets (and thus detract from asset liquidity), the two sectors often work in tandem, helping promote trading, hedging and investing and, by extension, market liquidity. Some systems allow use of repurchase and reverse repurchase agreements so that institutions can manage their short-term funding and investment needs efficiently and securely. While many of these efforts work well in some countries during most market conditions, they are not always guaranteed to function as expected; this is particularly, though not exclusively, true in less mature markets that lack strong breadth and depth and a history of regulatory experience. In fact, various emerging nations have been susceptible to fragile liquidity over the years, in part because of failures or shortfalls within their macro regimes.

Unfortunately, there are times when regulatory rules and best practice measures exacerbate liquidity problems. For example, use of risk policies and limits, standardized models/pricing routines, and regulatory capital rules means that banks and securities firms often develop a "herd mentality" in their approach to risk management. During stressful times their actions might actually magnify problems. If all institutions have approximately similar positions and a consistent view and approach to the management of risks and the protection of liquidity, then simultaneous response simply magnifies movements and dislocations. Two-way markets become

one-way markets, asset correlations decouple, volatilities rise, and liquidity disappears. In the absence of "contrarian forces" that view such dislocations as a buying opportunity, the asset and funding markets can remain in a state of turmoil and liquidity can remain very fragile. If contrarian forces actually exist they are most likely to come from sectors that do not face the same set of regulations. (For instance, during such times insurance companies and hedge funds can provide some amount of stability as they are governed by different regulations – if any at all.)

Endogenous and exogenous forces must be carefully considered in any analysis of liquidity risk. We shall note in Part II certain market-related stress mechanisms that can be incorporated into the risk management process to reflect the effects of micro and macro forces on firm-specific liquidity. With these general thoughts in mind, we turn our attention to specific sources of liquidity a company can draw on in order to manage its risk profile.

CHAPTER 3

Sources of Liquidity

As we consider liquidity risks and the challenges that can arise from an asset and funding perspective, it is helpful to begin by analyzing sources of liquidity that firms from a broad range of industries can access in support of their operations. This provides an understanding of how liquidity structure must be managed to ensure availability of cash resources when needed. In this chapter we review sources of liquidity found in the asset and liability accounts of the balance sheet, as well as those that exist off-balance sheet. We also discuss the amalgamated picture of liquidity, in both theoretical and actual terms.

When analyzing liquidity sources it is important to remember that this topic represents two sides of the same "coin": institutions that have or require access to liquidity place demands on institutions that supply liquidity. Thus, while a company can use an unsecured bank loan as a source of liquidity, the bank granting that loan must be prepared to manage its own liquidity by arranging access to funding mechanisms such as interbank or retail deposits. Interbank and retail depositors, in turn, must be prepared to supply such liquidity by arranging in advance their own access to cash. Similarly, a company selling assets to generate cash must find investors willing to buy those assets; they, in turn, will require their own sources of funding in order to purchase the assets. The same is true for other classes of assets, liabilities, and off-balance sheet contingencies. Suppliers and users of liquidity are therefore intimately linked, helping illustrate how endogenous and exogenous forces interact and impact a firm's operations.

As we analyze asset, liability, and off-balance sheet liquidity it is worth re-emphasizing that the first source of operating cash comes from core business revenues; without a solid base of positive cash flow operations, access to other sources of liquidity can become uncertain or prove inadequate. Our primary assumption is that a firm has one or more cash flow-

positive businesses that generate a base of internal financing; asset, funding, and off-balance liquidity serve to supplement that base of financing. Indeed, a firm that experiences negative operating cash flow over successive quarters will eventually threaten its liquidity position and may ultimately encounter some type of financial distress.

SOURCES OF ASSET LIQUIDITY

The balance sheet is a point-in-time snapshot reflecting the financial structure of a firm's business. As noted in the last chapter, an industrial firm typically has a larger amount of fixed assets and a smaller amount of liquid assets than a financial or non-financial service firm. Although fixed assets are less liquid than short-term securities inventories, it does not mean that the industrial firm has a greater amount of liquidity risk; as we noted in the last chapter, the typical industrial company is likely to match its long-term fixed assets with long-term liabilities, and must therefore only balance short-term assets and liabilities to ensure a proper liquidity position. Similarly, although a bank or service company might have a greater percentage of its assets in liquid form, it is likely to have a larger amount of short-term or uncertain liabilities and contingencies, and must therefore be even more acutely aware of its liquidity position. Indeed, comparing the amount of liquid versus fixed assets across industries tells us very little; comparisons must be made relative to liabilities and contingencies. Regardless of industry-specific characteristics, however, firms considered to be of good to average credit quality maintain a certain amount of liquid assets that can be used to meet obligations; they are also likely to preserve a reasonable percentage of unencumbered fixed assets that can be pledged to secure cash. We consider each of these in turn.

Liquid assets

Cash and marketable securities

Cash and near-cash instruments are the most liquid assets in the corporate portfolio. Cash is held to meet expected and unexpected payments; no conversion is required, so payments can simply be made from the cash account. However, since cash is a non-earning asset, companies that are sensitive to the liquidity risk/return trade-off we mentioned in the last chapter try to minimize their pure cash holdings, preferring to keep some amount of assets in the "near cash" category – very liquid, earning instruments that can be sold immediately at the carrying price. This class of investments generally includes instruments with negligible credit and

market risks, such as government treasury bills and money market instruments issued by very highly rated companies and financial institutions (such as A-1/P-1 industrial commercial paper, prime grade bank certificates of deposit, and bankers acceptances). Note that while such securities are readily saleable, they do not always result in an immediate infusion of cash; trading settlement conventions in many markets call for exchange of cash and securities over two, three, or five business days.

Next we find investments that carry higher yields but may not be as easy to sell on short-notice at the recorded carrying value. Although such investments lack the same degree of marketability (owing to greater credit and/or market risks), they are still an important source of liquidity. The prudent firm must therefore account for the relatively lower saleability by applying a "haircut" – or discount – when computing the value that might be obtained in a disposal scenario. If $100 million market value of short-term treasury bills will yield $100 million of cash, other securities – including medium and long-term corporate bonds, government bonds, and agency securities – might yield $95 million or $98 million instantly.

Lesser quality securities, such as emerging market bonds, high yield bonds, or preferred stock, will yield even less under the "rapid disposal" scenario because the instruments are riskier and the population of buyers is much smaller. This illustrates an important point: the riskier the investment and the more urgent the need to dispose of the investment in order to generate cash, the greater the discount. A seller that can liquidate an emerging market bond portfolio in a leisurely fashion over two weeks of normal market conditions might exit at a price that approximates the carrying value; an urgent or distressed seller will not.

Of course, not all investment portfolios stand ready to be sold; in many cases they are used as collateral for loans, which fulfills the desired liquidity function without requiring that the firm sell assets it may wish to retain. But there are several costs associated with this scenario. The first is the size of the haircut the lending firm will require for providing a collateralized loan, the second is the interest charge applied to the borrowing, and the third is the reduced financial flexibility that comes from encumbering the balance sheet. For instance, a bank may be willing to lend $98 million on an overnight basis for $100 million of treasury notes (that is, a 2 percent haircut) as it will have no concerns about price deterioration in the treasury securities or the ability of the company to repay the loan over the next 24 hours. If the term is for one week, without any ability for the bank to ask for additional collateral, the haircut might be 5 percent. If the term is 24 hours but the securities being posted are long-term corporate bonds, the haircut might be 5 percent or 7 percent; if the term is one week, it might be 10 percent. Thus, determination of the liquid worth of a securities portfolio that can be used as collateral is based on the haircut level imposed by the

bank, which is, itself, a function of the quality and price volatility of the asset, the tenor of the loan, and the ability to request additional collateral, should that prove necessary.

It is worth noting that financial institutions actively use reverse repurchase agreements, or collateralized loans to third parties, to place their excess cash. These contracts rank below marketable securities in terms of liquidity, although they can sometimes be sold on a secondary basis if needed – we therefore include them in this sub-section. It is common for banks and securities firms to grant reverse repo financing to customers, often on an overnight or very short-term basis. If an institution extending reverse repos needs to recover its cash, it simply ceases to roll over its overnight reverses and suspends renewal of short-term reverses as they come due; this gives the firm extra cash resources that it can apply to its own obligations. Longer term reverses, extending out several weeks or months, can be sold in a secondary market (as long as the underlying collateral is high-quality and fungible). Thus, the reverse repurchase book must be viewed as a good source of asset liquidity.[1]

Receivables

Receivables, which represent credit extended by a company to its customers, rank below cash and marketable securities in terms of liquidity. Receivables arise when a firm providing customers with goods and services permits them to pay at some future date (such as 7, 30, 60, or 90+ days from the date goods or services are delivered). The delayed payments generate implicit interest earnings for the firm, meaning that receivables are simply short-term, unsecured loans to customers. Since receivables represent future cash inflows to the firm, they are valuable assets that can be liquefied at an appropriate discount. Thus, a firm in need of cash can sell a portfolio of receivables to a third party directly (this is a process know as factoring) or use the portfolio as collateral against a loan (known as accounts receivable financing).

There are subtle differences between the two. First, factoring represents a direct inflow of cash, while receivables financing represents an indirect inflow through the draw-down of credit. Second, factoring is typically arranged on a non-recourse basis: that is, if the company sells the receivables to a factor, any customer defaults become the responsibility of the factor, not the firm. Receivables financing, in contrast, is typically arranged on a recourse basis: if defaults occur and insufficient cash exists to repay the loan, the bank can turn to the borrowing firm for restitution. In addition to factoring or collateralized lending, receivables can also be liquefied through the securitization process, which we discuss later in the chapter.

Inventories

The general category of physical inventory ranks below receivables in order of liquidity and potential for conversion into cash (we exclude inventories of financial instruments from this classification, under the assumption that they form part of the portfolios of marketable investments mentioned above). Inventory is generally classified as raw materials, work in progress, or finished goods, each with its own value and value-added elements. The type of inventory kept on hand to satisfy customer demand depends on the nature of a company's business. In some cases inventory is perishable and must be consumed rapidly (this is true of perishables such as food and certain pharmaceuticals), while in other cases it is durable and designed to be consumed over a period of weeks, months, or years (as with textiles, computers, automobiles, and steel bars). Durable inventory, in particular, can often serve as a source of liquidity; this is particularly true for inventory that is in strong demand and is relatively generic and fungible. Selling inventory rapidly to generate cash means, of course, that some discount to carrying value might be taken. But if cash proceeds are required, the sale of inventory is a viable solution.

It is important to consider how inventories are financed. If they are funded from general corporate sources (such as commercial paper, term loans, or revolvers) they are almost certainly unencumbered – meaning that they can be pledged instead of sold, should that prove an advisable course of action. The pledge may take the form of a specific lien on particular inventory, or a floating lien applicable generally to current and future inventories. Inventories of raw materials or finished goods that have been conveyed to bonded storage or warehouse facilities can be secured and documented via warehouse receipts, meaning that only the bearer of the receipt is entitled to withdraw the goods; once the warehouse receipt has been issued, it can be transferred to a third-party creditor as a form of collateral. In other instances inventories are financed through self-liquidating loans, where inventory sales in the normal course of business generate the proceeds used to repay the bank for the initial funding. Self-liquidating loans may include a claim by the lending bank over the inventory. In these cases a firm has no ability to use the inventory as a cash-generating asset, as the assets secure a previous cash inflow provided by the lending bank.

The liquid assets we have described above comprise (in whole or part) what is often termed a liquidity warehouse: a segregated portion of the asset accounts that can be sold or pledged to supplement the funding program to meet unexpected payments. The liquidity warehouse is likely to be based on securities that are available for sale (which are marked-to-market and unrestricted) rather than those that are being held to maturity

(which are likely to be marked at historical value and whose sale may be restricted). It may also include receivables that can be factored or financed quickly and, in some instance, generic inventories (although these are likely to comprise only a small percentage of the available warehouse). We shall revisit the liquidity warehouse concept at various points throughout the text, as it is an important element of prudent liquidity risk management. Indeed, some national financial regulators believe creation and preservation of a liquidity warehouse is so vital that they have mandated its use.[2]

Fixed assets and intangibles

While the main focus of asset liquidity is rightly on the liquid portion of the asset accounts, a firm might also have access to fixed assets that can be used to generate cash. These, not surprisingly, are of secondary importance as they generally cannot be used to meet emergency cash obligations; obtaining liquidity from fixed assets can be a time-consuming affair, certainly when compared with alternate disposal or pledging solutions in the liquid asset accounts.

Fixed assets

Fixed assets comprise the primary or sole means of production for companies in the industrial sector. As we have noted, they are as important to revenue generation as financial assets are to banks and securities firms. Hard assets, including plant and equipment used to transform raw materials into finished goods, must therefore be treated with care; pledging or selling such assets can reduce flexibility and impact a firm's ability to manage its daily business affairs and maximize enterprise value.

In practice, long-term fixed assets are typically financed with long-term capital, including equity and long-term debt. The debt supporting plant and equipment might or might not be secured, depending on the credit strength of the company and the nature and life of the asset. The strongest credits do not generally pledge fixed assets in support of borrowings, while those of medium and low quality typically must. Assets securing debt obviously cannot be sold or pledged to others, meaning a firm can only generate cash through its lien-free fixed assets. That said, negotiating a financing facility supported by a pledge of fixed assets can take time, and may not be suitable for emergency payments. Since the mechanics involved in arranging a credit facility that involves a valuation of fixed assets can take several weeks or months to conclude, unencumbered fixed assets can only serve as a source of liquidity when there is enough time available to perform necessary due diligence work.

Selling fixed assets to generate cash is not usually considered a viable, or advisable, action (although the sale and leaseback transaction, described below, and the sale of non-care assets, serve as exceptions).[3] Since fixed assets are central to revenue generation and the creation of enterprise value, outright sale leads to a decline in revenues and operating cash flows, and erosion in enterprise value. In addition, the disposal of fixed assets must be considered to be a medium-term transaction, especially for assets that are unique and lack a ready market of buyers. Selling heavy machinery, a microchip factory, or an auto plant, for instance, is a customized transaction that is likely to attract the interest of a very limited number of buyers and take many months to agree and finalize; unless a firm is willing to take a substantial discount to carrying value, fixed assets cannot typically be sold quickly.

Intangibles

Intangibles, which can be defined as assets that generate value but have no physical or tangible qualities, cannot be regarded as a potential source of liquidity. The primary intangible of the corporate world is goodwill – the reputation, branding, and intellectual property of a firm, or in an acquisition scenario the differential between the acquisition value and book value of the company or asset acquired. In either event, goodwill is a non-cash depreciable asset that has value to a company and marketplace – but not necessarily a value that can be immediately converted into cash. There are, of course, situations when a firm sells one of its brand products or services to a third party; the assets associated with the sale, including the transfer of goodwill, are exchanged for cash. However, such sales are relatively unusual, and designed for strategic reasons rather than as a liquidity management mechanism (for instance, exiting a market for a particular strategic or competitive motive).

Figure 3.1 depicts sources of asset liquidity for a standard corporation.

SOURCES OF FUNDING LIQUIDITY

After taking account of operating cash flows, funding is the first line of defense in raising cash to meet payments; only when funding has been exhausted or proves too expensive is a company likely to pledge or sell assets in order to supplement the cash position. In practice companies use various types of liabilities, including short-term financing facilities (such as commercial paper and Euro commercial paper, short-term bank facilities, payables, interbank/retail deposits, repurchase agreements, and putable funding arrangements), and medium/long-term facilities (such as

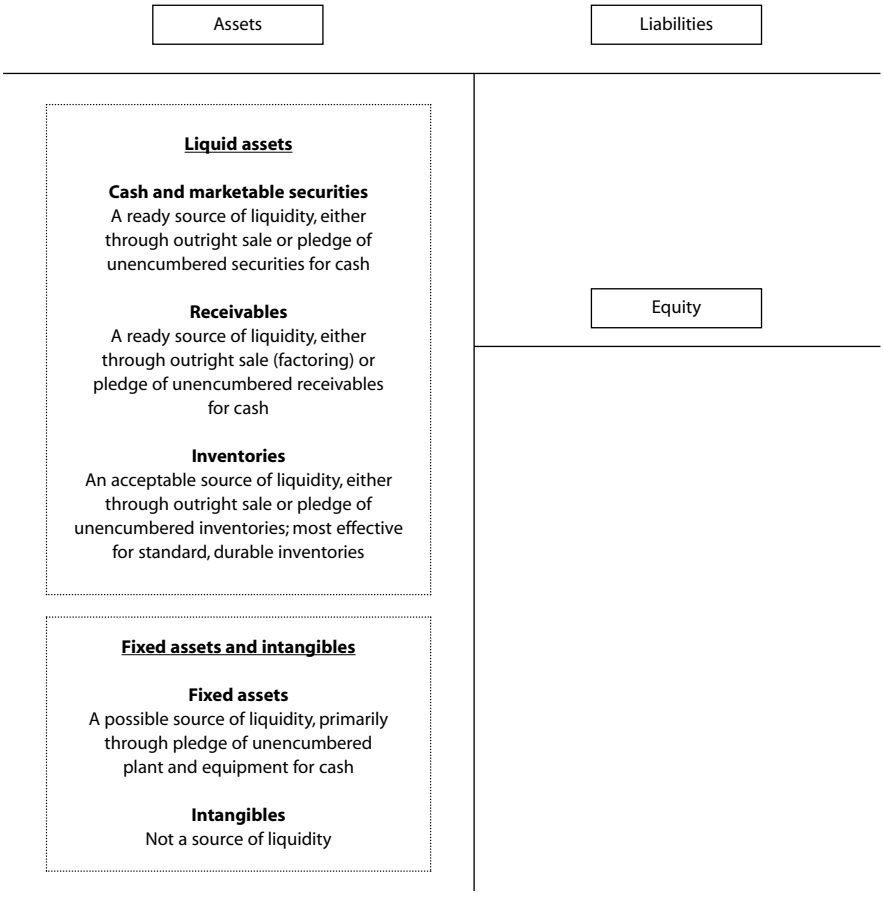

Figure 3.1 Common sources of asset liquidity

medium-term notes and Euronote facilities, non-putable funding arrangements, long-term bonds, and loans). Some firms, particularly those that are part of broader conglomerates, may also have access to intracompany cash; presuming other group members have excess liquidity, and assuming no meaningful regulatory and legal restrictions exist regarding intracompany flow of funds, this can be considered an additional source of financing.

Consistent with our comments above, the relative mix of short versus medium/long-term does not, by itself, indicate a firm's relative level of liquidity. While a firm that has most of its funding obligations coming due in three or five years might have fewer immediate funding pressures (that is, no need for constant rollovers, and no risk that short-term funds will be withdrawn rapidly) it might still be subject to liquidity risk if it lacks immediate access to cash to meet emergency payments. A firm that has a great deal of short-term liabilities might appear to have greater

liquidity risk, but if these contracts are well matched by short-term assets the liquidity position might be perfectly manageable and not much riskier than one with longer maturities. Gauging a firm's overall liquidity position therefore involves a joint evaluation of assets, liabilities, and off-balance sheet activities.

In practice firms from different industries appear to favor different types of funding liquidity. As noted, financial institutions often obtain a great deal of their financing from the short-term markets in order to balance the very liquid nature of their assets, contingencies, and off-balance sheet obligations, and to attempt to maximize earnings in a positive yield curve environment. Capital-intensive institutions derive the bulk of their funding from medium and long-term sources in order to match the financing requirements of long-term plant and equipment. (Of course, they still need to preserve access to the short-term markets in order to meet obligations coming due.)

Short-term funding markets

Commercial paper, Euro commercial paper

The commercial paper (CP) and Euro commercial paper (ECP) markets are a popular source of short-term unsecured funding for creditworthy companies in virtually all major industry classes.[4] The obligations issued by companies under CP programs (arranged and agented by investment and commercial banks) range from 1 to 270 days in the US market, and 1 to 360 days in the Euromarket. In practice only prime credits (those rated A-1+/P-1, A-1/P-1 and, periodically, A-2/P-2 and A-3/P-3[5]) can access the CP/ECP market; non-prime companies are effectively barred access by intermediaries and investors. Conventional CP facilities are unsecured,[6] but in the US market are generally backed by contingent bank lines (swing lines) that can be drawn down if rollovers of existing paper prove difficult. Rating agencies generally expect such bank lines to be committed and large enough to cover at least half of an issuer's program (and sometimes as much as 100 percent). Though popular, it is important to stress that the CP and ECP markets are credit and market sensitive, and extremely unstable during times of market stress; they cannot be considered a reliable source of funding under all conditions, even for good credits.

Short-term bank facilities

Corporations regularly use short-term credit facilities supplied by banks to cover seasonal or emergency needs. Such facilities, available as revolvers or fixed-term loans, have maturities ranging from 6 to 24 months and can

be viewed as a relatively stable source of funding during the period in which they remain in effect. As with other short-term funding, however, they must be managed closely as the maturity date approaches – the possibility of "non-renewal" exists, particularly if a borrowing company's credit standing has deteriorated or the financial system has become strained.

Payables

Accounts payable are another important form of short-term funding, particularly for non-financial service and industrial companies. Just as a company grants credit to its clients by allowing delayed payment on invoices, it accepts credit from suppliers by utilizing delayed payment terms. In fact, companies often seek to extend their payables to the last possible moment in order to enjoy funding access. There is, of course, a price for the credit that a firm absorbs: payables, like receivables, carry an implicit interest rate – in this case a cost, rather than a return, to the firm.

Like other short-term facilities, payables can be a volatile source of funds: while they may be stable when a firm's creditworthiness is steady and general market conditions are tranquil, they can disappear very quickly. Thus, if providers of trade credit are no longer comfortable with a company's financial situation or are coping with broader systemic dislocations, they may tighten the terms of payment for future transactions (for instance, payment within 7 days rather than 30 or 60 days) or simply refuse to renew payable credit terms at all (that is, move strictly to a cash on delivery basis).

Deposits and repurchase agreements

Deposits and repurchase agreements form the two primary sources of short-term funding for most financial institutions; these liabilities tend to be very liquid, with maturities ranging from overnight to several weeks. Interbank deposits are onshore or offshore institutional funds accepted by banks from other banks; most mature in 1 to 30 days and may be denominated in any one of several reserve currencies. Interbank deposits are part of what is termed "hot money," or credit and interest rate-sensitive funds that can be withdrawn and reallocated at very short notice.[7] Consequently, deposit takers must be prepared to fill the void should funds disappear or the offer price become too large.

The same instability does not necessarily exist with retail deposits, which have longer behavioral, if not always contractual, maturities. Banks with a broad base of core retail deposits enjoy a greater level of funding stability, as individual depositors are generally unwilling to shift their funds in search of extra yield. Retail deposits, in the form of checking and

savings accounts, money market accounts, and certificates of deposit, are said to be "sticky" – even in an era of electronic banking, where the potential for funds movement has increased dramatically but liabilities continue to remain quite stable.

Another major source of funding for financial institutions, particularly securities firms, comes from the repurchase agreement (repo) market – the opposite side of the reverse repo market mentioned earlier. Just as a financial institution extends credit by entering into reverse repos, it accepts credit by arranging repos, with terms ranging from overnight out to several weeks (term transactions to several months are also possible, though rather less common). Unlike interbank deposits, CP, and other financial institution funding mechanisms, repos are secured transactions. This means they are only available as a funding option if a firm has access to unencumbered securities that it can pledge as collateral per standard haircut requirements demanded by the marketplace. Haircuts can range from 25 basis points on high-quality government securities (for instance, $100 million of US Treasuries creates a $99.75 million loan) to 50 percent on emerging market and high-yield bonds (for instance, $100 million of bonds generates a $50 million loan). It is common market practice for the collateral to be revalued every day, and collateral calls to be made if certain minimum maintenance levels are breached.

It is worth noting that in some systems banks have access to other short-term sources of funding. For instance, in the US markets authorized banks can take advances (loans) at the Federal Reserve discount window, and can sell Federal Funds to other banks in the system; they may also borrow via the Federal Home Loan Bank system and accept brokered deposits. Similar facilities are available in various other national systems. Such mechanisms are important in equalizing surplus/deficit balances, but they are not necessarily available to all banks at all times.

It comes as no surprise that the short-term funding markets, while an extremely important source of corporate financing, and less costly than medium-term funds in a normal positive yield curve environment, are susceptible to a considerable amount of instability, and require close monitoring. The short-term nature of the obligations means that companies have to actively manage the repayment/redemption process, making sure sufficient alternative sources of funding are available in the event renewal is not possible or proves too expensive. A large company is likely to have to deal with millions, and even hundreds of millions, of maturing liabilities on a daily or weekly basis, and must therefore be prepared to take action in the event of disruption. In practice, short-term funding facilities are often the initial target of firm-specific or systemic financing problems. If any instance of disruption is not managed forcefully, problems can soon multiply. Lack of confidence by lenders/investors in the short-term markets soon

makes its way to other forms of funding, and can lead to cancellation or withdrawal of other facilities.

Medium/long-term funding markets

Medium-term notes and Euronote facilities

Companies regularly access funding via medium-term notes (MTNs), Euro MTNs and Euronotes (that is, note issuance facilities (NIFs), revolving underwriting facilities (RUFs), and related structures[8]) in order to lengthen liability maturities to the two to ten year sector. Notes can be issued in fixed or floating rate form, and in a variety of currencies and markets. Funding of this type has proven very popular over the past few years, as it can be accessed via "shelf" programs, with draw-down arranged quickly in order to take advantage of favorable financing opportunities or to meet sudden obligations. The shelf registration process means that the program only needs to be established and registered with regulators once every few years; multiple draw-downs can then occur when needed, with only a modest amount of new disclosure for each subsequent tranche issued. Notes are often floated on an unsecured basis; only weaker credits are required to post security in support of their issuance.

Lengthening maturities can help companies ease some of the active liquidity management demands imposed by the short-term funding markets. In addition, the public medium-term markets are less credit-sensitive than the short-term markets (apart from notes issued by sub-investment-grade credits). Once notes have been issued they remain outstanding until maturity (unless the issuing company breaches terms of the indenture or securities are putable by investors). This means that a multi-year obligation provides required funding and makes no demands on cash flow, apart from interest servicing (and possibly principal amortization via a sinking fund), for the period in question. The trade-off in the common positive yield curve environment is cost: medium-term funding is more expensive than short-term funding, and this must be considered in the cost/benefit analysis framework.

Funding agreements and GICs

Insurance companies rely heavily on funding agreements and GICs to finance portions of their insurance and investment management activities. Such agreements generally have maturities extending from one to ten-plus years, and are typically issued and placed with institutional investors on a fixed rate basis. Funding agreements and GICs that have stated maturity

dates and no put options or surrender provisions can be considered as medium to long-term financing. However, some contracts permit surrender at will or are putable by investors with relatively short notice; if such features exist, the funding must be considered short term. For instance, some funding agreements contain 7, 30, or 90 day put periods; although investors may hold the agreements for many years they retain the right to put the contracts back with as little as one week's notice, and these must therefore be considered short-term funding. GICs and other contractual liabilities that allow surrender on short notice must be viewed in a similar manner. In practice insurers attempt to limit putable and surrenderable features in their funding agreements in order to create true medium-term financing.

Long-term bonds

Long-term bond issues extend the funding yield curve even further, providing corporate financing in the 10 to 30 year sector. Unsecured bonds add an extra dimension of funding flexibility and stability for the reasons mentioned immediately above, and can often be used to match the time horizon of long-term investments that certain industrial companies are required to make. Long-term bonds can be issued in the US and Euro markets, as well as the domestic markets of other advanced national systems. Bonds may be fixed or floating rate, single or multiple tranche, and registered or bearer; they may be floated as public or private placement securities in any one of several currencies. Bonds may also be structured as senior or subordinated securities; those that are deeply subordinated can be viewed as a form of quasi-equity, particularly when they are issued on a perpetual basis. Convertible bonds are a form of hybrid bond financing (although mandatory convertible bonds are more accurately classified as equity). Secured bonds, supported through specific or general liens on an issuer's assets, are an important source of funding for some firms. Although the encumbrance prohibits the issuer from freely disposing of the underlying asset, the secured bond remains common in certain industrial sectors as a form of "semi-permanent" capital financing.

It is important to note that bonds might not always provide the timely liquidity injection that a firm requires. The process involved in issuing a bond can be lengthy. Although the shelf registration approach to bond issuance accelerates the flotation process, issuers that lack such programs must float securities on an ad hoc basis, which requires a minimum of several weeks to prepare and launch. In some cases bonds can take several months to bring to market, particularly for issuing companies that are not readily recognized in the marketplace. A firm seeking a quick

cash infusion to bridge a cash shortfall might thus find bonds ill suited for the task.

Loans

Medium- and long-term loans are another popular form of financing for a broad range of companies and are, in fact, the single most stable form of debt capital. Even when the public debt securities markets are in turmoil and the ability to issue is limited, companies are generally able to access the bank loan markets. This relates, of course, to documented credit facilities for which a borrower pays commitment and borrowing fees – those that are merely advised or undocumented cannot be regarded as robust.

Banks routinely lend funds to companies on an unsecured or secured basis for periods ranging from 2 to 20+ years. Loans may be fixed or floating rate, and structured with amortizing, balloon, or bullet principal repayments; they may be drawn onshore or offshore, in various currencies. Secured loans with a charge over fixed assets are quite common, although the same lack of flexibility mentioned above exists. Evergreen facilities, which are "dateless" facilities that remain in existence until the lending bank provides notice of conversion into a term loan with a defined final maturity, can be viewed as a form of medium-term lending (until the notice of maturity date has been established, which generally provides for a minimum repayment term of at least one year).

As we have noted, the medium and long-term funding markets can provide companies with greater certainty than the short-term markets, as cash flows are extended over a longer horizon and the need to constantly refund, rollover, or otherwise refinance liabilities coming due is eliminated. While regular payments of interest and principal amortization represent cash outflows, these are quite small in relation to principal repayments due several years in the future. Naturally, to be considered true medium or long-term funds, note, bond, and loan facilities cannot be putable, cancelable, or callable at the option of the lender or investor; the contractual and behavioral maturity of the liabilities must therefore be identical (or very nearly so). A 10-year straight bond without putable features or triggering covenants in the indenture is equivalent to 10-year money in the context of liability management. A 10-year bond that is putable by investors at 30 days notice is 30-day money and must be viewed as part of the short-term program; failure to do so misstates funding gaps and understates liquidity risk. We again re-emphasize the point that while funding may become more stable as it is termed out, it need not necessarily close or eliminate asset/liability gaps or mismatches, meaning liquidity risk issues might still exist.

Figure 3.2 highlights common sources of funding liquidity.

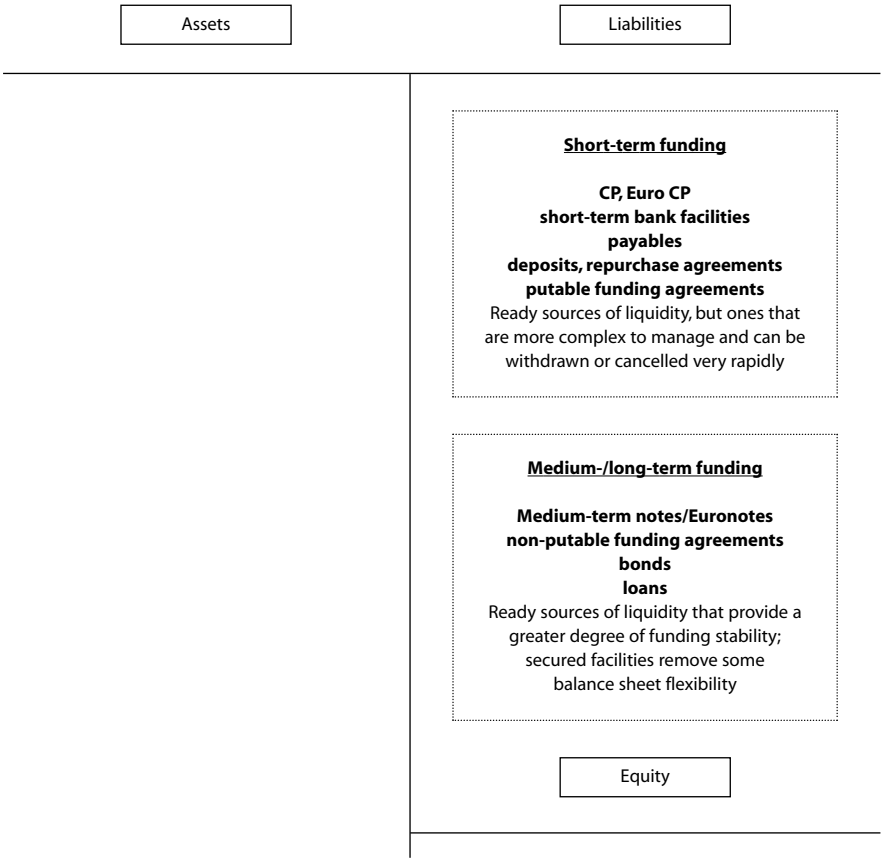

Figure 3.2 Common sources of funding liquidity

Equity capital

In considering the corporate balance sheet in a dual-entry accounting system we know that equity capital exists to support the assets and liabilities of the firm. Equity capital – retained earnings, paid-in capital, and capital surplus, along with certain classes of preferred securities – while absolutely critical to the solvency of the company and protection against unexpected losses, is not typically viewed as a short-term source of liquidity. From a practical perspective a firm in need of short-term cash to meet a payment coming due in one week or one month is unlikely to issue a new tranche of common or preferred stock; the process is time-consuming (a matter of several months in most cases) and not synchronized with the short-term time frame that is required when dealing with liquidity issues. A firm with a treasury stock contra account has some ability to resell shares repurchased at an earlier time, but this is an unusual transaction, not normally associated with liquidity management. Equity capital is also

considerably more expensive than general debt financing, and thus not a rational way of attempting to maximize enterprise value. Our discussion of sources of liquidity thus ignores any funding from the equity capital accounts.

SOURCES OF OFF-BALANCE SHEET LIQUIDITY

Off-balance sheet transactions have grown rapidly in scope, depth, and breadth over the past three decades, and are now an elemental part of financial and corporate risk management. As the name implies, off-balance sheet transactions reside off the corporate balance rather than as visible assets or liabilities, and are characterized by uncertain value. They might exist as contingencies that have not yet resulted in the creation of credit or market risk exposure, and they might feature economic worth that fluctuates with changing market conditions. Although portions of the exposure generated by these contracts can appear through the balance sheet and/or income statement as value is "crystallized" (for example derivative receivables/payables, based on mark-to-market valuations, appear on the balance sheet, and draw-downs on revolving credit facilities appear as assets for the lenders and liabilities for the borrowers), the remainder of the future/contingent exposure is generally referenced in the footnotes to a company's statutory financial statements.

Nevertheless such instruments represent important sources of liquidity for those who can use them to gain access to cash or assets. Perhaps more importantly, they represent potential liabilities of liquidity providers who might be required to fund in the event of exercise, sale or draw-down. Not surprisingly, companies have placed much greater emphasis on gaining a better understanding of their off-balance sheet activities, and how they can affect, and be used to manage, the corporate liquidity profile. In this section we consider several broad classes of instruments that can serve as sources of liquidity: securitizations, derivatives, contingent financings, and leases.

Securitization

Securitization is a common technique of financial engineering that can be used to transfer risk and generate liquidity. Although credit/market risk transfer is generally the main motivation for engaging in securitization, we shall focus strictly on the liquidity features of the process.

In a standard securitization a firm sells a portfolio of assets into a conduit (generally a trust or special purpose entity (SPE)), generating a cash inflow. The conduit then issues tranches of notes to investors, with

each tranche representing a different claim/priority/maturity that gives investors the option of purchasing the investment profile they prefer. Flows from the underlying assets are used to pay periodic interest payments to investors according to the sequence and schedule established through the tranching mechanism. At maturity the underlying assets are used to repay the principal, and once complete, the securitization transaction terminates. In some instances specific tranches are insured by outside support providers, such as insurance companies, in order to create securities with very strong credit ratings.

With this basic description, it is possible to see how securitization can liquefy the sponsoring institution's balance sheet: the sale of assets, such as mortgages, mortgage-backed securities, loans, corporate bonds, auto or credit card receivables, or inventories, converts a portfolio of liquid or semi-liquid assets into cash.[9] The process, however, takes time to arrange. Establishing a trust or SPE to purchase the assets, creating portfolios that generate the proper profile to meet investor requirements, and identifying investors interested in buying specific tranches can take months to structure, negotiate, and conclude. Even subsequent securitizations can take several weeks of work. Securitization must therefore be viewed as a medium-term solution to generating cash.

It is also worth noting that not all securitizations free a sponsoring institution from liquidity risk. When a bank is involved in selling assets to the SPE, it often provides a contingent liquidity facility that helps support timely payment of principal and interest on the notes; although the liquidity risk becomes contingent rather than first-order, it still exists and must be properly recognized as an exposure. (Corporate securitizations do not carry the same risks for the sponsors, as companies contract with banks to provide appropriate backstops.)

Figure 3.3 illustrates the generic flows of a securitization involving mortgages; as noted, we might just as easily substitute receivables or other assets, liabilities or contingencies.

Contingent financings

Contingent financings are an extremely popular form of liquidity for institutions, permitting the *ex ante* establishment of funding that might not be needed until some future time. For instance, rather than taking out a $100 million loan to fund a future event that might not occur, a firm can simply contract to take out an option to draw down $100 million when, and if, needed. (Once drawn, the liability becomes a funded loan, as described above.) Under most circumstances the firm will pay a fee for the facility (that is, a commitment fee), but need not inflate its balance sheet or pay a full funding cost for a facility that might never be required.

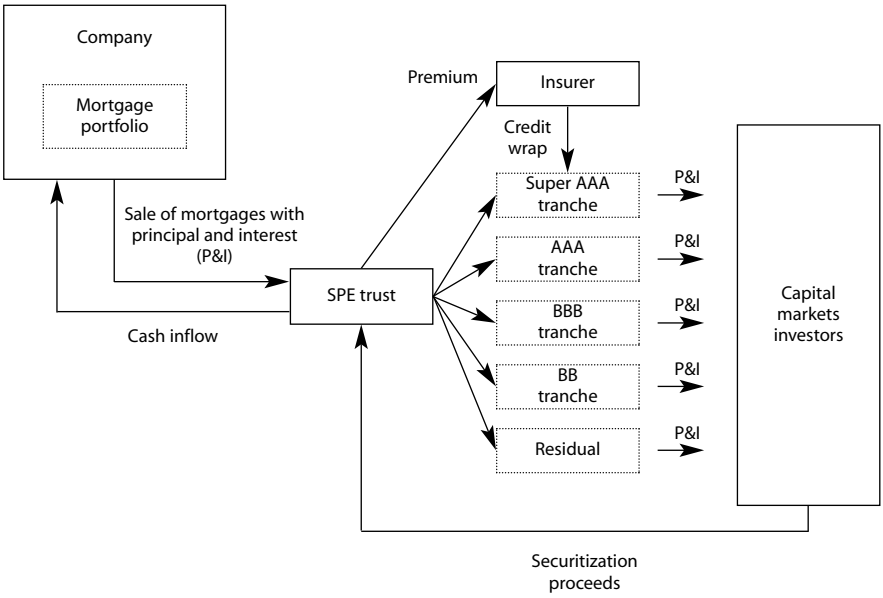

Figure 3.3 Generic securitization

Contingent financings are available in a number of forms, including revolving lines of credit (known also as a line of credit, revolver, or loan commitment), direct pay letters of credit, backstops, backup lines, and swing lines. Access to funds may be direct, as in a draw-down of a credit line, or indirect, as in a disbursement of funds by a bank/tender panel in the event existing liabilities cannot be rolled over or an issue of notes is not absorbed by investors (for instance, a swing line supporting a CP program, or a tender panel facility supporting a RUF or NIF). If draw-down actually occurs, the borrower generates cash for its operations and creates a liability that becomes due and payable over a period ranging from several weeks to several years. In most cases borrowings are senior, unsecured obligations, although security may be demanded (particularly if the credit quality of the borrower has deteriorated between the time of contract and draw-down). The nature of the commitment varies, from solid to advised. If only advised, a company that believes it has access to a source of funds must exercise due care, as the "commitment" may be withdrawn by the financial institution. In most instances a firm can strengthen the degree of commitment by executing a formal revolving credit agreement with defined terms and obligations, and paying a commitment fee.

Banks and insurers also provide contingent funding to third-party beneficiaries designated by client firms. This provides the third party with a source of liquidity should the contracting firm fail to perform as expected on a commercial or financial transaction. Surety bonds, financial guarantees, and

standby letters of credit are all examples of such third-party contingencies. If the drawing firm fails to make good on its obligations to the beneficiary, the beneficiary is left without a vital source of cash inflow. To compensate, it turns to the bank or insurer and obtains the expected cash flow.

Leases

Lease contracts are another source of off-balance sheet liquidity for companies that prefer to lease, rather than purchase, certain types of assets. Operating leases, for instance, act as *de facto* borrowing arrangements, permitting the lessee to use an asset without having to fund the principal element of the acquisition cost. Although lease payments can be likened to standard interest payments on a bond or loan, there is no principal exchange involved in the standard lease. The fact that the lessee does not own or fund the underlying asset creates a cash flow that can be used for other purposes, including the establishment of a liquidity buffer or the payment of obligations.

In one popular lease transaction, the sale and leaseback, a firm sells an asset to the lessor, then enters into a lease agreement that allows it to continue using the asset. The process liquefies the firm's balance sheet via the infusion of cash from the sale. Standard leasing arrangements covering various types of fixed assets are also common. Although they do not result in a direct inflow of cash as in the sale and leaseback, the effect is nearly the same: cash earmarked for asset acquisition can be reallocated to meet other obligations. Note that in certain accounting regimes various classes of leases appear on, rather than off, the balance sheet; when this occurs, the lease is simply classified as another form of long-term debt.

Derivatives

Listed and over-the-counter (OTC) derivatives – financial contracts that derive their value from an asset or market reference – have become a popular means of hedging, speculating, and arbitraging since their popularization in the 1980s and 1990s. While derivatives are used primarily to manage aspects of corporate investment and risk, they can impact liquidity by supplying or absorbing periodic cash flows. For instance, a firm can enter into a zero coupon swap where it receives regular quarterly payments for a period of years but makes no payments of its own until maturity of the transaction; until the final maturity it enjoys regular cash inflows without facing any outflows. (The bank on the other side of the transaction faces the opposite scenario, of course.)

A total return swap, which is a contract that synthetically replicates the cash flows of an underlying asset on an unfunded basis, provides the

purchaser with regular cash inflows without requiring it to fund the underlying asset; cash that would normally be used to buy the asset can be used to meet other obligations. Under a more speculative approach, a firm can generate extra cash inflows by selling options (derivative contracts that convey the right to buy (call option) or sell (put option) an asset at a particular price and time); the premium it receives represents a cash inflow on trade date, with no resulting liability until some future time, if ever. While this is a high-risk transaction, particularly if the underlying assets are not held on the balance sheet or insufficient cash exists to meet any exercise (this is known as "naked" option writing), a firm can actually generate cash.

Figure 3.4 summarizes common sources of off-balance sheet liquidity.

Other sources of on- and off-balance sheet funding exist, but most are variations on the structures we have mentioned above, such as related-party transactions, where a company borrows from a subsidiary, affiliate, or joint venture, SPEs established to raise funds and channel them to particular parts of a corporate operation, and so forth. Regardless of the specific mechanism, it is important to re-emphasize that sources of

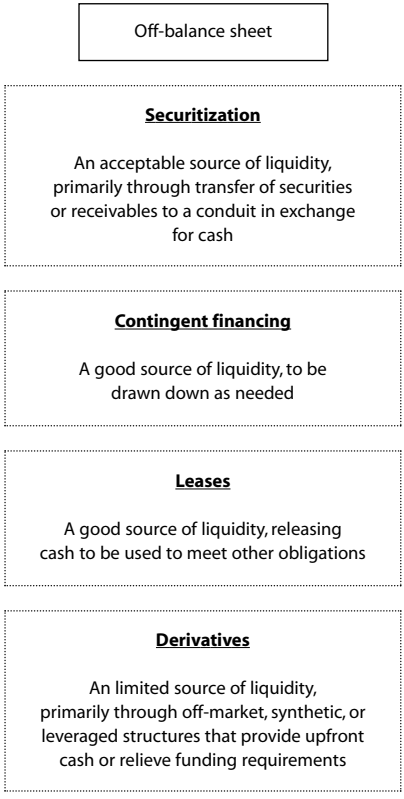

Figure 3.4 Common sources of off-balance sheet liquidity

liquidity are just one side of the equation. For every source that a company uses there must be a party to supply the liquidity – a purchaser of receivables, lender against an investment portfolio or fixed assets, provider of a swing line or term loan, investor in CP or MTNs, lessor of equipment, writer of a zero coupon swap, and so forth. Liquidity suppliers must therefore manage their own positions very closely; failure to do so means that they may be unable to provide the cash that other firms are counting on, creating a "ripple effect" that can lead to broader disruptions. As we have noted, this might happen during periods of financial stress, when those accustomed to providing large amounts of liquidity to the corporate system pull back, curtail their investments or loans, or commence flight-to-quality by redirecting capital.

Figure 3.5 summarizes key sources of on and off-balance sheet liquidity.

AMALGAMATING LIQUIDITY SOURCES

Companies often develop plans on how to access their amalgamated sources of liquidity in order to minimize costs and avoid any possibility of disruption. Such a plan might be especially relevant when a firm is in strong financial condition and in full control of its cash inflows and outflow, and the market environment is benign. It might, however, be less applicable when internal difficulties arise or external forces create market disruptions; adjustments might be needed in such cases, as we shall note in Chapter 10. Assuming normal market conditions, however, a firm is likely to use most, or all, of the liquidity mechanisms that it can access in a timely, and economically rational, manner. A typical "rank ordering" might therefore be as follows:

- Rollover of existing facilities.
- Draw-down of bank lines or contingent funding sources.
- Pledge of unencumbered assets for loans.
- Sale of liquid assets from the liquidity warehouse, in order of marketability.
- Securitization of assets.
- Sale of additional illiquid assets, including fixed assets and entire business units.

