1. INTRODUCTION

How much capital should a bank have? There was a time, not too long ago, when the answer to this question seemed simple, at least to some. More often than not, those who thought the answer was simple would have stated it in terms of the ratio of equity to assets, or something of that sort. Then came floating exchange rates, oil shocks, global inflation, swaps, inverse floaters and other tribulations, and the answer seemed not to be so simple after all. Regulators responded in kind with more complicated formulas; they introduced risk weights, credit-equivalent amounts, potential future exposures, maturity buckets and disallowances. How does this story end, and what is the moral of the story? Were things ever really simple? Do we have more confidence now in the accuracy of the capital assessments?

We must bear in mind two important facts in order to address those questions. First, regulatory capital has never been a mindless game played with simple mechanical formulas. In the United States, various guidelines have been used over the years, and compliance with the guidelines has always been reviewed by one or more supervisory authorities. However, supervisors have assessed the capital adequacy of individual institutions using the guidelines as only one of many inputs. Second, firms themselves have used a changing array of prevailing practices to develop their own estimates of the level of capital they should have. To be sure, mistakes have been made, but those mistakes typically did not result from thoughtless reliance on mechanical formulas.

This paper focuses on the relative emphasis that the structure of regulatory capital places on formulas and on supervision. The two are not viewed as mutually exclusive, but as elements to which capital policy implicitly assigns relative weights. We explore the relationships among regulatory formulas, supervisory appraisals and the prevailing business practices in the banking industry and ask: what is the appropriate mix of formulas and supervision?

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1. Although most of the discussion of this paper focuses on banks, the principles delineated apply also to other types of financial institutions that perform similar services. The focus on banks is adopted to make the analysis more concrete.
Why is this an important issue? Consider three related reasons. First, there is a risk of an increasing disconnect between regulatory capital and what banks and other financial institutions do. The last few decades have brought tremendous changes in the nature of financial firms, their activities, and their approaches to risk management. In such an environment, past regulatory achievements provide no guarantee of future success. Second, for much the same reasons, inertia will almost surely lead regulators down the wrong path. Steady progress in a given direction is not enough if the business has a tendency to change course – to innovate. Third, banks and other institutions are in danger of being over- or under-regulated as the business changes course. Over-regulation can thwart a useful economic role for financial institutions. Under-regulation can undermine faith in the financial sector and dampen its role as a catalyst for economic progress.

The issues considered here are difficult and fundamental, and they seem resistant to an approach based solely on straightforward economic analysis. Therefore, this paper makes use of a variety of tools. Section 2 examines the rationale for capital regulation. Section 3 then considers in detail the problems involved with using mechanical formulas to determine the appropriate level of capital, making reference to the expressed views of regulators, supervisors, market practitioners, and theorists. Section 4 considers new approaches to capital and section 5 concludes.

To preview the results, the principal conclusion is a reaffirmation of the benefits of informed supervision. Mechanical formulas may play a role in regulation, but they are in general incapable of providing a solution to the question of how much capital a bank should have. At the margin, scarce public resources are better employed to enhance supervision than to develop new formulas whose payoff may be largely illusory. Hence, among the new proposed approaches to capital, those that emphasize the importance of supervision relative to formulas seem to have the greatest likelihood of success.

2. ASSUMPTIONS OF REGULATORY CAPITAL POLICY

We examine in this section the basic reasoning that underlies regulatory capital as we observe it in practice. It is impossible to «prove» that there is any one right approach to regulatory capital. Support for any approach must ultimately rest on some ungrounded propositions. Therefore, I attempt here simply to list a series of assumptions that are likely to be representative of the thinking behind existing systems of regulatory capital. The structure provided by this inventory can then serve as a backdrop for the discussion of specific aspects of the regulatory capital framework.

The current system of regulatory capital requirements for banks in the United States and many other countries relies on formulas that indicate the minimum level of capital that each firm must hold at a given time. The formulas range from very simple measures, such as the ratio of equity to assets, to more complex constructs, such as the value-at-risk computations associated with recent market risk rules. Compliance with these minimum amounts is monitored through periodic regulatory reports and through regular on-site in-
specifications of the firms by examiners from the bank supervisory agencies. Firms that fail to comply with the stated requirements are subject to enforcement actions of differing severity, ranging from memorandums of understanding to orders of cease and desist.

What is the rationale for this type of system? Some support may be garnered by reference to technical or academic studies of various types. For instance, one may find in economics and finance journals a large number of studies that address the issue of the optimum level of capital for a bank in the context of stylized mathematical models of banking. Another relevant approach is to consider the deleterious effects of banking failures, either in actual periods of financial distress or in counterfactual analyses of potential systemic failures.