In general, sales of long-term, illiquid assets that form part of a company's core business are reserved for the latter stages of any liquidity management

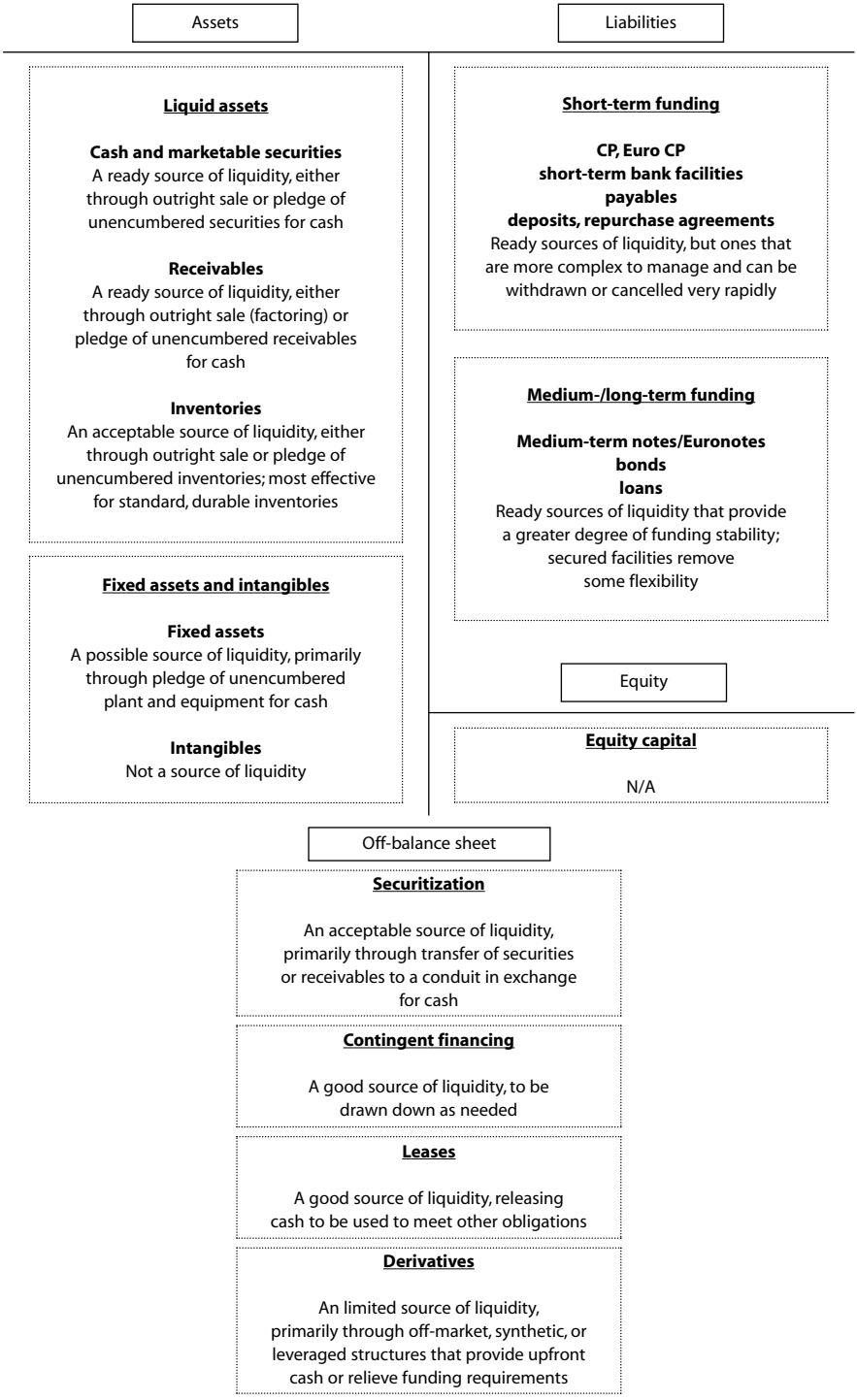

Figure 3.5 Key sources of on- and off-balance sheet liquidity

program, for at least two reasons. First, since they are not readily marketable – certainly not in the sense of cash, securities, receivables, or certain inventories – they are likely to be sold at greater discounts, meaning more significant loss of value. And second, since such assets form an essential component of business-generating activities, they can lead to a permanent reduction in enterprise value. Core long-term asset sales are often regarded as a last measure, taken to reinforce a damaged liquidity position.

Leaving aside these illiquid fixed assets, a company can create a list of liquidity sources that it can tap as needed. Obviously, no company can access every source of liquidity: some are industry-specific, others credit rating sensitive, still others restricted by regulatory actions or market practice. The liquidity "palette" for each company is thus a unique combination of the options we have discussed in this chapter. Furthermore, a distinction must be drawn between theoretical liquidity sources – accessible during normal market conditions – and actual liquidity sources – accessible during times of market stress. The two are often different. Consider, for example, the theoretical and actual sources a securities firm can access, as shown in Figure 3.6.

The actual source portion reflects the securities firm's true ability to generate cash or obtain cash from its amalgamated sources during all market conditions, and may be considered a more accurate representation

Theoretical sources:

Net cash from operations +
Cash on hand +
Borrowing value or liquidation value of unencumbered assets (post haircut) +
Commercial paper +
Broker call loans +
Medium term notes +
Unsecured portion of undrawn, uncommitted bank facility +
Unsecured portion of undrawn, committed bank facility +
Certain and contracted cash inflows

Actual sources:

Net cash from operations +
Cash on hand +
Borrowing value or liquidation value of unencumbered assets (post haircut) +
Commercial paper +
Broker call loans +
Medium term notes +
Unsecured portion of undrawn, uncommitted bank facility +
Unsecured portion of undrawn, committed bank facility +
Certain and contracted cash inflows

Disappear

Figure 3.6 Theoretical and actual liquidity sources for a securities firm

of cash power. During times of market stress, when the call for liquidity is particularly significant, some of the theoretical sources, such as CP, MTNs, payables, or uncommitted facilities, might disappear, creating a shortfall when compared with the theoretical source baseline. Knowledge of theoretical versus actual sources of amalgamated liquidity can be used when creating a liquidity risk management plan, as we shall note in Part III.

Financial and non-financial institutions have access to a number of liquidity sources. While not all types of asset, funding, and off-balance sheet liquidity are accessible to all companies at all times, many of them are. Companies seeking to manage their liquidity profiles are thus wise to arrange *ex ante* access to as many as possible. Although this implies a cost, it can help minimize the likelihood of liquidity-induced losses, particularly those that might appear during difficult market conditions. However, the process is not always simple; in the next part of the book we shall consider difficulties that can arise when funding, asset, and joint liquidity risk problems appear.

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PART II

Liquidity Problems

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CHAPTER 4

Funding Liquidity Risk

We begin our discussion of theoretical and practical liquidity risk problems with an analysis of funding liquidity risk, which we have previously defined as the risk of loss stemming from an inability to obtain unsecured funding at economically reasonable levels when needed. If short and long-term debt facilities and off-balance sheet contingencies cannot be accessed as required, a firm might experience funding losses; when coupled with the asset liquidity risk problems discussed in the next chapter, more serious instances of financial distress can develop.

Funding access might be influenced by endogenous or exogenous factors. If the factors are purely endogenous, a firm might not be able to obtain unsecured financing if its credit rating is too weak, or if it requires too much capital. If they are exogenous, market conditions might dictate precisely how much financing each firm can obtain.

Let us consider the notion of liquid and illiquid markets for funding. A liquid market allows participants to meet requirements when needed through rollovers of existing financing arrangements, or draw-downs of new or pre-arranged facilities. A liquid market will absorb a firm's funding requirement at, or very near, the firm's expected cost of funds, with no change in terms (such as no change in maturities, no inclusion of restrictive covenants or collateralization). An illiquid market – one that lacks depth or is suffering from instability – prohibits large financing needs from being met without a significant rise in costs, change in structure, and/or time delay; if lenders or investors are unwilling to supply funds at a company's expected cost levels on relatively short notice, losses may result. There are, of course, instances when a firm can fund a large position in an otherwise illiquid financing market by dividing its obligations into many small cash flows or utilizing multiple products or conduits; the market in total might be able to absorb the requirement, so funding levels might not rise appreciably. However, funding liquidity management is often based on speed. Immediate access to cash is

generally important, so the time dimension becomes as vital as the cost dimension, and the funding premium demanded for immediacy can lead to losses.

SOURCES OF FUNDING LIQUIDITY RISK

Unexpected demand for cash is at the heart of funding liquidity risk. Anticipated obligations can typically be accommodated without difficulty, since they fall within the scope of known corporate plans and forecasts. Unanticipated obligations are difficult to incorporate in a risk management plan, although some amount of contingent funding can be established to manage "surprises" (within the confines of a rational liquidity risk/return trade-off, as mentioned in Chapter 2). Whether this amount will ultimately be sufficient cannot be determined on an *ex ante* basis. Unexpected demand for liquidity can come from various sources. We consider several of the most significant in this section, including:

- unpredictable cash flows
- unfavorable legal or regulatory judgments
- mismanagement
- negative perceptions/market actions.

Naturally, each one of these factors can extend into asset liquidity risk. Unexpected demand for liquidity that exceeds the capacity of an unsecured funding program (and any *ex ante* contingent buffer) to cover obligations requires action on the asset side of the balance sheet, which reverts to the point we made immediately above: if a firm must post assets as collateral at unreasonably large discounts, or can only sell its asset portfolio at distressed prices, in order to supplement the cash position, then the very sources that impact funding risk feed directly into asset liquidity problems.

Unpredictable cash flows

Unpredictable cash flows are at the center of liquidity risks. The realities of the corporate environment mean that virtually every firm faces a certain amount of cash flow unpredictability; the greater the level of unpredictability, the greater the specter of funding liquidity risk (and, in more serious instances, asset liquidity risk). While some element of uncertainty can be managed through buffers, reserves, or extra sources of contingent financing, even the savviest companies cannot predict whether such measures will ultimately be sufficient.

Since the largest global corporate and financial firms are complex entities, cash flow surprises can come from many sources. A review of a typical cash flow statement based on generally accepted account principles (GAAP) reveals areas where such uncertainties might appear, including revenues, costs of goods sold, receivables, payables, disposals, acquisitions, financings, and investments. We consider corporations and financial institutions separately.

Corporations

Figure 4.1 illustrates a generic non-financial corporate cash flow statement prepared under US GAAP, with a highlight of potential sources of cash flow unpredictability, including those where a company may have considerable, little, or no control over value received or paid. As the figure demonstrates, cash flow uncertainties can impact various parts of tactical and strategic operations. Tactically, a company might misjudge the size, timing, and nature of its daily business requirements or might be presented with unexpected payment demands from suppliers. Strategically, it might miscalculate the nature of market expansion, acquisitions, product development, or competition. Either situation can cause the firm to underestimate its commitments and/or funding requirements.

Consider, for instance, a gain/loss on the sale of an investment. If a company estimates that it will realize $100 million from the sale of a factory but only receives $75 million, it experiences an unexpected cash flow shortfall of $25 million. Or if the firm anticipates earning $1 billion of operating revenue but is forced to make extra supplier payments of $100 million (reflected in its cost of goods sold account), it again experiences a cash flow shortfall.

We can also consider situations where the purchase price of a strategic acquisition is greater than originally budgeted, the non-discretionary capital expenditures of a hard asset build-out exceed targets, a catastrophic event damages a facility that is underinsured, and so forth. Any one of these events can create unexpected demand for cash, increasing funding risk pressures.

Cash flow unpredictability can also arise from off-balance sheet contracts with uncertain value and timing. Let us first take the case of a company that has sold a $250 million American exercise call option on an asset and has left the position unhedged. Assuming the transaction is not reversed at some future date, one of two scenarios will appear at any date prior to expiry. First, the option will move in-the-money, leading the buyer to exercise; this will compel the company to pay $250 million to buy the asset from the option buyer, and will require $250 million of financing. If the sole source of the $250 million is via sale of the asset, the company

must then hope that the price when it liquidates is high enough to yield at least $250 million. If the firm has other sources of funding, it will then have to tap those to meet the cash call.

Alternatively, the option might remain out-of-the-money, meaning the company is under no obligation to raise $250 million. Again, the main point to emphasize is that a simple option transaction creates a contingent cash flow that is uncertain with regard to amount and timing. Non-financial corporations may have hundreds (and even thousands) of such derivatives (financial corporations typical have tens, if not hundreds, of thousands), suggesting considerable complexity in distilling future cash flows. It is not difficult to see through these simple examples how estimating cash flows with a reasonable degree of precision can be challenging; the process can never be completely precise, meaning uncertain cash flows are a reality.

Financial institutions

Similar cash flow unpredictability exists with financial institutions. Although the nature of operating, financing, and investing cash flows is slightly different, the same challenge applies: predicting future cash flows with a reasonable degree of precision is a tricky task. For instance, a bank granting a backstop or revolving credit line is providing a commitment to fund in the future, at the borrower's option; the amount and timing of draw-down are unknown at the time the contract is created. Such contingencies are extremely popular with companies, as they constitute a form of liquidity insurance that allows funds to be called only when needed. (They are also attractive to lenders as they allow fees to be earned even when no credit has been drawn down.) But they are fraught with uncertainty from a cash flow perspective, because they can be accessed at any time, and in any amount up to the maximum size of the facility. The same is true for standby letters of credit, which require a bank to fund in favor of a beneficiary if the original drawing party ceases to make payments; non-performance is, of course, an unpredictable event.

While various techniques can be applied to estimate the likelihood that these types of contingent outflows will arise (for example past experience, probabilities based on interest rate or default forecasts over particular time horizons, and simulations under different scenarios), the results are never precise – meaning that an accurate estimate is virtually impossible. The bank must then multiply this uncertainty by thousands of customers that have been granted similar facilities, and add in the effects of other uncertain cash flows from optionable derivative contracts, demand or call liabilities that can be withdrawn almost instantaneously, and so forth.

Let us also explore the example of a bank that funds itself with a large percentage of demand (or sight) deposits, which can be immediately

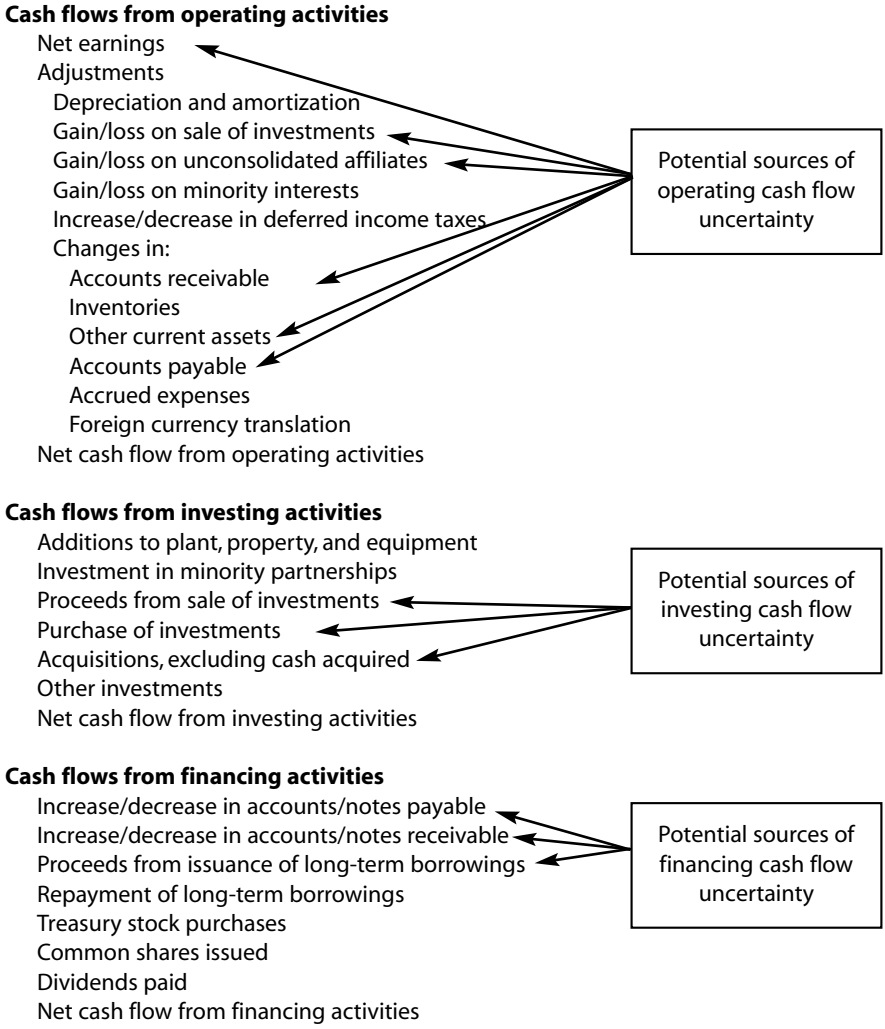

Figure 4.1 Generic statement of cash flows and possible sources of cash flow uncertainty

presented for redemption by depositors. The cash flow horizon of such deposits is completely uncertain; under most situations the deposits are likely to remain outstanding without change. However, if the bank becomes the subject of negative press or market rumor, more attractive alternatives present themselves in the financial markets, or the financial system in general enters a period of instability, depositors might withdraw their funds. The bank must immediately repay the demand deposits – failure to do so will lead to a loss of confidence and a potential run on

the bank. The cash flow behavior of the demand deposits is therefore uncertain.

As part of this process a bank must distinguish between the contractual and behavioral maturity of liabilities – this helps illustrate why estimating liability cash flows can be complicated. Contractual maturity is the actual maturity of a liability, or the earliest time at which the obligation can be presented for repayment or redemption; its time horizon is explicit and definite. Behavioral maturity is the practical maturity of a liability, or the "realistic" time at which the obligation will be presented for repayment; its time horizon is unknown and will depend on various internal and external factors. In fact, there is some evidence to suggest that behavioral maturity is a more accurate representation of liability horizons. For instance, retail or institutional depositors holding demand obligations can technically present them for redemption at any time; the contractual maturity suggests they should be viewed as overnight funding. In practice, however, depositors generally roll them over continuously, with no intention of redeeming them unless there is a disruption or more favorable investment opportunity. The behavioral maturity thus suggests the liabilities may be very long-dated, complicating the estimate of future cash flows and funding requirements.

The same often occurs in the CP market, where investors in 7, 14, or 30-day paper constantly renew their investments; the contractual and behavioral time horizons are thus quite different. The reverse can occur in the mortgage market, where an original contractual mortgage loan maturity of 10, 20, or 30 years might give way to a behavioral maturity of 3 or 5 years as a result of property sales or refinancings.

An insurance company might also have to deal with multiple sources of cash flow uncertainty. In the first instance the insurer must attempt to estimate claims payments it will have to make over a given time horizon. The nature, magnitude, and timing of these payments are, by definition, uncertain. The insurer has some idea of potential cash outflows through the use of actuarial techniques and the development of expected loss distributions, but an element of uncertainty remains. If an unexpected disaster occurs, claims might be much larger than the expected loss computation would suggest – leading to *ex post* cash deficits. Putable funding arrangements, which permit holders of certain liabilities to put them to the insurer at very short notice, can add to cash flow uncertainties; while the insurer might budget a certain amount of redemptions, it can never be entirely sure that it will not be faced with a simultaneous exodus of funding.

It is worth noting that some contingent and actual cash flows are uncertain but contain "delay" features or mechanisms that allow a firm to stagger any ensuing funding requirement. For instance, an insurance company that has sold an investor a GIC that can be presented for redemption at any time with a 30 day delay faces an uncertain cash flow (that is, uncertainty

over when (or if) the investor will present the GIC for redemption) – but an uncertain cash flow with a timing "cushion" that provides a window during which the insurer can attempt to arrange additional funding.

Again, it is not difficult to see how unexpected cash flows can filter through the entire financial sector. A financial institution will naturally be reluctant to be overly conservative and assume worst-case cash flow scenarios (such as instant withdrawal of liabilities, or complete funding of all contingencies) as this will result in a very inefficient use of resources. Equally, it will be hesitant to be overly aggressive by assuming best-case scenarios (such as no liability withdrawal, and no funding of contingencies) as such an approach could leave it with a potentially large cash shortfall if the contingent events actually occur.

Unfavorable legal or regulatory actions

There are instances when a firm might be called on to make unanticipated payments to customers or other stakeholders that have been financially harmed or misused. For instance, a court system might find a company liable for product defects, environmental damage, neglect, fraud, or breach of fiduciary duties. These actions can lead to what might be sizeable financial judgments in favor of the plaintiff(s). If this occurs, the firm must draw on sources of liquidity to make good any payments due. While it is unlikely that unfavorable legal judgments will be a "surprise" – the company will, after all, have spent many months, or even years, preparing for the possibility of a negative legal outcome – the magnitude of the payment might indeed be a surprise. It is possible, for instance, for a court to award punitive damages that are multiples of any amount originally sought by plaintiffs; these can put immediate funding pressures on the company, and although the right of appeal often exists, outcomes are uncertain and partial payments might still have to be made.

Short of pure legal action, a firm might be forced by regulatory authorities to unexpectedly recall a product, contain or clean up environmental damage, or otherwise "cease and desist" from some type of harmful activity. These are extraordinary events that might involve immediate payments, restitution, and/or closure costs, and which may temporarily or permanently disrupt operating activities and associated cash flows; both have the potential of pressuring funding.

There are, of course, instances when a company prepares for legal or regulatory eventualities by funding contingent reserves[1] or establishing certain types of insurance coverage. These comprise a general class of pre-loss financing, providing cash inflows in the event they are needed. However, not all companies engage in this anticipatory activity, and those that do might still be faced with shortfalls – meaning the potential for cash deficits remains.

Mismanagement

A firm that fails to properly manage its financial affairs as a result of incompetence or fraud might ultimately experience liquidity problems. Diligent discharge of financial responsibilities is a key function of executives operating under the direction and oversight of board directors; failure to perform this can lead to errors, bad decisions, or behavior that can jeopardize the cash position and create liquidity pressures.

Financial management is a complicated discipline that is characterized by a certain amount of unpredictability; the very nature of dynamic corporate operations, volatile markets, risk, and human behavior requires that this be true. That said, disciplined management can lead to prudent handling of assets and liabilities, while lax management can do precisely the opposite. If a company's executives accidentally or deliberately fail to adequately consider the liquidity process, or do not create a proper control environment to deal with liquidity risks, they may expose the company to an undue amount of cash flow unpredictability and pressure.[2]

Negative perceptions/market actions

Reputation in the marketplace – among investors, creditors, regulators, and rating agencies – is of paramount importance to all firms, especially financial and non-financial service companies that rely heavily on relationships, goodwill, and intellectual property to generate revenues. Defending reputation is an important executive management function: success leads to stakeholder confidence and, when coupled with solid business results, can translate into a higher stock price, improved credit rating, and lower cost of capital. The reverse is also true. Any doubt regarding the reputation of a company can prove costly – not only in terms of lost business opportunities, but in actual instances of increased funding pressure, rising funding costs and, in the extreme, financial distress.[3]

If a company is impacted by negative perceptions its business might begin to suffer. The specific reasons for the negative view are often less important than the uncertainty that is introduced into corporate operations and cash flows. Negative perception that leads to particular market actions by external stakeholders – such as capital withdrawals or facility cancellation – can thus be viewed as a direct source of funding liability risk; while causes may be endogenous, response is exogenous.

When depositors, creditors, lenders, or suppliers are no longer comfortable with aspects of a firm, its business, management, or strategy, they become nervous and pull back on the supply of capital, demand a greater premium for any capital they are still willing to supply, or renegotiate terms that place additional financial strain on corporate cash

flows. Any one of these can lead to unanticipated demands for funding. For instance, it is not unusual for a company with a bank credit facility to feature covenants or downgrade clauses requiring repayment of funds if a credit rating is downgraded or the stock price falls below some predefined level. If negative perceptions in the marketplace are enough to cause either event, a company might then be obligated to repay a portion of its facility: it will have an immediate, and unexpected, demand for funding. News of the downgrade and partial pay-down might exacerbate negative perceptions, driving the stock price down further, leading to the cancellation of more facilities, generating additional credit downgrades, and so on, in a continuing downward spiral.

EXOGENOUS CONSIDERATIONS

Not all funding difficulties are endogenous. There are instances when a firm might not be facing any significant degree of unpredictability in its cash flows, or be the subject of legal actions, or be impacted by mismanagement or negative market perceptions, but still find that it is affected by funding liquidity risks and associated problems. Forces at work in the macro-operating environment might leave a firm (or an entire sector or industry) without access to the funding it requires.

Sector or macro-economic difficulties, particularly among suppliers of liquidity, are a key catalyst. For instance, if the banking system at large has suffered large losses in its credit risk activities it may reduce its credit extensions to mid-grade companies, or require that they collateralize their borrowings; such actions are likely to increase the cost of funding for all borrowers in the category, even though their creditworthiness might remain unchanged. Or, if banks have concerns about a particular sector (believing, perhaps, that too much credit has been extended over a relatively short period), they may begin reducing or canceling facilities across the board; each individual company in that sector, regardless of credit strength, will feel the impact of the funding withdrawal. Similarly, if institutional investors in CP or MTNs discover opportunities to invest in other assets that provide a more attractive risk/return proposition, they may reallocate capital *en masse*, leaving companies that rely on such rollover facilities without a steady supply of financing.

It is worth noting that some institutions actually gain funding liquidity during periods of market stress. When a financial system is in the midst of panic selling and a general flight-to-quality, there is evidence to suggest that the largest banks in the system actually gain retail and institutional deposits from parties that wish to place funds in "safe haven" instruments. This does not mean that all banks are recipients of the flight-to-quality largesse, but the

leading banks – those that might be regarded as "too big to fail" within the local financial system – might indeed receive excess inflows. During market crises these banks might not even have to persuade depositors to increase their deposit flows, it may happen quite naturally. This has the interesting effect of allowing banks to increase their holdings of other investments (perhaps liquid investments, although there might be little need to do so if their own funding liquidity position is being revitalized by the flight-to-quality effect) and extend additional credits on a selective basis. Indeed, certain empirical research[4] has suggested that, as long as the demand for liquidity from depositors and borrowers is not highly correlated, banks may be willing to provide higher-rated corporate borrowers with additional backup lines of credit during times of market stress, at competitive all-in funding rates. The point to emphasize is that exogenous dislocations do not always damage the financing access of all institutions. That said, the conservative approach suggests that any beneficial effects accruing to a select group of institutions be ignored when considering stress scenarios.

THE NATURE OF FUNDING PROBLEMS

When liquidity difficulties increase for one of the reasons cited above, a firm turns to its funding program in order to address the problem. In the normal course of affairs, and assuming the firm's financing program is both comprehensive and stable, obligations can be met without difficulty. Access to incremental or rollover liquidity is gained through one or more of the liability sources referenced in the last chapter, necessary payments are made, and the firm continues to operate as it normally would. There are, however, instances when the funding program does not function as it should. This exposes the firm to risk of loss – directly, by forcing it to pay an increased cost of funds to secure alternate funds, or indirectly, by forcing it to sell or encumber assets (a topic we consider in the next chapter). Although there are various reasons why access to funding might be temporarily or permanently affected, we consider some of the most common in this section, including:

- rollover problems
- lack of market access
- commitment withdrawal
- excessive concentrations.

While each one of these difficulties is generally endogenous, problems can occasionally be compounded by the presence of exogenous forces.

Rollover problems

Difficulties rolling over, or renewing, credit can be an early sign of funding liquidity pressure. When credit providers – whether they are investors in a company's short-term securities, lenders providing evergreen revolvers, or suppliers providing trade credit through payables – are unwilling to roll over a firm's maturing liabilities as they come due, or are only willing to do so at sharply higher costs, a firm begins to encounter true funding problems. In fact, these can be very difficult to manage as negative news travels quickly and rollovers must be dealt with promptly.

Problems are generally attributable to actual or perceived problems with the company. If creditors believe that the firm's creditworthiness has become impaired, they will be reluctant to renew their funding obligations without extracting a higher premium. In more serious situations they may be unwilling to provide capital regardless of premium. Banks responsible for arranging short-term backup financing might be morally or contractually required to replace maturing liabilities through backup lines or swing lines. This can be a complicated situation, as creditors in the marketplace might view a company that is forced to draw on bank facilities as a substitute in a negative light. If perceptions are not managed at this early stage, broader loss of confidence might follow.

While most rollover problems tend to be company-specific, and therefore a direct reflection of the credit and liquidity risk of a particular firm, they can also be influenced by external forces, including those that create negative market conditions for all companies in a country, ratings category, or industrial sector. As noted above, while a firm's credit quality might not have deteriorated, it might still have trouble with rollovers if the market is in a state of turmoil. A financial crisis that causes flight-to-quality can lead to substantial withdrawal of capital from the short-term corporate funding markets. Alternatively, if investors are drawn to other investment alternatives that provide a higher return on invested capital, companies seeking to roll over their funding might have to do so at higher yields – even if credit quality is stable.

Lack of market access

Another common funding problem relates to lack of market access – simply an inability to utilize a particular financing market. We have described the broad array of debt-related instruments that are available to companies of varying characteristics and credit qualities. While not all sources of financing are available to all companies at all times, well-managed firms strive to arrange or use the largest number of funding conduits. For instance, a company may establish a shelf registration

program so that it can issue bonds on relatively short notice, arrange for a committed bank facility to be drawn down seasonally (or as needed in a crisis), and create a CP program to tap into short-term funds and roll them over when needed. However, not all companies have the ability to access all markets of their choice – either initially or on an ongoing basis – and this constrains corporate operations.

Let us first consider initial funding access. The global debt marketplace allows access based on the characteristics of each individual firm. In general, larger companies have better access opportunities than smaller ones, public companies better access than private ones, and creditworthy companies better access than less creditworthy ones. As noted in Chapter 3, the CP/ECP and short-term unsecured debt markets are generally reserved for the largest and strongest public companies, meaning that smaller, lower rated, or private companies are barred from access. The same is often true in the unsecured loan market: despite earning lower returns, banks often favor lending to companies with solid credit ratings, meaning weak firms may be prevented from tapping another important source of funds (unless they are willing and able to post collateral as security, an act that reduces financial flexibility).

Private firms, though potentially very creditworthy, may be unwilling to provide the marketplace with enough financial disclosure and might thus be prevented from gaining financing on favorable terms. Small firms, even if they are excellent credits, are often considered unacceptable candidates for unsecured financing by virtue of their scale. Even good companies that are reluctant to agree to specific bank loan covenants or supply sufficient swing lines for their CP programs might be unable to arrange proper access.

We must also consider funding access over time, which can deteriorate if a company's fortunes begin to weaken: avenues of funding generally shut down when the market is concerned about future ability to perform. Firms enjoying access to the money, capital, or loan markets might find some sources are cut off, and others become uneconomic as a result of very high interest costs as their credit quality deteriorates. Not surprisingly, decreased flexibility in accessing different markets, instruments, and lenders can lead to, or compound, funding liquidity risks, particularly when the market at large becomes aware of difficulties – a point we consider in the next section.

Commitment withdrawal

It is no surprise that the withdrawal of funds by suppliers of capital leads directly to funding liquidity risk problems. If a firm has not previously experienced withdrawals it might simply be forced to bear increased costs

as it arranges more expensive alternatives. If it has already been weakened by other facility withdrawals, additional cancellations can lead to more damaging problems, including instances of financial distress. Funding withdrawal can result from breach of covenants, triggers, or conditions precedent, and cause the supplier of funds to terminate a commitment (or refuse to renew the commitment when it comes due, which is akin to the rollover problem mentioned above). It may also arise from a perceived deterioration in credit quality: if lenders or investors are concerned about a firm's ability to remain current on its obligations – for reasons that include, but may not be limited to, those we have already indicated – they may simply withdraw commitments as they fall due.

For example, if a company is able to borrow through an unsecured revolving credit facility only by maintaining minimum net worth, maximum leverage, and minimum credit ratings, a breach of any one of these might lead the arranging bank to cancel the facility and perhaps demand repayment of any funds already drawn down. As the company attempts to secure new sources of funding to replace what has been lost, it might encounter difficulties with other capital providers – news of a cancelled facility can travel quickly. This can set off an entire chain of negative events, as we shall note later. The same might occur with other types of financing facilities. For instance, an investment bank may refuse to act as dealer or placement agent on a company's MTN program if it is concerned about the company's viability. While the program may not be technically cancelled, the effective result is the same: the bank charged with arranging funds simply refuses to participate in the intermediation or agenting process, meaning a source of financing is lost.

Excessive concentrations

Any of the funding problems we have cited above can be exacerbated by the existence of product, market, or lender funding concentrations. A firm that is overly reliant on a single product, marketplace, or lender/investor magnifies its funding liquidity risk because closure of, or withdrawal by, the concentrated source leaves a firm without access to a significant means of financing. Great effort might be required to replace what has been lost. For instance, a firm that derives 50 percent of its funding from CP, or the offshore term loan market, or a single bank, might be unable to replace, at a reasonable cost and within a short time frame, the necessary financing should that 50 percent disappear. Whether the loss occurs for endogenous or exogenous reasons is less relevant than the fact that the funds are no longer available.

In some cases concentrations can arise through changes in historical relationships or correlations. Although a firm might believe it has diversified its funding program by spreading its requirement across markets, products, and

institutions, a change in the systemic environment can lead to a change in correlations: products, markets, and lenders might all be affected by the same negative news and react in the same fashion, creating concentrations for the borrowing firm. Excessive concentration is not a theoretical concept, but a real problem that periodically impacts firms; we shall consider in subsequent chapters the financial damage that can be wrought by concentrated funding.

THE EFFECTS OF FUNDING LIQUIDITY RISK

The effects of funding liquidity risk are generally felt most acutely by financial firms operating in the "high liquidity risk" portion of the spectrum we introduced in Chapter 2. This is especially true for securities firms and other highly leveraged financial institutions that lack a core base of depositors and are reliant primarily on the wholesale market for funds. The effects of exposure might be compounded by the speed of news/price diffusion and institutional reaction; while a financial firm might appear to have sufficient liquidity based on normal market conditions, that liquidity could evaporate almost instantly.

To summarize aspects of our discussion in this chapter, we consider that in the normal course of business a company will be able to meet its expected and unexpected obligations without difficulty. There are, however, instances when funding uncertainties can arise. These might be due to unexpected cash flows emanating from balance sheet or off-balance sheet activities, a credit downgrade, some unfavorable legal action, general financial mismanagement, or negative perceptions circulating in the marketplace. Any one of these can lead to funding pressures.

The intensity of the funding pressure will depend largely on how the company reacts to the difficulties, and how external forces perceive the problem. Under the most benign scenario the firm can cope adequately by drawing on alternative sources of funds, redirecting activities, temporarily reducing its own commitments or expansion, and convincing the marketplace that problems are manageable. Under a more serious scenario the firm might succumb to deeper funding pressures, experiencing rollover problems, and partial or total loss of market or product access. When this occurs the firm suffers the economic effect of funding liquidity risk. At a minimum this involves sourcing new funds at a higher cost, generating a loss. In more serious situations it might lead to a heavier economic price: forcing a pledge or outright sale of assets in order to generate funds. In the most extreme cases funding liquidity risk problems, coupled with the burden of asset liquidity risk difficulties, can give rise to the liquidity spirals and financial distress scenarios we consider in Chapter 6.

Figure 4.2 summarizes aspects of our discussion in this chapter.

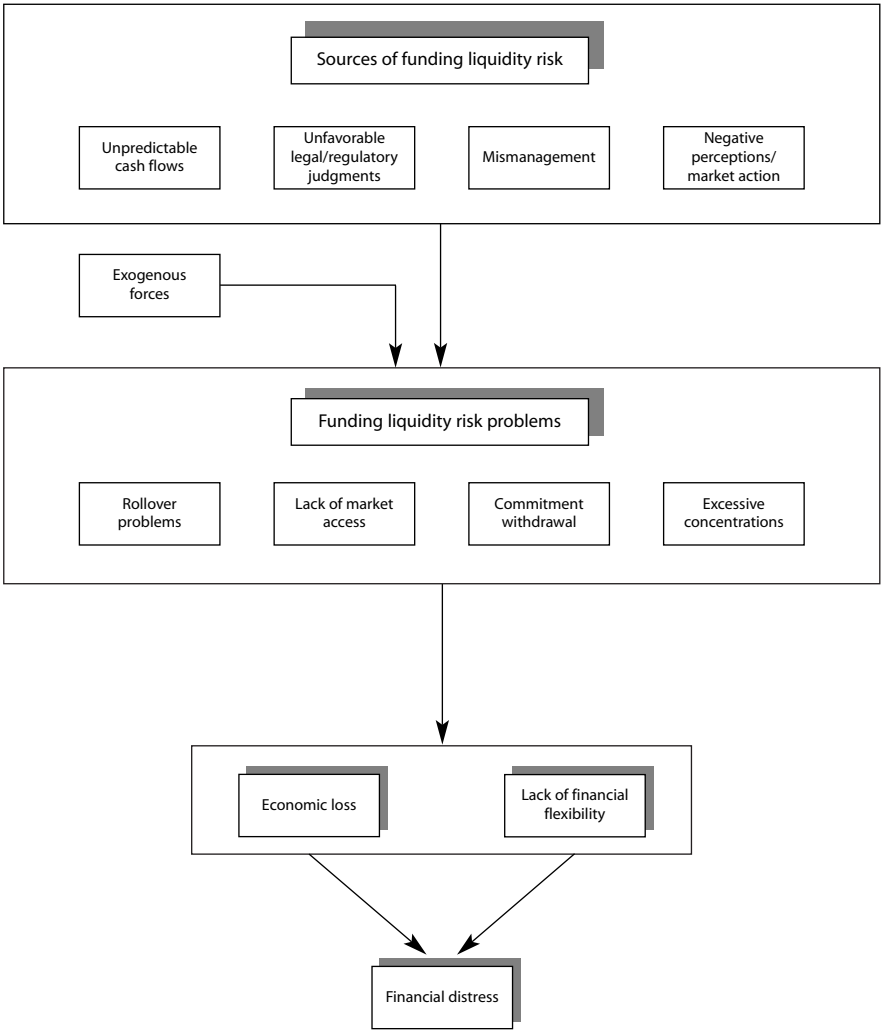

Figure 4.2 Funding liquidity risks

CHAPTER 5

Asset Liquidity Risk

As we continue with our discussion of the theoretical and practical nature of liquidity risk problems, we turn our attention to asset liquidity risk, which we have defined as the risk of loss arising from an inability to convert assets into cash at carrying value when needed. Asset liquidity risk is sometimes known as market liquidity risk, since the process relates to the market price that is assigned to, and can be obtained by, a portfolio of assets. In fact, the market value of an asset has two primary sources of risk: the uncertainty of asset returns (that is, pure market risk) and the uncertainty of liquidity risk (that is, pure liquidity risk), and the two may be strongly correlated.

Since a firm must periodically liquidate assets or pledge them as collateral to obtain financing, asset prices surface as a central element of asset liquidity risk management. Naturally, a firm with robust operating cash flows and adequate funding sources, that can hold all of its assets until maturity, faces no asset liquidity risk. Risk is injected when operating cash flows are inadequate and funding sources prove insufficient, unpredictable, or too expensive, and asset prices and holding periods become uncertain. Since these dimensions represent the realities of the corporate world, it is reasonable to assume that asset liquidity risk impacts the majority of firms.

To cover unexpected payments or obligations a firm must preserve some amount of truly liquid assets on its balance sheet. For most firms operating under most market scenarios, assets are a "backstop," or safety measure, in managing cash flows. As noted in the last chapter, unsecured funding arrangements form the first line of defense after operating cash flows; this is true because selling or encumbering productive assets reduces financial flexibility and detracts from a firm's ability to generate future operating income.

While borrowing decreases a firm's net income by increasing interest expense, the sale of assets, particularly those that are non-marketable or

are critical to a firm's existence, can damage enterprise value. If assets must be sold at a reasonably large discount as a result of illiquidity, and the operating cash flows they once produced are sacrificed, a permanent impairment in enterprise value can follow. This is an especially critical issue for non-financial institutions because it may not be easy to replace unique and productive assets at a reasonable cost. The same is true with asset pledges: though using assets to secure loans is not as drastic as a sale, the action reduces a firm's financial flexibility. Thus, the sale or pledge of productive assets must be viewed as a safety net, used only if operating cash flows are inadequate and unsecured funding strategies prove too expensive or are otherwise unavailable. This does not suggest that firms do not use assets as a liquidity risk management tool, simply that they may only choose to do so if other alternatives are too expensive or are unavailable.

Knowing this, it comes as no surprise to note that diligent management of assets is extremely important. Unfortunately, a firm might be susceptible to a number of potential problems, including lack of asset marketability, lack of unencumbered assets, excessive concentrations, misvaluation, and inappropriate collateralization. We shall consider each point below.

Before doing so, let us first discuss liquid and illiquid markets for assets, with a general focus on financial assets. A liquid market for assets allows participants to execute large sales or pledge transactions as needed, without impacting prices. In fact, the liquid market will not feature any meaningful difference between realizable and carrying value, reducing (even eliminating) the prospects of an unexpected cash shortfall through sale or pledging. An illiquid market for assets is one where large transactions cannot be executed without significant price impact or time delay. As noted in the last chapter, cost and time are key factors. There are cases when a firm can liquidate a large position in an otherwise illiquid market by atomizing the transaction into a series of smaller ones that can be absorbed by the market without materially impacting price levels. But, as with funding liquidity management, asset liquidity management is often based on speed, particularly in times of market stress. Immediate access to cash is generally an overarching goal, so the time dimension becomes as important as the cost dimension; the price discount that must be absorbed for immediacy can create a loss. Indeed, there is considerable evidence that this happens in the financial markets. The concept is sometimes expressed in terms of "slippage," where large asset purchases are filled at increasing offer prices, while large asset sales are filled at decreasing bid prices. We consider this in greater detail below.

Product fungibility, or the ability to substitute one asset with another, is a determining factor in an asset's liquidity. An asset with substitutes

offers alternatives that can induce greater activity, but can also fractionalize pools of liquidity.[1] Market structure, or the way in which market activity is conducted, is another influential factor. In a quote-driven dealer market, dealers give prices to brokers/traders who can then buy or sell; in an order-driven auction market, orders are grouped in the books of principals or agents, and are then matched according to certain rules. There is evidence to suggest that quote-driven markets offer more immediate execution, and thus generate necessary liquidity under certain scenarios, while order-driven markets offer more efficient price discovery and transparency and are thus better able to provide liquidity under alternate scenarios.[2]

Supporting structure and regulations may also influence market liquidity. Asset markets that permit, or provide for, short selling, repurchase agreements/collateralized lending, interdealer broking, listed/OTC derivative contracts, onshore/offshore dealing, and standardized settlement terms can help create two-way interest and volume. Although the volatility associated with supporting structures might increase, the benefits obtained from tighter pricing and larger dealing size might outweigh such "costs." Heterogeneity in both the dealer and customer base can help reinforce different views and create more robust two-way markets and an expansion of volume and dealing activity.

Asset liquidity is also impacted by transaction costs (that is, the higher the costs, the lower the level of activity, and vice versa) and information availability (the greater the depth of information on statistics, volatility, earnings, the more inclined participants are to make buy/sell decisions, and vice versa). When transparency declines, only informed participants are willing to increase their participation; when transparency increases, liquidity can accumulate as uninformed investors start participating. Market liquidity is also shaped by the behavior and views of participants. These can include preferred time horizons, level of risk aversion, reactions to market information, and future expectations regarding micro- and macroeconomic variables. For example, those with strong short-term views are more apt to participate, increasing market activity, and those lacking a strong view may exit or remain sidelined. Those that are risk-averse may be less inclined to join, decreasing activity, while those that are risk-seeking may be eager to join. Expectations are self-fulfilling: when dealers or customers view a market as being liquid they are more inclined to join, helping boost liquidity. The reverse is also true. Knowledge of market flows can also affect liquidity: for instance, the mere threat of large asset disposals by one or more institutions can freeze activity and cause a sharp drop in asset prices. All of these factors can influence asset market liquidity, which is particularly critical for financial assets that a firm might hold in its liquidity warehouse.

SOURCES OF ASSET LIQUIDITY RISK

The specific sources of risk we have considered in the last chapter can easily be extended to create or intensify asset liquidity risks. Unexpected demand for cash is at the heart of asset liquidity risk, but becomes a more prominent concern once unsecured funding alternatives have been exhausted. Again, obligations that are anticipated can generally be accommodated within the scope of a firm's standard funding plan. But if sudden demand for cash – caused by the unpredictable cash flows, unfavorable legal, regulatory, or management actions, or negative market perceptions we referenced in the last chapter – cannot be met by a firm's normal and contingency financing plans, then asset liquidity risk assumes a larger role in the financial risk process. Endogenous factors that consume available funding thus fuel asset pressures.

EXOGENOUS CONSIDERATIONS

Reverting to our discussion on exogenous factors, a firm can manage its asset liquidity in a prudent manner, but still encounter problems related to external effects and actions. This is most often expressed in terms of marketability, concentration, and misvaluation. For instance, a firm might believe that its portfolios of receivables or emerging market bonds are marketable, but stress within the economic or financial system might cause demand for such assets to disappear. If this occurs, what might have rightly been considered a marketable asset is now partly or wholly unmarketable. This tends to happen primarily with instruments that lack the flight-to-quality characteristics of government bonds and the highest rated corporate obligations. While high-quality assets rarely become unmarketable (perhaps only for very short periods of time during extreme market dislocations), the same is not true for other classes of assets. The temporary or permanent disappearance of asset market markers directly affects marketability.

The effects of asset concentration can also intensify in the face of an external dislocation. A firm might not believe that it has a concentrated position if its holding is equal to one day's turnover, but if systemic characteristics change, causing liquidity to decrease to the point where the position constitutes 20 days' turnover, the firm is left with a concentrated position – it will take 20 days, rather than one day, to realize cash, meaning a greater price discount when trying to sell or pledge the position.

If market dislocations cause a change in volatility or correlation, then assets – particularly those that are complex or model-driven – can become misvalued, sometimes by considerable amounts. These systemic

effects can feed through to the collateral taken by institutions to secure their credit extensions to others; this is especially true in the case of correlated credit exposures. Although a firm might consciously take collateral with value that is uncorrelated with the general performance of its counterparties based on historical correlations, relationships might change and cause the value of the collateral to deteriorate precisely as counterparties weaken. These effects illustrate again the joint nature of credit, market, and liquidity risks, and stress events tend to reveal the true degree of interrelationship.

Liquidity misvaluations might also be influenced, or compounded, by the existence of an imbalance – a temporary event that suspends traditional supply and demand equilibrium in the marketplace at large. In a liquid market, "negative feedback" traders act as buyers when asset prices fall, and thus dominate activity; this tends to dampen market price fluctuations and ensures liquidity does not completely disappear during market shocks. When "positive feedback" traders are in control, the situation changes: they sell as prices fall, meaning the market becomes increasingly one-way and liquidity erodes. The degree of positive feedback influencing a market is based on several factors, including stop loss rules (selling when certain levels are hit on the downside), leverage (selling assets to repay borrowings), arbitrage limitations (being unable to replicate negative feedback arbitrage trades that might help stabilize the market) and dynamic hedging (creating feedback loops by selling puts and shorting the underlying).

Stable market liquidity requires that investors not sell assets simultaneously, but rational behavior suggests that selling should be done before disequilibrium sets in. In response to instances of significant one-way selling, market makers might simply refuse to quote, creating a liquidity imbalance. Liquidity holes, a specific imbalance that can be difficult to gauge, can arise from information asymmetries, where market makers possess or lack information that causes them to bid or offer more or less aggressively than might be expected. If a liquidity hole arises, trading may be suspended temporarily, meaning that a large seller might hit a bid that is well below its carrying value (or even expected value).

In certain instances stop loss orders or limit orders can influence price and volume patterns and create slippage, imbalances, and liquidity holes. This is especially true if there is a "bunching" of orders around a particular trigger price; once the trigger is hit and dealers attempt to fill orders, price patterns might deviate rapidly and sharply from what might otherwise be expected. (For instance, during the 1998 Russia/hedge fund crisis, dealers with US$/yen carry trades saw the dollar fall from ¥131 to ¥112 and then close at ¥119 in just two days, through short covering of yen positions. Much of this occurred when firms with leveraged carry trades hit similar stop loss and barrier prices that forced automatic liquidation of long

dollars.) Liquidity traps can also appear: one-way markets may temporarily show signs of two-way business, luring others into the marketplace and creating the illusion of strong liquidity. Once in, however, dealers might see liquidity erode and the market return to its normal one-way state; exiting from the trap might prove extremely costly.

THE NATURE OF ASSET PROBLEMS

In the event a firm cannot reasonably and economically access enough unsecured funds to meet obligations, it must rely on its asset portfolio to make up for the shortfall. As outlined in our previous discussion, the focus turns to:

- pledging unencumbered assets to secure loans
- selling liquid assets from the liquidity warehouse, in order of marketability
- securitizing assets
- selling additional illiquid assets, including fixed assets and business units.

In many cases these solutions can be implemented successfully; although they might lead to some loss of flexibility and economic value, the chances of a firm encountering severe financial distress are small. In other instances more significant problems arise, creating stress. This can occur when pledging requirements are so large that they severely restrict financial flexibility, assets can only be sold into highly illiquid markets, or securitization proves too time-consuming to provide a viable cash solution.

In this section we consider the nature of five common asset problems, including:

- lack of asset marketability
- lack of unencumbered assets
- excessive concentrations
- misvalued assets
- insufficient collateralization.

These internal factors might be intensified by the external factors cited above. Since many of the asset-related solutions to cope with unexpected

obligations form the second line of defense after unsecured funding alternatives have been exhausted, institutions must manage the process forcefully. Failure to do so might ultimately lead to the joint asset/liability complications we consider in the next chapter.

Lack of asset marketability

Lack of asset marketability is a core issue in asset liquidity risk. A firm that holds assets that cannot be readily transferred, at or near carrying value, injects structural illiquidity into its operations and might suffer considerable losses if it needs to dispose of assets rapidly. Financial contracts that are transferable might still not be readily marketable. This generally applies to assets that are complex, customized, or risky (for instance a CMO residual or an emerging market bond) or that take too much time, effort, and/or legal negotiation to transfer. Such instruments have a limited base of buyers and, by extension, limited marketability.

The relative lack of marketability can be discerned by the liquidity premium investors demand for holding an asset: the less liquid the asset, the greater the premium. (For instance, during the Russia/hedge fund crisis of 1998 the liquidity differential between on and off-the-run assets with the same duration and credit risk was as large as 35 basis points (bps)).[3] Financial contracts that are created to be non-transferable and non-saleable prior to maturity (such as a non-qualifying private placement) must be considered completely unmarketable and illiquid. Physical assets such as property, plant, and equipment might have a degree of saleability but cannot be considered readily marketable. Selling a tract of unused land, an office building, or a semiconductor factory might take months, if not years, to negotiate and conclude.

Any firm that possesses an excessive amount of such assets cannot sell what it owns, and is thus constrained in its ability to generate a reasonable amount of cash in a short time frame. In some cases this shortcoming can be offset or mitigated by pledging otherwise illiquid assets for additional borrowings, but success depends on two factors: the assets are not already encumbered (for example, the factory might already be secured by a claim held by the bank that provided the original construction funding); and the loan-to-value discount is not so large that it yields insufficient proceeds (for instance, a bank will only lend $50 million against a $100 million asset, rather than the $90 million the firm thought it could obtain). Any balance sheet that is burdened by a large amount of unmarketable assets runs a high degree of asset liquidity risk – a problem that becomes very evident in the event of forced pledging or disposals.

It is important to note that asset marketability is a dynamic characteristic that can change over time. In some instances assets might be marketable but

then suffer from a problem that renders them less marketable or completely unmarketable. A period of "unmarketability" might last for weeks, months, or even years; in more extreme cases saleability can disappear permanently. The reasons are typically event-specific, but might commence with an accumulation of speculative positions by institutional investors and financial intermediaries. A reversal in economic strength, or the establishment of regulations or curbs, can alter market dynamics and create investor and intermediary losses. These losses can lead to a wholesale revaluation of assets, generating further write-downs and gradual or rapid exit. Subsequent activity may not reappear for a considerable period of time.

Consider, for instance, that high-yield bonds were quite marketable during the mid to late 1980s when issuer demand for capital was high, and investor demand for above-market yields was strong. The collapse of Drexel Burnham Lambert in 1990, negative connotations associated with high-yield bonds and hostile takeovers, and a significant US recession and period of credit defaults rendered high-yield bonds virtually unmarketable. Investors needing to sell or pledge their holdings suffered significant price discounts as liquidity evaporated. Not until economic growth restarted in 1993 did the saleability of high yield bonds recover. They remained actively traded until the credit crisis and recession of 2001, at which time marketability subsided, only to return with economic recovery and corporate growth in 2003.

In some instances marketability never returns in a meaningful way, as in the instance of perpetual floating rate notes (FRNs) issued by banks in the mid-1980s. Although the instruments were quite liquid for several years, a change in the market environment in late 1986 caused certain investors to withdraw. Concerns over regulatory treatment of perpetuals in bank capital computations and rumors related to the exit of various market makers created considerable investor nervousness. Buying ceased, prices fell, dealers and investors abandoned the market, and liquidity vanished. Although perpetual FRNs are still issued periodically, trading liquidity is negligible – the asset marketability that once existed has never recovered. Similar lack of marketability has occurred in other areas, such as ECU bonds, Swedish CP, and unrated US CP.

Lack of unencumbered assets

A firm may choose to borrow against its assets instead of selling them. By retaining ownership of productive assets and granting creditor liens against them, the firm preserves its ability to generate revenues and build enterprise value. For instance, an auto manufacturer might pledge its assembly line as collateral against a loan rather than sell it to a third party. Although it temporarily loses control (though not ownership[4]) of the assembly line

and constrains its financial flexibility, it still benefits from the productive qualities of the infrastructure and retains an ability to generate direct revenues. When the company reverts to a normal state of liquidity, it repays the loan and regains possession of its plant. The same is true of a bank holding a portfolio of investment securities; the bank can sell them in the marketplace to generate the cash it needs, but may prefer to pledge the investments to another bank through the repurchase agreement market. When its liquidity returns it simply unwinds the repo.

These concepts are important when considering another potential asset liquidity problem: lack of unencumbered assets. A firm that has pledged the majority or totality of its assets to creditors decreases its ability to manage liquidity-related problems: not only does it reduce its financial flexibility by limiting borrowing capacity, it no longer has control over its balance sheet. It cannot dispose of any of its assets, as the right to do so belongs to the creditors holding liens. A firm in such a state is fully leveraged and presents a considerable credit risk. The need to make any additional unexpected payments and the slightest difficulty in obtaining funding from conventional sources leaves it with little room to maneuver – meaning the likelihood of financial distress increases considerably.

Excessive concentrations

Significant asset liquidity risk problems can arise from concentrations. We can define a concentration as a position in an asset that is large relative to the daily turnover activity in the marketplace, or one that is large relative to a firm's own financial position. The degree of concentration depends on the specific asset, market, and turnover (as well as supporting activities in the off-balance sheet markets). For instance, a 10 percent share of a $10 million asset that trades an average of $100,000 per day might be considered excessively concentrated, while a 10 percent share of a $5 billion asset that trades $350 million per day in physical form and $150 million in derivative form might not be. A $1 billion position in a US Treasury issue might not be concentrated, while a $100 million position in a BB-rated junk bond might well be. There is thus no set rule on what constitutes a concentrated position, although a reasonable "rule of thumb" suggests that a position that comprises more than a few days of average trading volume under normal market conditions might be excessive. In addition, to be truly concentrated the position must be significant enough in the scope of a company's operations to create a meaningful financial loss. When a firm holds a concentration it might not be able to easily sell at the carrying value in order to generate cash. Indeed, it will likely sustain some loss, the magnitude of which depends on the absolute size of the position relative to market depth and the speed at which disposal must occur.

While a concentrated position can be carried at the mid-market price (or even the bid, in order to be conservative), and might thus appear to be fairly priced, it is important to remember that bids, offers, and the resulting mid-markets are generally only relevant for transactions of limited size, not those that are excessively large. Market quotes are a reflection of average trading size, which varies by market; rarely are quotes intended to apply to large volume blocks. Accordingly, a firm must be aware of the carrying value on the position by relating the actual size to market prices and market depth. Failure to do so might result in an overstatement of value, crystallizing a loss when forced disposal is required.

For instance, assume an asset is trading steadily with a 5-point bid–offer spread when a firm with a large holding decides to liquidate. If the size of the position being sold is within the quoted depth, the market impact cost will be the mid-market of 2.5 points (half of the bid–offer spread). However, if the size of the position is greater than the quoted depth, the market impact cost will be far greater as the bid–offer widens, suggesting a misvaluation and ensuing loss. Rather than filling the order at mid-market, the firm might only be able to realize a weak bid, meaning a loss versus carrying value. As noted earlier, this effect is sometimes referred to as slippage – the variation between the average execution price and the *ex ante* mid-market price. Figure 5. 1 highlights the slippage problem for a concentrated position of size X.

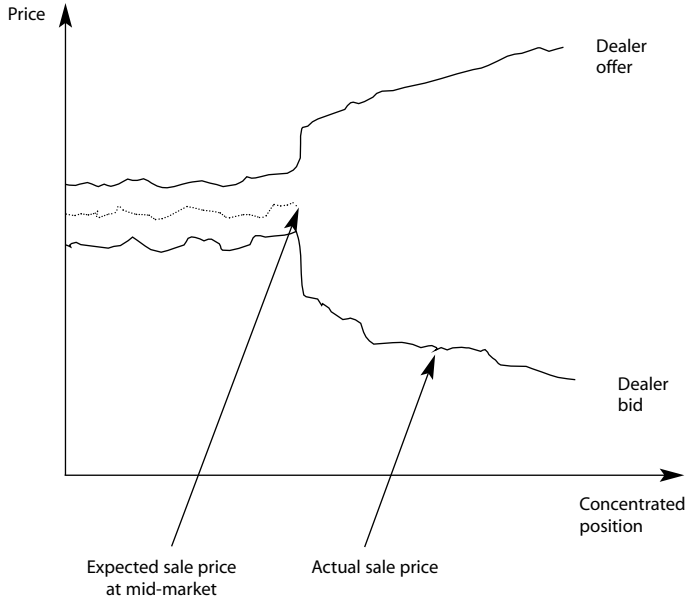

Figure 5.1 Sale price of concentrated position

Misvalued assets

Asset liquidity problems sometimes have their genesis in misvaluation. This is true whether a firm follows a mark-to-market convention, or an accounting policy of the lower of cost or market. If assets are misvalued, realizable prices from pledging or disposal might fall short of expectations, leading to a gap between anticipated and actual cash inflows. For example, if a firm believes that its investment portfolio is worth $1 billion and is counting on that estimated value to generate $800 million of new financing through collateralized borrowing, it will experience liquidity pressures if it discovers the investments are only worth $900 million. It might now only be able to borrow $700 million, $100 million less than anticipated, as a result of valuation errors.

Asset misvaluation can occur for a number of reasons, including excessive size, complex structure, or errors in modeling or haircut assumptions – or, from an exogenous perspective, the liquidity imbalances referenced earlier in the chapter. We have briefly mentioned the first problem above. A firm holding a concentrated position that it values at an expected mid-market disposal price (or a borrowing price of mid-market less some discount) will have insufficient asset coverage when it learns that the large position size requires disposal (or pledging) at a weak bid price. Again, the concentrated position might be large in absolute terms, or it might be large relative to trading volume – the effects are likely to be similar. In fact, while firms often mark their assets to mid-market, they should actually be marking at the bid, as only the first seller gets the mid-price: all others lose by paying the liquidity premium.

If an asset (or entire portfolio) is overly complex, it might be challenging to obtain a reasonable estimate. While a conservative firm might apply a significant discount to the value it believes it can obtain, a less conservative firm might not – and will, again, encounter a surprise when it attempts to liquefy the asset.

An asset might be difficult to value if it is based on dynamic parameters that fluctuate with market conditions, or assumptions that are subjective, or for which no external reference exists. For instance, the prices of certain mortgage-backed securities, particularly those with esoteric dimensions, require assumptions about future interest rates and prepayment behavior. If the assumptions are wrong the assets will be incorrectly valued, perhaps by a significant amount. The same is true with certain OTC derivatives. While vanilla derivatives can be quite simple to value (and benefit from robust benchmarks arising from strong two-way trading flows), exotic options and swaps are complicated and challenging to price – meaning the same pitfalls can surface. If a firm holding exotic assets makes assumptions regarding the mathematical behavior of the asset that prove flawed, it will not achieve the

value it expects. This has become more apparent in recent years, especially when market dislocations cause traditional statistical relationships to decouple. Historical correlations and volatilities underpinning a book of complex assets produce particular values, and any disruption as a result of stress or flight-to-quality can alter relationships and resulting values. Alternatively, if a firm experiences operational/programming errors in its valuation routines, an entire book of model-driven assets might be misvalued.

Assets might also be mispriced through the application of incorrect haircut assumptions. The prudent firm seeking to convert a particular asset into cash generally applies a haircut to the valuation in order to compensate for uncertainties related to actual disposal price or collateralized borrowing levels; the larger, more complex, volatile, or illiquid the asset, the greater the haircut and the lower the resulting cash value. If a firm has made an error in establishing haircut levels, it will suffer a shortfall when trying to obtain the cash it requires. Thus, if a particular asset is valued at $100 million and is haircut by 10 percent instead of the 30 percent the market demands, the firm suffers a $20 million shortfall in its realizable cash and will have to seek other solutions.

Insufficient collateralization

Collateral taken to secure transactions can also be impacted by asset liquidity problems. This is primarily relevant for institutions that are in the business of providing credit on the basis of security. Secured credit transactions are generally extended to counterparties that have some degree of financial weakness; this means that the probability of having to rely on an alternative source of repayment, such as collateral, is much greater than in a non-collateralized situation. If a lender has not properly defined the type and level of collateral it requires – it takes collateral that cannot be readily sold at the carrying value less haircut – it might sustain an asset-related liquidity loss if two events occur. First, the underlying borrower defaults on the extension of credit, forcing the lender to dispose of the collateral to effect repayment; and second, the sale of the collateral yields insufficient proceeds to cover the original amount of the loan. Although the joint probability of both events occurring is typically quite small (for example, if there is a 10 percent likelihood of each occurring there is only a 1 percent likelihood of both occurring), it can happen. During the crises of 1997 and 1998, for instance, certain borrowers and counterparties in Korea, Thailand, Indonesia, and Russia defaulted, and the collateral held by lenders proved in some cases to be insufficient to protect against losses as it was being liquidated in a weak market.

Two different pressures impact the asset value of collateral: the general state of economic affairs, and sales pressure from wholesale disposal of

collateral by banks. If a shock hits the financial system and conditions become particularly fragile, borrowers relinquish (or banks seize) collateral because they can no longer perform on their obligations. Banks then dispose of the security, perhaps simultaneously, to cover the credits they have previously extended. If the sale occurs synchronously with other liquidations, is too large for the market to absorb, too complex to value with accuracy, or based on extremely illiquid assets such as real property or plant and equipment, banks might find themselves with insufficient funds to redeem the credits they have extended. The shortfall places them in a disadvantageous position. The downward cycle of collateral valuation and margin calls can be self-fulfilling. Once the price of the asset collateral drops below a variation margin threshold and generates a margin call, one of two options exists: the borrower can fund the margin call through its own external sources, thus preserving the financed position, or it can refuse to fund and force the lender to dispose of the asset to cover the call. The liquidation of a position, particularly in a thin market, can cause price declines severe enough to trigger a new set of margin calls. Failure to meet the new calls results in additional liquidation, further declines in the asset price, and so forth, in a repeated cycle. The greater the degree of leverage in the system, the more damaging the liquidation process. We note examples of this in Chapter 7.

THE EFFECTS OF ASSET LIQUIDITY RISK

To summarize our discussion of asset liquidity risk, we consider that in the normal course of business a company will be able to meet its expected and unexpected obligations without difficulty. If it cannot, it turns first to its unsecured funding program, gaining resources through the acquisition of liabilities. However, in instances where unexpected cash flows are so significant that they overwhelm the firm's ability to meet the excess with unsecured funding (or when such funding becomes prohibitively expensive), asset liquidity pressures move to the forefront. The intensity of these pressures will depend largely on the company's actions and the presence of external forces.

Under the most favorable scenario the firm can cope adequately with the pressure by borrowing against unencumbered assets or disposing of the most liquid instruments in its warehouse. If it has been prudent in gauging the value of the assets in relation to their marketability (that is, its haircuts are correct), it will have little difficulty securing the resources it requires. Under a more serious scenario the firm might be susceptible to greater problems, particularly if it has not been conservative enough in its management of the asset portfolio, or is subject to greater exogenous forces. Problems can center on lack of marketable or unencumbered

assets, excessive concentrations that cannot be liquidated at, or near, carrying value, misvaluation, or insufficient collateralization to cover exposures due. At a minimum, these can lead to a financial loss through liquidation at a larger than expected discount, or pledging at a larger than normal haircut. If this occurs in tandem with maximized leverage from accessing all available sources of funding and permanent asset sales (which subtract from enterprise value), the firm reduces its financial flexibility and enters a more critical phase of joint asset/funding liquidity risk, which we consider in the next chapter.

Figure 5.2 summarizes aspects of our discussion above.

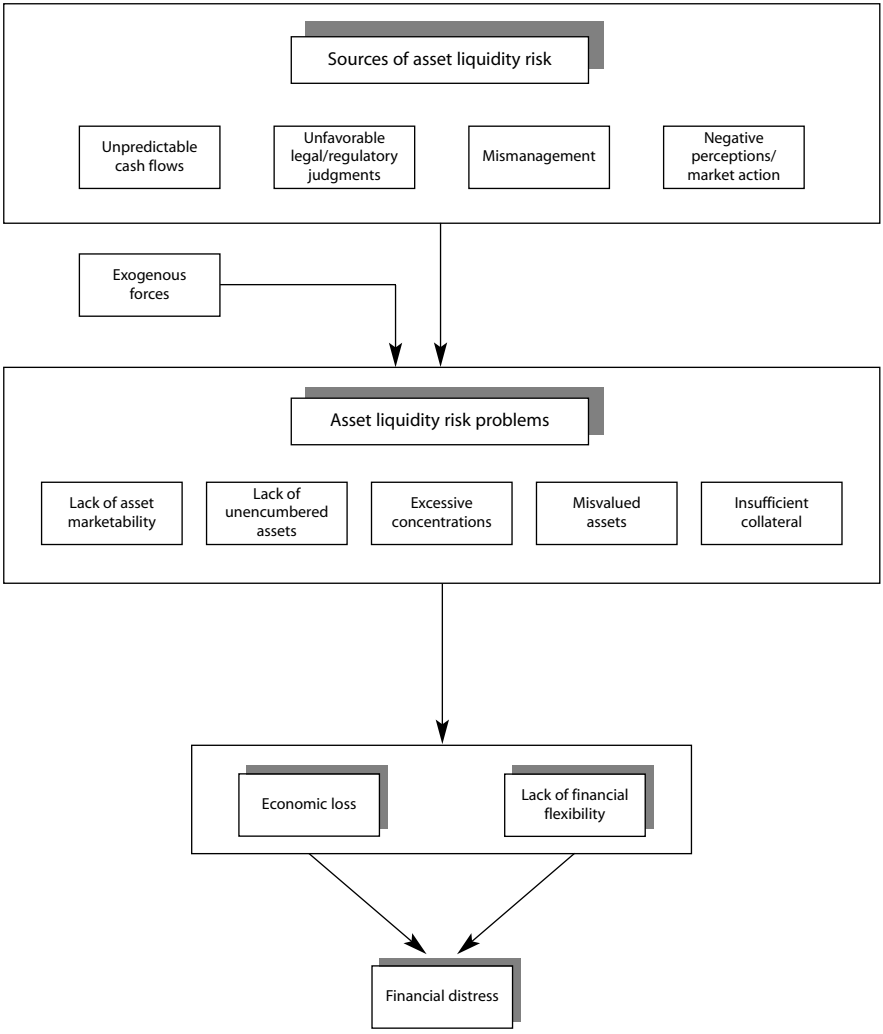

Figure 5.2 Asset liquidity risks

CHAPTER 6

Liquidity Spirals and Financial Distress

We have examined the difficulties that can arise with asset and funding risks, and extend the theme in this chapter by analyzing instances of financial distress that can arise from joint asset/funding liquidity problems. We know from previous chapters that difficulties in raising funding or selling/pledging assets can produce losses. While such losses can be serious, widespread financial damage can generally be contained. However, in some cases asset and funding difficulties combine to create a much more dire scenario. Specifically, when asset and funding liquidity risks join together, a liquidity spiral – or a cycle where attempts to secure additional liquidity come at an increasing cost and a decreasing level of flexibility – can develop. Once a liquidity spiral has commenced, each new attempt to source cash becomes more critical, difficult, and costly. A company caught in a spiral must deal forcefully with the crisis or risk sliding into financial distress and possible insolvency.

In this chapter we consider the specifics of joint asset/funding problems, the liquidity spiral, and the onset of financial distress. We shall relate this conceptual discussion to the realities of the corporate world when we introduce a number of actual case studies in Chapter 7.

JOINT ASSET AND FUNDING RISKS

In Chapter 1 we defined joint asset/funding risk as the risk of loss arising when funding cannot be accessed and assets cannot be converted into cash at a reasonable cost and within a necessary time frame. In fact, this perspective is perhaps closest to the practical experience of stress liquidity management, as liquidity issues tend to impact both dimensions of the corporate operation simultaneously when micro and macro difficulties are present.

Problems

Joint asset and funding problems, which can appear in different forms, impact firms in unique ways. The scenarios we consider in this section are by no means exhaustive, but are representative of our main point: namely, that the onset of a funding liquidity problem can lead to actions within the asset portfolio that can actually create more constraints, difficulties, and losses. To illustrate how joint problems can prove damaging, let us trace the hypothetical actions of a company migrating through various phases of funding and asset liquidity pressures.

A company attempts to source new funding in order to meet its normal, planned obligations and $100 million in unexpected payments (coming, perhaps, from a negative legal judgment or a product recall). News of the large payment causes concern among existing debt holders, leading to a moderate widening of credit spreads. The company is able to rollover existing liabilities in the CP market at higher spreads to cover its normal obligations, but cannot obtain enough new unsecured funding at a sufficiently reasonable cost to cover the unexpected payment. Although the company still has some undrawn bank lines in place, it prefers to preserve them for a serious emergency. Accordingly, it decides to pledge assets in order to raise cash to meet the $100 million payment.

If the company's unencumbered assets are liquid and generic (for instance, government securities), it can borrow sums that are very near the carrying value. Thus, a $100 million portfolio of US Treasury bonds might yield a $98 million loan when pledged. However, if its assets are more unique or esoteric, the discount will be much larger – larger, perhaps, than the firm was expecting. For instance, $100 million of work-in-progress inventory might yield $75 million of cash, and factory equipment only $60 million.

If the company lacks enough liquid assets to raise $100 million, it will have to put up a greater amount of collateral to secure the required sums, further encumbering its balance sheet. Importantly, any pledging of assets to secure additional funds (done, of course, in compliance with existing negative pledge agreements) reduces financial flexibility and sends a negative signal to credit rating agencies, investors, and bank lenders. In fact, creditors may become nervous and charge more for any future credit extensions and/or rollovers. In this case the company pledges a combination of securities, receivables, and inventories with a total carrying value of $120 million to generate $100 million of cash.

As a result of the asset pledges and the resulting increase in leverage needed to meet the unexpected payment, credit rating agencies lower the company's rating one notch, to the lowest investment grade category of BBB-/Baa3. On hearing the news, CP investors grow concerned and refuse to roll over their capital when notes come due over ensuing weeks;

payables terms compress dramatically as well, declining from 30 days to 7 days. The company now needs $80 million to meet the next round of normal operating requirements but lacks CP funding and is forced to draw down on the unused "emergency" bank lines. The draw-down again sends a negative signal to the marketplace. Other unsecured lenders who have provided advised, but not committed, facilities, cancel credit to the firm; in addition, suppliers move payables to a "cash on delivery" basis.

Needing access to additional funds to meet a third round of normal payments that can no longer be covered by CP or newly revoked uncommitted facilities, and possessing no further unused bank lines, the company is again forced to turn to its assets to generate cash. It can pledge remaining unencumbered inventories and securities carried at a combined value of $100 million for cash proceeds of $70 million, or it can sell them outright for $80 million. Increasingly desperate for the additional funds, the company becomes an outright seller of assets, sustaining a loss from sales at distressed prices. News of the asset sales filters into the marketplace, causing further concerns among stakeholders.

The credit rating agencies downgrade the company to sub-investment grade as a result of the firm's growing illiquidity, lack of financial flexibility (from draw-downs, cancelled bank lines, and lack of CP rollovers), and liquidity-induced losses (from outright asset sales at increasingly distressed prices and higher funding costs on outstanding facilities). The downgrade to sub-investment grade breaches covenants in the drawn bank lines. Certain lenders demand immediate repayment of their funds, though they know that such actions may force the company into greater financial distress. In order to repay the bank lines and secure enough cash for survival, the company and its investment bankers arrange for the issuance of a high-yield bond at a very high cost; proceeds are used to meet obligations and give the company time to restructure its asset and liability portfolios and negotiate new facilities with its bankers.

It is not hard to imagine continued deterioration if high-yield bond investors cannot be found and the company does not manage its operations forcefully following the bond issuance. The point of this simple example is to demonstrate that the confluence of funding and asset liquidity problems can create significant direct economic losses (higher funding costs, loss on sale of assets at prices below carrying value) and indirect losses (lack of investor confidence, diminished financial flexibility, deteriorating credit rating, and breach of covenants).

The classic "run on the bank" scenario is another good example of joint asset and funding problems that can lead, in theory and practice, to liquidity spirals and instances of financial distress. Although a bank run can occur for various reasons[1] (for example rumors circulate about a bank's bad loan portfolio, regulators discover problems in its operations, the bank is

believed to have been the victim of a very large fraud, or is liable under legal judgments) the first visible sign of difficulties might appear when short-term interbank deposits are withdrawn. This might be followed by retail deposit withdrawals, forcing the bank to tap alternate sources of funding (such as term funds or Federal Funds), where it will be required to pay a higher rate, sustaining a loss. If problems persist, the bank may then be forced to pledge or liquidate financial assets from its liquidity warehouse. The sale or pledge of assets, particularly those that are less liquid (such as high-yield bonds and loans), might be done at larger than expected discounts, leaving the bank with a shortfall and a loss. A credit downgrade might follow. Negative news on the asset difficulties, encumbrances, and downgrade might accelerate the spiral: more deposit withdrawals, more asset sales and pledges, higher funding costs, greater lack of flexibility, additional downgrades, growing loss of confidence, contractions in the credit business (which can impact funds availability for other borrowers), further deposit withdrawals, and so on. Unless the cycle is halted, the bank may be forced to seek funding from regulatory sources, an act which is almost certain to destroy any remaining confidence in the institution.

Problems are not always confined to individual firms – joint asset and funding risks can also appear at a macro level. Although each firm might be impacted by the events and suffer losses, the total effect is much more damaging as it can involve dozens of institutions from related or unrelated industries. For example, individual firms with lack of funding access can become sellers of assets in an attempt to generate cash; distressed sales lead to further shortfalls and more selling, in a ripple effect that engulfs other firms with similar funding needs. Each new wave of sales into a thin market leads to further price markdowns, more funding withdrawal and flight-to-quality, and so forth, until dozens, and perhaps hundreds, of institutions are damaged by the effects.

Causes

Joint asset and funding problems can arise as a result of endogenous factors, including one or more of those we have mentioned in the last two chapters: unpredictable cash flows, unfavorable legal or regulatory judgments, mismanagement, and/or negative market perceptions/actions. Any one of these can trigger the chain of events described above. A poorly planned or executed contingency funding program can exacerbate difficulties. If executives do not have the proper tools to control problems as they grow larger, events might ultimately overtake the company.

Exogenous forces can also play a part. Reverting to our point in Chapter 3 regarding theoretical and actual access to amalgamated liquidity, it is clear that during dislocations normal channels of capital-raising and asset

sales/pledging are disrupted, meaning standard operating procedures based on theoretical access might not solve the problems. Under stress scenarios assets might not be worth the amount suggested by carrying value; this is especially true for assets that are complex or non-standard. Equally, liabilities might not always behave as anticipated; contractual and behavioral maturities might diverge and sources of funding might be withdrawn, recalled, or cancelled.

It is precisely during times of market stress that firms demand liquidity and those that supply it might not be able, or willing, to do so. For instance, if a major financial dislocation occurs, investors in the CP or ECP markets may be reluctant to fund corporate balance sheets, preferring the relative safety of government securities. The short-term corporate funding markets shut down as the flight-to-quality process begins. In an effort to remain liquid companies may start tapping other facilities. While the capital markets might emerge as another funding alternative, in practice they might close down when there is evidence of significant systemic uncertainty – meaning firms place greater reliance on bank lines. If bank facilities are truly committed, banks have no choice but to fund, regardless of the general credit environment.[2] But if the facilities are only advised, banks may cancel them, placing companies in more dire financial straits, forcing them ultimately to pay more for their funding access.

Banks that choose to finance corporate clients in this stressful environment must arrange for their own liquidity; if depositors are nervous and have joined investors in the flight-to-quality movement, they may not be willing to grant deposits at reasonable rates, forcing banks to fund their operations at a higher cost, dispose of assets at a loss to carrying value, or pledge assets on unfavorable terms.[3] Systemic pressures can thus flow throughout the system, creating losses for institutions from various sectors.

The diffusion of illiquid conditions through a system – from related markets to seemingly unrelated markets – has been the focus of empirical work over the past few years. Although the reasons for contagion have yet to be fully understood, some studies point to the damaging effects of concentrated and leveraged positions in risky sectors, and the ensuing flight-to-quality that occurs as institutions seek relatively risk-free and liquid havens for their cash. Riskier markets grow increasingly susceptible to illiquidity, and quoting becomes offered-only. The ability for firms to dispose of risky assets declines markedly – liquidation horizons lengthen, volatility rises, and discounts deepen. Investors holding short-term, unsecured funding instruments may be unwilling to continue doing so, leading to further strains in funding. Until the systemic dislocation is halted and calm returns to the market, companies and banks are faced with declining asset values and rising funding costs. Exogenous factors can easily compound institution-specific problems.

THE LIQUIDITY SPIRAL

Joint asset/funding problems might be contained when the crisis is in the early stages and management deals aggressively with mounting problems. However, in some cases the situation can be difficult to contain and might spin out of control; indeed, the liquidity spiral can be quick and devastating, and can even culminate in insolvency. (We will note in the next chapter an example of a liquidity spiral and bankruptcy that took only ten days.)

Problems

There is no definitive sequence of events that leads a firm from joint asset/funding problems into a more serious liquidity spiral; each instance is institution and market-specific. Similarly, there is no set time frame during which problems can intensify: a spiral might appear and terminate in a matter of days, or it might take several weeks. It is unlikely, however, to last much longer than that, as a firm caught in a spiral utilizes all available resources and mechanisms until the point of recovery, intervention, or collapse. Building on examples from earlier in the chapter, we can trace a general sequence of events leading to a liquidity spiral.

A company is presented with an unexpected payment or obligation, and lack of sufficient funds requires a draw-down from backup sources; the remaining shortfall requires funding via asset encumbrances. Credit rating agencies, investors, and lenders become aware of the draw-down and pledging, and grow concerned; the company's cost of funds on rollovers rises, and some investors withdraw their capital. The loss of funding sources (such as rollovers) to meet standard operating payments leads to further encumbrances and asset sales; credit rating agencies downgrade the company's rating as a result of the decreased flexibility and growing funding pressures. More investors withdraw funds on news of the downgrade and some banks cancel their facilities or raise effective interest charges.[4]

The loss of additional funding leads to further encumbrances and the start of more active asset sales. The company becomes a distressed price taker, suggesting growing loss of control over its own financial position. As this pressure builds, rating agencies again downgrade the firm on heightened concerns about growing liquidity problems and decreased financial flexibility. The downgrade pierces the critical investment grade floor, triggering covenants that require the company to post collateral on existing credit facilities. This action reduces flexibility even further, and leads to wholesale withdrawal of funds by remaining investors. Banks with MAC clauses or financial test ratios that have been breached cancel their facilities, cutting off another source of financing.

The company and its investment bankers consider floating a high-yield bond to raise desperately needed cash, but investors shun the proposal as they are unwilling to supply funds at any risk premium. Investor, creditor, and rating agency confidence in the company deteriorates rapidly; the firm's stock price plunges on rumors of impending bankruptcy, and management utilizes the last of its assets to generate cash. However, the "last-ditch" actions come too late: loss of market confidence is total and the company is forced into a position of financial distress. It must arrange for a rapid sale to a third party or file a bankruptcy petition in the courts.

Curiously, in some cases regulatory pressures may heighten or accelerate aspects of the liquidity spiral. Consider, for instance, that banks subject to regulatory review in some national systems are prohibited from accessing certain types of funding as their financial condition deteriorates – precisely when an injection would prove most helpful. In the US system, banks with weak capital levels (created, perhaps, by excessive credit or market risk losses) cannot tap the brokered deposit market and are constrained in their ability to use the Federal Reserve discount window. Lack of access to these funds can cause other depositors to withdraw their capital, leading to more losses through higher cost of funding from alternate sources. Such actions create more difficulties, further restrictions, and an acceleration of the spiral.

Figure 6.1 illustrates a generic sequence of events in the liquidity spiral.

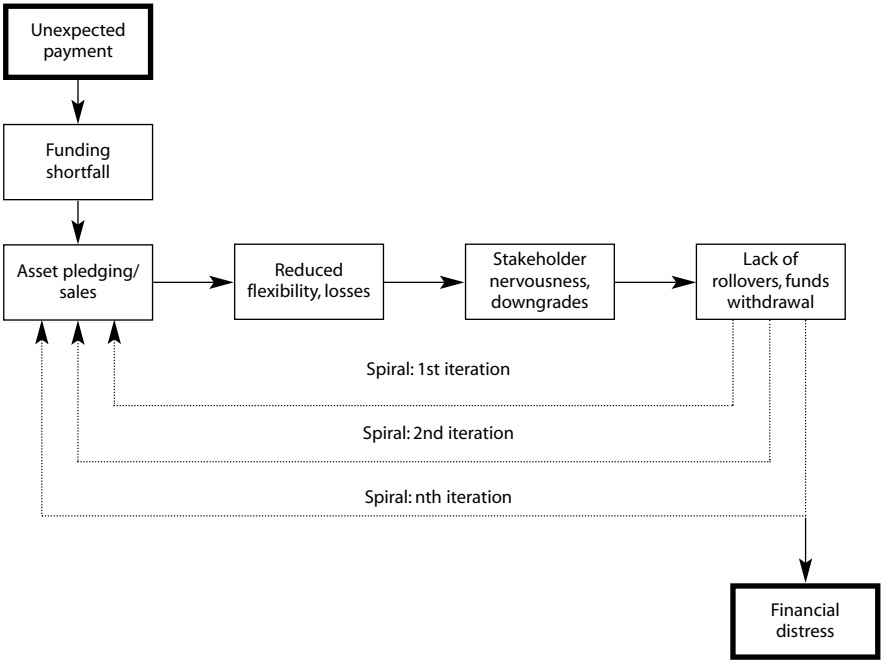

Figure 6.1 The liquidity spiral

The liquidity spiral can be expanded to the systemic level by applying the same sequence of events to dozens of institutions. This can result in a particularly severe crisis, leading ultimately to the financial impairment or insolvency of a large number of firms. When financial institutions are at risk, regulatory intervention may be required in order to prevent contagion. Indeed, some regulators may choose to suspend financial requirements or measures – such as solvency ratios or resiliency tests – during times of system-wide crisis in order not to perpetuate or accelerate behaviors that might actually fuel further market instability. In other cases they may be forced to sponsor or orchestrate rescue packages. Though such systemic liquidity spiral events are quite rare, they do occur (they did so in the UK banking systems in 1974, Sweden 1991, Southeast Asia 1997 and Russia/hedge funds 1998).

Causes

Liquidity spirals do not occur in every instance of joint asset/funding problems – additional forces must generally be present to create a deterioration that leads to a spiral. While the initial reasons for liquidity problems might be entirely endogenous (mismanagement of a liquidity facility, unexpected cash flow surprises, and so on), the accelerating spiral might be a mix of exogenous and endogenous factors, based on both loss of stakeholder confidence and management inability to respond to the crisis. Loss of confidence can appear in investors or depositors (who may be unwilling to hold or renew liabilities), bankers (who may be reluctant to provide additional funding), and rating agencies (who may question or doubt a firm's ability to repay obligations as they come due).

The actual reasons for the loss of confidence may be irrelevant once a crisis is under way. Indeed, lack of confidence need not always be grounded in fact – rumor can be enough to trigger a damaging chain of events. The critical point is that once confidence is lost it can feed on itself; since news travels fast, it is rarely long before other stakeholders become aware of the concerns of other parties, and take defensive actions in order to protect capital or reputation. The banker that has lost confidence will refuse to lend any more funds; investors holding bonds or CP will sell or refuse to rollover; rating agencies, aware of the exodus of funding, may downgrade the firm. These actions lead to further loss of funding, asset disposals, and encumbrances, perpetuating the spiral.

If management does not act forcefully to stop the outflows and halt the spiral, events can continue until they reach their final conclusion – financial distress, which we discuss below. The role and actions of certain

stakeholders, and management's response, are thus critical in determining whether a joint problem is resolved or accelerates. We consider the specific roles of debt investors/banks, rating agencies, and company management.

Debt investors and banks

Debt investors, including those holding short-term debt obligations of a company (as well as medium/long-term bonds coming due in the current period), often hold the fate of a company in their hands. Their willingness or reluctance to continue supplying a troubled firm with funds is central in determining whether a spiral will accelerate or slow. If debt investors are concerned about the financial status and outlook of the firm, but not to the point where they believe a default is imminent, they may continue to supply capital through rollovers, extensions, or new money. (Recall our example from the beginning of the chapter, where the hypothetical company was able to place a high-yield bond because investors agreed to continue providing capital.) Although they will demand a higher risk premium because the company has become a poorer credit, funding remains intact. As long as management can convince debt investors that sufficient cash will be available to pay interest and principal and meet other obligations, the firm gains time to strengthen its overall financial status.

However, if investors grow wary, they may be unwilling to continue their rollovers. If they truly believe default is inevitable, they will seek to recover whatever capital they can while the firm remains solvent. If management is unable to convince investors to remain committed, redemptions/lack of rollovers will occur, and the firm will be forced to take additional measures, such as borrowing on a secured basis (assuming that is an option). Debt investors, in declaring their unwillingness to roll over funds, thus have a direct hand in deciding the firm's fate. The actions they take might actually induce an acceleration of the spiral that leads ultimately to default.

A similar process is true, to a lesser extent, for investors holding medium and long-term debt. Although they cannot refuse to roll over their paper, as maturities are not current, they can sell the liabilities in the marketplace at what might be considered distressed prices. The sale of a firm's debt at a deep discount is almost certain to convey a negative signal to others in the marketplace, leading again to an acceleration of the spiral.

Banks play an equally important role. As the primary suppliers of secured or unsecured funds to a company, they have a significant say in whether or not a troubled firm will be able to exit a spiral. If banks believe that the company can be salvaged through the injection of additional short or medium-term loans (on either a secured or unsecured basis), they

provide the marketplace with a vote of confidence and can often reverse a deteriorating situation. Debt investors and rating agencies are likely to view such actions positively, and the company once again buys additional time to strengthen its position. If, however, banks become convinced through their discussions with management and/or the due diligence process that any further supply of credit is unwise (that is, it represents "throwing good money after bad"), they will almost certainly have sealed the firm's fate. Banks that refuse to provide further cash injections, even on a secured basis, indicate to the marketplace that the company is not worthy of additional credit, meaning the firm will be forced to take drastic action (such as distressed asset sales, or sale of business units or the entire firm to a competitor).

In arriving at this decision banks are likely to have analyzed their position as creditors in a bankruptcy situation. They will already know that a decision not to lend is almost certain to lead to default and a sharp discount in the amount they will recover in liquidation or reorganization, so the decision they ultimately take will be based on knowledge of near-certain losses (unless all banks are properly secured by valuable assets or an eleventh-hour corporate acquisition can be arranged).

The decision we refer to in this section relates primarily to a company's lead bankers. While it is common for a company of reasonable size to feature a number of banking relationships (say, five to ten), lead banks are primarily responsible for driving the relationship and the key funding decisions, and organizing the syndicate of second-tier banks. Although a secondary bank might choose to withdraw at any time and for any reason, such an action is unlikely to be interpreted negatively by the marketplace. The same is not true with the lead bankers: if a lead decides not to commit further funds or support the relationship, the signal is negative.

Rating agencies

The major global rating agencies (Moody's Investors Services, Standard and Poor's, and Fitch IBCA), play a central role in the corporate process by examining the financial status, performance, and outlook of companies (and sovereigns) and assigning ratings that reflect creditworthiness, or perceived ability to meet obligations. The best investment grade credits are considered to have very strong financial capacity to meet payments as they come due; weaker credits, such as those rated sub-investment grade (for instance, below BBB–/Baa3) do not have the same capacity. For reasons related to leverage, liquidity, earnings quality, market share, management, competitive pressures, and asset quality, such firms face a greater likelihood of problems in meeting contractual obligations. Publicly rated companies rely on ratings to tap the debt capital markets at the best

possible rate. Investment grade credits enjoy broad and deep access and good funding levels, while sub-investment grade credits often face hurdles related to both market access and cost of funds. The weaker the credit, the more difficult and expensive the debt-raising process, down to the point where no further financing is possible.

It comes as no surprise that rating agencies wield considerable power when it comes to determining the fate of companies that are experiencing financial difficulties. We have indicated through our examples above instances when a rating agency may downgrade a credit as a result of illiquidity and/or lack of financial flexibility. With each subsequent downgrade, investors and lenders relying on external ratings as part of their own debt investment strategies become increasingly nervous, sometimes to the point of withdrawing funds. The withdrawal can lead to more credit downgrades, triggering more capital flight, further downgrades, and so forth, accelerating the spiral. Financial deterioration might also breach leverage or liquidity covenants contained in bond indentures or credit agreements, leading to downgrades as well.

Agencies have the ability to influence (although, in most cases, not directly affect) the speed of the downward spiral by considering a downgrade action. If an agency believes a company in financial distress can arrange for sufficient financing to keep operating on a reasonable basis, it may preserve the rating and inject confidence into the marketplace. This might be enough to halt the downward spiral. Conversely, if the agency believes the outlook is bleak and continues with its downgrade actions, it might simply accelerate the spiral.

Management reaction

The reaction of management to internal and external forces that lead to, and accelerate, the liquidity spiral is exceptionally important in determining whether or not the spiral can be halted, or at least slowed until other plans can be developed. Management that has developed a contingency plan (such as we discuss in Chapter 10), and can deal forcefully with the problems that have generated a crisis, might be able to restore stakeholder confidence and raise the funds required to exit the spiral. There is no guarantee, of course, that strong management action alone can halt a slide: in some instances exogenous forces are so overwhelming that even a strong executive team operating through the most robust contingency plan can fail to achieve a successful end. Nevertheless, the chances of success are greater when management reacts quickly and decisively. If these ingredients are lacking, and executives are unable or unwilling to execute an emergency recovery plan, migration into severe financial distress is a virtual certainty.

FINANCIAL DISTRESS

A company unable to escape from a liquidity spiral enters a state of financial distress.[5] Once in this phase there is often little that can be done to preserve the company in its original form. The end game generally involves one of two scenarios: insolvency or regulatory/private intervention.

When a firm's cash position has been so badly impaired and the events of the liquidity spiral have taken their toll, a firm must either file for bankruptcy or sell to (or receive assistance from) a competitor or investment group. In the special case of banking institutions, primarily those considered to be "too big to fail," a regulatory intervention or bailout might occur. For the remainder of companies lacking such a regulatory "safety net," a common course of action is to file a bankruptcy petition and opt for liquidation or reorganization.

If a company is deemed to have sufficient value in its asset base, and has simply been the victim of unfortunate circumstances related to an insufficiency of cash, then creditors and administrators may feel that an attempt at reorganization is worthwhile. Although shareholders will lose their investments and creditors will sustain considerable losses, the firm will be able to continue to operate in some form once it emerges from the bankruptcy process. It is common in such cases for the bankruptcy court to appoint an administrator to oversee the firm's operations. If no such administrator is appointed, the courts may permit existing management to continue operating the firm as debtors-in-possession, under the monitoring of both the bankruptcy court and creditors. The reorganization process, which might take anywhere from months to years to complete, culminates in a reorganization plan and the re-emergence of a new corporate entity. However, if the company is not believed to have enough value, the courts may opt for liquidation. Corporate assets will be sold and proceeds distributed to creditors in order of priority, with secured creditors receiving the largest payout. The company will cease to operate as a going concern.