One conclusion to be drawn from all these studies is that it is difficult to define – let alone compute – the right level of capital for an arbitrary institution. In the end, the problem is so complicated and the technical tools so limited that reasonable persons may have substantial disagreements about the right amount of capital that a given firm should hold. Furthermore, there are no surprises to be found in the modeling approach. Writing down a model is tantamount to writing the conclusions from the model, which follow mathematically.

Hence, I do not approach the problem of capital here as an attempt to solve an optimization problem by standard technical means. Instead of thinking of the rationale for the approach to regulatory capital as a series of models, think of it as a series of assumptions, and consider whether the assumptions are acceptable. Only in this way can we hope to step back from preconceived notions and deal with the fundamental issues.

Thus, I list a series of assumptions, some of which are likely to be widely acceptable, whereas others may be more questionable. The subsequent analysis will not require acceptance of all of these assumptions, but specifying the assumptions in advance will help to elucidate some key issues in the design of regulatory capital and will provide a context for the discussion that follows.

Consider first some very general assumptions concerning the rationale for capital. These assumptions are relatively non-controversial and are probably widely held.

1. Capital can help protect the safety and soundness of individual institutions.
2. Capital can help protect the safety and soundness of the financial system.
3. Supervisors can play a socially useful role by monitoring the capital levels of financial institutions.

Assumption (1) is straightforward. Normally, the more capital a firm has, the less likely it is to fail or to experience financial distress, everything else equal. Assumption (2) is almost corollary to (1), save for issues relating to aggregation and to the correlation be-

2. Excellent surveys of this literature are found in Berger, Herring, Szego (1995), Dewatripont, Tirole (1994) and Santomero (1991).
tween the risks to which different firms are subject. We can conceive of a financial system in which firms' risks are largely independent and which is more stable in the aggregate than the individual firms. Alternatively, we can think of firms whose risks are so highly correlated that the sector as a whole contains much greater dangers than any one firm. In any case, the key point here is that capital helps deal with risk at the aggregate level as well as at the firm level. Support for these propositions may be found in Berger, Herring, Szegö (1995) and in many of the references contained in that paper.

Assumption (3) may be slightly less straightforward, particularly if an extreme «free market» point of view is adopted. Nevertheless, it seems likely that most observers would admit that the capital decisions of individual institutions may produce externalities and that an impartial public-sector supervisor with enforcement powers can play a useful monitoring role. In a related more general context, economic historian Douglass C. North (1990) argues that: «There are immense scale economies in policing and enforcing agreements by a polity that acts as a third party and uses coercion to enforce agreements.»

The following assumptions involve the appropriate levels of capital more directly, or the means of estimating such levels. Most of these assumptions are likely to have been maintained in the framing of capital requirements at one time or another.

(4) There is some level of capital that is consistent with the interests of the firm and the regulatory and supervisory objectives of safety and soundness. Call this the optimum level of capital.

(5) The optimum level of capital can be estimated with reasonable accuracy.

(6) A lower bound for the optimum level of capital can be computed from a mechanical formula.

(7) An accurate estimate of the optimum level of capital can be computed from a mechanical formula.

Assumptions (4) and (5) complement (3). Supervisors can perform a useful monitoring role as long as they know what to look for, and (4) and (5) essentially maintain that there is some appropriate level of capital and that an informed observer can reasonably ascertain whether that appropriate level is or is not attained by a given firm. Assumption (4) strikes a balance between the objectives of the firm and those of regulators, which in general are not identical. It is important to note that assumption (5) does not require that the supervisor be able to generate an estimate of optimum capital in the first instance, nor does it maintain that the estimate be obtainable from mechanical formulas.

Assumptions (6) and (7) can be expressed in statistical terms. They both may be viewed as stating that there is a mechanical formula that can produce a statistical estimate of optimum capital. In the first instance (6), the estimate may contain a large degree

4. The Modigliani-Miller (1958) theorem implies that under certain ideal conditions, the firm would not have a preference for any determinate level of capital. However, finance theory suggests that there are many important «market imperfections» that would argue for a determinate level of capital. See, for instance, Berger, Herring, Szegö (1995) and Miller (1995).
of uncertainty, and is useful only to the extent that it can provide a lower bound for the appropriate level. Assumption (7), in contrast, requires that the uncertainty regarding the estimate be relatively small. Note also that the term «mechanical formula» does not presuppose that the formula is simple. All that is required is that the formula be computable in a mechanical way, for instance by means of a computer program, however complicated.