Short of a bankruptcy filing, there are instances where directors have enough time, and the company has enough value, to arrange for the sale of the firm to a third party. By doing so the acquiring company assumes the liabilities of the distressed company, or provides enough of a cash injection for the latter to continue operating under its control. Such situations are rather more rare than bankruptcy motions, but they can occur when it is clear that the firm, but for its cash strain, is a worthy franchise that can continue to create value for investors, and an interested acquirer can react to the opportunity quickly enough. Although the ending is not as dramatic as the liquidation or reorganization scenarios, it is clearly still one of financial distress and loss of corporate identity and independence.

Joint asset/funding liquidity risk is a significant problem, yet one that is sometimes overlooked. Indeed, it is tempting to isolate the potential loss events that can occur when problems arise either within the asset or funding portfolios. But the approach can fall short, as it fails to examine the damage that can be wrought when the effects are working in tandem. To help illustrate the practical nature of such problems we consider a number of actual case studies in the next chapter.

CHAPTER 7

Case Studies in Liquidity Mismanagement

In the last three chapters we have explored concepts of liquidity risk and the financial losses that can arise from such exposures. In this chapter we extend our discussion by exploring a select number of "real world" case studies that help illustrate different dimensions of liquidity risk and the degree of damage that can be wrought.

The examples we have chosen represent the apex of liquidity risk: financial distress leading to bankruptcy. But our sampling is necessarily small. Many institutions have either failed or been rescued over the years, solely or largely as a result of liquidity problems. Still others have encountered liquidity-induced financial problems but managed to avert massive losses and even bankruptcy by taking "evasive action" at a late hour. For instance, in the 1980s and 1990s Continental Illinois,[1] Development Finance Corporation of New Zealand, Bank of New England, Colorado Utilities, British and Commonwealth Merchant Bank, and Peregrine Securities, among others, succumbed to liquidity problems and had to be restructured or liquidated. Others, such as the Bank of New York, Salomon Brothers, and Citibank, suffered significant losses as a result of liquidity problems, but managed to avoid the final stages of financial distress.[2]

In some instances entire sectors have been impacted by the same pressures, creating system-wide losses and institutional failures: the British secondary banking crisis of the mid-1970s, the global stock market crash of 1987,[3] the Swedish banking crisis of the early 1990s, the Mexican banking and corporate crisis of 1994 and 1995,[4] the Turkish banking crisis of 2000, and the global airline industry dislocation following the September 2001 attacks created liquidity-related losses for numerous institutions.[5]

While all these are important and instructive, space considerations require us to focus on a limited number of examples. Accordingly, in this chapter we consider case studies related to industry/services (Enron, Swissair), finance (Drexel Burnham Lambert, Askin Capital, Long Term

Capital Management, General American) and government (Orange County). We find that in each situation liquidity problems were caused by unique factors. For example, with Enron we note instances of financial fraud and internal control failure; with Drexel we find a breach of fiduciary duties and lack of effective risk and funding management; in General American we discover mismanagement of funding sources; in Askin Capital we see concentrated funding built on risky and illiquid investments; and so forth.

Although each features different root causes, they all share a common theme: lack of access to sufficient cash to continue operations, leading ultimately to the liquidity spirals and financial distress discussed in the last chapter. This does not mean that sufficient liquidity would have altered the fate of each entity: for example, there is little to suggest that Enron could have carried on for another 6 or 12 months even with liquidity access, as its financial fraud ran deep. But the end result in some cases might have been different. An examination of these cases is therefore an important step in understanding the practical effects of liquidity risk, and this will allow us to consider, in Part III, the construction of a risk management process that can cope with such exposures.

DREXEL BURNHAM LAMBERT (1990)

Drexel Burnham Lambert (DBL), which started out as a second-tier Philadelphia firm and grew into a Wall Street power, dominated the market for high-yield (or junk) bonds for most of the 1980s. Through the efforts of trader/originator Michael Milken, DBL began focusing in the late 1970s on "out of favor" investments, such as real estate investment trusts, convertible bonds, preferred stock, and, most important, fallen angels – investment grade bonds that had been downgraded to "junk" status (below BBB–/Baa3).

Milken analyzed default probabilities and returns on these securities, and concluded that spreads were too wide given default experience. He realized that investors holding diversified portfolios of high-yield bonds would be exposed to a greater amount of default risk, but less than was apparent from a pure examination of credit ratings (certainly when compared with the spreads that could be earned). In 1978 DBL set up an office in Los Angeles to expand the high yield business. Milken and his team started developing an investor base for high-yield bonds (including large institutional investors such as Mass Mutual, Lord Abbett, Reliance Insurance, First Executive Life, and American Financial Corporation). Simultaneously, DBL's bankers called on lower-rated companies, promising to originate bond deals for them. Through these joint efforts the bank

became the top underwriter of junk bonds, a status it held until its downfall in 1990.

The high-yield business of the early 1980s was active but benign: the bonds were not yet viewed negatively and companies issued them mainly for growth (two-thirds of bonds were used for corporate expansion). However, by the mid-1980s they began to be used for hostile transactions and leveraged buyouts (LBOs), and acquired a negative patina. During this period DBL made a strategic decision to provide junk bond financing for hostile transactions and LBOs, and create "war chests" for companies seeking to acquire others. The bank also developed the "highly confident" letter, a loose underwriting commitment given to companies that were eager to purchase competitors and needed to demonstrate funding availability.

As the market continued to grow Milken ran afoul of securities laws, and the bank put itself in conflicted situations related to front-running and unfair pricing on internal partnership positions. DBL also began accumulating a larger amount of risk positions. Many new junk issues were arranged on a fully underwritten basis, and some of the highly confident letters the bank issued ultimately turned into firm underwritings as well. As the market moved into a speculative phase and the credit quality of issuers became increasingly marginal, DBL had greater difficulty placing the bonds: the bank was evolving from a relatively flexible and liquid securities firm into a semi-permanent lender with an illiquid balance sheet.

By the late 1980s the bank routinely carried billions of dollars of junk bonds in its portfolio, and funding the positions was becoming increasingly difficult. While a typical Wall Street bank with a liquid portfolio of government securities and high grade corporate bonds can finance them in the repurchase agreement market at haircuts of 25 basis points (government bonds) to 1–5 percent (corporate bonds), high-yield bonds are treated much more conservatively, commanding a 50 percent haircut (based on changes in US securities laws enacted in 1986). This requirement obviously reduces financial flexibility.

As the market moved through its most difficult stage in the late 1980s, regulators investigating DBL and Milken discovered evidence of corrupt sales practices, insider trading, self-dealing, and conflicts of interest. Under the threat of criminal Racketeer Influenced and Corrupt Organization (RICO) charges, Drexel settled by paying a $650 million fine and ousting Milken and several of his associates. (Milken himself was charged on 98 counts and pleaded guilty to six felonies.)

DBL's punishment coincided with a downturn in the US economy and a rapid rise in corporate default rates. The bank, holding a multi-billion dollar portfolio of risky junk bonds that were being financed at 50 percent haircuts, began experiencing a serious liquidity squeeze. As other Wall

Street banks grew nervous about DBL's strained funding position they began withdrawing their Treasury repo and short-term unsecured bank facilities. Investors in DBL's CP stopped rolling over their capital as paper matured. In addition, falling junk bond prices triggered margin calls on the repo financing, which forced the bank to put up scarce cash to preserve the financing. As cash dwindled, some repo lenders liquidated the underlying collateral, creating further downward pressure on prices.

As the liquidity strain mounted in January and February 1990, the combination of short-term line cancellations, margin calls, forced bond disposals, and reputational damage pushed the bank into an accelerating liquidity spiral. With insufficient access to cash, the bank defaulted on $150 million in interest payments under one of its facilities, which triggered cross-defaults on other obligations and forced the bank to file for bankruptcy protection.

DBL represents an example of how an illiquid portfolio of assets funded at significant discounts, coupled with management and reputational problems, can create severe financial distress. Although the bank's problems had been years in the making it was able to sustain its operations as long as other securities firms and banks were willing to provide funding, and investors were willing to roll over CP. Although the 50 percent haircut on the high-yield portfolio was burdensome, the financing was manageable as long as the bank maintained the confidence of other institutional investors, and the market for high-yield securities remained buoyant. But when the bank's reputation suffered and management could no longer contain negative press, the concentrated high-yield positions and lack of funding alternatives took their toll; external selling pressure in the junk market exacerbated the situation.

Reverting to our discussion from earlier in the book, DBL suffered on various fronts:

- excessive concentrations in risky, illiquid high yield assets
- use of a large amount of short-term financing that could easily be withdrawn or cancelled (such as CP and Treasury repos)
- heavy reliance on collateralized financing based on very large discounts to carrying value
- insufficient liquid assets to meet redemptions and other obligations
- lack of alternative funding sources for emergency draw-down
- absence of a robust contingency plan to deal with a disaster scenario based on erosion of lender/investor confidence and deterioration in the high yield market.

ASKIN CAPITAL (1994)

Askin Capital, a hedge fund group operating a number of sub-funds, was formed in 1992 when David Askin, a mortgage-backed securities (MBS) specialist associated at one time with Merrill Lynch, DBL, and Daiwa Securities, joined, and then acquired, an investment fund known as Granite Partners. Between 1992 and 1994 Askin Capital expanded the operation and restructured it into three separate funds: Granite Partners, Granite Corporation, and Quartz Hedge Fund. Askin's strong track record allowed him to attract investment funds from a number of top institutions, including AIG, Rockefeller Foundation, and McKinsey. Total assets under management expanded rapidly, from $130 million in 1992 to $300 million by mid-1993 and $600 million in March 1994.

While at DBL and Daiwa, Askin had developed MBS modeling and investment strategies based primarily on the most esoteric elements of the mortgage market (derivative tranches of collateralized mortgage obligations (CMOs)), and he applied the same approach to the new funds. Askin assembled interest-only (IO)/principal-only (PO) strips and other CMO tranches into "market neutral" portfolios that were meant to perform well in either rising or falling interest rate environments.

Askin Capital relied primarily on Wall Street banks for its supply of investments. Since the Granite and Quartz funds were invested primarily in esoteric CMOs, the banks and the fund were heavily dependent on each other. The banks created "tailor-made" CMO tranches to meet Askin Capital's specifications, giving them an outlet for the riskiest, and most troublesome, components, and in exchange provided the fund with collateralized financing facilities. In fact, most of Wall Street's major houses[6] lent to Askin Capital on a collateralized basis, using the portfolio of CMOs as security. The fund then used the loans to acquire more CMO derivatives, and so on, until the portfolio was leveraged between four and five times.

The close relationship between Askin and the banks ultimately created problems. Since the CMOs were so complex, Askin Capital was initially dependent on the banks for upfront pricing and ongoing valuation (to measure investment performance and ensure a sufficient margin on the collateralized financing). However, the fund regularly disputed the pricing it received, and eventually began valuing securities on its own and communicating performance figures to its investors directly. (Pricing for repo purposes remained the responsibility of the banks, and the two sets of prices eventually diverged.)

By mid-1993 the three sub-funds were more than 95 percent invested in esoteric MBS, supported by a cash cushion of only 5 percent. The concentrations were well in excess of those held by other MBS "specialty" funds,

which generally limited their holdings of esoteric securities to a maximum of 20 percent. In fact, the concentrated position in highly illiquid securities proved to be Askin Capital's primary weakness, and led eventually to its downfall.

As the Federal Reserve began raising rates in early 1994, Askin Capital's market-neutral strategy appeared to suffer. (The Granite portfolio might only have been market neutral within a relatively small 10–15 basis point range.) In fact, as rates had begun edging up in advance of the formal Federal Reserve hikes, dealers providing repo financing had urged Askin Capital to lower its leverage, but the fund had refused. Calls for repayment of collateralized loans intensified as a number of smaller dealers began liquidating their own CMO portfolios.

With the rising interest rates of 1994, the record number of refinancings and repayments that had occurred in October 1993 came to a sudden halt. Prepayments slowed dramatically, meaning the duration of MBS and CMOs lengthened substantially, causing the prices of many securities to drop by a significant amount. The most esoteric and volatile securities (and those most sensitive to slowing prepayment speeds) suffered badly; in fact, many issues within the Askin Capital portfolios plummeted in value. The fund, however, continued to preserve its positions and leverage, even through the earliest rate hikes.

Thereafter, events deteriorated rapidly. As Wall Street grew nervous about the $600 million fund and the $2 billion-plus credit it had extended, it lowered the prices of the CMOs held as collateral, triggering a series of margin calls. Askin disputed the calls, protesting that the value had not fallen as low as Street firms had indicated. Nevertheless, the funds were required to post $120 million of fresh capital in order to preserve the portfolios. As Askin Capital attempted to raise new money it apparently refused an offer from one dealer to buy the portfolio outright, still believing that sufficient money could be raised in time to meet the margin calls. But investors were unwilling to post additional capital, meaning Askin Capital was unable to meet its obligations. Banks liquidated the collateral positions in an orderly, if heavily discounted, manner, repaying their loans and driving Askin Capital out of business.

When the sales were complete (a process that took a number of weeks), Askin's investors had lost their full $600 million. A number of banks sustained credit losses as they had failed to take sufficiently large haircuts on their repos (while some had discounted the esoteric CMOs by as much as 50–70 percent, others had only done so at a 15–20 percent level, which was insufficient to cover the losses on disposal).

In the aftermath of the crisis, Askin Capital sued a number of banks, claiming that they had unfairly lowered prices on the securities in order to trigger margin calls and cover their loans. The court considering the affair focused

on whether the sales prices were "commercially reasonable" and concluded that they were, leaving the fund with no further recourse. Investors in the Askin funds sued the fund manager, claiming that the prices conveyed through proprietary models were inaccurate and misleading, and not representative of the true value of the portfolio.

The case of Askin Capital illustrates the effects of limited asset marketability arising from complex and highly customized investments that lack pricing transparency, and the damage that can be caused by holding concentrated positions driven by a single risk factor (such as interest rates). The fund's strategy was only viable in a benign interest rate environment; as rates tightened, the losses grew. The fund relied heavily on financing via the repo market and had no meaningful backup sources. In addition, it was impacted by exogenous factors: not only was Askin dealing in an interest rate environment that hurt the value of its portfolio, it was forced to dispose of assets in a marketplace that was already unstable and illiquid. Many other institutional players had been caught off guard by the sharp rate hikes, suffering losses of their own. In fact, disposal occurred at the worst possible time, meaning liquidation value could not be maximized. Askin Capital was thus affected by a number of liquidity-related problems:

- excessive concentrations in risky, illiquid MBS and CMO assets
- inability to effectively price the assets in the investment portfolio
- heavy reliance on repo financing at a large discount to carrying value
- insufficient liquid assets to meet obligations (such as only 5 percent cash on hand)
- lack of alternative funding sources for emergency draw-down
- lack of a contingency plan to deal with a disaster scenario based on a sharp rise in interest rates.

ORANGE COUNTY (1994)

Orange County (OC), a prosperous region of Southern California, was the site of significant leverage and liquidity-induced problems that led to its bankruptcy in late 1994. The county's problems emanated from the Orange County Investment Pool (OCIP), a municipal investment fund managed by county treasurer Robert Citron. Over the course of 22 years Citron built a solid record as a capable investment manager that was routinely able to outperform the market and return attractive yields to county investors

(including school districts, water councils, towns, and so on); OCIP boasted a long-term average yield of 9.4 percent versus an average 8.4 percent for other state funds.

In order to achieve attractive returns over the medium term, Citron invested OCIP funds in the US fixed income markets (primarily in Treasuries, agency securities, and structured notes), which he then leveraged. The OCIP portfolio started 1993 with a cash balance sheet value of approximately $7.5 billion. But Citron arranged a large number of repurchase agreement transactions with firms such as Merrill Lynch ($2.1 billion), Morgan Stanley ($1.6 billion), CSFB ($2.6 billion), and Nomura ($1 billion), leveraging the portfolio several times. He also purchased a significant amount of structured notes that contained embedded leverage (such as 20-year inverse floating rate securities, paying higher coupons as rates fall and lower coupons as rates rise). The combination of repurchase agreements and structured notes meant that OCIP's $7.5 billion portfolio of securities had the same sensitivity to interest rates as a $21 billion portfolio – a considerable exposure to the direction of interest rates and the shape of the curve. Although the extra leverage provided OCIP with above-market yields, it also raised the fund's risk profile dramatically, and left it extremely vulnerable to a rise in rates.

As noted above, the Federal Reserve began the first of several interest rate increases in February 1994, which impacted investors holding long, unhedged bond positions. Though concerned, Citron and others initially ignored the rate hikes; the treasurer operated under the assumption that since OCIP was a "hold to maturity" fund that did not have to mark its portfolio to market, it would ultimately crystallize a known value when all of the investments in the portfolio matured. However, such a strategy only works if the fund's assets and liabilities are properly matched and it maintains sufficient cash to meet obligations as they come due (margin calls on repurchase agreements, fees, payments, and so forth). In the absence of cash to meet outflows a fund such as OCIP is forced to access any remaining unsecured funding, or dispose of assets to raise cash. In fact, OCIP had no meaningful access to additional unsecured funds. The large majority of its "repoable" securities were already pledged in support of the leverage program that was generating such handsome returns. Only its structured note portfolio was unencumbered, although its value became increasingly uncertain in the rising rate environment.

OCIP continued to lose money as interest rates rose throughout 1994, and by September the fund already had unrealized losses amounting to several hundred million dollars. By November Citron and other fund officials were in desperate negotiations with banks about preserving the repo financing. As OCIP's remaining cash drained away, the likelihood of being unable to meet margin calls on the Treasury repos increased dramatically.

The relative lack of liquidity within OCIP meant that the "hold to maturity" strategy was in danger of failing: the sale of Treasury collateral by the banks to repay the loans they had extended would crystallize losses in the fund.

By early December it became clear that the fund lacked the cash needed to meet further margin calls, and officials were forced to announce that OCIP had suffered $1.5 billion of paper losses. In order to provide temporary liquidity and attempt to carry the fund through its margin calls, JP Morgan examined the unencumbered structured note portfolio and offered to buy it for $4.4 billion (a $100 million profit to OCIP based on where they were valued, but almost certainly a low bid). County officials declined the offer and forced Citron to resign.

Several days later Nomura noted that OCIP was in technical default on $5 million of bonds, CSFB demanded repayment of $1.25 billion of repos and a run on the fund commenced. All of the repo lenders, except Merrill, liquidated their collateral, forcing OCIP to crystallize more than $1.5 billion of losses; the county had to file for bankruptcy. Over the course of the ensuing weeks the portfolio was unwound; $4.7 billion of proceeds were returned to the county and the rest went to repay creditors. The final loss within OCIP reached $1.7 billion, including $360 million from fixed-rate notes, $600 million-plus from inverse floaters and $600 million-plus from repos. In the aftermath of the event, county officials brought a number of legal actions against Citron and the banks that had provided the county with leverage.[7]

Orange County exemplifies the problems associated with an operating strategy based on a "hold to maturity" horizon. We noted in Part I that institutions that can match and hold assets and liabilities until maturity, and have enough of a buffer to meet cash calls, face little or no liquidity risk. Rarely, however, is this approach tenable, as OCIP discovered; the excessive market risk exposure the fund held in an adverse environment created cash outflows that could not be met. In addition, the concentrated repo funding OCIP maintained meant it had no real financing alternatives once lenders decided to withdraw their collateralized lines. The fund therefore suffered on various fronts:

- excessive exposure to a single market risk factor (such as US interest rates) that created significant losses
- insufficient cash to meet obligations and absorb the growing losses
- false comfort in not having to mark obligations to market and reveal unrealized losses
- lack of diversified funding sources

- improper monitoring of liquidity positions and stress scenarios (such as the effect of rate rises and margin calls on the funding position); insufficient transparency related to risk positions
- lack of a contingency plan to deal with a disaster scenario (such as sharply rising rates, or withdrawal of financing facilities).

LONG TERM CAPITAL MANAGEMENT (1998)

John Meriwether, former head of fixed income arbitrage at Salomon Brothers, founded Long Term Capital Management (LTCM) in 1993. The fund, which included a number of well-regarded quantitative experts and academics, raised over $7 billion of capital by 1994 and commenced leveraged investing, focusing initially on its fixed income arbitrage expertise. During its first two years of operation LTCM generated exceptionally good returns of 43 percent and 41 percent. By 1997, however, the team found that it was increasingly difficult to uncover profitable opportunities. Rapid growth in the mutual fund and hedge fund sectors meant many institutions were pursuing the same investments (particularly in the corporate credit markets, where credit spreads tightened considerably as bond and loan investors demanded lower risk premia – the lessons of the Mexican and Asian crises having been temporarily "forgotten"). In response, LTCM migrated into other areas, including those where it lacked the same degree of expertise or where risk levels were significantly higher, including equities (such as selling equity volatility, and creating equity risk arbitrage positions on 75+ stocks), and esoteric and illiquid fixed income spreads (such as long-dated callable bunds versus Deutschemark swaption volatility, Danish mortgages versus Danish government bonds, Italian treasury bills versus Lira deposits, Russian carry trades). Importantly, LTCM built large positions in many of these risk classes, becoming more concentrated, leveraged, and illiquid in the process.

In late 1997 LTCM's managers returned $2.7 billion of capital to investors as they were unable to find enough profitable investment opportunities; they did not, however, reduce their risk positions by a commensurate amount, meaning the fund became more leveraged and illiquid than ever before.

By mid-1998 the financial markets had become increasingly fragile; the Asian crisis of 1997 had left some institutional participants with losses and reduced risk appetites, and corporate earnings had started deteriorating. In July 1998 Citibank began unwinding its large fixed income arbitrage book, which caused LTCM – holding similar positions – to sustain reasonably large losses. This was followed by news in August

that Russia could no longer sustain the value of the rouble; the Russian central bank declared a domestic debt moratorium and devalued the rouble. This event was the catalyst for much broader problems: equity volatilities soared, issuance and trading in the corporate bond/loan markets temporarily ceased, convergence trades diverged, and liquidity in many asset classes evaporated.

While these conditions proved problematic for many institutions, LTCM was particularly susceptible because of its extremely large and leveraged positions – positions that would have been considered too big under normal market circumstances, and that were enormous in relation to a market with rapidly draining liquidity. Virtually all of LTCM's trading strategies became money-losers during this crucial period: proprietary credit and carry trades in Russia, swap and credit spread convergence strategies, short equity volatility positions, and esoteric fixed income spreads all reversed course, causing LTCM to lose significant amounts of money. By late August the fund had lost $550 million; several weeks later total losses had mounted to $2.5 billion (down 52 percent for the year) as flight-to-quality, divergence, and volatility remained in full force.

As the crisis continued during September (including another $500 million loss for the fund on September 21), the fund's liquidity pressures increased, prompting regulators to intervene and inspect LTCM's books. They discovered that the fund had leveraged positions that were well in excess of the market's ability to absorb them in the event of unwinds. Balance sheet leverage had reached 30 times (for instance, $125 billion assets supported by $4 billion of equity), but off-balance sheet derivative notionals of $1 trillion meant actual leverage was greater than 300 times.

The sheer size and concentration of LTCM's asset portfolio meant that it was effectively "too big to fail" – any collapse of LTCM would have tremendous systemic implications for other financial institutions (many carrying the same positions and/or acting as credit providers to LTCM). As regulators and banks came to realize this, a number of different groups put forth proposals to finance or acquire the fund. Interested parties moved with speed and care, as they knew a single default within the portfolio would trigger cross-defaults and force liquidation of huge positions into a thin market. After intensive and rapid negotiations, a 13-bank group arranged $3.6 billion of bailout financing in exchange for 90 percent of the fund, intending to unwind the entire portfolio gradually through an oversight committee so as not to further damage already strained markets. There can be no doubt that the bailout helped prevent what might have been a devastating crisis.[8]

After a few more weeks of losses, markets stabilized and the fund started generating earnings. By June 1999 the fund's earnings were up 14 percent, leverage was down through orderly liquidation of positions, and the fund

was able to repay investors $300 million and the bailout group $1 billion. The entire fund was ultimately unwound.

LTCM was not alone, of course. Many financial institutions and institutional investors suffered similar losses during the same period as they delevered their own portfolios and liquidated assets; in some instances the liquidations were voluntary, in others cases they were triggered by standing stop-loss orders and internal/external capital and risk requirements. In many cases illiquid market conditions meant asset disposal prices were well below those predicted by *ex ante* haircuts and collateralization levels.

In the aftermath of the crisis it became clear that LTCM's managers had relied too heavily on the assumptions underpinning their pricing and risk models, and ignored the concentrated positions they had built – effectively failing to take account of the illiquidity they were injecting into their operations. The losses investors sustained were proof of a flawed approach to business and a general disregard of illiquid risk positions. Of course, banks with lax risk management standards aided the fund.[9] Many banks sustained significant losses in the process and were forced to re-evaluate their own standards and policies related to risk management, concentrated lending, and liquidity measurement.[10]

As noted, one of the most significant problems arose from the use of flawed risk models – those used to compute market and credit risks and, by extension, liquidity risks. For instance, many financial institutions control their market risks through value-at-risk (VAR) models, which, as we discuss in the next chapter, have certain shortcomings. During the LTCM crisis these flaws exacerbated matters by causing actions that increased volatility and drove out asset liquidity. In fairness, banks and securities firms were simply adhering to the regulatory rules that they were (and are) required to follow. (For instance the 1996 BIS Market Risk Amendment requires banks to use VAR models to manage their risk capital levels, flaws notwithstanding.) But the fundamental assumptions underpinning VAR models proved dangerous. Many firms believed that the statistical properties driving the models would remain stable in all market environments – hardly a realistic view of the world. Since participating institutions adhered to the same models, they all had similar responses: shifting from high to low volatility assets, and from speculative to safe-haven investments. This meant a mass migration out of certain securities and contracts, turning two-way markets into one-way markets, magnifying price volatility, and dramatically lengthening liquidation horizons. Thus, an average size investment-grade corporate bond position that might have taken an hour to liquidate at carrying value took several days to sell at prices 10–25 percent below carrying value; risks that were more speculative suffered even greater delays and discounts. The resulting losses were thus much larger than any *ex ante* statistical measure would have suggested.

LTCM represents an excellent example of how internal and external forces can join to produce significant liquidity problems for an individual institution and the marketplace at large. Excessive leverage, concentrated and illiquid risk positions, and flawed models meant liquidity risks were essentially ignored. The fund (as well as a number of other financial institutions) thus suffered on various fronts:

- large, leveraged concentrations in risky, illiquid assets, including esoteric spreads and equity arbitrage positions
- concentrated use of collateralized, short-term financing that could easily be withdrawn or cancelled and off-balance sheet leverage that could not easily be unwound or transferred
- lack of sufficient liquid assets to meet redemptions
- reliance on flawed risk measures, which significantly understated liquidation periods and volatilities, and did not properly account for the possibility of changing relationships between assets
- lack of a contingency plan to deal with a disaster scenario (e.g., asset illiquidity, forced asset disposal).

GENERAL AMERICAN (1999)

General American (GA), a US insurance group that owned and operated the GA Life Insurance Company, was formed to offer life insurance policies throughout the United States. At its peak in the late 1990s the insurer featured more than 300,000 policyholders and held a solid A1 credit rating from Moody's; at least one reason for the strong credit rating came from the fact that GA was protected against capital losses through reinsurance agreements it had in place with Reinsurance Group of America (RGA).

From a funding perspective GA arranged much of its financing through ARM Financial, an intermediary that helped the insurer establish more than $7 billion of short-term financing facilities with 40 institutional investors (primarily money market funds). Unfortunately, the bulk of the financing was short-term in nature, and it featured an excessively large percentage with embedded options giving investors the right to call back their money at very short notice. While most insurers use similar funding arrangements GA was a dominant player, holding 20 percent of the total short-term insurer funding market and 60 percent of the seven-day putable funding market. The insurer was thus at significant risk of having funds called away, and then being unable to replace them without sustaining a significant cost. In retrospect it appears that GA's management did not believe

that investors would call back their funds (or at least would not do so simultaneously); indeed, they had not done so for a period of several years, and management apparently had little reason to believe that the situation would change.

In the spring of 1999, however, certain investors grew nervous as a result of rumors related to the financial strength of RGA and ARM Financial, both central to GA's operating strategy. On March 5 Moody's downgraded GA from A1 to A2 over concerns about the insurer's financial standing, funding status, and financing and reinsurance strategies. With rumors intensifying over the next few months, GA's management announced on July 29 that it would absorb $3.4 billion of funding obligations under existing financing arrangements. The intent was to quell any negative press related to the reinsurance strategy or the funding structure. But on July 30 Moody's downgraded GA from A2 to A3 on the grounds that the insurer's financial flexibility would be compromised through the redemptions.

The move triggered a rapid spiral into financial distress. Following the downgrade, 11 money market funds put their short-term obligations back to GA, requiring the insurer to repay funds within seven days. By August 2 more investors exercised their 7- and 30-day puts, intensifying the repayment cycle and the funding liquidity spiral. Although GA started liquidating assets in its portfolio to meet the scheduled repayment demands, it soon became clear that it would not have enough cash to complete the task; the insurer had been prepared to meet up to $3.5 billion of liabilities, but not the full $7 billion investors sought. On August 9, just ten days after announcing its intent to recapture the funding obligations, GA filed for protection with the State of Missouri's Department of Insurance.

GA represents an important example of the speed with which a liquidity spiral, fuelled by market rumor and a funding profile heavily skewed towards very short-term liabilities, can create financial distress; in only ten days a solidly-rated insurer discovered that it had insufficient cash to repay its financial obligations. With the benefit of hindsight it is clear to see that GA's funding program was severely flawed, and that its credit rating should have been lower. Indeed, GA was impacted by a number of difficulties, including:

- excessive share of a single funding market
- use of a large amount of financing with short-term optionable characteristics, including those requiring payment in only one week
- insufficient liquid assets to meet redemptions
- lack of alternative funding sources for emergency draw-down
- lack of a contingency plan to deal with a disaster scenario based on multiple credit downgrades and very rapid erosion of investor confidence.

SWISSAIR (2001)

SAirGroup (SAG) – the holding company that owned Swiss national airline Swissair, domestic and short-haul carrier CrossAir (70 percent), AirGourmet catering, and majority/minority stakes in various other European airlines – was originally founded in 1930. After decades of successful operations and relatively conservative growth, SAG's management, led by CEO Philippe Bruggisser, commenced an aggressive, multi-year expansion plan (the "Hunter strategy"), to give SAG a stronger footing in pan-European and regional flight routes. Since Swissair already controlled a reasonable and stable share of international long-haul traffic to North America, South America, and Asia passing through Switzerland via its Zurich hub, as well as a fair amount of European short-haul travel passing through Basel via CrossAir, management believed that the only viable expansion opportunity was through other airlines. Directors felt that the company would need to acquire other airlines and develop alliances if it wanted to remain Europe's fourth largest carrier in an increasingly competitive environment.

Unfortunately, SAG's management found that purchasing existing high-quality airlines was an expensive and complex strategy. Accordingly, the company began acquiring stakes in second and third-tier regional carriers, in some cases building up to majority interests over a period of time. These included Sabena (Belgium), TAP (Portugal), AOM/Air Liberté (France/Africa), LOT (Poland), and Air Littoral (France). The company's policy of paying a full price for such carriers (which often operated with outdated physical equipment that ultimately needed to be replaced through a debt-based capital investment program) was central to SAG's downfall.

In 1998, with the acquisition strategy in full motion and global economic business conditions remaining healthy, the company's share price reached a peak of CHF500 ($308). As the company expanded (for instance spending on airline stakes, new capital equipment, staffing, and headquarters), it continued to finance itself primarily through debt. Leverage grew steadily, and by the turn of the millennium it was becoming a considerable burden on cash flows. In addition, by 2000 it became increasingly clear that air traffic within the Hunter portfolio was deteriorating rather than improving. The onset of the global economic slowdown and extreme competition from pan-European cut-rate carriers put considerable pressure on all of the company's routes. And since SAG was one of the industry's highest-cost carriers, the company was soon experiencing serious cash flow strains.[11]

As the company's financial standing deteriorated the board dismissed Bruggisser and abandoned the Hunter strategy. Directors also requested new funds from UBS and Credit Suisse, the company's main bankers.

Before injecting additional liquidity, however, the banks demanded internal reorganizations. In March, nine out of ten board members were ousted; the remaining director, Mario Corti, was appointed CEO. One month into his new role Corti announced a $1.8 billion loss, the first in the airline's 70-year history. Much of the loss – which reduced capital to dangerously low levels and squeezed liquidity – was attributable to the firm's bloated costs and interest burden; total debt had increased from $4 billion in 2000 to $9.2 billion in 2001, and interest expense had more than doubled. Lack of earnings from the poorly performing Hunter carriers compounded the loss (for instance Sabena lost $180 million, TAP $92 million, AOM, Littoral and Liberté a combined $360 million). Corti put forth a restructuring plan centered on cost cuts, asset sales and a delay in previously committed purchases of TAP and Sabena shares. This move preserved cash, allowing Corti to work on a more comprehensive plan, including arranging a more robust and reliable banking facility to ensure ongoing availability of funds.

Shortly thereafter, however, SAG was forced to deal with the collapse of Air Liberté and a massive restructuring at Sabena. Corti presented the board with a second reorganization plan on September 24, just two weeks after the terrorist attacks in the United States brought international air travel to a temporary halt. The restructuring called for the creation of a new carrier, Swiss Airlines, comprised of Swissair and CrossAir (based on the latter's low-cost model), along with staff reductions to help bring costs under control and conserve cash.

However, the company was using its available cash resources at a very rapid rate. Since revenues from new travel were not replenishing cash, the firm's overall liquidity position grew increasingly fragile. (Indeed, the defensive interval, a measure of a firm's ability to manage cash outflows without access to new funding or revenue inflows, was decreasing quickly.) By late September several small banks cut their credit lines to SAG. At this stage the company had less than $120 million in liquid assets on hand, barely enough to keep flying for a few days.

With a liquidity disaster already well in progress, UBS and Credit Suisse agreed, on September 29, to purchase a $160 million stake in CrossAir and grant an interim credit of $150 million, guaranteeing flights through October 3. With the ownership stake in hand, the bank syndicate was expected to arrange for more stable credit facilities for the period extending beyond October 3. In a curious turn of events, however, execution of loan documents and dispersal of funds were delayed, meaning SAG literally ran out of money and could no longer fly. On October 3 SAG cancelled all outstanding flights and filed for bankruptcy protection (leaving 39,000 ticket holders to join the creditors' queue); shares plunged from CHF100 to CHF1.27 in a single day. UBS and Credit Suisse were maligned in the

national press for not providing funds on time or being more effective in preventing what many termed a "national tragedy."

On October 3 the Swiss Bundesrat (upper house of parliament) granted temporary credits so that the airline could fly in limited form until a reorganization plan was developed. As events unfolded it became increasingly obvious that SAG's board and management, as well as politicians, had been aware of the company's fragile financial position for weeks (and in some cases months), and knew that very drastic actions would be required – including politically unpopular wage and staff cuts. Although some members of the Bundesrat later admitted that they knew about SAG's financial weakness, most indicated that they had not expected the dénouement to move as quickly as it ultimately did. The leading finance representative of the Bundesrat was later quoted in the *Neue Zuricher Zeitung* as saying that the government "underestimated the internal dynamics of such a liquidity crisis and thus the speed at which the situation could come to a head." Corti disputed that claim, noting that he had approached the Bundesrat members prior to October 1 with details on the firm's growing illiquidity and a request for $300 million in credit. When the Bundesrat failed to take action at that point, SAG and the banks were on their own.

A restructuring operation followed the bankruptcy filing. Corti and most of the board were dismissed and a new CEO was appointed. CrossAir absorbed two-thirds of Swissair's existing flights in order to keep traffic moving. A 70 percent stake in CrossAir was taken up by the two lead banks for $150 million, and the Swiss federal and cantonal governments agreed to contribute funds as well – at a total cost to taxpayers of nearly $2.5 billion. (The final shareholding split, agreed by shareholders in December 2001, included 65 percent to individual and institutional investors (including 10 percent each to UBS and Credit Suisse), 20 percent to the federal government, and 12 percent to the cantonal governments.) CrossAir was transformed into the new Swiss International Airlines in December 2001.

The SAG situation reflects a series of strategic management problems that resulted in the implementation of a flawed expansion plan using a very large amount of debt financing. The leverage (growing to $9 billion over six years) placed considerable financial strain on the firm's operating income. When this was coupled with poorly performing airline subsidiaries (most with negative cash flow), external events that sharply reduced international travel during a critical time in the company's attempts at reorganization, political infighting, and lack of aggressive management in the face of rapidly declining cash balances, SAG was left without liquid resources when it needed them the most. Unlike the Enron case discussed below, however, there is widespread belief that with sufficient cash on hand and a more aggressive turnaround plan in place, SAG could have reversed its

fortunes without being forced to enter bankruptcy. Ultimately the airline suffered on various fronts:

- excessive leverage and resulting interest burden that detracted substantially from cash flow
- poorly performing subsidiary operations that absorbed valuable cash resources
- lack of sufficient liquid assets to meet daily operating requirements
- heavy dependence on the actions of two large lenders to arrange financing
- insufficient unencumbered assets on hand to secure emergency funding
- lack of alternative funding sources for emergency draw-down
- lack of an aggressive crisis management plan.

ENRON (2001)

The case of Enron, the Houston-based energy concern, has been widely reported and analyzed in the press, given its position as one of the largest bankruptcies in US corporate history. Although there is much to consider in relation to flawed governance, we shall focus primarily on the firm's liquidity crisis – a general byproduct of fraud and poor internal controls.[12]

Enron was created in 1985 through the merger of natural gas pipeline companies in Nebraska and Texas; Ken Lay assumed the role of chairman and CEO, a position he held through most of the next 16 years. Although Enron focused on the integrated gas sourcing and delivery business for several years, it began realigning its operations in the early 1990s, primarily by matching buyers and sellers of gas and taking fees for intermediating. On the surface, Enron's model appeared successful and became the basis for subsequent trading and risk management endeavors.

The process accelerated when Jeff Skilling, future president (and, for a time in 2001, CEO), joined the company. Under Skilling's direction Enron shed more of its physical properties, converting from an asset-intensive natural gas pipeline to an "asset-light" trader – resembling, in many ways, a financial trading institution. During its conversion the company actively monetized many of its fixed assets: selling plant and equipment used in the core energy business to realize current period cash, rather than preserving assets for the long term to generate ongoing operating cash flow. (Indeed, the lack of cash flow proved to be a perpetual problem for the company, and one that led the firm's executive officers to engage in fraudulent behavior.) Given

the firm's strong trading focus, it is worth recalling our remarks from Chapter 2: financial trading firms are highly leveraged institutions that must preserve a large amount of liquid assets in order to meet obligations and supply liquidity to others. Enron lacked a strong buffer of liquid assets, a fact that became all too clear in its final months. Trading business is also driven by reputation, and any damage to that reputation can result in loss of flows and revenues and, from a liquidity perspective, vital cash. Again, Enron discovered the importance of reputation as its fortunes turned.

As the US energy market deregulated and energy prices grew more volatile, Enron's model appeared sound: revenues grew rapidly and permitted expansion into new areas. During the boom years of the late 1990s the company positioned itself as a trader of virtually any type of asset – pulp and paper, weather, commodities, credits, and so on. It also expanded into areas that it thought would benefit from rapid growth, including water distribution, fiber optic capacity/Internet bandwidth, and so on. These were capital-intensive businesses that were not profitable (and were often cash flow negative); indeed, the company ultimately lost an estimated $7 billion on its ill-advised investments in bandwidth and water (as well as energy operations in Brazil and India). Still, analysts and investors remained positive about Enron and its prospects. Quarter after quarter of improving earnings in the 1990s caused the stock price to increase steadily (including doublings in 1998 and 1999).

In early 2001 Enron reported revenues of $100 billion and ranked seventh on the Fortune 500 list of the largest global companies. With a record stock price near $90, Enron's market capitalization reached $60 billion – far greater than many industrial companies and financial institutions. Even as it reached these lofty heights, however, the company was in desperate need of cash; in fact, it had actively engaged in large "prepay" swap transactions with Citibank and JP Morgan for a number of years in order to generate enough cash to pay for its operations. Since prepays are off-balance sheet transactions that act as loans but do not impact balance sheet or leverage ratios, Enron was able to secure the cash it needed without alerting investors, rating agencies, and other creditors to the fact that its actual cash position was extremely weak.

In early 2001 the company's problems started mounting: the Internet and telecom bubble burst, calling into question the firm's aggressive and expensive expansion into the broadband sector. With a slowing economy and a sliding stock market, Enron's own stock price started falling. The decline in the stock price triggered certain covenants in disclosed and undisclosed financial contracts that added to the company's financial pressures. In August 2001 CEO Skilling left the company for "personal reasons," unsettling investors even further; former CEO Lay returned to his old role. While this was under way, whistleblowers within the firm – aware

of widespread financial improprieties – attempted to convey information to the board of directors; one employee was finally successful in alerting certain board members that all was not well.

The "house of cards" began collapsing shortly thereafter – disclosure of financial errors and internal manipulation radically changed the financial profile of the company. Much of the problem centered on obscure and complex dealings between Enron and various special purpose entities (SPEs);[13] although these were meant to be 'arm's length' dealings, they were intricately entwined with Enron's own financial structure and performance.

In mid-October 2001 the company announced a $544 million after-tax charge against LJM2, an SPE created and managed by Enron CFO Andrew Fastow. The firm also announced a $1.2 billion reduction in shareholders' equity as a result of improperly accounted transactions between Enron and an SPE – the news shocked investors and analysts, who had come to believe and support the Enron strategy and growth story (and ever-escalating share price). The company's reputation suffered, and various trading counterparties altered their credit terms: while Enron had previously traded primarily on an unsecured basis (even with its BBB+ rating), it was now being asked by some of its dealing counterparties to post collateral, an action that consumed precious cash resources and encumbered its balance sheet. The rating agencies placed the company on negative credit watch.

One month later the firm was again forced to restate its earnings from 1997 to 2001 as a result of accounting errors;[14] the restatements reduced net income over the four-year period by nearly $1 billion, lowered shareholder's equity by $2 billion and brought an additional $2.58 billion of debt onto the balance sheet – changing, rather dramatically, the company's already significant leverage profile, and making clearer the fact that Enron's supposedly strong record of earnings was largely a fabrication. The news was accompanied by the fact that Fastow and several other Enron employees had profited handsomely from the partnership transactions. These events caused the rating agencies to downgrade the company to the borderline of junk status, and caused even more counterparties to pull back on their credit facilities to the firm. The firm's reputation suffered a marked blow and trading flows all but ceased.

Enron's downfall accelerated from this point on. Citibank and JP Morgan remained committed to lending Enron additional cash throughout much of November, granting $1 billion of fresh money against Enron's last unencumbered assets (two pipeline systems in the western United States). Even as the banks were lending, however, Citibank's due diligence team uncovered the fact that by the end of the first quarter of 2002, based on no new "prepay swaps" or asset sales, Enron would have a negative cash position of nearly $1.6 billion; by the end of 2002 the gap would grow to negative $10 billion. (Enron officers did not concur with the assessment, as they

believed that they would be able to secure $6 billion-plus of prepays in 2002 and could supplement the cash position with another $3 billion in asset sales.) By any reasonable measure, the company's cash position was in massive deficit.

During the Thanksgiving weekend Citibank and JP Morgan attempted one more time to raise additional funds for the company, but the effort was for naught; the gap was too large to be filled and no further hard assets remained to be taken as collateral – the two were unwilling to provide further funds. The final act took place in late November when other banks started canceling Enron's remaining liquidity facilities; rumors of imminent bankruptcy were rampant. The firm's core trading business was no longer generating cash and collateral calls could no longer be met. When it became clear that Enron lacked cash and could no longer survive the crisis of confidence, Lay attempted to team up with cross-town rival Dynegy for an eleventh-hour merger; however, even Dynegy did not like what it uncovered in its due diligence and scuttled the deal days later. With no more cash on hand to meet current obligations, Enron filed for bankruptcy protection on December 2.

During the reorganization process the company sold off a number of remaining fixed assets and conveyed the remainder of its energy trading business to UBS. Most stakeholders suffered considerably: shareholders saw the value of their investments vaporize almost completely, thousands of employees lost their jobs, and creditors lost billions of dollars. Investigations ultimately revealed that the company suffered from widespread financial misrepresentation, mismanagement (including mismanagement of liquid resources), fraud, self-dealing, conflicts of interest, and unethical behavior, as well as weak controls and a flawed corporate governance process.[15]

Enron serves as an important illustration of how a firm that is engaged in a leveraged trading business without sufficient liquid resources or credit standing can soon find itself in dire straits. Fraud aside, in the last three years of its existence the company relied heavily on trading revenues to keep its operations functioning, but it mismanaged the process by holding insufficient liquid and unencumbered assets. When market confidence eroded and funding sources began evaporating, its trading business could no longer be sustained, meaning cash flows from its only truly profitable operation came to a halt.

The case also illustrates how quickly a crisis of confidence can subsume a company, leading to a halt in business (and the vital cash flows that result) and the withdrawal of funding alternatives. From October to November 2001 the company tried desperately to assuage its investors and creditors by "confessing" to accounting errors and internal fraud; such actions were insufficient, however, partly because the firm had no effective crisis management program. Although the creditor team attempted to

bridge the gap for a time by providing access to additional funds, even that proved insufficient for the marketplace at large. Of course, it is not clear that Enron could have survived over the medium term, even with additional liquidity injections from the banking community, or from a hasty merger with Dynegy. (Indeed, Dynegy's own future might have been jeopardized had the deal been completed.) The financial fraud that destroyed the company's reputation ran very deep and had a material impact on the firm's credit profile. It seems likely, however, that the firm could have existed for at least several more months with appropriate access to liquidity; whether some alternate restructuring solution might have surfaced over that time to help prevent large losses for the community of stakeholders is unknown.

Reverting to our discussion from earlier in the book, Enron suffered on various fronts:

- near-total reliance on market/reputation-based trading business to generate cash flows to meet obligations
- use of a large amount of short-term financing that could easily be withdrawn or cancelled
- insufficient liquid or unencumbered assets to meet obligations or the collateral calls necessary to continue operating its trading business
- squandering of cash resources on capital-intensive, but negative cash flow, business ventures
- lack of alternative funding sources for emergency draw-down
- lack of a contingency plan to deal with a disaster scenario based on rapid erosion of lender and investor confidence.

The cases we have presented in this chapter are representative of problems that can arise when asset, funding, or joint liquidity difficulties appear. As we have noted, they represent the most extreme instances of liquidity problems, culminating in severe financial distress and/or insolvency. Although each case is unique, certain common threads run through all of them: lack of sufficient unencumbered assets to pledge as a "last stop" measure; reliance on a limited number of funding sources; and lack of truly robust, and aggressive, crisis management plans to deal with rapidly accelerating crises. In fact, the inability to deal forcefully with liquidity pressures and attempt to shore up investor and/or creditor confidence is a "fatal" problem in each case. As we consider the effective management of liquidity risk in the next part of the book, we shall recall some of the practical instances of distress and failure and how these can be overcome with a robust risk management framework.

PART III

Managing Liquidity Risks

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CHAPTER 8

Measuring Liquidity Risk

In the first two parts of this book we have considered why liquidity is so vital to corporate operations and illustrated what can go wrong, in theory and practice, if it is mishandled. The degree of financial damage that can arise varies. In some cases it may be limited to losses from higher funding costs or asset disposals at prices below carrying value; in other cases it may be more serious, extending to instances of financial distress and insolvency. Every entity exposed to liquidity risk must therefore attempt to avoid damage through a liquidity risk management process. An effective framework, our topic in this part of the text, is based on a number of fundamental elements. In this chapter we discuss the measurement of liquidity risk through various tools, in Chapter 9 we consider ways of managing liquidity risk as part of the corporate process, and in Chapter 10 we discuss the development and implementation of a liquidity crisis management plan. We summarize key thoughts on active liquidity risk management in Chapter 11.

COMMON LIQUIDITY MEASURES

Measuring liquidity risk can be challenging, primarily because the underlying variables that drive exposures can be dynamic and unpredictable. Indeed, liquidity risk is often considered to be more difficult to measure than other dimensions of financial risk precisely because it is so fluid. Although some aspects of asset and funding liquidity risk are readily identifiable and quantifiable, others are not; this is particularly true when we consider joint asset/funding risks and off-balance sheet/contingent transactions. Despite the challenges, however, some attempt must be made to estimate the relative magnitude of risk. If this can be done then the next step in the process, controlling risk through limit mechanisms, can be successfully accomplished.

Although specific measurement techniques vary by company and industry, we can consider several broad approaches, including liquidity ratios and cash flow gaps. Liquidity ratios convey a picture of an institution's liquidity position by measuring items from the corporate balance sheet, income statement, and statement of cash flows to determine the sufficiency of resources. Cash flow gaps, in contrast, focus on known or estimated cash inflows and outflows over various time horizons to determine possible surpluses or deficits. Companies, especially those from the financial sector, often supplement these metrics with specialized financial asset liquidity measures that examine the risks associated with on and off-balance sheet financial contracts and risk portfolios. All three classes can be strengthened through the use of two additional measurement techniques: haircuts and stress testing.

Regardless of the specific tools used, liquidity risks must be measured at a granular level (that is, for individual business units, regional groups, and/or legal entities). Indeed, an *ex ante* requirement in any financial measurement process is a robust accounting backbone that is built on clean, granular data. A firm must be able to gather and collate detailed data for financial measurement with ease and accuracy; if it cannot do so without significant effort, the measurement task will be of limited use. Although the process within any large global organization is likely to be challenging, it is a worthwhile endeavor because it allows development of a multi-dimensional picture of corporate liquidity risk. By measuring liquidity risk from the "bottom up" and the "top down", a firm can uncover pitfalls and opportunities. It might discover areas where cash can become trapped or raised in a more cost-effective manner, it might find that it is vulnerable to large contingent cash flows if particular events occur in remote subsidiaries, and so forth. The multi-faceted picture that emerges is extremely informative.

Figure 8.1 summarizes the common liquidity measures we discuss in the chapter.

Liquidity ratios

Dissecting a firm's financial position is an essential starting point in measuring liquidity risk. By understanding the composition of a firm's assets, liabilities, and off-balance sheet cash flows, we can develop a useful view of liquidity.[1] In fact, the best approach is holistic: measures that provide information on assets, liabilities, and associated contingencies jointly provide a more accurate picture than a simple examination of each category on its own. For instance, a company might have a great deal of short-term liabilities coming due that might appear to be a concern, but if they are properly matched by an equally large amount of short-term assets, the concern is mitigated. Or, a company might have a portfolio of seemingly illiquid assets maturing over the intermediate term, but if its liabilities also carry medium-

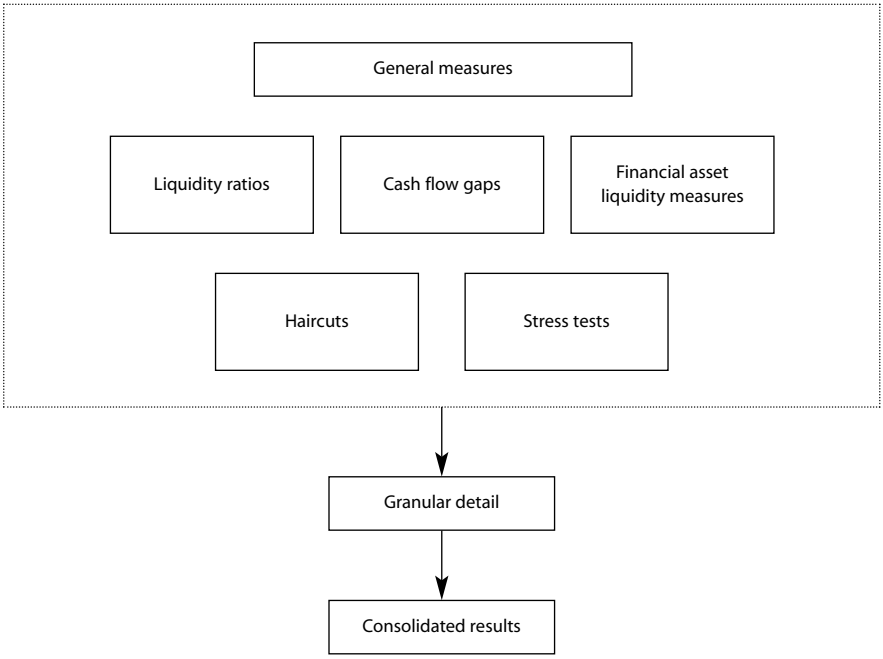

Figure 8.1 Common liquidity measurement techniques

term maturities and contain no optionable features, concern is again mitigated. The reverse can also occur, so a joint examination is useful.

Since significant liquidity problems arise from short-term lack of funds, metrics that reflect short-term asset and liability positions are an essential dimension of the measurement process. The state of a company's liquidity position can be determined by examining a number of measures from the balance sheet, income statement, and statement of cash flows. While these are generally "point-in-time" estimates of liquidity that soon become outdated, they can still be useful: when historical point-in-time information is accumulated, trends can be developed to determine whether a company is becoming more or less liquid over time. In this section we consider a number of essential corporate and financial liquidity ratios.

Working capital is an essential indicator of corporate liquidity. Gross working capital is defined as current assets plus current liabilities. Current assets, as noted in Chapter 3, include cash and equivalents, marketable securities, receivables, and inventory; current liabilities include short-term debt obligations (including CP, notes, and deposits), the current portion of long-term debt, and payables. The time horizon for current assets and liabilities is often set arbitrarily at one year, and any contracts falling outside the one-year horizon are considered non-current. Net working capital (or simply working capital) is equal to current assets less current liabilities, and indicates how

well current assets cover current liabilities – that is, whether the cash flows from maturing current assets are large enough to cover outflows associated with maturing liabilities. The net working capital figure should always be positive if a firm is to be considered liquid.

The working capital ratio, simply working capital divided by total assets, is a common ratio measure that indicates whether a firm is becoming more or less liquid as it grows or contracts; a ratio that increases over time suggests that working capital remains stable as the balance sheet is shrinking, or increases more rapidly as the balance sheet is growing. The current ratio, or current assets divided by current liabilities, is another popular measure that expresses working capital in ratio form: a ratio above 1.0 indicates that a firm has sufficient current assets on hand to meet current liabilities, while a ratio below 1.0 suggests possible problems. A slightly more conservative version excludes inventories from the current asset computation. Specifically, the quick ratio (also known as the acid test) divides current assets less inventories by current liabilities (under the assumption that inventories might not be saleable near carrying value, when needed). A further refinement excludes receivables from the computation to yield the cash ratio: this, as the name suggests, is simply cash and marketable securities divided by current liabilities, and reflects the most liquid asset accounts available to meet liabilities coming due. Current, quick, and cash ratios that increase over time are a sign of strength; those that decrease are indicative of financial problems.

A variation on the theme, the liquidity coverage ratio (also known as a defensive interval), compares a firm's quick assets to average daily operating expenses; this ratio is a balance sheet/income statement hybrid intended to estimate "survivability," or how many days a company can continue meeting expenses using only its current resources (with no new funding or revenues) – the greater the cover, the stronger the survivability horizon. Similarly, a review of the hybrid operating cash flow coverage ratio, or cash flow from operations divided by current liabilities, provides a measure of how well core operating cash covers obligations coming due; the higher the ratio, the stronger the position.

Some firms also compute a current liability ratio by comparing current liabilities with total liabilities, equity, or total assets; this indicates the burden of short-term obligations on various aspects of the broader corporate balance sheet – the lower the ratio, the lower the short-term liability burden. Since trade credit forms a key source of funding for many companies, the behavior of payables can also be considered; the length of the average payables maturity, or average accounts payable divided by purchases, indicates whether credit extensions are coming due more rapidly over time. If maturities are declining, a firm faces more short-term funding pressure.

Average payables turnover, which measures how quickly or slowly a firm is repaying its payables, is determined by dividing purchases by average annual payables; the slower the turnover ratio, the greater the use of trade credit. Receivables can be viewed in a similar light. Since receivables are an important means of providing liquidity to others, a firm that finds its receivables are lengthening might be suffering from collection problems; its own asset portfolio is becoming less liquid, a situation that might demand corrective action. (Note that the collection problems might also have a negative impact on the value, and thus saleability, of the receivables portfolio.) The length of the average receivables maturity, computed as average accounts receivable divided by sales, is thus a key measure. Similarly, average receivables turnover, or sales divided by average annual receivables, measures how quickly accounts are being replaced, and indicates whether customers are paying slowly or rapidly; longer turnover periods indicate less liquidity in the receivables portfolio.

Table 8.1 summarizes key corporate liquidity ratios.

Table 8.1 Corporate liquidity ratios

Gross Working Capital = Current Assets + Current Liabilities
Net Working Capital = Current Assets – Current Liabilities
Current Assets = Cash + Marketable Securities + Receivables + Inventories
Current Liabilities = Short-Term Debt Obligations + Current Portion of Long-Term Debt + Payables
Working Capital Ratio = Net Working Capital/Total Assets
Current Ratio = Current Assets/Current Liabilities
Quick Ratio = (Current Assets – Inventories)/Current Liabilities
Cash Ratio = (Cash + Marketable Securities)/Current Liabilities
Liquidity Coverage Ratio = (Current Assets – Inventories)/Average Daily Operating Expenses
Current Liability Ratio 1 = Current Liabilities/Equity
Current Liability Ratio 2 = Current Liabilities/Total Assets
Current Liability Ratio 3 = Current Liabilities/Total Debt
Average Payables Maturity (days) = (365 * Average Payables)/Purchases
Payables Turnover = Purchases/Average Annual Payables
Average Receivables Maturity (days) = (365 * Average Receivables)/Sales
Receivables Turnover = Sales/Average Annual Receivables
Capital Expenditure Coverage = Operating Cash Flow/Capital Expenditures

Financial institutions use various liquidity ratios that are calibrated to their operations; although the ratios measure similar types of risks to those presented above, they are based on slightly different definitions, and we consider some of the most common in this section.

Since financial institutions rely heavily on the state of their unsecured funding to generate liquidity and credit for their clients, some of the most important measures are based on the liability accounts. Borrowing ratios, such as total deposits divided by borrowed funds, volatile funds divided by liquid assets, and volatile funds minus current assets divided by total assets minus current assets, measure a bank's need to use volatile borrowings to support business, and the degree to which cash and equivalents can be used to repay "hot money" that might be presented for repayment on very short notice.[2] High ratios indicate a larger amount of deposit turnover or volatile funding in a bank's total plan, which can create liquidity pressure.

The loan to deposit ratio, or total loans divided by total deposits, indicates the degree to which a bank can support its core lending business through deposits; a refinement of this ratio excludes from total deposits the more stable retail component, to demonstrate the degree to which credit business is truly supported by hot money.

Cash balances are also important as they indicate how well a bank can meet hot money calls without curtailing credit business. Common bank cash liquidity ratios – simply variations on corporate working capital ratios – include cash divided by total assets and quick assets divided by total assets; the higher the ratios, the more liquid the asset portfolio.

Within the securities firm sector, measurement of the matched book ratio, or repurchase agreements divided by reverse repurchase agreements, indicates the degree to which a firm's leveraged position is properly matched and can be reduced or completely unwound. A higher ratio reflects a greater liability mismatch and more difficulty in unwinding the operation, should that prove necessary.

Short-term liquidity in the insurance industry is measured through insurance liquidity ratios, such as marketable securities divided by surrenderable liabilities, and 30-day saleable assets divided by surrenderable liabilities. Surrenderable liabilities are demand liabilities with uncertain time horizons; to determine the financial impact of surrender, an insurer may examine a portfolio of demand liabilities, multiply each facility by a probability of surrender, and sum across individual contracts to obtain an estimate of the total. In either case the higher the ratio, the greater the ability to meet call liabilities.

Banks and securities firms routinely measure the difference between their rate sensitive assets (RSAs) and rate sensitive liabilities (RSLs) for both liquidity and interest rate risk purposes. (Note that these measures typically include the impact of off-balance sheet cash flows.) The gap

ratio, simply RSA divided by RSL, equals 1.0 for the perfectly matched portfolio of assets and liabilities (although a ratio of 1.0 does not mean that interest rate risk is eliminated, as the asset and liability rate movements might not be well correlated). When a bank's RSAs are lower than its RSLs (a gap ratio of less than 1.0) it has an asset duration that is shorter than its liability duration and is said to be running a negative gap (it is liability-sensitive). While this can be profitable as long as the yield curve is positive and rates are stable, it is a risky strategy: as interest rates rise, the negative gap means a bank assumes more market-based interest rate and liquidity risk, and experiences a compression in its net interest margin (interest earned less interest paid). When a bank's RSAs are greater than its RSLs it has a liability duration that is shorter than its asset duration (a gap ratio greater than 1.0) and is said to be running a positive gap. These relationships are highlighted in Table 8.2. Banks typically compute an overall gap ratio to provide a picture of the total liquidity position; they may also supplement this with gap ratios by maturity bucket/duration, as discussed in the cash flow section below. The actual gap, defined simply as RSA less RSL, can be computed in total and for each maturity bucket.

It is important to note that in some jurisdictions, financial institutions are required to produce specific liquidity measures as evidence of their financial strength. These might be duplicates of those already produced and used internally, or they might be supplemental. For instance, in the UK and United States, banking regulators engage in regular "CAMEL (S)" reviews (capital, asset quality, management, earnings, liquidity, sensitivity to market risk); the liquidity portion of the review focuses on the volume and volatility of deposits, overall reliance on interest-sensitive funds, frequency and amount of borrowings, structure of liabilities, and access to cash through the asset portfolio. Other regulators impose their own liquidity metrics to determine whether an institution is being managed prudently. Table 8.3 summarizes key financial institution liquidity ratios.

The drawback with measuring current corporate or bank liquidity through pure working capital measures is that the process ignores other sources and uses of liquidity, such as reserve borrowing power via unencumbered fixed assets (a possible source for the borrower), a committed but undrawn revolver (source for the borrower), an operating lease (source for the lessee), a guarantee (use for the guarantor), and so forth. And apart

Table 8.2 RSAs, RSLs, and interest rates

		Rising interest rates	**Falling interest rates**
RSA – RSL > 0	Positive gap	Earnings increase	Earnings decrease
RSA – RSL < 0	Negative gap	Earnings decrease	Earnings increase

Table 8.3 Financial institution liquidity ratios

Borrowing Ratio 1 = Total Deposits/Borrowed Funds
Borrowing Ratio 2 = Volatile Funds/(Cash + Marketable Securities)
Borrowing Ratio 3 = (Volatile Funds – Current Assets)/(Total Assets – Current Assets)
Loan to Deposit Ratio = Total Loans/Total Deposits
Cash Liquidity Ratio 1 = Cash/Total Assets
Cash Liquidity Ratio 2 = (Cash + Short-Term Investments + Funds Sold)/Total Assets
Cash Liquidity Ratio 3 = Marketable Securities/Surrenderable Liabilities
Cash Liquidity Ratio 4 = 30-day Saleable Assets/Surrenderable Liabilities
Matched Book Ratio = Repurchase Agreements/Reverse Repurchase Agreements
Actual Gap = Rate Sensitive Assets – Rate Sensitive Liabilities
Gap Ratio = Rate Sensitive Assets/Rate Sensitive Liabilities

from the bucketed gap ratios, these measures indicate very little about the maturity or duration of obligations, meaning liquidity problems might still exist. For instance, a portfolio of liabilities that matures in two days is considered current, and a portfolio of assets that comes due in 30 days is also considered current. However, unless other financing is available or the current assets can successfully be pledged for immediate cash, a liquidity squeeze will appear. Cash flow gap measures, which we consider in the section below, seek to overcome such shortcomings.

Cash flow gaps

Asset–liability gaps are important in the effective management of liquidity risk (and aspects of market risk). A firm might have stable funding and/or asset liquidity sources, but it must still manage the gap between the two if it is to create a robust liquidity plan. Firms often measure cash flow mismatches because any gap that leads to a funding deficit will place demands on the firm's liquidity program; it is therefore important to consider just how severe such deficits can become and whether cash cushions should be accumulated in advance. Equally, any mismatch that creates a surplus can serve to reinforce the liquidity buffer in anticipation of future deficits or emergencies.

Cash flow gaps can be measured in basic form through discrete time buckets, or through more advance measures such as duration (i.e., the weighted average maturity of cash flows);[3] indeed, simple maturity gaps are generally

considered too blunt to effectively capture the nuances of cash flows unless a firm's operations are particularly straightforward. Fundamentally we know that liquidity risk (LR) is simply the supply of liquidity (near cash resources) less the net funding requirement (NFR, or cash inflow minus cash outflow) for a given period of time. If LR is less than 0, then NFR is greater than available liquidity and some cash access will be required; if LR is greater than 0, then NFR is less than the available liquidity and some buffer exists. This simple calculation can be repeated for every single time period, and although distant cash flows can be more difficult to measure with certainty, an NFR profile can be developed to illustrate the gap between inflows and outflows. For a generic firm, the NFR at each relevant time horizon can be computed as shown in Figure 8.2.

These can, of course, be decomposed to even more granular levels (for example, operating outflows might include interest payments, cost of goods sold, overhead; a five-year fixed payer interest rate swap can be decomposed into a short position in a five-year deposit and a long position in a floating rate note, and so on). These might be shown as in Figure 8.3.

It is important that all cash flows – including those arising from off-balance sheet transactions – be properly included in any gap computation; as we have already noted, cash inflows and outflows from commitments, derivatives, leases, and so on, are just as important in the overall corporate funding picture as those from the visible balance sheet.[4] For banks and securities

Cash inflows from:

Operations +
Maturing assets +
Early asset retirement +
Asset sales +
Assets pledged +
Credit draw-downs +
Off-balance sheet activities

Less

Cash outflows due to:

Operations +
Maturing liabilities +
Early liability calls +
Off-balance sheet activities

= **Net Funding Requirement**

Figure 8.2 Computation of the net funding requirement

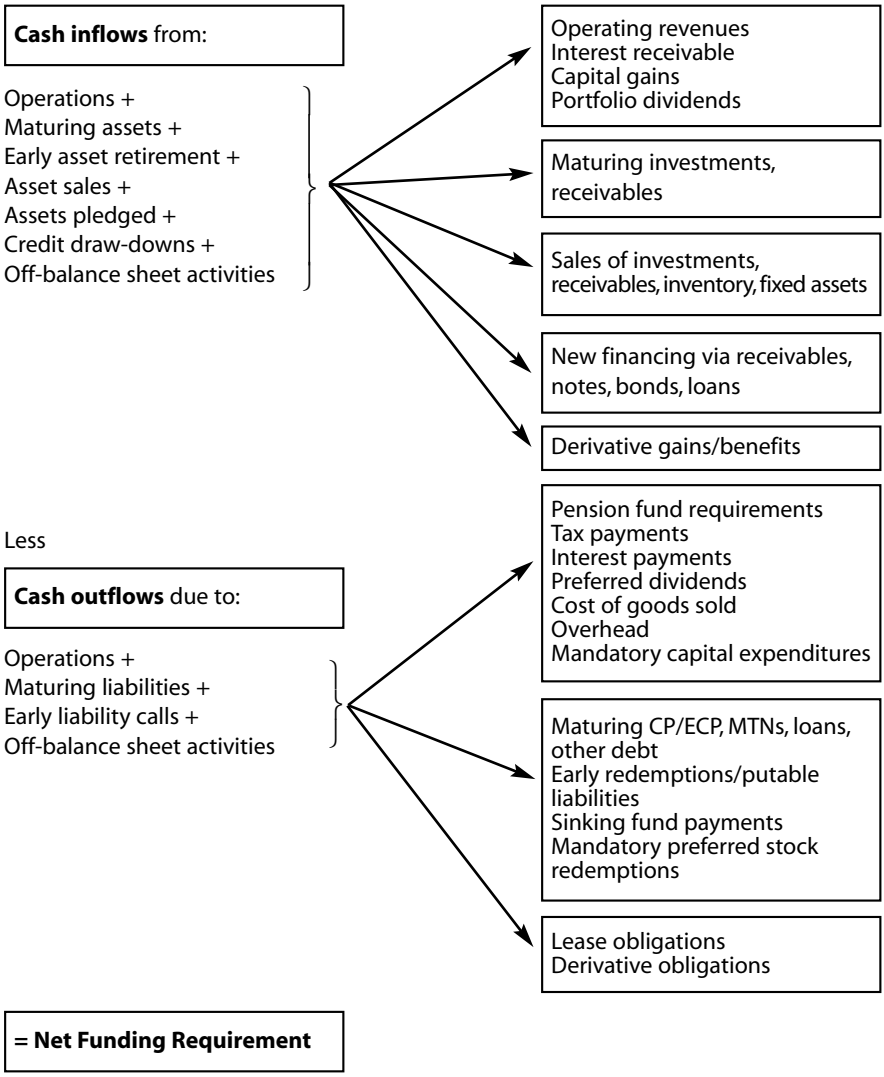

Figure 8.3 Decomposition of the net funding requirement

firms, the gap ratio mentioned above can be extended to each individual maturity/duration bucket to provide a more meaningful assessment of cash surpluses/deficits arising from RSA and RSL mismatches.

Figure 8.4 reflects a matrix of cash sources and uses against a time horizon based on simple maturity or more precise durations. The end goal is to measure the net cash balance requiring funding at any time horizon. The granularity of time horizons must be considered carefully. While an extremely detailed cash flow breakdown – perhaps daily for 30 or 60 days, then weekly for several months after that – can provide valuable informa-

Cash flow source/Use	1 day	2 day	3 day	5 day	2 week	3 week	1 month	3 month	6 month
Assets – – – Liabilities – – – OBS – – – NFR									

Figure 8.4 Cash flow sources/uses by maturity bucket or duration

tion, it can also generate a certain amount of confusion in interpretation. This is particularly true if a firm is operating in a very dynamic environment, where cash flows arising in two or three weeks might change radically by the time they move to the immediate sub-one-week bucket. A firm needs to gain experience with the optimal level of granularity before it uses such measures in its risk management process.

Figure 8.5 illustrates the net funding requirement measurement.

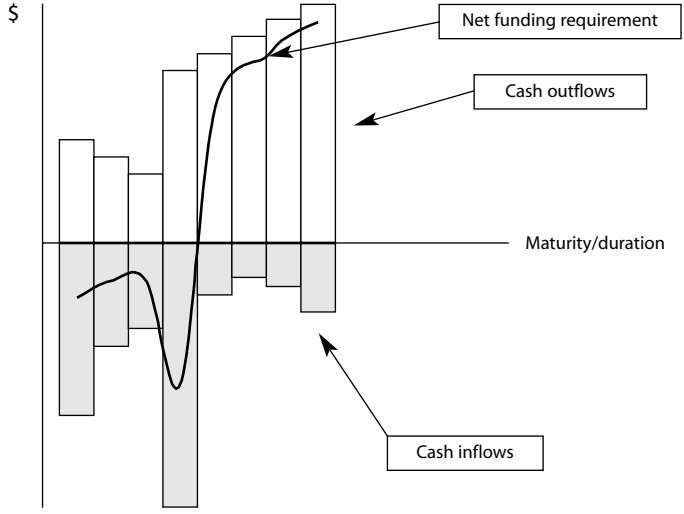

Figure 8.5 Net funding requirement

Basic bucketing or duration approaches can be refined through statistical analysis by examining the likelihood of accessing liquidity at different points in time (and at different costs) to meet cash flows. Recalling our discussion from Chapter 2, we know that cash flow and timing variables must be considered, each of which can be certain or uncertain:

- certain net cash flows at a certain time horizon
- certain net cash flows at an uncertain time horizon
- uncertain net cash flows at a certain time horizon
- uncertain net cash flows at an uncertain time horizon.

To deal with the uncertain variables (NFR and/or time), a firm can use statistical probabilities to assess the likelihood that cash will be required at a particular horizon: that is, that a net cash flow deficit will arise. For instance, dealing with uncertain cash flows at a certain time horizon demands the use of a probability distribution reflecting possible cash flows with a specific horizon; the same is true for certain cash flows at an uncertain time horizon, and so forth. The probability of having sufficient liquidity (which can be viewed as the probability of accessing liquidity times the amount of liquidity available) is then given as the probability that a particular net cash flow occurs at time horizon t, multiplied by the probability that the asset sold or the funding accessed provides the expected value, aggregated across all time horizons.

Financial instrument liquidity measures

It is critical for firms that deal actively in financial instruments, including marketable securities and derivatives, to measure the amount of liquidity inherent in such contracts. Not surprisingly, these measures are of particular interest to banks, securities firms, funds, and insurers, because financial instruments comprise the bulk of their accounts, and create or absorb most of their cash. A firm attempting to manage its financial asset liquidity risk needs to develop a strategy where it can sell or pledge a quantity of assets with particular liquidity characteristics while minimizing the value reduction in all remaining assets. It seeks to maximize the asset cash flows it receives, where each asset is governed by a specific price and liquidation horizon. To do this two factors must be considered: a forecast of changes impacting the market risk component of a portfolio's risk (that is, determining the change in asset value due to market-wide movements, with no influence by the firm's own actions), and a determination of possible price declines owing to the firm's own selling actions.

A body of research has focused on three different dimensions of financial asset liquidity measurement, including depth, tightness, and resiliency.[5] Depth is the amount of trading volume in a market, or the volume of trades that can be accommodated before prices change; tightness is the spread between the bid and offer of an asset, or how far transaction prices diverge from mid-market prices; and resiliency is the speed at which price movements disappear, or the time it takes for a market to return to "normal conditions" after having absorbed a large buy or sell order. By measuring these three dimensions, a firm with financial assets is able to evaluate the magnitude of liquidity risk inherent in its investment or trading portfolios. Although there is no consensus on the best measures for these indicators, various alternatives exist.

- Depth can be measured by the amount of orders in an exchange trading book or the buys and sells flowing through an OTC-traded product line. The greater the amount of orders and volume, the deeper the market, and the more likely it is that an institution will be able to liquidate its position at, or near, carrying value. It is worth noting that absolute market size is not necessarily an indication of depth (for instance the Japanese Government Bond market is extremely large, but does not feature much depth away from the five and ten-year benchmark securities – most non-benchmark issues are extremely illiquid).
- Tightness can be measured through observable bid–offer spreads: the tighter the spread, the greater the activity and depth, and thus liquidity.
- Resiliency is considerably more difficult to gauge, as meaningful data is hard to obtain; in fact, there is no agreement on the most effective measure of resiliency, although some favor speed as a proxy; that is, the time that it takes for the bid–offer spread on a particular asset to return to its "normal" level. In general, the more resilient the market, the greater its ability to absorb liquidation of a large block of assets.

These indicators can be combined to generate a measure referred to as friction, or the initial quoted spread (that is, the full bid–offer spread[6] before a transaction occurs) adjusted for a temporary price impact that disappears at a speed reflecting resiliency. This figure is simply the compensation to market makers that are willing to absorb the market and liquidity risk embedded in an asset.[7] Of course, there might be a permanent price impact due to ongoing divisions in the mid-market quote for the asset; this is likely to be attributable to an informational change related to the asset rather than any temporary compensation to dealers. The price impact of an asset trade can thus be measured by friction.

Various other measures of financial asset liquidity exist, including:

- Number of trades in an asset: in general, the greater the absolute number of trades in an asset, the greater the liquidity. This, however, is simply a rule of thumb, and allowance must be made for trade size; for instance, 100 trades at $100 each might or might not signify greater liquidity than 50 trades at $200, although they are likely to suggest better liquidity than one trade at $10,000.
- Monetary volume of trades in an asset: in general, the larger the monetary volume of trades in an asset, the greater the liquidity. This measure helps address some of the shortcomings found in a pure tabulation of the number of trades, as it takes account of the actual market value turnover.
- Frequency of trades in an asset: in general, the more frequently an asset trades, the better its liquidity. Those that trade several times per minute or second are more liquid than those that trade "by appointment only," irrespective of monetary volume.
- Turnover in an asset: in general, an asset that turns over rapidly is more liquid than one that turns over slowly (where turnover is defined as average volume divided by outstanding securities).
- Number of market makers: in general, the greater the number of market makers quoting two-way prices in an asset, the greater the liquidity in that asset. This presumes that market makers are obligated to fill either side of the trade at the level quoted and cannot renege or back away.

Not all of these measures are applicable in every market setting – each asset market has unique characteristics and dynamics, so asset liquidity measurement must be tailored accordingly. Indeed, some measures are more robust than others (depending on the market system and conventions) and might be most useful for "conventional" assets rather than those that are highly customized or specialized.

Model-based measures, VAR and LAVAR

Asset liquidity cannot always be computed through bid–offer spread movement or turnover statistics. Certain contracts and portfolios lack sufficient turnover and/or transparent market prices as a result of their structural complexity or unique features, meaning that institutions must rely on models to estimate value and liquidation prices. Models possess a systemic characteristic that assumes a significant role in liquidity management. In the absence of transparency institutions must measure, price, and manage

their assets and liabilities and off-balance sheet risks based on assumptions related to stochastic processes and price independence. While these assumptions might be acceptable during normal market conditions, they might not hold true during a dislocation. Assumptions regarding independent and continuous price movement might break down, leading to errors in measurement and management. In addition, identical institutional responses (some forced by particular regulatory rules) might occur, magnifying the relative volatility and liquidity characteristics of the marketplace, again altering underlying assumptions.

Risk is not a separate stochastic variable underpinning a model; the distribution of risk changes in a stress situation as firms implement risk protection strategies. Consider, for example, that regulators in many countries require banks to use value-at-risk (VAR) models, market risk quantification processes that attempt to estimate how much an institution's portfolio of risks might lose over a stated time horizon, to a specified degree of statistical confidence. (The process is also applicable to a portfolio of collateral an institution might be holding to secure counterparty exposures.)[8] Unfortunately, VAR models contain several fundamental flaws, including:

- no gauge of tail risks and losses
- no consistent method of aggregating risks across different classes
- difficulties capturing the non-linear price characteristics of many derivatives
- dependence on assumptions related to volatility, correlation, and liquidation horizon
- separate modeling of asset prices and portfolio size.

These flaws draw into question the efficacy of the VAR process, especially during systemic dislocations. In a crisis situation, firms managing to the same VAR process (for example the 99 percent confidence level, or the ten-day liquidation horizon promulgated by the BIS under its 1996 Market Risk Amendment) are likely to take similar defensive actions in order to reduce risks. This is a manifestation of the positive/negative feedback trading scenarios we mentioned earlier – mass migration from high to low risk assets can cause some asset liquidity to evaporate and liquidation horizons to lengthen. As a result, *ex ante* VAR loss estimates might be understated in comparison with actual experience (to wit, the model-related problems apparent during the LTCM crisis).

VAR models are not unique in this regard: many other financial models, including those used to value exotic derivatives and dynamic credit risks,

might be subject to the same statistical shortcomings, meaning the same caveats apply. The use of models has to be properly considered and shortcomings must be understood; one way of achieving this is to ensure that model assumptions are thoroughly discussed by management and directors. It is also important to introduce judgment and experience into management response.

We have mentioned some of the flaws contained in the standard VAR computation. Risk management under normal market conditions focuses on the distribution of portfolio value changes from moves in mid-market prices, disregarding any element of friction. VAR assumes that a bank's entire position or portfolio is unwound in a single trade at a fixed mid-market price at the liquidation horizon, regardless of size or complexity. This, not surprisingly, is a rather unrealistic assumption. The common approach to VAR liquidation periods is based on an orderly process that assumes a sale occurs at the end of the defined period, and that a single liquidation period holds for all assets; this approach ignores liquidity trade-offs and costs. While traditional models assume static and constant liquidation periods of one day, five days, two weeks, and so forth, these often prove unrealistic in times of market stress; they are also a "blunt instrument" as they are uniform and constant across all market conditions and asset classes,. For example, the operating assumption is that it will take a bank one day (or five days, or two weeks) to sell a $100 million block of securities at the quoted mid-market price, regardless of whether the securities are US Treasury bonds or emerging market bonds, and whether the general market environment is benign or hostile.

To refine the measure, and make it more useful in the context of market and liquidity risk management, several VAR adjustments have appeared in recent years. One basic approach involves the use of an "add-on" to the mid-market price that reflects relative liquidity or illiquidity. The add-on can be determined via:

- An empirical adjustment to match a stated liquidation period, taking account of asset class and position size. This technique requires VAR to be rescaled to one day, and is intended to provide a "worst case" estimate add-on to the mid-market price of an asset.
- An estimated adjustment to the current or expected value of the bid–offer spread based on the size of the risk position, thus adding to VAR the expected costs from the quoted spread.

While these adjustments make VAR somewhat more useful, they require significant data sourcing and management efforts. In addition, simply extending VAR by adjusting the bid–offer spread ignores the market

impact factors we have discussed above and in Chapter 5, which are an important dimension of liquidity risk.

Another approach centers on the concept of liquidity-adjusted VAR (LAVAR). As the name suggests, this process involves recalibrating the VAR computation to take account of liquidity characteristics directly. Although there is no single accepted method of computing LAVAR (just as there is no single way of calculating VAR),[9] several analytical alternatives exist, including:

- A volatility scaling factor incorporated within the variance/covariance matrix, which applies greater volatility estimates to positions that are believed to carry greater liquidity risk (such as those with large size or thin trading volume). The scaling factor essentially increases VAR for any portfolio with predefined characteristics.
- A time scaling factor added to the liquidation period. In this instance large positions, as well as those based on fundamentally illiquid assets, are "penalized" through a scaling factor that shifts the liquidation horizon from one, five, or ten days, to relevant multiples – once again increasing VAR. In order to scale the liquidation period, an institution can divide its risk portfolios into various sub-portfolios that reflect specific liquidity characteristics; different time horizons are assigned according to the expected ease or difficulty of liquidation (or risk neutralization via hedging). In this sense LAVAR can be viewed as VAR with an asset-specific sampling horizon and a liquidation period that is synchronized to some exogenously determined trading frequency; a link between saleability, depth, and liquidation thus exists.

These approaches improve conventional VAR, as they reflect the fundamental reality that different assets do, indeed, face different liquidation horizons under a range of scenarios. However, they still have shortcomings; for instance, there is no indication of the correct volatility adjustments or time scaling factors, and no explicit accounting for how the market price impact function relates to the correlation between an institution's activities and systemic supply or demand. That said, some financial institutions have begun implementing LAVAR in order to circumvent some of the problems and shortcomings that became so apparent during the financial crises of the late 1990s and early millennium.

Haircuts

In order to provide a buffer related to the sales or pledge value of assets, it is common for institutions to measure, and then apply, a haircut to the value

of the financial asset(s) in question. By injecting a degree of conservatism into the process, haircut measures help ensure that the probability of a shortfall is minimized. Assets that can quickly be converted into cash (directly or through a loan) face little or no haircut, while those that cannot draw a larger haircut. Thus, a $100 million block of US Treasury bonds can be liquidated at the mid-market carrying value with minimal discount; a firm might thus consider the post-haircut value of the block to be $99 million. A $100 million block of emerging market securities cannot necessarily be liquidated rapidly at the mid-market carrying value, and thus attracts a larger haircut, perhaps 25 percent or more, bringing the liquidation/pledging value down to no more than $75 million. While it might be possible for the firm to sell or pledge that block of emerging market bonds at mid-market if it has the luxury of many days or weeks to arrange such transactions, we are primarily concerned with the ability to generate cash quickly – to meet an unexpected obligation at a moment's notice. The short time-horizon scenario is thus important.

Haircuts can be measured in various ways, but most are based on asset quality and type, with a specific focus on the price volatility of the asset, the liquidation horizon, and the degree to which the asset can be rehypothecated. It is generally true that the greater the volatility of an asset, the larger its haircut. Price volatility, in turn, might be directly or indirectly influenced by the depth, tightness, and resiliency of the market. Those that are deeper, tighter, and more resilient can absorb a greater amount of activity without much visible change in the quoted mid-market price; accordingly, they exhibit less volatility. Those that are shallower and wider lack the same absorption capacity, and are more likely to demonstrate greater price volatility, and thus haircut.

Any computation must also take account of the liquidation horizon. Again, it is generally true that the longer the time available for liquidation, the smaller the haircut (though the greater the likelihood of larger price movements between measurement date and liquidation date). A firm that has a portfolio of assets that can be liquidated over 30 days will not face the same value discount as the firm that must dispose of the assets within 24 hours. Although the conservative approach might assume instantaneous disposal/pledge value, more realistic time horizons should be computed. In fact, haircuts can be calculated for a range of liquidation horizons as part of the stress testing process discussed in the next section.

The ability to rehypothecate securities taken as collateral in a financing transaction can also influence the level of the haircut: those that can easily be accepted and then re-pledged in the market are likely to carry smaller haircuts than those that cannot, as they create greater flexibility and liquidity within the asset portfolio. Government securities are routinely rehypothecated – this feature (along with other liquidity characteristics like high

volume and low volatility) helps generate smaller haircuts. The range of financial asset haircuts, illustrated in Table 8.4, thus varies widely. (It is important to note that the discussion above relates to financial assets that are marked-to-market. Firms that value to lower of cost or market must first revalue their assets and then apply an appropriate discount; this allows for a more realistic computation of the liquidation or pledge value of the asset.)

The haircuts depicted in the table can be considered as internally applied discounts, used to compute possible access to cash resources through disposal or pledging. When considering the pledge scenario, the haircuts might or might not correspond with prevailing market conventions in the repurchase agreement/bond borrow markets, where participating institutions set general ranges on an asset-specific basis and then supplement the process through daily marks-to-market and variation margin calls. The prudent firm is most likely to use haircuts that are even more conservative than those found in the professional financing marketplace. It is also worth noting that although each institution with a financial portfolio may perform its own haircut computations, regulators sometimes impose minimum haircut levels of their own. While these may be determined in a similar way (for instance by volatility or time), there is no guarantee that they will match the figures generated by market participants.

The haircuts applied to fixed assets can be more challenging to determine, because they are based on assets that are unique and often lack a ready market of buyers. An industrial company with an unencumbered factory valued at $500 million (after depreciation) may not receive the full value in a disposal or pledging scenario; how much it receives will depend on both the perceived worth of the factory to a lender or buyer, and the time horizon during which transaction execution must occur. Engineers and auditors must perform due diligence on the estimated sales value of the factory, and investment bankers might then approach commercial banks and/or competitors to determine whether they would be willing to lend or buy at the independently

Table 8.4 Sample asset haircuts

Asset class	Haircut ranges
Short–term government securities	<1%
High quality money market securities	1–5%
Generic agency and mortgage–backed securities	10–20%
High-quality corporate bonds	10–20%
High-yield corporate bonds	25–50%
Emerging market bonds	30–50%+
Large capitalization equities	30–50%+

assessed value. The process is time-consuming and far from transparent, meaning an *ex ante* haircut value can be difficult to ascertain. The time dimension again features in the equation, with rapid disposal or pledging creating a larger discount. As with any illiquid asset, it is reasonable to assume that in most instances the haircut will be considerable, 25–50 percent of book value, and possibly even more.

Stress tests

Liquidity problems often arise from tail risks – events with a low probability of occurrence but a potentially large financial impact. A strong regimen of endogenous and exogenous stress testing that reveals the potential for tail-based losses is thus a useful element of any measurement process. This can be accomplished by creating hypothetical scenarios reflecting extreme movement in various parameters, or by "replaying" certain disaster events that have occurred in the past (such as the 1987 stock market crash and the 1998 Russia/hedge fund crisis) and examining the effects on internal financial structure and liquidity patterns. Stress scenarios can also be created by manipulating macro-economic variables, such as those reflecting economic slowdown, loss of consumer confidence, rise in inflation, and general deterioration in corporate credits. Event risk scenarios and joint scenarios can provide perspectives on even more severe tail events.

Ideally, stress testing should be measured over short-, medium-, and long-term horizons several times per year, and the results should be linked into the contingency plans we consider in Chapter 10. In order to properly benchmark the results, a company should first run a series of tests under its normal operating baseline case to determine how its positions perform in the absence of endogenous or exogenous stresses; this provides a gauge of just how sensitive a firm becomes in the face of specific disruptions. It can then apply scenarios to stress market parameters, cash flows, asset disposals/pledging, funding, covenants, collateral, and currency exposures – any stock or flow variable that can impact a firm's liquidity position and access. In practice, the stress testing process relies on a variety of tools, including simulation analysis, mathematical programming, and forecasting models, to produce desired results.

Market parameters

Stress tests can be used to examine market liquidity parameters that are often troublesome, including variables that VAR-type models ignore (that is, how much might be lost via market, credit, and liquidity risks in a disaster, rather than the minimum amount lost on a "losing day"[10]). Key variables that should form part of any stress measurement include:

- volatility
- correlation
- liquidation horizon
- funding spreads
- haircuts.

Liquidation horizon, as we have noted above, is an essential input into many models and is a frequent source of problems – primarily because there is a tendency to underestimate, during times of market dislocation, the length of time that it will take to sell a position. Stress tests must abandon "common thinking" and extend liquidation horizons to include those that appear inconceivable. This can lead a firm to consider responses that it might otherwise disregard. For instance, if a company knows with certainty that it will have to make a large payment in three weeks and is seeking to fund the payment through asset sales, it might identify a portfolio of corporate bonds that it believes will take no more than one week to sell. If, however, it cannot sell them in time, it will face a liquidity squeeze and be forced to seek other, more expensive, alternatives. The firm should question the liquidation assumption by considering that it will take one month to sell the bonds, and run stress scenarios on that basis. It may discover that it will have to begin selling the bonds earlier than anticipated, or plan for some other contingency funding if it wants to meet the cash payments on time.

Cash flows

Stress testing must be applied to cash inflows/outflows and the resulting NFR referenced earlier in the chapter. By manipulating operating cash flows, and sources and uses of liquidity, across time horizons, different scenarios can be computed, some of which may reveal areas of vulnerability. The results can be incorporated into broader management and contingency plans. For instance, the regimen can be based on measuring cash inflows from operating revenues, credit draw-downs, asset sales, asset roll-offs, and contingent off-balance sheet receipts, and cash outflows related to liability redemptions, putability, roll-off, and contingencies. A focus on intra-day cash spikes can also be examined, as these can be the source of large financial pressures when in deficit.

Stress testing can also be used to measure a firm's ability to survive without accessing new sources of cash; we have already mentioned that the defensive interval is an important gauge of a firm's ability to continue operating for a defined period of time with no new cash inflows. Stressing the

amount of cash outflows by injecting additional unexpected payments or withdrawing existing funding lines can help demonstrate the strength or fragility of a company's position. A test based on maximum cumulative outflow, or the maximum amount of short-term unsecured funding needed to finance outflows in the event of a disaster scenario, can also provide important insight into the liquidity position.

Cash flow stress testing of off-balance sheet activities is particularly important for financial institutions. A bank or securities firm must be aware of what might happen to the corporate balance sheet if derivatives are exercised, revolving credit facilities are drawn, margins are required, or guarantees are called on. Any scenario analysis should measure the impact of such contingencies. While there is no foolproof way of conducting such tests, a firm can begin by examining historical activity in the face of dislocation and then supplement this with judgment and hypothetical behaviors given particular market events.

Asset disposals and pledging

Stress testing can measure the sensitivity of a firm's asset accounts generally, and liquidity warehouse specifically, and the values that can be realized in the event of market dislocation. While the conservative firm is already likely to discount by a certain percentage the amount that it believes it can obtain through disposal or pledging under normal market conditions, the stress test must focus on extreme discounts, such as the new carrying value of the portfolio that results if all markets decline by 5 percent, 10 percent, or 25 percent, or become offered-only as a result of exogenous events. Asset portfolios that are concentrated or have limited marketability (as a result of riskiness or complexity) should be discounted even more heavily in the test (for example, by 30 to 50 percent) to reflect the fact that realizable cash value will almost certainly be far smaller than expected during difficult times.

Funding

Funding sources must also be a central focus of stress testing. Indeed, a sharp rise in funding costs or the disappearance of existing facilities is often the first sign of a stress liquidity problem, and can lead to more serious problems. An extreme stress test might therefore estimate the economic loss sustained if all funding costs rise by 100, 200, or 500 bps on committed facilities and existing programs. It can also include the cash flow effects and incremental funding requirements arising from the instantaneous withdrawal of all of a firm's uncommitted banking facilities and a certain percentage of its committed facilities.

The behavior of customers, clients, investors, or creditors that provide funds can also be examined. This moves from the endogenous to exogenous, and is intended to convey what might occur if depositors suddenly withdraw a large portion of funds, investors refuse to rollover CP/ECP in order to reallocate their funds to other opportunities, trade creditors encounter difficulties of their own and change the payable credit terms they offer their clients, and so forth. This dimension is important because it captures an idea we discussed earlier: a firm can manage its own operations very prudently, but remain susceptible to external forces. In some instances, of course, very strong companies can benefit from a flight-to-quality movement if their credit standing is sufficiently strong to attract the funds of nervous investors or depositors. As noted, in a systemic dislocation some institutions gain additional liquidity, giving them considerably more financial flexibility. This phenomenon, while limited to a relatively small number of AAA and AA rated financial institutions, must be recognized as a possibility, and can be included in relevant tests.