Explicit regulatory capital requirements in the United States and in most other industrial countries are consistent with assumption (6). In fact, the 1988 Basle Accord (BASLE COMMITTEE ON BANKING SUPERVISION 1988) states that: «It should be stressed that the agreed framework is designed to establish minimum levels of capital for internationally active banks» (italics in original).

Assumption (7) is more controversial. The BASLE COMMITTEE ON BANKING SUPERVISION (1988), for example, is careful to point out that their measure is in no way optimal. They emphasize «that capital adequacy as measured by the present framework, though important, is one of a number of factors to be taken into account when assessing the strength of banks.» Of course, the fact that one specific formula is not sufficiently accurate does not rule out that other more accurate formulas may exist.

If assumptions (1) through (7) all held, there would be a high degree of confidence in the well-functioning of regulatory capital. In fact, many of these assumptions are unlikely to be controversial. Most problematic are those assumptions that involve some knowledge of the optimum level of capital, perhaps obtained by means of a mechanical formula. I refrain at this point from taking a stand on the assumptions. In the next section, I explore the issue of whether optimum capital is calculable by means of mechanical formulas.

3. THE PROBLEMS WITH FORMULAS

The landmark Basle Accord of 1988 was issued by the BASLE COMMITTEE ON BANKING SUPERVISION under the chairmanship of W.P. COOKE. The Accord relies heavily on mechanical formulas, but it is clear from the document that it by no means constitutes an unqualified endorsement of formulas. In fact, a few years earlier, COOKE (1981) had stated bluntly that «There is no objective basis for ex-cathedra statements about levels of capital. There can be no certainty, no dogma about capital adequacy.»

This section is an attempt to understand the limitations of mechanical formulas. Thus, we need to ask not just what is wrong with the formulas we have but, more importantly, whether we have reason to be optimistic about the existence and future discovery of better formulas that may be reliably applied for regulatory capital purposes.

5. There are other plausible formulations of assumption (6). For example, a mechanical formula could be seen as setting a level at which liquidation of the firm could minimize losses to taxpayers, or as a level at which aberrant behavior is curtailed, or as a lower bound for an acceptable – not necessarily optimum – level of capital.
One could easily conceive of mechanical formulas playing a useful role in banking if the business were completely determined by formal laws that were clearly stated and strictly implemented. In the words of legal philosopher H.L.A. Hart (1994), «Everything could be known, and for everything, since it could be known, something could be done and specified in advance by rule. This would be a world fit for mechanical jurisprudence.» However, the reality of banking is quite different: the business has important informal determinants and conventions that have evolved over the course of several centuries and that continue to evolve.

Banking has developed in most countries as a market solution to a common array of business problems. Furthermore, not only is the institution of banking an evolving response to economic conditions, but evolving economic conditions are in turn profoundly affected by the institution of banking. These mutual influences are so important that it would be impossible, in the context of a mature banking sector, to identify one as logically or chronologically prior to the other.

Fundamentally, banks and other financial firms are social institutions. They have emerged not by external design, but as sets of rules that rest on a social context of common activity. These rules are not limited to formal laws, like banking statutes and regulations, but also include conventions that are predicated on the agreement of the parties involved and on the existence of formal and informal criteria that may be used to determine whether the rules are being followed. Long ago, Commons (1934) recognized that «Collective action is even more universal in the unorganized form of Custom than it is in the organized form of Concerns. Yet even a going concern is also a Custom.»

Examples of informal rules abound in banking. There is remarkable consistency in the instruments that banks employ, even banks of different sizes and geographical locations. Consider, for example, commercial loans. There is some variation in the terms of these loans, such as maturity and reference interest rates, but the choices are typically conventional and essentially «menu-driven.» Furthermore, even the criteria for loan approval are determined by the normal practices of the business. Other examples of conventional instruments are consumer loans, mortgages, demand deposits and time deposits.

Although it is easy to conceive of such mutual influences, it is difficult to analyze them by means of a formal economic model. An interesting attempt is Caplin, Nalebuff (1997), who construct a model in which an institution’s policy depends on its membership, while its membership depends on the policies of all the institutions. They show that in general an equilibrium may not exist, but they analyze several useful special cases.

In this paper, the terms «rules», «formulas», and «models» have very different meanings, as the usage in the text demonstrates. «Rules» are interpreted quite generally to include conventions and other practices that are generally followed in the course of business but are not formally prescribed, for example, by statute or regulation. «Mechanical formulas» include mathematical expressions, but more generally any formula that can be constructed, for example, by means of a computer program and that, therefore, can be computed without human judgment or intervention. Finally, «models» refers to mathematical techniques applied to a specific problem, say to the estimation of optimum capital for a given bank. These models may include, among others, value-at-risk models for calculating market risk of trading portfolios.
to the issue of regulatory capital are conventions with regard to risk-management, such as simulation models for calculating exposures to fluctuations in market prices and, more generally, value-at-risk models. Consensus on these techniques, while not universal, is widespread.