Covenants and terminations

We have indicated that many bank credit agreements and bond indentures contain financial covenants and market events that are designed to ensure debtor firms remain prudently managed. These are generally well intended and designed to protect both parties, and their stakeholders, from mismanagement. Since the triggering of covenants can create a "chain reaction" of funding events (such as cancellation or repayment of facilities), a thorough understanding of what might occur is an important part of stress measurement.

The funding scenarios can be stress tested by considering a firm's obligations under its financing facilities should covenants be breached or the firm's credit rating be downgraded to a threshold that leads to step-up funding costs, posting of collateral, and/or repayment of outstanding facilities. In some instances this might reveal the need for significant amounts of new funding or a redirection of cash flows from alternative sources. Similarly, a firm can examine its portfolio by taking account of early terminations embedded in financial contracts, allowing one or the other of the parties to end a transaction. In some instance early termination is possible at will; in other cases it must be triggered by a specific event, such as counterparty default or a rate movement. In either case, a firm should understand the positive and negative cash flow implications of early terminations.

Collateral

There are situations when firms accept or deliver collateral in order to secure credit-sensitive transactions. Since the collateral forms an important

element of the credit risk management process, and since credit risk can impact on liquidity risk, the dimensions of the collateral portfolio should be subject to stress tests. In fact, several aspects need to be explored: receipt versus delivery of collateral, delays in receipt, and discounts in collateral value. In the first instance, a company might wish to create stress scenarios that involve the delivery of collateral to other institutions, either as part of the normal course of business or as a result of a credit downgrade that requires posting of security. The implications of having to source or reallocate assets to secure a credit exposure must be examined in detail, as the action will have a direct impact on the firm's liquidity and financial flexibility.

Next, a firm must consider collateral that it is expecting to receive from another party through the same types of agreement. Receipt of collateral, which can then be rehypothecated, is an important source of cash for those capable of managing the collateral process. Again, issues related to the timing of collateral delivery should be analyzed, including instances where collateral that is meant to be received is delayed and the firm is forced to take actions to cover the credit exposure.

Finally, the value of the collateral should be stressed by applying the very asset haircuts we have described earlier in the chapter. If the firm's counterparty defaults and the stress value of the collateral proves insufficient, a cash shortfall may arise. The deficit might have to be funded through alternate sources, and must therefore be incorporated into a contingency plan. A stress measurement of these collateral arrangements is most important for firms that have a great deal of assets flowing into, or out of, the balance sheet as part of corporate operations. While this is generally associated with financial institutions, certain large companies have similar collateralized business as well.

Currency exposures

Institutions with global operations holding a certain portion of cash flows and balance sheet accounts in a foreign currency must measure the economic effects arising from a depreciation/devaluation of the local currency, as well as those arising from a lack of local currency access. For instance, a stress scenario might examine the cash flow impact of a currency devaluation of 10, 25, or 50 percent, or a large spike in local interbank rates that might occur in defense of a currency (and which would impact a firm's local currency borrowing costs). In addition, scenarios might be constructed to consider the financial impact owing to an inability to source or convert local currency (perhaps as a result of capital controls, an event risk we consider immediately following).

Event risks and joint scenarios

In some instances a firm is exposed to event risks that can alter access to cash or the way in which business is conducted. These might be considered structural changes – highly improbably legal, political, or sovereign events that can dramatically change the firm's liquidity profile. Although such exogenous structural changes have a low probability of occurrence, they are worth considering in the context of a liquidity measurement exercise.

Candidates for event-related stress testing include currency convertibility controls placed on an important local marketplace, freezing or seizure of capital within a country, destruction of an uninsured plant, regulatory changes prohibiting a legal entity from upstreaming cash to the parent, and imposition of double leverage constraints at the holding company level. Each one of these events can sharply curtail a firm's access to cash and place increased demands on existing facilities.

The regulatory and rating agency view of institutional liquidity should be a central focus of any event risk testing. These bodies command considerable influence in determining appropriate levels of sector liquidity, and it is prudent to hypothesize on their behavior during a market dislocation. For instance, if regulators are concerned about a systemic financial crisis, they might require financial institutions to increase their level of liquidity to particular minimum thresholds. Or if rating agencies are worried about growing leverage and declining revenues in a particular industrial sector, they might penalize firms that fail to preserve a larger than normal cash buffer through a lower credit rating. As we noted in Chapter 6, a regulatory sanction or credit downgrade can actually exacerbate a liquidity crisis and help fuel a spiral. Anticipating such institutional changes through stress testing is an important element of anticipatory risk management.

The stress scenarios we have noted above can also be considered in combination. In fact, this is a realistic approach when considering disasters, as shocks can often impact assets, funding, and contingencies simultaneously. For instance, it can be useful to consider what might occur to the firm's cash position if the value of its investment portfolio or liquidity warehouse falls by a particular percentage at the same time as the cost of its committed funding sources rises by several percent, uncommitted funding is completely withdrawn, and currency controls are imposed on its primary offshore market. Naturally, results obtained from such joint scenario analysis must be considered carefully; although the results might reflect rather significant financial losses, it is important to recognize that these are very low probability events, and daily management to such unlikely events will not result in an optimal use of resources.

Table 8.5 provides a simplified view of the stress testing process. The output from each one of these variables and scenarios might be a change in

Table 8.5 Summary stress testing grid

Variable	Baseline	Stress 1 Market crash	Stress 2 Economic slowdown	Stress 3 Sovereign event risk	Stress 4 Joint scenarios
Market parameters					
Volatility					
Correlations					
Liquidation horizon					
Spreads					
Haircuts					
LAVAR					
Cash flows					
Assets					
Liabilities					
OBS Items					
NFR					
Asset disposals					
Portfolio 1					
Portfolio 2					
Portfolio 3					
Receivables					
Inventories					
PP&E					
Funding					
CP/ECP					
Payables					
MTN/EMTN					
Loans					
Putable arrangements					
Bonds					
Covenants					
Liquidity ratio					
Leverage ratio					
MAC					
Collateral					
Received					
Delivered					
Currency					
Currency 1					
Currency 2					
Currency 3					

a market parameter leading to a change in the way cash flows are computed, and/or an actual change in the timing or magnitude of the cash flows – each of which can affect the firm's need to access additional funding.

The measurement process is a central component of any liquidity risk management framework. Before an institution can actively manage its liquidity risk exposure it must understand how large such exposures are, and how significant they might become under normal and stressed market conditions. With this information in hand, an institution's executives and directors can control liquidity risk in a manner that is consistent with internal guidelines and overall risk tolerance levels, topics which we consider in the next chapter.

CHAPTER 9

Controlling Liquidity Risk

We know from our discussion in previous chapters that active management of liquidity risk is central to a company's success. A well-structured approach to managing risks that have been identified and measured helps a company avoid the cash flow surprises that can lead to problems. Liquidity risks can be managed through a multi-stage stage process that is based on developing proper governance practices, defining and implementing a liquidity risk mandate, assigning management duties and responsibilities, creating and implementing liquidity risk controls, and monitoring the liquidity risk profile. We consider each of these essential points, summarized in Figure 9.1, in greater detail in this chapter.

GOVERNANCE STRUCTURE

In order to control liquidity risks a firm must start by creating an effective risk governance structure. The board of directors, acting as agent of the

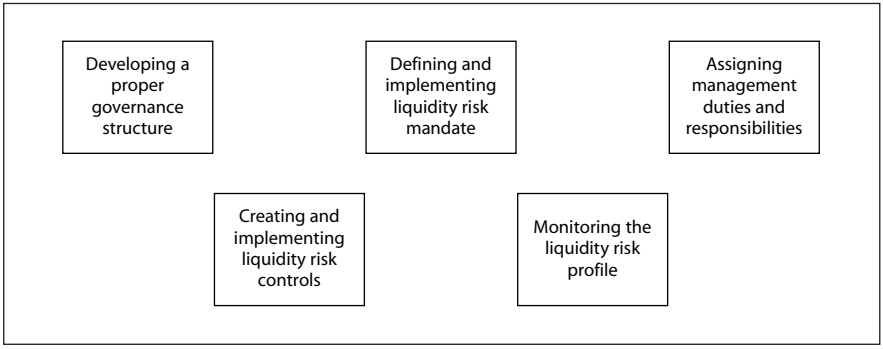

Figure 9.1 Controlling liquidity risks

shareholders, must delegate authority for liquidity risk management to the executive team (that is, CEO, COO, CFO, and/or treasurer) and authorize the creation of an independent committee or department (or unit within an existing department) to oversee the implementation of a liquidity risk management process. We term this function the liquidity committee (LC) for ease, though it is commonly known as an asset–liability committee (ALCO) in some financial institutions. The LC, in its capacity as the operating arm of the board on all matters relating to liquidity, should include senior representatives from relevant disciplines, including business units, finance, treasury, and risk management. If a separate treasury function already exists to manage daily balance sheet funding and short-term liquidity risks, close cooperation must be fostered between the two groups. The duties of the executive team and the LC must be very clearly defined, and the audit committee of the board should ensure that internal and external auditors regularly review the functions.

The LC, as a process and policy-making unit, should be responsible for:

- defining, in conjunction with the board of directors and senior executives, the firm's liquidity risk mandate, and communicating elements of the mandate to interested stakeholders
- developing a business and liquidity risk strategy that is consistent with the company's stated liquidity risk mandate
- creating a liquidity crisis management program
- ensuring appropriate risk measures are developed and promulgated
- evaluating the liquidity impact of new products and business lines to determine how they can be supported within the firm's control framework
- delegating duties and authorities related to the management of liquidity risk to the business units and control functions (depending on the degree of decentralization that is sought)
- reviewing for the board and senior executives the status of liquidity risks and recommending periodic adjustments to the mandate to accommodate changing corporate or market circumstances.

Senior executives, as part of the management group, should be responsible for:

- ensuring prudent daily management of the firm's liquidity process, including short- and long-term funding, asset structure, and bank/investor relationships

- allocating and directing resources in support of a sound liquidity environment
- making certain that new products, strategies, and business lines with liquidity risk implications are submitted to the LC for consideration
- testing the liquidity crisis management program and invoking and directing it when needed (in conjunction with others on the crisis management team).

The board, senior executives, and the LC must consider whether liquidity risks should be managed on a centralized or decentralized basis. Each approach has advantages and disadvantages. Decentralization permits local units to manage liquidity according to local market practices and conditions, and in a manner consistent with legal entity or regulatory restrictions, but gives head office less direct control and consistency. Centralization allows for strong headquarters control and a consolidated and consistent view of exposures, but might not promote proper awareness of unique local market issues. In some firms a balanced approach can prove optimal: regional or product units can be granted responsibility for daily liquidity management but must adhere to certain centralized directives developed by the LC, central treasury, finance, or risk groups (such as limits, controls, and reporting). In times of crisis daily responsibility may shift completely to a centralized mode, as we shall note in the next chapter.

In general, preserving some modicum of local/business flexibility is important, as it permits those with the best knowledge of a region, market, or product to take appropriate actions in managing daily liquidity needs. When this flexibility exists, communications back to the central function must be strong, or an inaccurate picture of firmwide liquidity might develop. Regardless of the approach, local and centralized responsibilities must be well defined for both normal and crisis scenarios. Ultimately, a firm's risk governance structure must ensure that the liquidity risk management process is robust, well designed, and capable of minimizing liquidity-induced problems.

LIQUIDITY RISK MANDATE

Directors and executives, acting through the LC, must define the company's approach to, and tolerance for, liquidity risk. The process can be formalized through a liquidity risk mandate – a definition, or crystallization, of a firm's approach to risk. For many companies this may be an extension to an existing risk process: if a company has already established a framework for risk management – and many major firms operating in the

marketplace of the twenty-first century have – then liquidity risk can be regarded as another risk variable to be considered and defined within the firm's overall risk operations. If no such process exists, it must be developed as a matter of priority.

The liquidity risk mandate is created through a comprehensive risk plan and must be supported by relevant risk resources. Since the funding and asset liquidity exposures we have considered in previous chapters are an element of most corporate activities, a firm must be prepared to accept some amount of exposure in its operations. But corporate leaders still have the ability to define an overall approach and tolerance to risk. If the firm wants to minimize asset and funding exposure in order to reduce the likelihood of loss and remain focused on core operations, it should state so through a formal notification to stakeholders, and ensure that its controls are strong enough to allow adherence to such a philosophy. Conversely, if it prefers to maximize liquidity risk in hopes of generating additional returns, its mandate should convey that position and stakeholders should be aware that a more significant amount of exposure is embedded in corporate operations.

Risk plan

The liquidity risk mandate should be based on the firm's overall plan for sourcing cash through operations, assets, liabilities, and off-balance sheet activities, and should be consistent with general corporate operations/strategy related to production, investment, and expansion. The LC, CFO, and treasurer should create a funding plan that addresses the firm's ongoing needs and seasonal requirements, and is sufficiently large, flexible, diversified, and committed to provide cash when required; a number of the funding controls we consider below can help reinforce the essential components of such a plan. The same is true of the firm's asset portfolio: an appropriate amount and mix of liquid and unencumbered assets must form part of the firm's overall risk plan, and can again be reinforced by the right controls. Given the growing importance of off-balance sheet items, it is equally vital for the firm's plan to include the correct balance of contingent inflows and outflows.

In practice, this type of planning function must occur within the confines of the board's risk directives: the team must focus on how much liquidity the firm needs to operate its business under normal conditions, cyclical variations, and stressed market conditions, and where (and at what cost) it can access liquidity. While the risk plan is necessary for companies in all industries, it is especially critical for those in the financial sector, where institutions must determine how to maximize net interest earnings (as well as trading revenues) by balancing the cost of providing risk capacity to

others. Considering potential business opportunities in light of current and future market cycles and the relative returns that can be earned from interest rate and credit-sensitive activities is one way of doing this.[1]

From a pure liquidity perspective the risk plan should indicate how asset and funding maturities will be managed as the yield curve turns positive or negative, foreign exchange volatilities rise, credit defaults increase, and so forth. The plan cannot, of course, view liquidity risk in isolation – other dimensions of risk must also be considered. We have indicated the close relationship that exists between market, credit, and liquidity risks; while each can be viewed in isolation, the holistic view is far more useful. Thus, the firm that actively takes a great deal of market and/or credit risk must be prepared to assume a considerable amount of liquidity risk and manage all dimensions consistently.

Financial and human resources

Management must also consider the financial resources that are available to support liquidity risk exposures (as well as all other financial and operating exposures). A firm that has insufficient financial resources to take a significant amount of liquidity risk should not do so. Capital, as the ultimate buffer against unexpected losses, is the primary driver of resource availability. Firms that are well capitalized (from both an economic (internal) and regulatory (external) perspective) have greater ability to assume financial and operating risks, including those associated with liquidity. However, the resource allocation must be disciplined: directors and executives must allocate scarce capital to ventures that yield the greatest return to shareholders, while being consistent with the overall business mandate. Even a well-capitalized firm would be unwise to squander capital resources on ventures that provide an inadequate return. Accordingly, the disciplined management process requires that capital be allocated on a risk-adjusted basis, with appropriate minimum hurdle rates and target returns. Risk-adjusting profitability across risk classes provides an opportunity for management to measure the real worth of risk-taking activities, and direct resources where value can be maximized. The same applies to human resources and intellectual capital; a risk-taking firm must possess both, or it will soon jeopardize its resources.

Creation of a liquidity risk mandate ultimately ensures that management has:

- analyzed the costs and benefits of running liquidity risks of varying size
- determined how exposures influence corporate operations and profitability

- allocated financial resources to support any losses that might arise under normal and stress conditions
- communicated its approach to interested parties, including investors, regulators, creditors, and customers.

With a liquidity risk mandate in place, the firm's LC can actively measure and control liquidity risk in manner consistent with the company's overall philosophy.

MANAGEMENT DUTIES AND RESPONSIBILITIES

The management of liquidity risk covers distinct time horizons that correspond to the nature of a company's business, its financial condition, and the strength of the external environment. Some functions must be performed every day, others every week, month, or quarter. Daily procedures typically involve:

- managing current cash inflows and outflows by balancing positions through cash management, rollovers, bank line draw downs, and other short-term funding sources
- examining cash surpluses and deficits arising over the key overnight to one month horizon and developing appropriate short-term response strategies
- monitoring the cash flow position in relation to limits that have been established
- examining liquidity crisis "early warning" indicators and invoking the crisis management program, when and if necessary.

Weekly, monthly, and quarterly management, in contrast, is centered on:

- analyzing ongoing cash needs over the 1 to 24 month horizon
- developing new sources of funding to meet anticipated changes in cash flow patterns
- restructuring the investment or asset portfolios to help fulfill liquidity goals
- changing the current liability mix to suit future requirements or take advantage of cost/market opportunities
- running stress scenarios on current and future portfolios to detect areas of strength and weakness

- proposing adjustments to the liquidity risk mandate, consistent with the firm's liquidity risk appetite and business strategies, and with a view towards maximizing returns for a given level of liquid holdings.

As noted above, the LC must formalize delegation of daily and periodic responsibilities; there should be no doubt about which individuals, teams, or departments are responsible for managing individual aspects of the process.

LIQUIDITY RISK CONTROLS

In order to control liquidity risk in a manner that is consistent with the firm's mandate, the LC must develop and implement a set of policies and procedures. A liquidity policy can be considered a practical expression of a company's liquidity risk mandate, conveying strategies for dealing with exposures. It also serves to formalize interdepartmental activities and responsibilities, which is especially important if a company opts for a decentralized management approach. Liquidity procedures, in contrast, provide detail on executing the liquidity policy. An effective set of procedures, based on limit controls and other safeguards, constrains exposures, eliminate surprises and errors, and creates a valuable audit trail.

In practice, short and intermediate liquidity management is centered on the creation and use of tools that control asset, funding, and off-balance sheet exposures. Depending on the nature of the firm, its scope of operations, and approach to decentralization, controls may be applied on a consolidated basis, business unit/regional basis, and/or legal entity basis. Indeed, legal entity controls are vital when considering regulatory restrictions that may be applied to holding company activities, parent/subsidiary financing, and dividend/cash flow upstreaming; the liquidity relationships between cross-border, intragroup companies must be well understood or a firm might find itself in breach of local rules or susceptible to trapped funds.[2]

The LC must create a balance of controls: enough to cover the true sources of risk, but not so many that the resulting matrix becomes difficult to manage. In practice, firms may create overarching consolidated controls and then establish granular sublimits by business unit/region/legal entity. To illustrate the mechanics of the process we consider five general categories of controls under the broad umbrella of liquidity procedures:

- asset liquidity controls
- funding liquidity controls
- joint liquidity controls

- off-balance sheet liquidity controls
- other safeguards.

(These should be supplemented by a comprehensive crisis management/contingency funding plan, which we consider in the next chapter.)

Many of the controls we consider in this section are limit-based. Limits, which can be denominated in different forms (for example value or percentage), are useful in constraining different types of exposures in a manner that is consistent with a firm's liquidity risk mandate. Indeed, they are a transparent way of gauging and corralling liquidity exposures, and can be implemented with relative ease once measurement has taken place (and presuming data and technology infrastructure are robust enough to capture distinct elements of risk exposure).

Asset liquidity controls

A company can use a number of controls to manage its asset liquidity risk, including those that divide the balance sheet between liquid and fixed assets, those that restrict different elements of the liquid asset portfolio, and those that establish ceilings on the amount of assets that can be pledged to creditors at any time. Firms in capital-intensive industries have less flexibility in the amount of liquid assets they can maintain. The bulk of their productive assets must be allocated to sourcing, processing, or creating raw materials/finished goods; the remaining liquid assets must often be held in receivables and inventory, which, as we have already noted, are characterized by varying degrees of marketability. The control focus is therefore on ensuring enough high-quality liquidity in the remaining balance of assets on hand. Financial and non-financial service companies face the reverse situation: they hold a majority of assets in relatively more liquid form, suggesting they have a greater need to manage the liquid asset portfolio on a continuous, dynamic basis.

Liquid and fixed asset limits

At a broad level a company must ensure that it establishes a minimum holding of liquid assets and that it sets a cap on its fixed assets. Setting limits on liquid and fixed assets is likely to be a twofold process: reviewing historical experience through multiple business/economic cycles, then projecting what might be required over various future intervals. History can provide important information on the level of liquidity needed to manage a business under normal market conditions, and can demonstrate the effects of surplus or deficit liquidity. For example, a steel company

might find that it must hold 10 percent of its assets in cash, investments, and receivables, 20 percent in steel inventories, and 70 percent in plant and equipment in order to operate securely and profitably under normal market conditions. This is a relevant starting point in calibrating liquid/fixed asset limits. Since history cannot necessarily predict future events, the results of the stress tests discussed in the last chapter should be used to consider liquidity demands under various growth/contraction assumptions. These results might reveal instances where the historical liquid/fixed asset mix proves insufficient; proper adjustments can then be made, bearing in mind the liquidity risk/return trade-off we discussed in Part I. If, after running a variety of scenarios that factor in certain events related to environmental litigation or import tariffs, the steel company determines that it might face unexpected cash demands over the next 12 months that cannot be properly accommodated by its funding program, it may then alter the mix of its liquid versus fixed assets slightly – increasing cash/marketable securities investments and receivables from 10 percent to 15 percent, reducing inventories by 5 percent in response, and keeping constant its plant and equipment.

The same type of broad asset mix exercise can be performed for companies in other industries. The end goal, in all cases, should be guidance limits on overall asset composition related to potential sources of future liquidity. Again, this implies minimum amounts of liquid assets (including cash and receivables), a maximum amount of inventories (on the assumption that, although they are more liquid than plant and equipment, they are less liquid than cash and receivables), and a maximum amount of fixed plant and equipment.

Figure 9.2 provides an example of the fixed/liquid asset limit approach.

Liquid asset limits

The liquid asset portfolio, or liquidity warehouse, is the core of a firm's asset backup and must be constructed properly and managed carefully. A firm is well advised to place limits on maximum concentration, maturity, quality, complexity, and aging within the warehouse; this can help ensure appropriate balance under the risk/return framework and the firm's liquidity risk mandate, and reduce the likelihood of a cash flow deficit remaining uncovered. While the liquid asset portfolio is important for all firms, it is particularly critical for those relying on volatile, short-term wholesale funding sources that can be withdrawn quickly; an even greater focus must be placed on creating a liquidity portfolio that is readily convertible into cash.

- **Concentration:** we noted in Chapter 5 that concentrations can lead to liquidation problems: a large position can be more difficult to liquefy

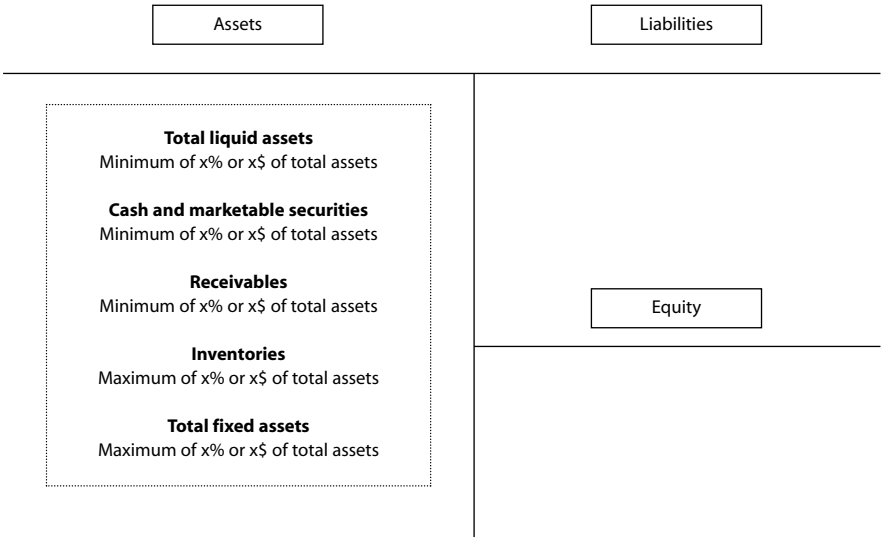

Figure 9.2 Fixed/liquid asset limits

at carrying value than a small position, all else being equal. Accordingly, the absolute size of any liquid asset held on the balance sheet should be capped. There are obviously exceptions to this rule: holding a large block of on-the-run Treasuries or benchmark gilts, for instance, is unlikely to create any meaningful liquidity-induced loss if the block needs to be sold or pledged quickly, so these should be accommodated in the limit process (either through specific exceptions or larger limits). In general, however, concentrations have to be avoided through limits that cap the maximum amount of an issue, issuer, or asset class at a particular value or percentage of the total liquidity portfolio (and overall balance sheet). For instance, a firm might establish maximum asset concentration limits of $100 million for any single high-grade corporate bond issue, $200 million for any conventional mortgage-backed security, and $1 billion for any on-the-run Treasury or gilt position. In developing appropriate limits it is important to consider that individual assets that appear to be independent and uncorrelated might actually become correlated in times of market stress. For example, a high-yield bond position and an emerging market bond position, which move independently during normal market conditions, might react in a similar fashion during a financial crisis; two previously acceptable positions might now become a single, concentrated, high-risk position, so due consideration must be given to this fact when setting limits.

- **Maturity:** asset maturities should be tightly controlled. Assets with short-term maturities provide a firm with more immediate access to

cash than those with long-term maturities (although they are prone to greater reinvestment risk and may also be lower-yielding). Converting long-term assets into cash might result in a larger discount to carrying value, leading to losses/shortfalls, so an appropriate weighting of short versus long-term maturities should be instituted. General limits can be set to cap the value and/or percentage amount of liquid assets in specific maturity buckets. For instance, a firm may set a minimum of 10 percent of assets maturing within 30 days, a further 20 percent within 60 days, 20 percent within 180 days, and a maximum of 50 percent maturing beyond 180 days. The process cannot, of course, be done in isolation: if a firm is attempting to create a matched operation in order to minimize liquidity risk, then asset maturities (or more accurate durations) must take account of liability maturities. Assets with an uncertain time horizon can obviously complicate the cash flow analysis by giving a potentially false picture of asset maturities, so care must be taken when tabulating maturity exposures.

- **Credit quality:** the quality of assets comprising the firm's liquid portfolio should be carefully considered. Since liquid assets must be readily available to convert into cash or pledge as collateral, it is prudent to cap the amount that can be held in sub-investment-grade instruments that have a higher degree of price volatility and greater probability of default. Thus, a firm may limit by value and/or percentage the portfolio of securities and receivables in the sub-investment-grade ratings category (and even within individual sub-investment-grade bands). For example, it may set a maximum of 10 percent of the liquid asset portfolio in credit obligations of BBB–/Baa3 issuers/customers, 5 percent for those rated BB+/Ba1, and 1 percent for any rated below that level. Although the risk/return trade-off surfaces once again (that is, holding a greater percentage of lower yielding/higher quality assets that are certain to provide a more stable liquidation value, versus higher yielding/lower quality instruments that might have questionable liquidation value), the conservative stance suggests tight limits should be placed on lower credit quality assets.

- **Complexity:** we know that asset marketability is important in managing liquidity. Assets that are simple and transparent can be valued with ease and typically have a broader base of buyers than those that are overly complex or opaque. Accordingly, limits on the value and/or percentage of complex assets that can be held in the liquid portfolio can prevent over-investment in contracts that might otherwise be too difficult to sell or pledge. For instance, a firm may limit to $100 million its holdings of assets it deems to be complex, such as structured notes or exotic collateralized mortgage obligations.

- **Aging:** every firm holding a portfolio of liquid assets for operating, investment, and liquidity purposes must ensure that the portfolio turns over regularly. When securities, investments, inventories, or receivables are not regularly being sold, renewed, replenished, or replaced, there is a significant chance that the assets are becoming illiquid. This might be the result of mispricing, changing market conditions, excessive complexity, or regulations, and calls into question carrying value. For instance, if a firm finds that receivables have historically turned over every 30 days but the horizon has gradually lengthened to 60 days, then its portfolio has become far less liquid (and might be the source of credit, pricing, and market problems). The same can be applied to securities inventories that fall within the liquid portion of the balance sheet. It is therefore important for a firm to limit and monitor the value and/or percentage of the asset portfolio aged beyond specific time horizons. For instance, a firm may choose to set limits of 5 percent of liquid assets in the 90 day-plus aging category and 2 percent in the 180 day-plus category. By doing so it ensures that management addresses instances where holding periods are lengthening.

In some cases it is useful to subdivide a liquidity warehouse into more granular portfolios that reflect specific liquidity risk and return characteristics. This approach preserves layers of liquidity while focusing on imperatives related to enterprise value maximization. For instance, a firm might create a liquidity warehouse with three subportfolios: portfolio 1, used for immediate cash needs and comprised exclusively of cash and near cash instruments with little or no yield; portfolio 2, a discretionary portfolio used to meet regular payments that cannot be covered by portfolio 1 (or other cheap funding), and comprised of very liquid assets with a low yield; and, portfolio 3, a stable portfolio to be used only for exceptional payments, and comprised of somewhat less liquid securities with higher yields. Each one of these can be governed by the limits described immediately above.

Figure 9.3 summarizes the limit structure within the liquid asset portfolio.

Collateral/pledging limits

Since pledging assets for cash is often preferable to outright disposal, a firm must avoid a situation where all of its assets have unknowingly been pledged in support of other funding facilities. A limit structure can cap the maximum amount of assets that can be pledged, per asset account, in support of funding. Any breach of these limits should serve as a warning

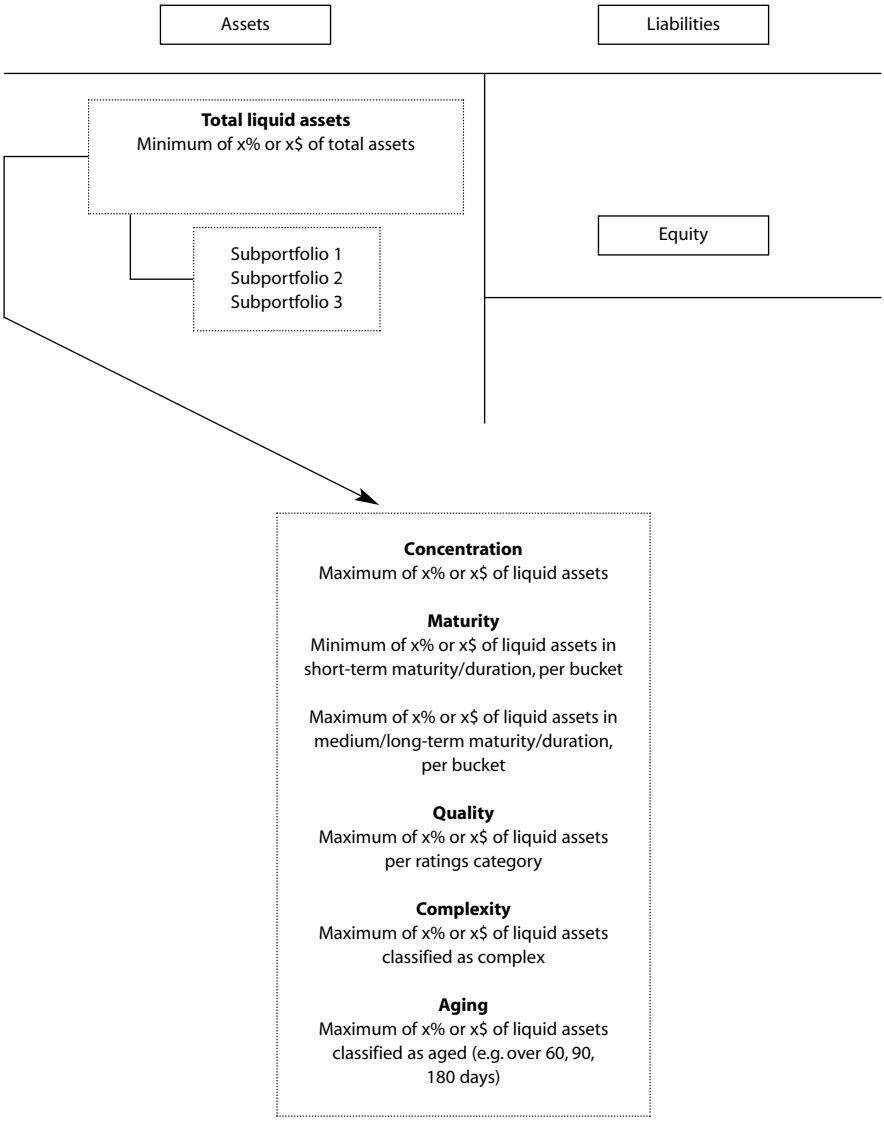

Figure 9.3 Liquid asset limits

signal that financial flexibility is declining rapidly, and broader problems related to unsecured funding access are at work. For instance, in order to ensure a sufficient liquidity buffer through future asset pledges, a company may limit its encumbered receivables to 40 percent of the total receivables portfolio, encumbered inventory to 50 percent, and encumbered plant and equipment to 70 percent. If the firm finds that it is pledging more assets to secure funding and is approaching any, or all, of its collateral/pledging limits, it should investigate the reasons as a matter of urgency.

Figure 9.4 summarizes the limit structure related to collateral and pledging.

Funding liquidity controls

A firm must control its funding profile closely in order to minimize the possibility of a funding liquidity loss. This is particularly true for firms that are very dependent on volatile short-term financing. Limits should be established to ensure proper funding diversification and commitment. As with assets, the funding profile is heavily dependent on the nature of the company and its operating industry: some firms rely more heavily on short-term funding, others on medium and long-term funding. Ideally, companies should strive for a mix of liabilities in order to maximize the number of options and achieve an optimal cost of funding. As we have noted, this becomes particularly important during times of market stress. For example, if the medium-term loan market closes down, a firm that has historically match-funded its capital assets with medium-term financing must be able to quickly seek alternatives from the short-term market. While the risk management effort might be more involved (for instance, having to hedge short-term liabilities with medium-term assets), the important point is that the company preserves access to some type of financing. *Ex ante* establishment of a range of facilities is thus a critical element of the management process, and can be driven by a structure that limits usage in any particular financing sector.

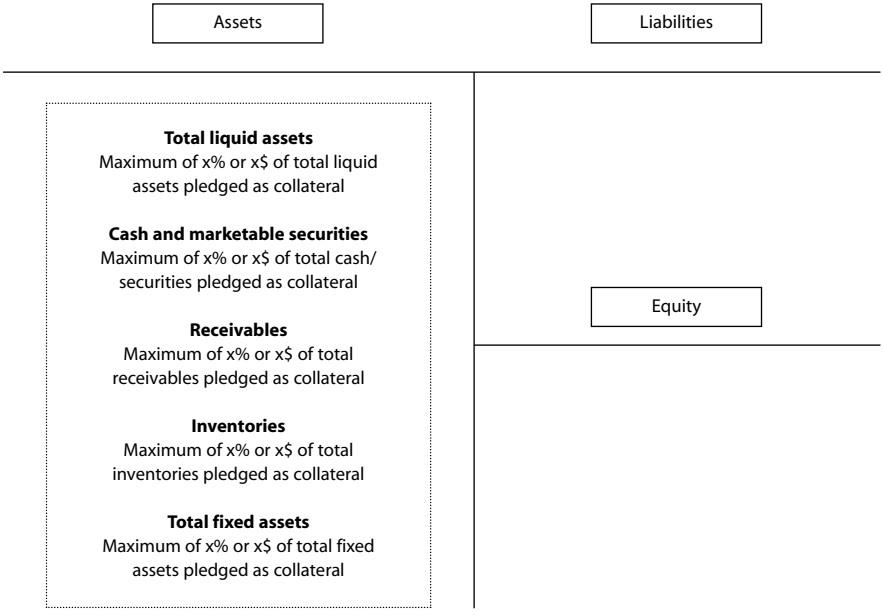

Figure 9.4 Collateral/pledging limits

Diversified funding limits

In order to create a balanced funding program that eliminates undue concentrations and over-reliance on single sources, a firm should create funding limits across markets, products, maturities, and lenders/investors. Naturally, the definition of what constitutes a funding concentration is likely to vary by institution, industry, and national system, and might be influenced by the corporate governance process or mandated by regulators.[3]

- **Markets:** the limit process can begin at a macro level through the establishment of maximum amounts that can be drawn from any broad marketplace, such as the CP, MTN, deposit, loan, or long-term offshore bond markets. Limits can be established in both value and percentage terms. For example, a firm may cap market access at $250 million from any single marketplace, or no more than 40 percent of liabilities from the US market, 30 percent from the Euro-markets, and so on. Where relevant, geographic/national market restrictions can be imposed; this can be useful for funding that is sourced from marketplaces where regulators might place controls, levies, or reserve requirements on non-domestic borrowers.
- **Products:** the value or percentage of the funding portfolio can be limited by product type – a more granular representation of the market limits above. For instance, a bank might cap CP/ECP financing at 10 percent of all funding, short-term interbank deposits at 20 percent, subordinated debentures at 30 percent, and so forth. Following the logic immediately above, this process ensures a firm does not become overly dependent on a single source of product-based funding, and decreases its vulnerability to financial loss should product-specific financing be suspended for a period of time.
- **Maturities:** the contractual maturity of liabilities must be constrained so that a firm does not face an excessive repayment or rollover burden. As noted above, limits on funding maturities (durations) should not be considered in isolation from those set for asset maturities; a firm trying to match-fund a significant portion of its balance sheet must consider the two elements jointly. Where possible, however, it is critical that maturities be properly dispersed across a reasonably wide maturity horizon, with an appropriate mix of short, medium and long-term funds. For instance, a firm may set a maximum of 10 percent of funding on an overnight basis and 10 percent up to one week, and a minimum of 30 percent from one week to one month, 30 percent from one month to two months, and 20 percent beyond two months.

Care must also be taken to consider the behavioral and contractual maturities of the liabilities. This can be a complex task, and is generally only possible with direct experience on how investors and lenders behave regarding rollovers, extensions or callability/putability. There is no precise way to determine, for instance, whether a short-term investor base will continue to rollover its CP, ECP, or overnight repos, or whether holders of insurance liabilities with short-term put features will exercise their options. When doubts exist, the preferred route is to assume a conservative stance. Firms should always limit funding structures with embedded options that give investors or creditors the right to call away their capital at short notice. In addition, maturities on optionable funds must be appropriately staggered; while a putable feature increases funding liquidity risk, the severity of that liquidity risk depends on whether all of the puts are exercisable at a given time horizon (for instance, seven days from exercise) or whether they can be spread out (say, 7, 30, 60, 90 days). Staggering reduces the specter of a sudden funding withdrawal.[4]

- **Lenders/Investors:** the diversified funding program must take account of the number and quality of lenders/investors providing financing. A company must again limit the amount it draws from any single lender or investor, minimizing its reliance on any institution that may be unwilling or unable to supply funds at some future point. For instance, a firm may cap at 5 percent all funding derived from a single CP/ECP investor, 10 percent from any single commercial bank, and so forth.

  When considering maximum value or percentage limits it is important to take account of correlations between the firm and lenders/investors that might appear during times of market stress: if the firm is relying on a small number of institutions for liquidity, and those institutions are exposed to the same exogenous factors that might cause the firm to demand liquidity, the supply of funds might not be available when required.

  Apart from limiting exposure to name-specific lenders/investors, it is prudent to limit participation by broad credit rating, with value or amount that decreases as credit quality declines; this helps protect the firm from becoming overly exposed to borderline investment-grade or sub-investment-grade institutions that might be unable to provide capital if they encounter financial difficulties of their own.

  It is worth noting that while lender diversification limits are important, a firm must still try to deal with a "manageable" number of institutions. This is important in the event the firm encounters financial difficulties and must restructure the financing relationship. For instance, a firm wants to avoid renegotiating terms with dozens of

banks that form part of a diversified syndicate; it is far better if it can deal with a relatively small number and reach agreement on new terms more rapidly. Lender diversification is thus a balancing act; a compromise solution can be achieved by incorporating a reasonably large number of banks under a single master credit agreement (presuming "unanimous consent" clauses in the agreement can be minimized).

Figure 9.5 summarizes diversified funding limits.

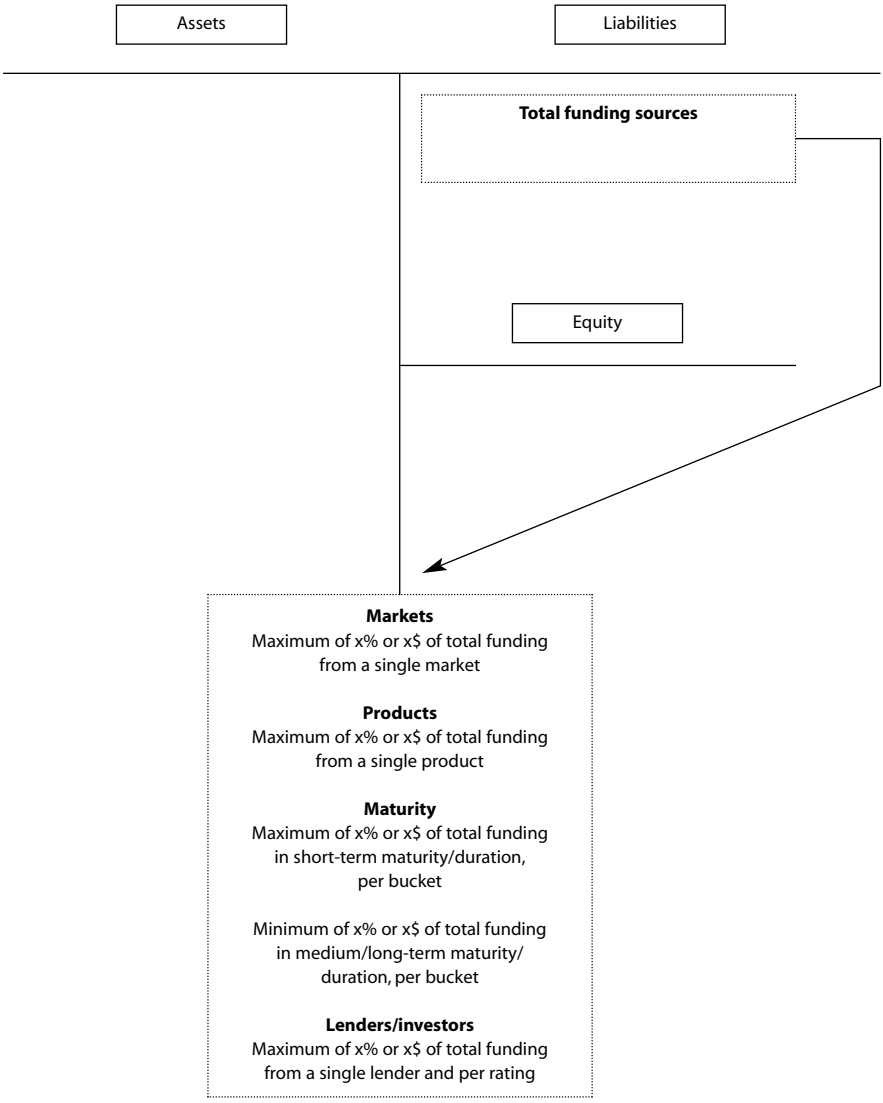

Figure 9.5 Diversified funding limits

Committed facility limits

Limits that constrain the type of contingent funding commitment drawn from the loan markets represent another form of control. It is essential for a firm relying on bank lines to be confident that facilities will be available precisely when they are needed; this means explicitly limiting or minimizing those that might not be available under all market circumstances. Note that this type of control can more accurately be considered a hybrid of on-balance sheet funding and off-balance sheet contingent financing, as it is dependent on whether or not facilities have already been partially or fully drawn; we discuss the matter in this section for continuity.

- **Advised facilities:** recalling our discussion on theoretical and actual sources of liquidity, the conservative view assumes advised facilities will be withdrawn at the first instance of internal or external difficulty, meaning a source of funding will be lost. Maximum value and percentage limits should therefore be applied to any facility that is considered to be advised, for which no commitment fee has been paid by the firm to the lender(s), and which is not governed by a formal credit agreement. In practice a firm should severely limit the amount of funding it obtains from advised facilities, and be prepared to discount availability entirely in turbulent times.
- **Committed facilities:** these, for which a firm pays standby and usage fees, and which are governed by credit agreements, are far more robust and reliable than advised facilities. Accordingly, a greater amount of a firm's diversified loan program should be based on such lines. That said, the nature of the commitment must still be analyzed as some limits may be required. For instance, some commitments are subject to the fulfillment of positive and/or negative covenants. A borrowing firm might be required to maintain certain minimum financial ratios, or agree not to engage in certain activities, in order to preserve its right to borrow under a facility. Some of these covenants are prudent and intended to protect both parties. However, a firm should cap the maximum amount of draw-down when covenants are too restrictive or conservative. If there is a significant likelihood that the covenants will be breached when the firm is experiencing financial pressure – precisely when it might require access to liquidity – the lender might withdraw the facility, compounding pressures. When financial covenants are less restrictive, and are unlikely to be breached even under difficult times, a firm can have greater confidence that the facility will remain intact, ready for draw-down when needed – and thus increase its percentage allocation under the funding program.

The same approach should apply when considering material adverse change (MAC) clauses; if a facility contains "market-outs" that can be interpreted very liberally by the lender, tighter limits should be imposed. Conversely, when a MAC is defined very precisely and limited to the onset of truly materially adverse conditions (that is, it is an "escape-proof MAC"), greater allocation can be considered.

It is important to stress that financial covenants and MACs can quickly magnify a small problem, so due care must be taken when considering contractual language and the possible effect on liquidity access.[5] Note that similar covenants and ratio tests are periodically included in public debt offerings, meaning the same guidelines should be applied. (That is, if a covenant or ratio is breached the company, as issuer of the securities, might be forced to redeem the bond, or commence or accelerate payments into a sinking fund.)

Figure 9.6 summarizes committed facility limits.

Joint liquidity controls

While individual control of asset and funding risks is essential, it is equally important for a firm to control the risks arising from a combined view of the two. In practice this can be accomplished by setting limits related to cash flow gaps, overall balance sheet targets, and hybrid ratios.

Cash flow gap limits

In the last chapter we considered cash flow gaps arising from asset and liability mismatches (as well as those generated by off-balance sheet activities). By dissecting corporate cash inflows and outflows over discrete time horizons, or through more intricate measures such as duration or probability-based statistical analyses, a firm determines whether it will face an NFR surplus or deficit. Establishing gap limits reduces the chance that a firm will have an NFR deficit that it cannot adequately meet. From a practical perspective a firm can compute its NFR gap in a manner of its choosing, and then set maximum limits per discrete time/duration horizon, along with a cumulative limit for a given block of time/duration. The most relevant time/duration horizons are likely to cover the overnight to one-month period – thereafter a firm might have enough ability to reshape elements of its cash flow profile to rely solely on monthly or quarterly limits.

Consider, for instance, a company with reasonable access to funding through its backup facilities and liquidity warehouse. It may feel comfortable that it can quickly draw down $200 million, and therefore sets its NFR gap from balance sheet and off-balance sheet items at $50 million on any

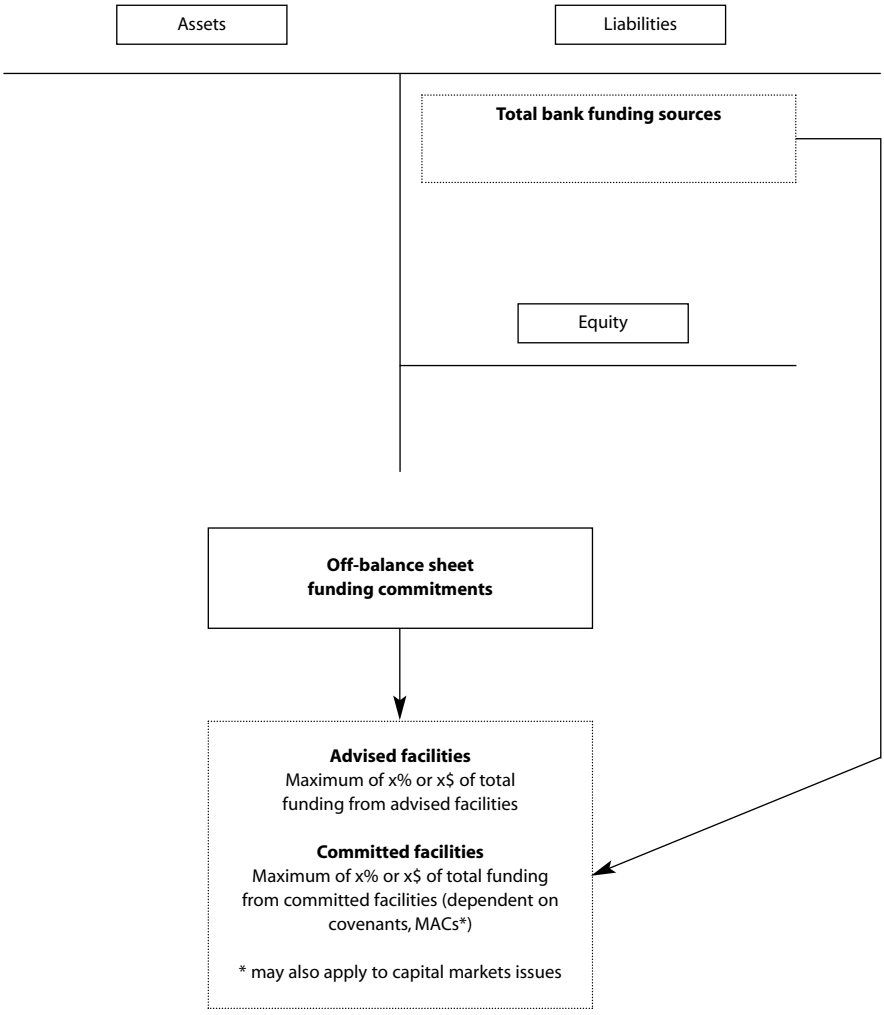

Figure 9.6 Committed facility limits

given day and $150 million for a cumulative one-week period. Similarly, a financial institution that uses duration-based RSAs and RSLs to compute rate gaps and plan interest-rate risk and business origination strategies can set individual maximum net open gap limits by bucket, such as $50 million per day for the next month. By utilizing these gap measures in conjunction with the other asset and funding mechanisms mentioned above, a firm controls the joint interaction of cash inflows and outflows from its assets, liabilities, and off-balance sheet contingencies.

Naturally, other cash flow gap limits can be considered, such as maximum overnight funding limits (to minimize the need to seek emergency funds through regulatory channels) and foreign currency gap limits (to

minimize the risk of being unable to properly fund offshore operations without assuming significant foreign exchange exposure).[6] A firm should carefully evaluate the nature of its operations to determine whether other types of limits are necessary.

It is important to re-emphasize that cash flow limits are likely to be a reasonable, though not perfect, constraint on exposures; we have already noted that unexpected cash flows arising at a future time are one of the key causes of liquidity problems. However, by establishing gap limits with some buffer to allow for a certain amount of unexpected change, a firm can deal with a broad range of likely outcomes.

Balance sheet target limits

Joint asset and funding risks can also be controlled through balance sheet target limits, which cap the amount and speed of balance sheet growth and help ensure that business opportunities do not outpace a firm's ability to properly fund them. Without such controls a firm that is expanding rapidly through organic growth or acquisition might find that it has not appropriately considered its funding needs, and the leverage it has used for expansion purposes is not calibrated with the liquidity profile of the assets being funded. For instance, a company with $100 million in fixed assets and $100 million in liquid assets, funded with $150 million of long-term debt and $50 million of equity, might have an opportunity to buy a competitor or enter into a large investment project that will add $100 million in fixed assets. The firm may simply issue $100 million of CP to fund the expansion, leaving it with a significant increase in leverage, a large funding mismatch, and a far less liquid asset portfolio; each of these could add to liquidity pressures. By establishing broad controls on total assets, total debt, and total liabilities, a firm restricts the amount of expansion that can occur without a thorough, *ex ante* evaluation of financing and liquidity alternatives.

Hybrid ratio limits

A firm can also consider using hybrid ratios to control aspects of liquidity risk. These limits include a mix of balance sheet, off-balance sheet, cash flow, and/or income statement accounts, and are a combination of stock and flow measures. For instance, a firm may wish to ensure that it has adequate coverage of short-term obligations coming due, and can set a limit based on the following ratio: cash, haircut value of unencumbered securities, and the unsecured portion of unused, committed lines, divided by unsecured debt due within 12 months. The ratio must remain above a minimum level at all times; if it does not, then its coverage of short-term

liabilities is weakening and should prompt management to take corrective action.

Alternatively, a firm may wish to establish a minimum defensive interval of one month without tapping new sources of funding, and might establish the following limit: cash inflows from all sources during the month and haircut value of unencumbered securities, divided by cash outflows from all sources during the month. Again, the ratio must remain above a specified level, and if it weakens management must be prepared to take corrective action. Similar types of hybrid ratios, including those tailored to specific industries, can be developed to limit exposures.

Off-balance sheet controls

Since off-balance sheet items can impact cash inflows and outflows, sometimes dramatically, they must be properly constrained. In practice this can be done through limits on forward commitments and contingencies. As already noted, off-balance sheet funding contingencies that generate cash through draw-down (such as advised or committed bank lines) are described in the funding section above.

Forward commitments and contingencies

Cash flows from derivatives, loan participations, revolving credit agreements, letters of credit, leases, recourse facilities, and guarantees supply and absorb cash, and must therefore be explicitly controlled. Though cash flows might be certain or uncertain (for instance, a true contingency that might or might not come to pass at some future time), the conservative approach caps, by future period, any net cash outflows that might require funding. Such limits control the amount and speed of off-balance sheet growth, and help ensure that contingencies do not outpace the firm's ability to properly fund them. In fact, this is consistent with the balance sheet target limits described above, but applicable specifically to the gross amount of contracts with uncertain timing and value that might create cash outflows or require funding.

The same need not necessarily apply to net cash inflows, unless they are intended to fund another future obligation (that is, if the contingent cash inflow does not occur but the future obligation must still be funded, the firm will have to seek alternate sources of financing). Since this approach involves establishing limits on contingent cash inflows and outflows it can be viewed as a stressed scenario limit framework that assumes the worst case will occur. In addition to limiting the absolute amount of contingent exposure over various future time horizons, the structure should control concentrations and credit quality, as in the

discussion above. These may be denominated in value or percentage terms.

Figure 9.7 summarizes the limit structure for forward commitments and contingencies.

We have presented a matrix of limits that can be used to control different aspects of liquidity risk in a manner that is consistent with the board-directed liquidity risk mandate. As we have indicated, these limits must be linked to the company's desire and ability to absorb liquidity-induced losses of a given magnitude. In practice, however, they should be considered limits rather than absolute ceilings. In the normal course of affairs a company will find opportunities to engage in incremental business that might add risk and breach previously agreed limits. A strict reading of policy and procedure might suggest this is unacceptable. In reality exceptions can, and should, be accommodated to take advantage of worthwhile ventures, including those that are consistent with the firm's business focus, and where the returns adequately compensate for any risks assumed. The LC should create sufficient flexibility within the limit process to handle temporary exceptions; exception procedures must, of course, be well understood and diligently applied. In addition, exceptions must be temporary in nature, and infrequent in occurrence. A limited number of exceptions should be granted for defined periods; a semi-permanent excess is a sign of flawed risk management that might eventually lead to serious problems. In fact,

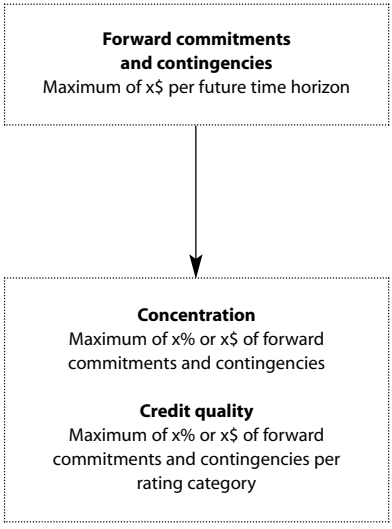

Figure 9.7 Diversified funding limits

exceptions can serve as important "early warning" indicators: if a company has established prudent and realistic limits that allow it to handle the liquidity risks of its business under normal conditions and then exceeds them with increasing frequency, it might be experiencing a subtle, though growing, liquidity problem. The LC should analyze the nature, reasons, and trends to determine whether protective action needs to be taken.

An associated point suggests that limits must be effective in constraining a firm's risk, regardless of the amount of financial resources available. If limits are too large, they will fail to constrain a firm's exposures properly; when they are smaller and exceeded from time to time (with prior approval), they increase awareness and elevate discussion.

Other safeguards

In addition to the formal matrix of limits presented above, firms can use other tools to manage their liquidity exposures. Some of the most useful are reserves, mark and model verification, penalties, and external relationship management.

Reserves

Firms often establish *ex ante* reserves in order to cover possible surprises from financial and operating risks. This is considered prudent behavior, as no firm can be completely certain that it has accounted properly for all of the financial, operational, legal, and regulatory variables that impact business. Establishing reserves by reallocating a portion of current earnings allows a firm to build a buffer against unexpected cash flows. In most jurisdictions additions to reserves must follow strict accounting rules that dictate when funds can be reallocated or released in support of a particular loss or cash outflow. By enforcing such rules, authorities attempt to minimize instances of financial "smoothing" or earnings manipulation. Some jurisdictions follow a more liberal approach and permit the establishment of hidden reserves through undervaluation of assets; these are not necessarily identifiable on the balance sheet, so their existence and use may be uncertain. Reserves can therefore be viewed as pre-loss financing to cover an unexpected cash flow, an expected future liability, or a shortfall arising from an asset disposal. Rather than having to secure specific funding for the eventuality, the reserves can be funded in advance of actual need and drawn down as required. However, they must be considered a relatively small part of total funding or cash-generating requirements; accounting rules do not generally permit a company to reserve excessively for contingent events.

Mark and model verification

Ensuring that balance sheet and off-balance sheet items reflect correct economic value is another important aspect of the liquidity control process. There is little point in creating a limit framework based on the amount of cash that can be generated through assets or contingencies if the assigned values are not accurate. For instance, the firm that values its portfolio of investment securities at $100 million when they are actually worth $90 million, or the unencumbered factory at $1 billion when it is actually worth $800 million, is creating a false picture of its access to liquidity. Accordingly, management, working through the LC, internal accountants, and external auditors, must enforce proper valuation of all assets and contingencies, and thoroughly question any discrepancies. This exercise is particularly critical for any contract that lacks a transparent market (such as certain derivatives, structured notes, and securitizations). All models used to value complex risks or portfolios must be independently vetted and benchmarked before being employed in the valuation process; this can help minimize instances of error.

We re-emphasize a caveat presented in the last chapter: due care must be taken when using models to measure, value, and manage liquidity risks. Although good models are helpful tools, false comfort must not be derived from a process that is likely to be imperfect, and subject to instability and change in the face of stress. Care must also be taken regarding supervisory approval for models. While banking regulators often review and approve market and credit risk models – and, by extension, the embedded liquidity risks – such approval cannot be taken as a sign that all is well. Flawed models – coupled with inexperience, positive feedback trading cycles, and systemic risks – can exacerbate liquidity pressures.

Penalties

Behaviors can be shaped through the use of incentives and penalties. Incentives are well established in the corporate world: businesses and managers that exceed their revenue targets and performance goals are rewarded through higher compensation and ancillary benefits. Penalties are not necessarily as common, but they can be extremely useful in helping a firm achieve a particular set of goals, such as the preservation of adequate liquidity. By creating well designed and specifically targeted penalties, executives motivate managers to help the firm protect its liquidity.

For instance, we have noted that the amount of aged securities held for resale on a bank's balance sheet must be minimized. Portfolios of securities that cannot be sold at, or near, carrying value for 60 or 90 days are

clearly not valued correctly; those that are not being resold must be marked down to the clearing level and sold, or should attract aging penalties. A bank discovering that a portfolio of supposedly liquid securities remains on its books after 90 days can levy on the management team responsible for the position a charge equal to a certain percentage of the outstanding balance; the charge detracts from that business unit's revenues, and will result in lower year-end compensation for those responsible for managing the unit. Once sold, any aging charges that have been accumulated can be credited back to the unit. Through this process managers have incentives to find proper clearing levels for the assets (or create mechanisms, such as securitizations, to sell the assets).

Similar penalties can be applied to corporate trade receivables that are constantly lengthening and are not being actively collected, or off-balance sheet financial contracts that absorb too much "emergency" funding as a result of improper coordination between originators and the treasury/funding department. Naturally, if penalties are to be effective financial controllers responsible for tracking assets must be diligent about the process, and management must be strict in enforcing discipline.

External relationship management

While the management controls we have cited immediately above relate exclusively to the manner in which a firm handles its internal operations, external relationships are another important element of control. Since micro funding needs and the macro funding environment change continuously, a firm must make certain that it evaluates its funding program and makes relevant adjustments. It should develop new financing relationships in order to create future flexibility. Perhaps more importantly, it should remain constructive in its relationships with current lenders and investors. A firm has to have strong communications with its key stakeholders, including debt investors, lenders, equity investors, and regulators. By ensuring that these relationships are mutually beneficial and productive, a firm increases its ability to source funds on favorable terms when it needs them, and gains the confidence of the regulatory community. Lenders and debt investors, in particular, must feel that the firm is in command of its financial risks generally (and liquidity risks specifically). The firm that neglects these stakeholders might ultimately find that its funding access is curtailed during difficult times. Managing these relationships closely in good times is thus a prudent form of "qualitative" risk control.

Figure 9.8 summarizes the firm-wide liquidity risk controls we have described above.

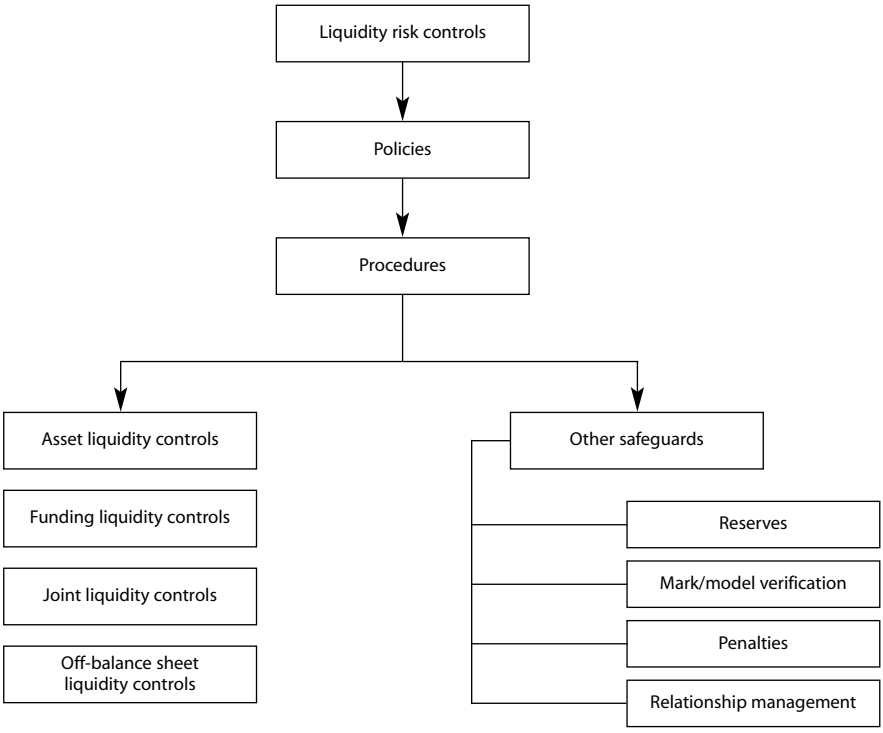

Figure 9.8 Liquidity risk controls

LIQUIDITY RISK MONITORING

Active management of liquidity through the framework of controls presented above is only possible with proper monitoring capabilities. Indeed, there is little point in attempting to manage liquidity risk if no mechanism exists by which to monitor and report on the results. The monitoring process, which depends heavily on proper technical capabilities, should focus on asset and funding portfolios, off-balance sheet contingencies, the forward balance sheet, stress scenarios, and general indicators; where relevant, information and data should be compared against any limits that have been established.

Asset and funding portfolios

Monitoring liquidity risk in the asset portfolios requires detailed information on:

- the maturity profile of assets, especially those coming due over the critical 1 to 30 day period (in value amounts)

- large or concentrated positions (value and percentage of assets)
- aged positions (value and percentage)
- "problem" assets (such as uncollectible receivables, bad loans, other non-performing assets) (value and percentage)
- unencumbered assets (value and percentage)
- encumbered assets (value and percentage).

Monitoring in the funding portfolios centers on:

- the maturity profile of liabilities, particularly those coming due over the critical one month period (value)
- committed, undrawn credit facilities (value and percentage of funding)
- large and concentrated funding positions (by market, product, lender, region) (value and percentage)
- status of trigger events (such as leverage, working capital, net tangible asset covenants) that could lead to cancellation of facilities
- status of accounts payable terms
- spreads on short-term funding instruments (such as CP, ECP, and deposits).

The two broad portfolios should also be reviewed and monitored in a combined manner. Joint review of asset and funding portfolios (for instance via gaps or NFRs) can reveal the existence of mismatches (related either to cash inflows/outflows or maturity/duration variations). Other portfolio measures, such as VAR and LAVAR, should be reviewed when relevant. The asset and funding positions of the firm should be monitored on a regional, business unit, legal entity, and consolidated basis; this will provide information on whether sufficient cash flows exist within regions and entities, or whether any concerns exist regarding blocked funds or upstreaming/downstreaming. Where relevant the reported values should be compared against limits that have been established by the LC.

Off-balance sheet commitments and contingencies

Off-balance sheet items must be monitored carefully, particularly liabilities that might require future funding; since the contracts do not appear on the balance sheet, are unpredictable with regard to value and timing, and can

be difficult to interpret, there is a risk that future liquidity demands might be overlooked, leading to one of the cash flow surprises we referenced in Part I. Monitoring should be detailed enough to reveal cash inflows and cash outflows arising from:

- option exercises and other derivative contract settlements
- revolving credit draw-downs
- lease payments/cancellations
- guarantee and standby letter of credit receipts or payments
- contingent receipts or payments (including recourse participations).

Forward balance sheet

Although monitoring the forward balance sheet is a mix of actual, probable, and unlikely, it can reveal important information about future cash inflows and outflows. The construction of the forward balance sheet is based on assumptions regarding events that might or might not occur, meaning different degrees of conservatism may be applied. For instance, reporting may include scenarios that depict cash flows and balance sheet items based on 100 percent, 75 percent, 50 percent, and 25 percent probability of exercise, draw-down, or triggering of the contingent event. Alternatively, a firm may choose to segregate contracts that are certain to come into effect at some future point (that is, 100 percent probability), then weight all remaining contracts against an estimated market-driven likelihood of occurrence. In either case, the range of probability-driven scenarios provides a sense of the possible impact on firm-wide liquidity, and must be monitored.

Stress scenarios

Monitoring stress scenarios is the practical end-result of a measurement process that helps a firm prepare for a catastrophic event. A regular (that is, monthly or quarterly) creation of predefined stress scenarios, such as those described in the last chapter, can help reveal whether a firm's liquidity profile grows more robust or fragile with the onset of improbable, though not impossible, events. Crystallizing such information through standard reporting allows the LC and management to take defensive action where necessary. As with forward balance sheet reporting, stress scenario reporting is based on a set of assumptions that might or might not occur. Despite the uncertainty, the nature of the firm's liquidity profile under a stress event must be part of the monitoring process.

It is worth noting that construction of a forward balance sheet for monitoring purposes is different from creating one for stress scenario purposes. The former is a probability-weighted cash flow analysis, under normal market conditions, of transactions that are contractually in place (such as the draw-down of an existing credit facility, the consummation of the sale of certain assets, or the exercise of a purchased or sold option). The latter is a cash flow impact analysis of very extreme market scenarios. The two tools are complementary, but unique in the information that they convey. In particular, the stress scenario results are typically based on low probability "disaster" events (such as a repeat of a 1998 market dislocation, placement of currency convertibility controls in an important local marketplace, freezing of capital within a country, destruction of a plant that is not adequately covered by insurance, severe credit downgrade by the rating agencies, or regulatory changes prohibiting a legal entity from upstreaming cash to the parent); results must therefore be used and interpreted with caution.

General indicators

While many of the items we have discussed above form the core of a liquidity monitoring process, certain other financial and anecdotal market indicators can also reveal important liquidity information. A regular process of monitoring such indicators can be good corporate practice, and might even provide the additional reaction time that is essential in attempting to manage through a liquidity crunch.

- **Growth in risk:** a firm that is becoming riskier in its operations (whether from financial or operating risk) might be increasing its illiquidity should events move against it. For instance, the bank or company that assumes more market risk or credit risk might suffer greater losses in the event of volatility or default, and the losses might create additional cash flow pressures.
- **Decline in asset quality:** for financial institutions in particular, a marked decline in asset quality (measurable through past due loans, non-accrual loans, and other non-performing assets) might signal the need for greater credit reserves. The lack of income/cash flow from loan arrangements, together with any increase in reserves, can squeeze available liquidity. The same might be true, albeit to a lesser degree, with corporate receivables.
- **Rapid growth in assets:** while most firms seek to expand their assets steadily in order to support increased production, a sharp spike in asset growth, particularly when it must be funded through short-term liabilities, can create liquidity pressures.

- **Erosion of revenues/earnings:** a firm that is consistently earning less than it projects, or that suffers outright losses, is no longer generating the cash flows it needs to fund operations. This can increase the demand on the funding program and decrease the amount of financing available for future needs.
- **Financial terms/relationships:** the financial terms and relationships a firm maintains with its creditors, suppliers, and investors must always be monitored for signs of change. Any deterioration in dealing terms can signal potential problems and must be addressed as a matter of priority. These can include changes in bank credit and/or trade/supplier terms (such as new security/collateral requirements, smaller facility/deal size, shorter maturities, higher fees or rates), a decrease in correspondent bank relationships, a shrinking of the investor base in short-term liabilities, and so forth.
- **Increased withdrawals of short-term funds:** any instance where a firm's traditional short-term funding sources are withdrawn through explicit cancellation, early redemption, or lack of rollover must be treated very seriously. Although such withdrawals might be institution-specific or industry-wide, the ultimate impact is generally the same: increased short-term funding pressures.
- **Market news/rumors:** in an age where information circulates freely and rapidly, a firm must monitor market-moving news and rumors. Any information that reflects negatively on the company or its financial position must be addressed without hesitation (as we shall note in the next chapter); failure to do so can lead to a rapid escalation of problems, such as funding withdrawal or lack of rollovers.
- **Financial market measures:** aspects of every public firm can be measured and monitored in the marketplace for change. This includes sensitive indicators such as credit rating watch status, credit spreads, and stock price. If a firm's financial market measures are trending in a negative direction (for instance, falling stock price or widening credit spreads), the reasons must be ascertained as quickly as possible and defensive action should be considered. Steadily weakening financial market measures, whether or not they accurately reflect a firm's operating state, can fuel negative press and generate market rumors; these, as we have already noted, can lead to the withdrawal of liquidity.

Monitoring goals

Monitoring of assets, funding, joint cash flows, off-balance sheet commitments, forward balance sheet, and stress tests should reflect point-in-time

snapshots to provide a current picture of liquidity status. These snapshots must be supplemented by trend information so that management can determine whether the firm is becoming more or less liquid over time. Information must also be specifically linked back to limits and the liquidity risk mandate, to ensure that the firm's philosophy is being followed and resources are being allocated properly. This is an essential part of the "feedback loop" and informs directors and executives about the efficacy of the mandate.

The end result in any reporting endeavor should be the communication of relevant and actionable information to directors, executives, and senior finance, risk management, and business management professionals with direct or indirect responsibility for generating or mitigating liquidity risks. Information should reflect legal, business unit, and regional views to accommodate the needs of multiple users from a single source of data. The LC should take a leading role in designing information mechanisms and ensuring that the information generated becomes the basis for meaningful dialog and action. The degree of reporting frequency and information granularity is likely to be institution and function-specific; in general, however, the LC should keep directors apprised of the firm's liquidity profile, changes, and trends on a quarterly basis. Senior executives should be advised at least monthly, and more often as market circumstances warrant. Risk, finance, and business executives must review reports on a daily basis to ensure continuous scrutiny of what will undoubtedly be a dynamically changing picture of cash flows.

Similar information must be provided to regulators and other key stakeholders (such as shareholders (via the annual and interim financial reports), lending banks, and rating agencies).[7] Information such as the status and availability of committed credit facilities, the construction of the liquidity warehouse, and the state of key ratio measures (and associated compliance with any minimum requirements) can be of use to stakeholders and should be conveyed on a timely basis. Indeed, the firm that is willing to distribute more information builds stronger stakeholder relationships. Figure 9.9 summarizes the spectrum of liquidity monitoring that a firm may consider in its operations.

Technical capabilities

Monitoring and reporting of liquidity risks is only possible in the large organization with the proper technological infrastructure. Liquidity risks that can appear across business, product, legal, and/or geographic divisions must be captured within a robust data management and technology environment. This demands a uniform mechanism for the collection and aggregation of data, along with the ability to use that information to

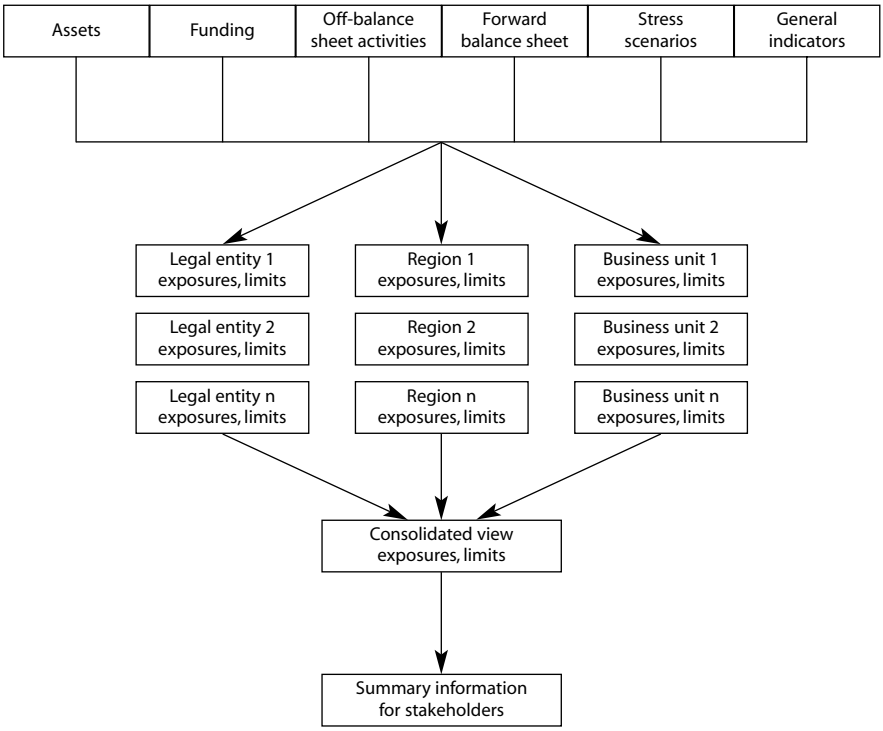

Figure 9.9 Dimensions of liquidity monitoring

measure risks and project stress scenarios. Specific modules are needed to report on ledger balances, fails, contract settlements, cash inflows and outflows, loans, placements, and other funding activity.

Technical capabilities must be sufficient to produce quality information in a timely manner. Executives using the information to manage the firm must have confidence in the integrity of the results, and must be able to access the data quickly. This is particularly true in a crisis situation – a firm's leadership cannot afford to discover that key information is missing from the reporting process, or that the aggregation of data is delayed. Investment in the technology that permits effective reporting must be considered a worthwhile use of corporate resources, as it may help avoid more serious problems in the future; this is particularly true in instances involving crisis management, as we discuss in the next chapter.

CHAPTER 10

Liquidity Crisis Management

A firm operating under normal market circumstances will be able to rely on its mandate, policies, and limits to control the liquidity exposures inherent in its business. If these mechanisms are structured properly and followed diligently, the financial impact of the exposures should remain manageable. However, there may still be instances when endogenous or exogenous factors overwhelm the firm, giving rise to the possibility of greater financial problems and even instances of financial distress. In such extraordinary cases a firm must immediately implement a liquidity crisis management program. A successful program allows a company to move beyond the crisis stage and normalize its operations at a minimum of cost; an unsuccessful program – or indeed the lack of any program at all – can lead to complications, including liquidity spirals and insolvency. In this chapter we consider the scope and focus of liquidity crisis management, *ex ante* market access, defensive measures, communications, trigger events, disaster recovery, and plan testing.

SCOPE AND FOCUS

Although liquidity crisis management is institution-specific, crisis programs typically have the same end goals: ensuring sufficiency of cash, and limiting reputational and economic damage so that operations can be normalized as quickly as possible. A crisis program formalizes a firm's objectives with regard to sourcing, managing, and maintaining liquid assets and funding during a stress period. In most cases this can be accomplished by focusing on three broad areas:

- *ex ante* market access
- defensive measures
- communications.

We consider each of these, independently and in light of general disaster recovery and contingency plan testing, at greater length below. Before doing so, however, it is important to review overarching scope and focus.

A crisis management program should serve to protect a company during difficult times. The essential point is for the firm to create and preserve enough cash to continue operations; prioritizing actions and modifying behaviors can help accomplish this goal. Accordingly, a proper program must be developed in advance of any dislocation; simply reacting to a crisis on an ad hoc basis as events unfold is unlikely to be successful. Although a crisis plan is generally driven from the top down and is a reflection of a firm's consolidated liquidity needs, there are instances when separate plans have to be created for individual operating units in order to deal with specific needs, issues, and restrictions. If this is necessary, plans must still be properly coordinated; we have already noted that the liquidity position of one unit might have a significant impact on that of another unit, so coordination is vital.

Executives must drive the crisis management process as a priority – both in the development stage and in actual implementation. Directors and executives must lead the way in creating a plan, and should be ready to activate it when advised by senior financial officers. Once in motion it must become the focus of their efforts, as survival of the company might depend on whether they handle matters decisively. As we shall note later, the program should be thoroughly tested in advance of use. Indeed, such "dress rehearsals" should be a matter of regular review to ensure that all processes function as intended and all variables related to market access, defensive measures, and communications remain relevant. Testing should be comprehensive and include drawing down on backup revolving credit facilities, selling a portion of the liquidity warehouse, entering the repurchase agreement market, issuing a tranche of long-term notes from an MTN program, and so forth.

Effective crisis management relies heavily on clear "command and control." In normal operating conditions many managers are likely to be part of the liquidity risk management process, each contributing experience and expertise and enjoying a certain amount of authority. This is especially true for firms that opt for a decentralized risk management process. During the crisis management period much of this delegated authority should be redirected towards a very small team that can keep tight control of the process and guide human and financial resources as needed. In practice, a firm may find it beneficial to concentrate authority in a liquidity crisis management team (LCMT), comprised of the:

- CEO or COO
- CFO

- treasurer
- head of risk management
- head of operations/settlements
- Liquidity Committee (LC, that is, the professionals responsible for the ongoing management of the company's liquidity profile, as noted in the last chapter).

This small team should be able to convene quickly, and coordinate all necessary actions. Indeed, the LCMT must be prepared to put in motion a time-sensitive plan that addresses, in order of priority, the specific tasks that need to be performed: those that must be completed within 24 and 48 hours, those that must be in place within one and two weeks, and so forth. As part of the command and control chain a policy of temporary recentralization, discussed below, should be enacted.

A key element of the plan centers on financing alternatives. In order to fulfill the primary goal of cash sufficiency the LCMT, through the treasury and finance groups, must be aware of the firm's short and medium-term cash flows, and how these can be accommodated during the crisis period. Indeed, we indicated in Chapter 8 that cash flows should be stress tested to see how they change during a crisis period; this is especially critical when optionable or cancelable liabilities form part of the funding plan (while this involves assumptions about the behavior of trade credit suppliers, investors, depositors, or lenders, "worst case" behavioral changes are often a worthwhile starting point in the analysis exercise). Stress testing should also incorporate assessments of asset pledge or disposal value that might be obtained during difficult times.

With information on anticipated cash flows in hand, a prioritized action plan can be developed and put into motion. Although such a plan will be institution-specific and change over time (as the firm's business, market access, and cash flows change), an example might be as follows:

1. Modifying liabilities (such as drawing down bank lines, issuing MTNs, reducing CP, altering maturities).
2. Suspending discretionary or non-essential cash outflows.
3. Pledging assets from the liquidity warehouse or other accounts.
4. Neutralizing other financial risks through hedging.
5. Selling marketable assets from the liquidity warehouse.
6. Reducing other assets (for example, slowing new business and shrinking the balance sheet).

7. Crystallizing off-balance sheet opportunities (such as securitization and option exercises).
8. Selling hold-to-maturity investments, fixed assets, business units.

We shall consider several of these points in greater detail below.

EX ANTE MARKET ACCESS

A company experiencing a severe liquidity squeeze must be prepared to take all actions that will help ensure its survival. This means it must be able to sell or pledge liquid assets, increase short and long-term liabilities, decrease long-term assets, and defer non-essential cash flows. Each one of these actions demands proper access to markets.

From a liability perspective, a firm can develop appropriate *ex ante* market access by making sure that its funding program is diversified, secure, and deep. Any program a firm creates should obviously be available for use during normal and crisis conditions. As noted in the last chapter, a firm must develop a portfolio of funding options that spans a variety of products, markets, and providers; this diversification helps ensure that the firm is not overly exposed to a single source of funds and can select from alternative products/conduits at any point in time. The funding program must also be secure; a company entering into a difficult financial period cannot afford to discover that facilities it believes are committed are actually subject to cancellation or withdrawal. Finally, the funding program must be deep enough to give the firm access to the resources it requires under a variety of stress scenarios. Creating a diversified and secure funding program that accounts for only a fraction of what might be required in difficult times will do little to avert more significant problems; the program must be large enough to accommodate all of the cash outflows that might become apparent during stress scenarios.

From an asset perspective, a firm creates *ex ante* market access by establishing a liquidity warehouse that is specifically isolated from the rest of its corporate operations; this decreases the likelihood that a firm will have insufficient cash access during times of crisis. Indeed, a properly structured liquidity warehouse reduces a firm's reliance on the actions of short-term investors, depositors, or creditors – thus reinstating some amount of control within the firm itself. The liquidity warehouse is, of course, a partial drain on resources and will not contribute in the short run to enterprise value maximization. Nevertheless, the warehouse can be viewed as a valuable liquidity option, exercisable in the event of a true financial dislocation. As

we have indicated, the portfolio must be comprised of high quality, saleable instruments that retain their market value (particularly during flight-to-quality cycles), and should be appropriately diversified across obligors and markets. The liquidity warehouse should not be used as a "dumping ground" for unwanted assets, or "raided" and put to use in other endeavors (such as selling marketable securities to invest in fixed assets). By following these simple rules a firm ensures that the pool is available to generate cash through disposal or pledging precisely when needed, in an amount dictated by a true carrying value.

DEFENSIVE MEASURES

Recentralization

When a firm moves into a crisis management mode, the actions taken by the LCMT are defensive, meaning that recentralizing authority is advisable. Any delegated authorities granted to those responsible for managing a business, product, or region (including the financial dimensions that generate or absorb liquidity) should be temporarily revoked so that actions can be properly coordinated from the center. This does not mean that those managing businesses or regions cannot form part of the crisis management process; indeed, they must, as they are likely to be intimately familiar with important information that can impact the firm's liquidity. But their role must temporarily be limited to one of communication and guidance rather than action or decision making. The LCMT responsible for the process must use business and regional managers in any way necessary to see the firm through difficult times, but must retain decision-making authority.

Funding management

In most instances the LCMT should expect to turn to the funding program as a priority; this is logical since the liability portfolio always provides the first line of defense in generating cash (apart from flows generated by core operations). Crisis-based funding management centers on prioritizing draw-downs, extending funding maturities, and suspending non-essential cash flows.

Prioritizing funding draw-downs

A firm in a crisis mode must make every attempt to accumulate a sufficient cash buffer in order to carry on with its operations. Accordingly, it should

be prepared to quickly draw down on its credit and funding facilities. The process begins by prioritizing funding access: a firm must determine which facilities to access, when, and in what amount, in order to secure the cash it needs. This brings us back to a point we introduced in Chapter 3, regarding the differences between theoretical and actual amalgamated sources of liquidity. Although the full complement of theoretical sources of liquidity might be available and accessible to a firm during normal market conditions, only the actual sources of liquidity that are still available matter when a crisis strikes. From a liability perspective, the firm's contingency program should discount, heavily or completely, any theoretical funding sources that are likely to disappear during stressed market conditions; funding prioritization should exclude liquidity sources that are not absolutely undoubted.

In most crisis situations a firm is unlikely to call on all of its prearranged financing facilities simultaneously, meaning it must prioritize draw-down. Prioritization might be a function of a firm's relationship with lenders/investors, its desire for a particular type/class of funding (such as floating versus fixed rate, senior versus subordinated, onshore versus onshore, domestic versus foreign currency), its access to intracompany or group funds, and its need for specific maturities (as noted immediately below). It might also relate to the relative cost of access, the total amount of funds available in a market or product, and the speed at which funds can be accessed. (In fact, a firm must be extremely sensitive to the notification period required for draw-down, as certain facilities/products incorporate multi-day delays; crucial time might therefore be lost.) Regardless of the specific criteria used, the important point is for the LCMT to implement a clear road map regarding funding draw-downs. Box 10.1 provides a simplified illustration of such a road map. (In practice the road map is likely to be much more extensive and detailed, and include amount, rate, and currency draw-down options based on remaining availability, investor appetite, market levels, the shape of the yield curve, and so forth.) Once prioritized, funding should occur automatically via the treasury or finance department, so that no time is wasted.

Extending liability maturities

When a firm enters a crisis mode it must attempt to reshape its funding profile. This generally means replacing short-term, credit and market-sensitive liabilities with longer term funding. From a practical perspective this may involve drawing down 6 or 12 month bank revolvers, and issuing two or three-year MTNs or EMTNs, while allowing 7, 14, or 30 day CP and payables to roll off. In a normal positive yield curve environment this will lead to an immediate rise in funding costs, and a resulting decrease in

Box 10.1 Summary funding draw-down road map

Company ABC: contingency funding priorities

Bank XYZ facility
- $100 million, three-year, fixed rate
- $100 million, five-year, fixed rate

Bank ABC facility
- $100 million, five-year, floating rate, swapped into fixed rate

MTN program
- $200 million, two-year, fixed rate

EMTN program
- €300 million, three-year, fixed rate, 50 percent remaining in €, 50 percent swapped into $

Bank TUV facility
- $300 million, seven-year, fixed rate

Private placement
- ¥10 billion, three-year, private placement, floating rate

enterprise value. Nevertheless, it is an important defensive measure that relieves short-term funding pressures that are so often the source of major liquidity problems. Of course, it is not always possible for a firm in a crisis mode to term out its funding; medium-term capital (via the loan or capital markets) might be relatively scarce unless stable, *ex ante* arrangements are in place. Where possible, however, a firm should attempt to extend maturities.

Suspending cash flows

When preserving cash is an overriding corporate goal, non-essential cash outflows must be suspended. Discretionary payments that can safely be eliminated, postponed, or reduced without damaging enterprise value or reputation should be curtailed as a matter of priority. During the pre-crisis planning stage, the LCMT should obtain information on the firm's near and medium-term cash flow commitments, segregated into discretionary and non-discretionary components. Non-discretionary cash flows typically give a firm little maneuvering flexibility; in most instances these are contractual cash flows associated with planned investments, capital expenditures, raw material/resource acquisition, debt and lease servicing, and so forth, and cannot be suspended. Discretionary flows, in contrast, allow a

firm to manage cash in relation to the current financial position. If a firm can curtail a previously planned investment or capital expenditure, or if it can quickly close down a business unit with negative cash flows, it must consider doing so. Cash that can be preserved while in the crisis mode strengthens the overall financial position during a critical time period.

That said, a firm should not take any actions that might permanently impair enterprise value or reputation. For instance, even if a contract allows a firm to cancel a long-standing project with another partner, due consideration must be given to whether this is the best course of action; cancellation might damage the relationship and jeopardize future business opportunities. Equally, the suspension of dividends on common stock or non-cumulative preferred stock, although a cash saving measure, is generally a drastic action that sends a negative signal to the investment community. While cash is preserved, dividend suspension can cause the value of the firm's stock to drop and remain depressed for an extended period of time. The costs and benefits must therefore be thoroughly analyzed before any decision is taken by executive leadership (including board directors, who are typically responsible for dividend policy).

Asset management

A firm in a crisis mode must still fund its assets in order to remain a viable operation. That said, the program must focus on opportunities to decrease the amount of assets requiring funding: that is, reducing the balance sheet. While liquid assets that are coming due can be allowed to roll off, sold at carrying value, or pledged against new funding, and are thus unlikely to present a problem, less liquid assets that are only marginally productive might represent an unnecessary funding burden. A company should identify, on an *ex ante* basis, assets that can be sold during a crisis phase in order to relieve associated financing pressure. The same applies to new business: if a firm actively generates receivables or inventories as an element of its operations, it may wish to reduce or halt business, and the assets that are generated, in order to temporarily decrease its funding requirements. Business levels can be rebuilt once the crisis has passed and the firm is in a better position to finance its portfolio of less liquid, or illiquid, assets (including those with less attractive returns). Naturally, decreasing earning assets, even temporarily, must be handled with care, as these are the very investments, receivables, inventories, and plant and equipment that generate a firm's enterprise value. If the process is handled improperly, it might be difficult and expensive for a firm to recover value once the liquidity crisis has passed. Note that the same consideration must be given to off-balance sheet contracts; where these have the potential to result in cash outflows, they must be reduced.

Risk hedging

In Part I we noted the close relationship that exists between on and off-balance sheet credit, market, and liquidity risks. It is generally true that a firm that is heavily exposed to market and credit risks directly or indirectly generates a significant amount of liquidity risk. Accordingly, one of the most important defensive moves of any crisis management program centers on neutralizing, or minimizing, the credit and market risks impacting the business. By doing so, a firm reduces the chance that its liquidity profile will be further pressured in the event of new or incremental risk challenges. This is especially true when we consider systemic dislocations, which can produce a larger amount of credit failures/defaults and asset flight-to-quality. A firm's crisis management program must therefore focus on the nature of market and credit risks at the time the crisis plan is invoked, and determine which can be hedged through offsetting transactions or derivatives in order to ease cash flow pressures.

COMMUNICATIONS

Information voids can be extremely damaging and actually exacerbate a negative situation, meaning external and internal communications are vital. From an external perspective, stakeholders that have a vested interest in a company, its financial condition, and future prospects, need to be kept apprised of developing events. This is particularly true with credit-sensitive relationships when the specter of default might be increasing. Accordingly, the contingency program must include robust and effective external communication mechanisms. Management must take steps to ensure a regular flow of information to debt and equity investors, lenders, regulators, credit rating agencies, and the financial media at large. Stakeholders who receive information directly from a company on its financial status and plans are less likely to create, or fall victim to, rumors and sensationalized accounts of problems – which, as we have noted, can intensify liquidity pressures and even fuel liquidity spirals. Particular attention must be paid to regulatory queries.

Communicating internally is equally important. Employees and managers that drive a firm's business do not want to learn about potential problems through rumors or gossip; they have a vested interest in the firm by virtue of their status as employees (and often shareholders), and must be given relevant information about the state of affairs during the crisis period. But communication must flow towards management as well. Managers operating business units or regional offices often have valuable

and unique information regarding the firm's condition that may affect its ability to manage the situation; mechanisms such as daily conference calls or message repositories must be established to ensure that the information is delivered to the LCMT on a timely basis.

INVOKING AND TERMINATING THE PROGRAM

A crisis management program should be invoked through a process built around objective triggers from external measures and subjective input from executives and managers. A firm must identify measures that reflect changing liquidity circumstances; these should be supplemented by anecdotal evidence from the marketplace and management's interpretation of such facts (such as difficulties with rollovers, widening spreads, reluctance by lenders to renew long-term facilities, increased reliance on brokers to source funds). Measures should be agreed in advance by executives and the financial controllers responsible for compiling statistics, and should form part of the regular monitoring process detailed in the last chapter. When the objective measures are triggered, or reach pre-defined warning thresholds, the LCMT must quickly obtain supplemental qualitative information from the marketplace on the nature of the liquidity disruption or pressure. The combination of objective and subjective inputs should be sufficient for authorized parties to determine the need to invoke the program. It is important that the process be sufficiently automated that response can be quick, but not so automated, or bereft of human judgment and experience, that it becomes a rote exercise that is subject to misinterpretation or misuse.

Terminating a crisis program should also be a defined event. The LCMT should develop and use *ex ante* measures that indicate the firm is poised to return to a normal operating environment – one where it can safely devolve duties back to the line/region, rebuild business, replenish the liquidity warehouse, reshape funding maturities, and so forth. The process can again consist of objective metrics, such as a return to the liquidity risk measures that existed prior to the crisis, along with subjective input and analysis from market sources, investors, and lenders. In practice this might take one or two quarters to achieve; lender and investor confidence – as reflected through credit spread movements, ease of rollovers, and access to fresh funds – is unlikely to occur in a matter of days or weeks, particularly if the firm has been through a wrenching event. Once terminated, the LC and internal/external auditors should examine the crisis program in detail to determine whether there are any points of weakness or areas for improvement. Adjustments should be made to the program in advance of any future re-enactment.

DISASTER RECOVERY

In an era where institutions rely heavily on technology to manage their businesses, it is important to ensure that appropriate disaster recovery plans are in place. Such plans typically center on establishment of remote business locations, computer, network, and data redundancy, and communications backup. In order not to jeopardize business opportunities, franchise value, financial commitments, or reputation, a firm must be able to resume its business without pause in the event it becomes the subject of a catastrophic disaster that interrupts normal operations. Indeed, the topic is so important that the entire discipline of disaster recovery is taking hold in the corporate world, and more firms appear to be engaged in serious consideration, design, and implementation of disaster recovery plans. While these plans are typically broad-based and intended to cover the widest possible scope of corporate operations, the very liquidity contingency plan that a firm develops must form a leading part of the exercise. While cash access is always vital, it becomes even more vital during a disaster: cash availability in the midst of general or specific disruptions must be undoubted. If a firm can arrange its liquidity program so that it has simple, efficient, and secure access to funds as it attempts to cope with other operating interruptions caused by a catastrophic event, then it mitigates a risk that might otherwise create financial distress. This is especially true when a disaster is broad, impacting an entire sector, country, or system.

TESTING THE PLAN

The time to determine whether a crisis management plan is working as anticipated is not in the midst of a company-specific or sector-wide crisis but before it is required. Accordingly, a firm's contingency plan must be tested during normal market conditions to ensure that all aspects function as intended. Testing should be comprehensive, covering all parts of the plan outlined above, including market access, funding, hedging, and other defensive measures, as well as internal/external communications. Simulated events should be conducted in order to determine whether responsible parties are effective in managing their portions of the contingency plan, communicating with others, and directing resources. Such dress rehearsals can demonstrate vulnerabilities and reveal areas for improvement – in advance of an actual crisis.

Part of plan testing should also focus on real-life exercises, such as drawing down bank facilities, issuing new CP, selling a portion of the investment portfolio, and so forth. Indeed, actually drawing down bank facilities that serve primarily as a backup is a sensitive topic. Some firms are loath to do so, even in a "trial mode," as they are reluctant to send the

wrong signal or have use of the facilities misinterpreted. However, since backup lines are such an essential component of the contingency plan they must be tested periodically. No stigma should be attached to draw-downs of backup or emergency revolvers – firms must be able to test their facilities without sending a negative signal. Similar testing should occur via issuance of short and medium-term notes, the sale of small portions of the liquidity warehouse to test asset prices, and so forth.

While standard liquidity policies and procedures are likely to be used in the normal course of a firm's business, it should be clear that advance preparation of a crisis program is an important part of prudent risk management. A firm can manage through a crisis situation with greater ease if it has a robust contingency plan in place.

Figure 10.1 summarizes aspects of the process discussed above.

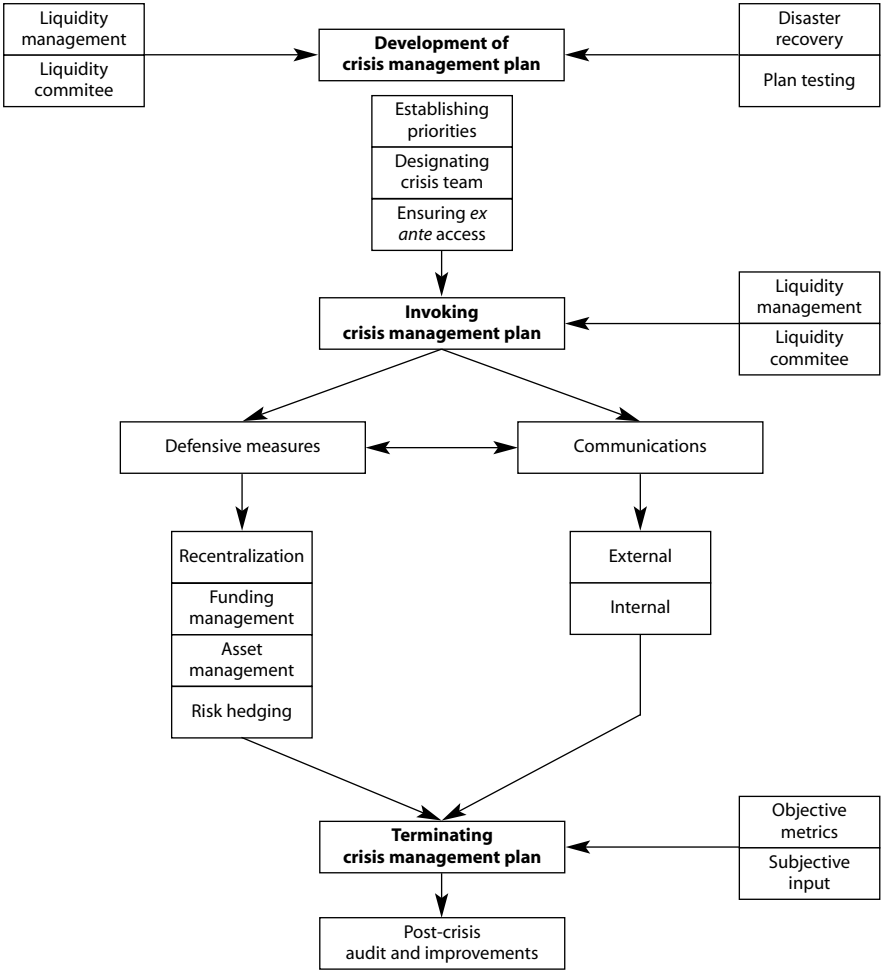

Figure 10.1 A liquidity crisis management program

CHAPTER 11

Summary: Toward Active Liquidity Risk Management

As we conclude our review and analysis of liquidity risk, we consider the prospects for active liquidity risk management over the medium term. It is clear that companies (and sovereigns) have become more attuned to risks and risk management over the past two decades: volatile markets, dislocations, systemic stresses, and resulting losses have played an important part in heightening risk awareness, generally to good effect. With little to indicate that the economic and financial operating environment will become more benign in coming years, rigorous risk management will remain essential.

In order to cope with business uncertainties, many institutions now feature formalized risk management processes, including those focused on liquidity exposures. Indeed, with each new micro or macro crisis, firms appear more willing to consider changes that will allow them to manage their liquidity risks more effectively. Some, for instance, have made conscious efforts to reduce their reliance on a small group of funding markets, lenders, or investors; others have created policies allowing them to decrease assets in times of financial strain, and still others have created robust liquidity warehouses with an appropriate mix of high-quality, saleable assets. Such processes must be extended even further, to the point where all firms have some type of liquidity risk management mechanism in place – ideally, one that is linked to other aspects of financial risk management. As we summarize our work in this book, we consider the nature of essential firm-specific best practices and discuss the role of regulatory authorities in helping promote a system of sound liquidity.

THE MICRO ROLE: BEST PRACTICES

We know from our discussion in this book that there is no single "correct solution" to the effective management of liquidity risk: processes that are effective for one company or industry might be of limited use to another, those that are best suited for normal market conditions might be inappropriate for a crisis, and so forth. That said, the conceptual basis for managing liquidity risk is sufficiently universal that it is possible to develop a micro-level summary of best practices, applicable across firms and market conditions. This summary is a crystallization of ideas we have presented in previous chapters.

Creating a sound governance framework

- Preserving stakeholder confidence is an essential element of liquidity management; companies must be perceived as being stable and in control of their liquidity position at all times, and should communicate this message to stakeholders.
- The board of directors must play a leading role in defining and communicating the firm's ability and desire to assume liquidity risk. It must authorize the creation of the mechanisms needed to create a proper liquidity risk management process (including a liquidity committee, policies, procedures, and technical infrastructure).
- The board of directors should define the firm's liquidity philosophy through a liquidity risk mandate, ensuring that it is consistent with the firm's strategy, business focus, risk appetite, and resources.
- The liquidity risk mandate must be conveyed to all interested stakeholders, including investors, creditors, regulators, employees, and rating agencies; subsequent changes (approved under the direction of directors and executives) should also be broadcast.
- Overarching liquidity risk policies and procedures must be crafted by the liquidity committee and promulgated throughout the firm; policies should be reviewed annually to ensure they remain relevant.
- The degree of decentralization and nature of delegated responsibilities related to management of liquidity risks must be clearly defined by directors and executives.
- Liquidity practices must be properly incorporated into all of the firm's financial activities; the linkage between market, credit, and liquidity risks means that they must be considered and managed jointly, particularly if a firm is attempting to operate efficiently and maximize enterprise value.

- The liquidity risk/return trade-off is always present; the firm must consider the right balance between revenue maximization and liquidity preservation.
- A comprehensive liquidity risk management program that makes appropriate use of assets, liabilities, and off-balance sheet transactions to generate liquidity, as and when needed, should form the centerpiece of any process.
- The liquidity risk process must be based on realistic assessments of current and future business and cash flow needs under a variety of operating and growth scenarios.
- Banking and investor funding relationships must be reviewed frequently to determine whether they are robust and diversified and can adequately meet the company's changing needs.
- The liquidity risk management process should be surrounded by independent controls capable of regularly analyzing and auditing aspects of measurement, monitoring, and management. The process should be examined by directors and executives at least annually to make sure that it remains consistent with the firm's mandate, structure, and growth plans, and is relevant in the market and regulatory environment.

Implementing proper measures and reporting

- The firm should develop and use robust liquidity risk measures that are applicable to its business. While balance sheet measures can provide useful point-in-time stock measures, these should be supplemented by dynamic flow measures that take account of gaps, durations, probabilities of draw-down, disposal discounts, and loss of market access.
- Measures must be conservative in their treatment of pricing and liquidation parameters, particularly during stress periods. Conservative evaluation of asset discounts and funding access (including quantity and speed) is the safest way of managing general liquidity risks; although a conservative approach can dampen overall enterprise returns, it can help minimize the chance of financial distress.
- Independent experts must always value assets, liabilities, and off-balance sheet contracts, and model valuations should be routinely tested for reasonableness.
- Assets, liabilities, and off-balance sheet activities must be regularly stress-tested to reveal areas of vulnerability.

- Continuous monitoring of profiles and trends is essential; qualitative and anecdotal measures must also be followed closely (such as the status of credit renewals, widening of spreads, and changing terms in loan agreements).
- Detailed information related to critical daily, weekly, and monthly flows must be given to business and control managers. Summary information must be given regularly to directors and executives.
- The firm's infrastructure should be able to provide managers with granular detail on liquidity risks.

Using tactical controls

- Limits should be created to control all relevant aspects of liquidity exposure, and should relate directly to the firm's liquidity risk mandate.
- Concentrations within the asset, funding, and off-balance sheet portfolios can intensify a liquidity problem; diversification across investments, obligors, lenders, maturities, credit ratings, markets, and products is an essential component of prudent risk management.
- A liquidity warehouse must be established and maintained to help absorb unexpected payments. Additional protection via reserves is advisable.
- A firm must maintain constructive relationships with its key lenders and investors, and should continuously develop new sources of funding.
- Off-balance sheet activities should be controlled; since they can expand future contingencies and liabilities in an uncertain, and sometimes opaque, manner, they must be explicitly limited.
- The firm should regularly test its ability to sell complex, difficult to value, or thinly traded assets as a way of verifying model accuracy, asset valuations, and haircuts.

Developing a crisis management process

- A centralized crisis management program, that is regularly tested and updated, must be a management priority. Knowing when to invoke the program is absolutely essential, as any unnecessary delay can prove costly.
- The program should be based on well-defined asset, liability, and hedging priorities, and feature a proper communications process.

- Objective measures should be the primary method of invoking a program, but subjective review and judgment should form part of the process.
- Indicators that can serve as possible "early warning signs" should be reviewed regularly.
- Committed backup bank lines should be tested on a regular basis, regardless of the negative message it might send the marketplace.
- Advised bank lines should be completely discounted in a crisis management scenario.

Performing ongoing reviews

- A firm's liquidity risk process should be thoroughly vetted by internal and external auditors to ensure that it meets necessary governance and regulatory standards. Auditors should verify proper independence and segregation of duties between those generating and controlling liquidity risks.
- When liquidity problems arise and are ultimately resolved, a firm must examine the causes, reactions, and solutions to determine whether enhancements to the overall process are necessary.
- Policies and procedures should be analyzed to determine their efficacy and consistency with the liquidity risk mandate.
- Procedures related to violations and penalties should be reviewed, and actual application of proper disciplinary action should be confirmed.
- Valuation models (such as VAR, LAVAR, derivative and credit risk pricing, and stress testing algorithms) must be independently reviewed and benchmarked.
- The integrity of the data used for liquidity measurement and monitoring should be verified.

THE MACRO ROLE

While much of what we consider in this book is directed towards institutional-level management of liquidity, we know that macro bodies have a role to play as well. Any regime or rule that promotes system-wide liquidity helps individual institutions cope with their own liquidity. The issue becomes increasingly important as global asset and funding markets become more intricately related and co-dependent: effective

funding, trading, financing, investing, hedging, and speculating require systemic stability. Unfortunately, in a drive to achieve certain levels of market share or profitability, entire sectors may misprice or ignore their risks, which can add to systemic instability. As we have seen, ripples that flow through the system can be especially damaging, and have the potential to create significant financial losses for individual firms and entire sectors. Accordingly, it is incumbent on industry regulators, representatives, and self-regulatory organizations to consider mechanisms that can help promote and expand stability. While some national authorities already play an active role in this area, others do not, or need to improve their processes and techniques.

The role of regulators in fostering conditions that protect and encourage liquidity is important. Although this relates primarily to the financial sector in its role as liquidity provider to all other industries, it need not be limited to financial institutions; where relevant, industry representatives and trade groups should promulgate best practices for other sectors as well. Within the financial services industry a number of national banking regulators, insurance commissioners, securities regulators, and supranational organizations have put forth varying rules and recommendations regarding the protection of liquidity. We quoted briefly from some of these in Chapter 1, and note further that their recommendations are often quite extensive and, in the main, constructive. But they are not exhaustive: while financial regulators have been quite direct and precise in the management of credit and market risks, they have tended to be more oblique in their approach to liquidity risks, in some cases addressing the issue only indirectly – if at all.[1] In addition, we have noted that there are instances where regulations can actually exacerbate liquidity problems (such as the use of standard risk models, and the creation of capital controls). Fortunately these are the exception rather than the norm. Although certain regulatory initiatives exist, regulators can help foster an even more robust environment by conducting regular inspections, promoting competition, avoiding fragmentation, minimizing costs, harmonizing accounting treatment, ensuring proper capital allocations, and providing selective lender of last resort access. We consider each one of these.

Conducting regular inspections

Regulatory and industry bodies should regularly examine the liquidity practices of institutions operating in their jurisdictions. The review should focus on many of the topics we discussed in previous chapters, including measurement, monitoring, and management, as well as the nature of governance and independent controls that surround the process, mecha-

nisms used to manage legal entity requirements, and the particulars of any contingency/crisis management program. In fact, authorities should insist on the creation and use of contingency programs, as these can help minimize instances of systemic dislocation. While much of the focus of external regulatory inspections is, rightly, on the financial institutions sector, trade groups and self-regulatory organizations should review the activities of non-financial institutions based on minimum best-practice standards. We have already noted instances where large non-financial institutions, without the proper approach to liquidity risk management or the scrutiny of a regulator, have encountered significant difficulties. Future problems can be minimized through a formal review process.

Promoting competition

It is clear that market makers, dealers, and exchanges have a central role to play in the provision of financial asset liquidity. They must be allowed to operate in a competitive and efficient manner, and regulators should promote any prudent deregulation measures that allow for greater competition. We have indicated that as more participants are attracted to a market, bid–offer spreads tighten, volumes increase, additional participants are drawn in, and so forth, in a self-perpetuating cycle. Regulators should encourage measures that support heterogeneity in order to help build two-way flows; for instance, allowing certain parties to participate in areas that have previously been restricted or prohibited can create opposing views and generate more trading interest. But promoting competition does not mean allowing risks to be mispriced; it is important to stress that undercutting margins to gain market share and inject liquidity is not a viable or sustainable process, either for individual institutions or marketplaces at large. Firms and supervisors need to be vigilant on this point.

Avoiding fragmentation

Regulators must avoid actions that lead to market fragmentation. This represents a balancing act, as it is generally beneficial to promote alternatives in order to keep competition strong. But too much fragmentation has been shown through empirical studies to damage trading volumes and divide liquidity pools; this applies across asset classes and funding sources, and also includes off-balance sheet contracts. Wherever substitutes can be introduced, care must be taken to ensure that they are value-added and complementary, and not destructive. For instance, local government bonds (and the government yield curves they generate) play multiple roles: providing "risk free" safe haven investments (certainly for industrialized economies with solid investment-grade ratings); supplying price references

for private sector financing issues and bank borrowings; providing a supply of securities for repurchase/reverse repurchase activities; and, creating references and deliverables for listed and OTC derivatives. Each one of these functions promotes liquidity in other asset and funding classes. Accordingly, it is vital for activity in government bonds to be as strong as possible. This means issuance cannot be spread too widely across issues, coupons, and maturities. Such an approach will almost certainly fragment the market and leave associated asset and liability mechanisms in an uncertain state. In fact, it is preferable for national issuance to be concentrated on a handful of benchmark issues (with authorities "reopening" them as needed rather than issuing new tranches and creating greater market atomization).

Minimizing costs

It is well established, theoretically and empirically, that measures that reduce the cost burden of participating in a trading, investment, or funding market lead to an increase in activity – and, hence, liquidity. There is considerable evidence to demonstrate the positive effects of lower costs (for example transactions costs, stamp duties, and taxes) on activity levels (not just trading volumes, but also borrowing levels, investment activities, and so forth). Where regulators have the ability to eliminate unnecessary costs, they should be prepared to do so.

Harmonizing accounting treatment

Firms are periodically precluded from participating in a market or transaction (for example an investment, a funding or new issue transaction, or a derivatives trade) as a result of accounting rules. While there are often good reasons for particular accounting treatments, there are also instances where rules are a vestige of past practice and may no longer be applicable to the current state of industry or markets. Whenever possible, rules should be harmonized or synchronized with the realities of the corporate world of the twenty-first century. The removal of artificial barriers based on accounting, rather than economic, rules is almost certain to generate additional activity in specific market segments.

Reinforcing proper capital allocations

Global financial regulators have generally done a creditable job in ensuring that financial institutions preserve sufficient capital for core market and credit risks; the discipline is by now well established and appears to have served the financial community, and by extension all other industrial and

service sectors relying on the community, very well. But the process is not yet complete: formal capital allocation must occur in support of other risks, most notably liquidity risk and operational risk. The lessons from financial dislocations of the past few years demonstrate that some types of financial institutions may not be providing adequate capital in support of their non-credit/market risks. A formalization of rules regarding the process must be considered as a matter of priority.

Providing selective lender of last resort support

Preserving our focus on the financial sector, we note that there is a defensible argument to be made in ensuring that certain financial institutions be granted undoubted access to a lender of last resort. The systemic stability that can be gained from making sure that the most significant liquidity conduits have a "backstop" is of considerable importance.

The main criticism of lender of last resort access is rightly one of moral hazard: financial institutions, knowing that they have support through a central bank or monetary authority, may behave recklessly in an attempt to maximize returns (including holding insufficient liquidity in order to boost profits). Equally, depositors who believe they are placing their funds in an institution with an implicit government guarantee may be less vigilant regarding the bank and its activities. This is a valid argument, meaning lender of last resort access should only be granted selectively, to those institutions that are too big to fail and that do not appear to be deliberately managing their operations in a reckless manner. The gains that can be derived from a stable environment must surely outweigh the potential costs of moral hazard problems and, in the event of a problem, the actual costs of interceding.

When *ex post* regulatory intervention must occur, it should take the form of open market operations and liquidity injections into the financial system, as well as direct loans to the troubled institution(s).[2] Where direct access is not possible or convenient (because it involves an institution that is "out of scope"), regulatory authorities should take any actions that can lead to private sector support or bailout. This is particularly true for securities firms that lack formal backstops, and may also be useful for certain private investment funds (as in the LTCM case).

The key point in relation to the topic above is not to insert regulators into the process to actively promote liquidity, but to have them consider structural reforms and deregulation measures that can further liberalize financial and physical asset and funding markets. Success will ultimately benefit the liquidity access of all companies.

Figure 11.1 summarizes our consideration of overarching micro and macro practices that can promote effective liquidity risk management.

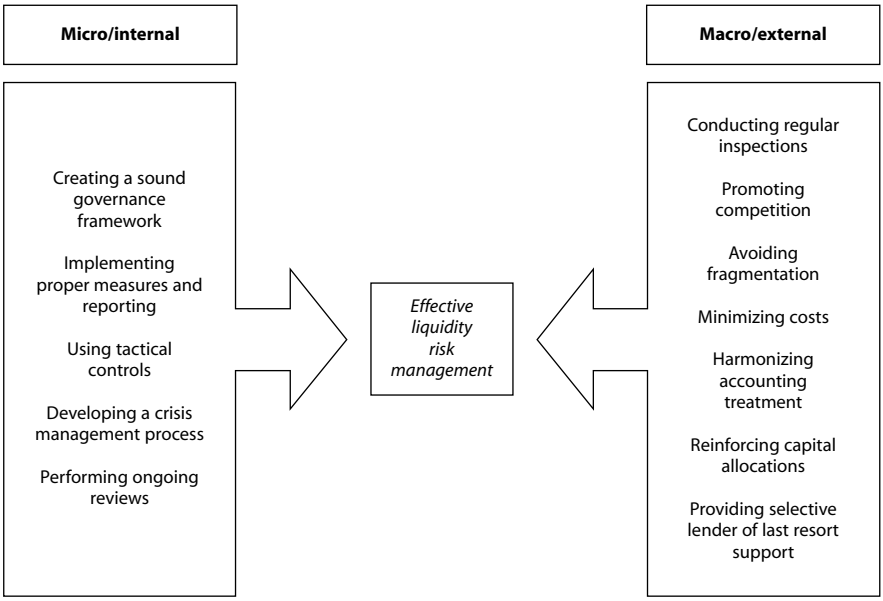

Figure 11.1 Towards effective liquidity risk management

In concluding, we wish to reiterate that in an era of financial uncertainty, a firm must manage its liquidity diligently, through a combination of internal best practices and external support. The end goal should be to minimize, or avoid, the likelihood of disrupting access to cash resources. A firm must ultimately seek to preserve its business franchise through the most severe financial stresses, emerging intact to continue prospering. Prudent, and active, liquidity risk management makes this goal achievable.

Notes

CHAPTER 1: LIQUIDITY RISK DEFINED

1 The specific term "liquidation risk" is sometimes used to denote the risk of selling an asset at a loss.

2 Although the value of derivative transactions must now be reported on a firm's balance sheet and income statement under some accounting systems, the nature of future commitments and obligations under such contracts is still generally oblique.

3 Financial operating risks, such as securities and foreign exchange settlements, delivery of cash against securities, and so forth, comprise a separate category of operational risk that can also impact liquidity risk. For instance, failure by a bank to receive payments on securities that have already been delivered can result in a cash deficit that needs to be funded on a short-term basis.

CHAPTER 2: LIQUIDITY AND FINANCIAL OPERATIONS

1 Interestingly, half of all US bank failures between 1984 and 1989 occurred within institutions that would have been considered "adequately capitalized" under the BIS 1988 Capital Accord definitions; capital alone is thus not enough to prevent a firm from failing.

2 We note that sovereign organizations, though not necessarily concerned with value maximization, are often equally interested in minimizing financial problems.

3 Indeed, in an effort to manage greater funding liquidity risks, some securities firms arrange for committed bank line facilities from the banking sector; this gives them some measure of safety in the event the short-term markets prove challenging.

CHAPTER 3: SOURCES OF LIQUIDITY

1 It is true, of course, that banks active in the repo and reverse repo market often run "matched books" so that they do not face an excess of interest rate risk or curve risk. Thus, if a bank allows its reverses to roll off in order to generate additional cash, it must either rebalance its own repurchase agreement position by constructing appropriate interest rate risk hedges, or allowing the repos to roll off as well; if it selects the latter it will, of course, face a liquidity constraint of its own as it will have lost a source of funding. However, the securities it receives back from the repo close-outs can then be sold in the marketplace to generate additional cash. Such a process is common when a bank is shrinking its matched book, which often occurs prior to quarter-end financial reporting periods.

2 For instance, in 1996 the Bank of England introduced the Sterling Stock Liquidity Regime (SSLR), which broadened the liquidity requirements for commercial banks with a large retail presence. Under the SSLR banks must supplement the traditional cash inflow/outflow gap/ladder approach (which we discuss in Chapter 8) with a portfolio of liquid sterling assets that can be used to cover any potential loss of wholesale funding. (Note that a separate process, the Mismatch Liquidity Regime, was introduced in 1999 for non-SSLR banks, which permits committed funds and a broader array of assets to be used in computing the net liquidity position for each ladder maturity.)

3 In fact, certain empirical research (see Schlingemann, Stulz, and Waking, 2001 for example) suggests that a firm is most likely to sell portions of its business that are liquid, or those that are unrelated/immaterial to core operations or poor performers, and far less likely to sell portions that are illiquid.

4 Note that similar local CP markets exist in other countries as well: Canada, for instance, features a relatively active marketplace for unsecured C$-denominated CP.

5 Investor demand for A-2/P-2 and A-3/P-3 issues is very small (less than 5 percent of total outstanding during normal market conditions) and can disappear very quickly, particularly during times of market stress or general credit deterioration, when investors are less eager to speculate on short-term credit spread movements. When this occurs, lower rated issuers with outstanding notes in the market may work with their dealing banks to "manage out" of the CP market (without causing any disruption in their operations or creating any negative publicity) by tapping alternative facilities, such as bank borrowings.

6 A small number of CP programs are supported by bank letters of credit or are structured as asset-backed programs, and would thus be considered "secured."

7 Even deposits with longer maturities can indirectly affect a bank's funding. For example, institutional investors that sell medium-term bank deposits in the secondary market at a discount in order to retrieve their capital can send

a negative signal to other low-risk institutional investors, making rollovers of other funds more difficult.

8 Euronote facilities generally permit issuance in the one to ten-year sector (complementing the shorter term issuance provided by ECP) and are often backed by bank tender panels, which absorb unsold notes and so provide contingent funding. Tender panel facilities are generally committed or transferable to other banks upon agreement by all parties.

9 Some securitizations are liability, rather than asset, based, and are intended to remove particular types of risks from the liability side of the balance sheet. The concepts are similar, although we shall not consider them in further detail.

CHAPTER 4: FUNDING LIQUIDITY RISK

1 It is worth noting that such reserves may have to be held in low/no-yield assets, which reverts to the issue of risk/return trade-off and enterprise value maximization.

2 Financial mismanagement has been at the heart of significant corporate problems over the past few decades, including those associated with Enron, Tyco, WorldCom, Swissair, and many others. Many problems ultimately manifested themselves in the form of severe liquidity pressure.

3 Bankers Trust serves as an interesting example of a firm that was plagued by reputational problems. It was ultimately subsumed by Deutsche Bank when it was unable to overcome the crisis of confidence. Although not strictly a liquidity problem, the bank's well-publicized client derivative lawsuits and settlements (such as Procter & Gamble, Gibson Greetings, and Sandoz) in the early 1990s, coupled with nearly $500 million in losses in Russia in 1998, eroded depositor and investor confidence in the bank and its management. The firm was downgraded on various occasions and was unable to generate a competitive cost of funds as a result of its problems. Deutsche Bank ultimately stepped in to acquire the bank when it was clear that further growth was becoming virtually impossible.

4 For instance, Gatev and Straham (2001) have found that bank assets (securities and bank lines of credit) increase more rapidly when short-term credit spreads (that is, commercial paper less Treasury bills) widen, and that the quantity of assets funded with deposits increases during a crisis period. The study has also found that banks have a comparative advantage over other financiers in extending loans during a crisis, as the yields they pay on flight-to-quality deposits decrease as credit spreads widen. Credit extensions, however, are not granted uniformly; that is, they are not granted to idiosyncratic borrowers who might wish to draw down based on their own credit circumstances, but to systematic borrowers, who draw down based primarily on the availability of market liquidity. Banks can thus lend to highly rated systematic borrowers

during times of market stress, suggesting some "winners" exist when exogenous forces are otherwise proving disruptive. The reverse is also shown to be true: when markets regain their balance and depositors withdraw funds to reinvest in higher yield alternatives, banks are no longer flush with cash and thus scale back on the highly rated systematic lending they once engaged in.

CHAPTER 5: ASSET LIQUIDITY RISK

1 For instance, there is empirical evidence that in some markets futures and the underlying cash assets they reference complement each other, promoting strong liquidity in both sectors – Eurodollar futures and Eurodollar deposits are one example of this. In other cases futures and cash are independent and fractionalized, because they act as true substitutes. In such instances one of the instruments might exhibit a great deal more liquidity. In Japan, for example, the 10-year Japanese Government Bond (JGB) futures contract is far more liquid than the underlying benchmark bond. The same can occur with corporate or sovereign bond issues. If the issuer offers too many different maturities as part of its debt management program it might fractionalize the market so much that insufficient liquidity builds in any single issue. Alternatively, if it issues only a few maturities, it might fail to generate enough interest among investors and will be unable to construct a meaningful yield curve. Balancing these two "fungibility forces" is not an easy task.

2 Most institutional OTC markets are quote-driven, while many public equity markets are order-driven (or hybrid).

3 Similar spread differentials between on and off-the-run securities have been observed in other asset classes during a variety of market conditions. For instance, off-the-run asset-backed securities might trade at a spread of +4–5 bps to the on-the-run asset-backed benchmark during normal market conditions, but as much as +40 bps in poor conditions; the same has been observed for investment grade bonds. Off-the-run high-yield bonds, in turn, might normally trade at +10–20 bps to the high yield on-the-run benchmark, and in excess of +50–75 bps in poor conditions.

4 A company will only lose ownership of the asset if it defaults on the terms of the collateralized financing transaction: that is, it fails to pay timely principal and interest or breaches a covenant.

CHAPTER 6: LIQUIDITY SPIRALS AND FINANCIAL DISTRESS

1 There are various academic theories about the underlying causes of bank runs. For instance, Diamond and Dybvig (1983) posit a model where banks

are providers of liquidity insurance to depositors who may decide to flee based on random events; Chari and Jagannathan (1988) focus on a model where systemic risks may be derived from idiosyncratic risks that lead to bank runs; Gorton (1988) assumes that bank runs are recession-related and tied directly to corporate and business failures. Despite different models and views, empirical and anecdotal evidence suggest that bank runs tend to be driven by institutional, rather than retail, depositors, because institutions have better access to information and less insurance coverage. The growing level of interbank and off-balance sheet activity, and the ease by which contagion can spread to other banks in the system, might exacerbate the runs.

2 Although some facilities contain material adverse change clauses giving funding banks the option to opt out if the credit environment has deteriorated enough to pose a financial risk, such clauses are rarely invoked; private "restructuring" may be a preferred alternative.

3 Credit extensions by banks can accelerate during stressed times as companies draw down facilities (such as during the 1998 Russia/hedge fund crisis, when credit expanded by 30 percent). The main issues center on whether deposits flee or are attracted, and whether banks are willing to assume the additional credit risk. Large banking institutions can often attract deposits, but the same is not necessarily true for small or mid-sized banks.

4 In some national systems regulators limit or prohibit the amount of credit that can be extended to rapidly deteriorating firms, which would exacerbate the problem.

5 It is important to note that liquidity problems are not the only reason a company might enter into a state of financial distress. Difficulties related to earnings, asset quality, overall leverage, or strategy, for example, can be equally damaging and might also induce a state of distress. While these are all important, they are outside the scope of this text.

CHAPTER 7: CASE STUDIES IN LIQUIDITY MISMANAGEMENT

1 In 1984 Continental Illinois, which was heavily reliant on wholesale and international markets for its funding, was unable to halt interbank deposit withdrawals fuelled by news of problems within the bank's emerging market and energy loan portfolios. As liquidity drained away a consortium of 29 banks and the Federal Deposit Insurance Corporation interceded with a $7.5 billion rescue package that reinjected cash into the bank; this was supplemented by a further $4.5 billion of borrowings from the Federal Reserve's discount window. The bailout was considered necessary as the possible disruptions from a large bank failure were deemed to be too great.

2 The reasons for the liquidity problems varied, but the end result was always the same: extreme difficulty accessing funds, resulting in very high funding costs. The Bank of New York suffered a large liquidity deficit in 1985 through operational errors, Salomon Brothers through the Treasury bond auction scandal in 1991, and Citibank through massive commercial real estate writedowns in 1991.

3 Although the October 1987 stock market crash was caused by a number of different factors, including excess leverage and speculation, and weakening economic conditions, the fall was exacerbated by the use of portfolio insurance, which involved selling assets (such as individual stocks or index futures contracts) into a falling market. The estimated $100 billion-plus of portfolio insurance programs created greater market instability on the downside, and converted two-way flows into large one-way flows; the dynamic replication of portfolios via portfolio insurance called for selling more stock or index futures contracts as prices fell, injecting more selling pressure into the market and creating a self-fulfilling downward spiral. During the immediate pre-crash period some $12 billion of index rebalancing was required, but only $4 billion was executed. By the time the crash was in full motion the pent-up selling forces were unleashed: when the cash market faced delayed openings, the rebalancing programs were shifted to index futures, which exacerbated the fall. Liquidity eventually became so impaired that rebalancing could no longer be undertaken; portfolio insurance techniques were widely criticized in the aftermath. Circuit breakers, designed to avoid market free-falls, were eventually instituted and remain in place in various markets to the present time.

4 Following Mexican bank privatizations in 1991 and 1992 the sector entered a phase of rapid asset growth; indiscriminate lending led ultimately to deteriorating asset quality, which strained bank revenues. This was compounded by a very heavy reliance on domestic and offshore interbank deposits (63 percent of all funding) rather than more stable retail deposits. When the Mexican government devalued the peso by 56 percent in late 1994 most major banks suffered a rapid, and significant, loss of funds as interbank depositors exited. The ensuing losses left many banks in a weakened state; many smaller institutions were forced to close down or merge, and the government bailed out several larger banks (through the deposit insurance company and central bank).

5 Caprio and Klingebiel (1999) record 112 systemic banking crises in 93 countries between the 1970s and late 1990s, many of them the result of significant liquidity risk difficulties. Importantly, the authors indicate that such crises have impacted developed, as well as developing, nations; countries such as the US, UK, Spain, Finland, and Sweden, appear to have been just as susceptible to systemic problems as emerging market systems.

6 Kidder Peabody, Donaldson Lufkin Jenrette, Lehman, Nomura, JP Morgan, Morgan Stanley, Merrill Lynch, Salomon, UBS, Bear Stearns, and Prudential were all lenders to Askin Capital.

7 In January 1995 Orange County sued Merrill for $2.4 billion, claiming it "wantonly and callously" sold the county risky securities in violation of state and federal laws. Orange County claimed *ultra vires*, saying that it was acting out of its legal scope and that the transactions were unsuitable. County bondholders also sued Merrill and Citron for false disclosure in the July 1994 bond prospectus, and suits were filed against Morgan Stanley, Nomura, and CSFB for their role in granting excessive amounts of leverage. All of the banks initially denied any wrongdoing, but eventually settled out of court: Merrill paid $437 million, Morgan Stanley $70 million, CSFB $52 million, and Nomura $48 million. Separately, the courts determined that Citron was to blame for the flawed strategy; Citron pleaded guilty to six felony counts related to making misleading statements in selling securities, falsifying accounting records and redirecting investment funds (not for losing the $1.7 billion).

8 To be sure, many banks were acting in self-interest; this was not a public bailout, obviously, but a reorganization with creditors risking $3.6 billion of their shareholders' funds to avoid a catastrophe. The Street's risk exposures were so large that it likely that many players would have been severely damaged without the bailout.

9 Many major banks gave LTCM the leverage – repos, derivatives, and credit facilities – on very liberal terms, essentially mispricing their risk in order to secure a portion of the fund's commission-based business. They also lent without good disclosure (contrary to standard credit operating procedures), opted not to require upfront collateral, and relied too heavily on their own flawed models. In some instances they attempted to replicate LTCM's own positions, injecting the same illiquidity into their own books.

10 For instance, exposure to LTCM caused UBS to lose $690 million, the Bank of Italy $100 million, Credit Suisse $100 million, Dresdner $145 million, Sumitomo Bank $100 million, and so on. Broader market dislocations arising from volatility, illiquidity, and forced selling in other asset classes generated additional losses: CSFB reported losses of $1.3 billion in Russia, including nearly $640 million in rouble forwards purchased via the Moscow Interbank Currency Exchange to hedge rouble exposure; Citibank lost $60 million on Russia and $300 million on its arbitrage positions; Merrill lost $1.5 billion, mostly on spread widening affecting very large, and often illiquid, portfolios of corporate bonds and preferred stock; Goldman reported proprietary trading losses of $650 million across various markets; and so on.

11 SAG featured 72,000 workers, including 21,000 in Switzerland, far more than any other carrier operating similar fleet size and routes, and its employees were among the highest paid in the entire industry. It also incurred

additional expenses from its inconvenient dual hub system (Swissair/Zurich, CrossAir/Basel).

12 Readers interested in a broader review of the details of the case from a corporate governance perspective may wish to consult the discussion in Banks (2004a).

13 Including LJM1, LJM2, JEDI 1, JEDI 2, Chewco, and Raptors I-IV.

14 Andersen, Enron's external auditor and architect of the partnerships (for which it earned many millions of dollars in fees), indicated that it had not accounted for the SPEs correctly; as a result of errors early in the process, the SPEs were not consolidated on Enron's balance sheet as they should have been, forcing the restatements. Many of the SPE transactions between Enron and the LJM1, LJM2, and Chewco partnerships were arranged because the company could not, or would not, do them with third parties; the end-game in all cases appears to have been financial window dressing rather than genuine risk transfer.

15 There was fallout in other sectors as well: external auditor Andersen eventually failed under the weight of criminal obstruction of justice charges, and various banks and law firms that assisted in the creation of a number of special, and ultimately illegal, transactions, were fined and sanctioned.

CHAPTER 8: MEASURING LIQUIDITY RISK

1 Liquidity ratios are an important aspect of overall financial analysis and bankruptcy prediction; empirical research on bankruptcies suggests that the most important financial variables with predictive capabilities include leverage, liquidity, profitability, earnings volatility, and company size.

2 Hot money is characterized by a perfectly elastic supply curve, meaning it is extremely sensitive to interest rate levels and changes.

3 Duration can be measured in a number of different forms, including Macaulay's duration and modified duration. For a standard fixed income instrument these are given as:

$$Dur = -\frac{1}{(1+y)} * \left[\frac{1C}{(1+y)^1} + \frac{2C}{(1+y)^2} + \ldots + \frac{nC}{(1+y)^n} + \frac{nM}{(1+y)^n} \right]$$

$$Dur\ (Mod) = \frac{\frac{C}{y^2} * \left[1 - \frac{1}{(1+y)^n} \right] + \frac{n\left(100 - \frac{C}{y}\right)}{(1+y)^{n+1}}}{P}$$

where C is semi-annual coupon interest, y is the semi-annual yield, n is the number of semi-annual periods, and M is the maturity value of the bond (generally par). These can be supplemented by measures of convexity, or the

change in duration for a change in yield, which is important in determining the sensitivity of cash flows to large changes in rates:

$$Cvx = \sum_{t=1}^{n} \frac{t\,(t+1)\,C}{(1+y)^{t+2}} + \frac{n\,(n+1)\,M}{(1+y)^{n+2}}$$

4 Interestingly, a survey by IOSCO (2002) found that many firms at the turn of the millennium still did not regularly measure commitments or other off-balance sheet contingencies.

5 See Kyle (1995), for instance.

6 Note that spreads can also be measured in other forms, including the realized spread, or the differential between the weighted average bid–offer for executed trades over time, and the effective spread, or the actual transaction price incorporating the direction of price movements.

7 It is worth noting that dealing can occur within the full bid–offer spread (such as limit orders and guarantees) so friction may be overstated; in order to avoid this overstatement a half spread (bid – offer/2, or quoted mid-market point prior to a trade) can be used as a proxy.

8 There is a large body of practical, empirical, and theoretical literature on VAR, which the interested reader may wish to consult; Jorion (1996) serves as an excellent primer. In general terms we note that "standard" parametric VAR (or variance/covariance VAR) relies on use of a multivariate distribution of asset returns and a variance/covariance matrix that is specified by time series returns. Volatilities and correlations may be estimated through historical processes (and may be exponentially weighted to give more recent observations greater weight in the sample) or they may be approximated through volatility estimation techniques (such as GARCH). The resulting parametric VAR, which is a multiple of the standard deviation of the distribution of portfolio returns, is simple to implement but cannot accommodate non-linear instruments (or can only do so crudely, through the use of delta approximation techniques.)

A second approach, the historical simulation VAR, is useful when the observed distribution of returns cannot be accommodated by a parametric approach. Under this framework historical returns for assets in the portfolio are sampled, a time series of portfolio returns is simulated, and the appropriate confidence level VAR is determined. This process does not rely on assumptions about the shape of the distribution or estimates of volatility and correlation for individual assets; however, it requires a long history of data (and might be questionable for any data regime shifts). From a regulatory perspective, the BIS requires banks to perform a VAR computation based on the method of its choosing, adjusted to the 99 percent confidence level and a ten-day liquidation horizon, and scaled by a multiplier of 3 (which represents a safety cushion). The process also requires a regimen of stress testing, backtesting of results, input parameter

updates, and appropriate qualitative standards and controls. While the aim is constructive and well intended it has shortcomings, including some mentioned in this chapter. Sophisticated financial institutions rarely rely on standard VAR as their only means of measuring and managing market risk (and, by extension, aspects of liquidity risk).

9 Readers interested in an excellent overview of alternative LAVAR approaches (e.g., Almgren-Chriss, Jarrow-Subramanian, Bangia, Diebold, Schuermann and Stroughair) may wish to consult Erzegovesi (2002).

10 One area of study that attempts to provide better estimates of the tails of statistical distributions is extreme value theory (EVT). EVT estimates probabilities by fitting a model to the tail of a probability function using only extreme event data; a tail index is derived and the thickness of the distribution in extreme regions can be analyzed.

CHAPTER 9: CONTROLLING LIQUIDITY RISK

1 These are often driven by expectations regarding key financial indicators such as economic growth, interest rates, term structure movements, foreign exchange rates, consumer confidence, and inflation.

2 Consider, for instance, that in the United States a bank holding company (BHC) cannot accept deposits or make use of the Federal Reserve discount window, and must therefore rely very heavily on the interbank market for liquidity. In addition, a BHC faces considerable constraints regarding upstreaming of funds and dividends from main bank units, putting even greater pressures on funding (e.g., credit from a main bank unit to a BHC must be collateralized, a main bank unit cannot repay a BHC's obligations, dividends can only be moved upstream as long as the main bank's capital ratios remain sound). Similar restrictions exist in the insurance industry and in other regulated/unregulated industrial sectors. All of these relationships must be well understood before liquidity can be properly controlled, hence the importance of a legal entity and consolidated focus.

3 To give just one example, the US Office of the Comptroller of the Currency (OCC) believes that a funding concentration exists when a single decision or single market factor could lead to a large withdrawal of funds. The OCC has also indicated that US banks must be very cautious about over-reliance on the interbank funding market, even if activity is spread out among a large number of banking institutions.

4 In some cases institutions can create products that allow better control of what might otherwise be an uncertain maturity; for instance, a liability may include an early exercise penalty that effectively dissuades presentation prior to the original contract maturity.

5 Even in instances when a MAC is not publicly triggered, there is the possibility

that bankers will press the borrowing company to take certain actions or enact certain reforms that will add pressure to its financial position.

6 It is interesting to note that at least one banking regulator has proposed the establishment of one week and one month cash flow gap limits built atop multi-week dynamic "stress factors" that are applied to actual and contingent inflows and outflows. Larger stress factors are used when currency mismatches exist. This approach can be viewed as a matrix of hybrid multi-currency cash flow gap limits that have been recalibrated for the effects of stress testing.

7 In some instances regulations or accounting conventions require firms to comply with specific liquidity-related disclosures. For instance, in the regulatory community the US Securities and Exchange Commission, commenting on Management Discussion and Analysis of Financial Condition and Results, has indicated:

> In determining required or appropriate disclosure, companies should evaluate separately their ability to meet upcoming cash requirements over both the short-term and long-term. Merely stating that a company has adequate resources is insufficient unless no additional more detailed or nuanced information is material.… One starting point for a company's discussion and analysis of cash requirements is a tabular disclosure of contractual obligations, supplemented with additional information that is material to an understanding of a company's cash requirement. Companies should address, where material, the difficulties involved in assessing the effect of amount and timing of uncertain events, such as loss contingencies, on cash requirements and liquidity. Any such discussion should be specific to the circumstances and informative.
>
> (SEC, 2003)

Within the accounting sector, the International Account Standards Board, referencing disclosures related to financial instruments, has noted that "an entity shall disclose (a) a maturity analysis that shows for financial liabilities the remaining contract maturities; and (b) a description of how it manages the liquidity risk inherent in (a)." Other accounting systems have requirements of their own.

CHAPTER 11: SUMMARY: TOWARD ACTIVE LIQUIDITY RISK MANAGEMENT

1 Consider, for example, that UK securities firms are not directly subject to the liquidity rules imposed by the Bank of England on other domestic banking institutions, even though they may have considerable liquidity exposures. The only "indirect" constraint that is applied is a capital charge on "non-trading" and "illiquid" assets, which might not be a sufficiently robust control.

2 The process should also involve ancillary and indirect forms of support, such as temporarily relaxing collateral, reserve, and solvency requirements for other institutions in the system, and sterilizing any system-wide liquidity injections in order to avoid inflationary pressures and currency weakness. In general, more "extreme" government actions, such as interest rate cuts, capital controls, or deposit freezing should be avoided, as these can send a potentially damaging signal to the marketplace at large, and actually affect liquidity.

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