The importance of informal rules or conventions is pervasive – not at all limited to banking. Even in disciplines that pride themselves on accuracy and objectivity, such as the natural sciences, informal rules are essential to the development of knowledge, as Thomas S. Kuhn has forcefully argued. In Kuhn (1970), he maintains that

Close historical investigation of a given specialty at a given time discloses a set of recurrent and quasi-standard illustrations of various theories in their conceptual, observational, and instrumental applications. These are the community’s paradigms, revealed in its textbooks, lectures, and laboratory exercises. ... Normal science can be determined in part by the direct inspection of paradigms, a process that is often aided by but does not depend upon the formulation of rules and assumptions. Indeed, the existence of a paradigm need not even imply that any full set of rules exists.

Similarly, North (1990) identifies informal rules – together with formal constraints and enforcement mechanisms – as a key factor in the development of economic institutions. He asks: «Where do informal constraints come from? They come from socially transmitted information and are a part of the heritage that we call culture.»

These interpretations suggest why it is problematic to apply mechanical formulas in the context of banking. The business practices of the financial sector, and in particular the informal criteria on which they are partly based, are dynamic and complex. A supervisory or regulatory regime that ignores these practices will fail to deal with the economic reasons for the existence of the financial sector and, if the restrictions are binding or even relevant, the regime will create economic distortions and inefficiencies that will make everyone worse off. Consider in turn the implications of dynamism and complexity.

There is no question that the financial sector is dynamic. As Greenspan (1997) put it: The question is not whether we will have changes in financial markets. Technology, globalization, and market innovations are bringing rapid changes that cannot be reversed. The open questions are how banking organizations will participate, and will they do so in ways that appropriately balance the tradeoffs among risk, minimal use of the sovereign credit, and maximum competition, public benefit and convenience?

This dynamism is not simply a result of the hectic pace of contemporary existence. Again, Commons (1934) anticipated later observers in noting that «Working rules are continually changing in the history of an institution.» And North (1990), drawing on historical observations, contends that «The stability of institutions in no way gainsays the fact that they are changing. From conventions, codes of conduct, and norms of behavior to statute law, and common law, and contracts between individuals, institutions are evolving and, therefore, are continually altering the choices available to us.»

The implications for the applicability of mechanical formulas to banking are clear. How can we rely on static formulas if they have to be applied to a business that is continually changing? This problem was clearly exemplified with the development of de-
derivative instruments in the 1980s. As noted earlier, one of the motivations behind the 1988 Basle Accord was to capture in capital calculations a new assortment of activities, such as swaps and other over-the-counter derivatives, that were virtually non-existent before 1982. Obviously, the only way to keep pace is to change the formulas.

However, a certain degree of predictability in regulation is helpful to keep the business sector running smoothly. What happens if, in an effort to keep up with the dynamism of banking, inflexible regulatory regimes have to be modified at an increasing pace? There is a tradeoff between predictability and dynamism, and there is a danger that changes are now (and will continue to be) required with increasing frequency.

Let us turn to the issue of complexity. The very fact that an activity is based on informal rules brings with it some degree of complexity. North (1990) contends that:

It is much easier to describe and be precise about the formal rules that societies devise than to describe and be precise about the informal ways by which human beings have structured human interaction. But although they defy, for the most part, neat specification and it is extremely difficult to develop unambiguous tests of their significance, they are important.

To be sure, one of the reasons for the complexity of informal rules is that they have not been written down, or formalized. However, the problem is not simply that they have not been specified, but rather that they defy specification. Behind the network of routine practices of the business lurks a system of true inherent complexity.

Just before the introduction of explicit capital requirements in the United States, the General Accounting Office (1981) issued a report that emphasized the difficulties in assessing such requirements. The report concluded that:

There is considerable doubt that required capital ratios can be set across the board, on other than a purely arbitrary basis. Prudent capital ratios will vary with the quality and character of a bank’s assets, the competence of its management, and the stability of the economic environment in which it operates. Banks differ greatly with respect to these characteristics.

These types of difficulties are even greater in the case of bank holding companies, which may comprise many different business lines – such as banking, securities and insurance – which may differ greatly as to both formal and informal determinants.

Now, we may ask, are the limitations imposed by the complexity of the problem merely a reflection of the current state of technical expertise, or are they in some sense hopelessly intrinsic, signaling that mechanical formulas will never work? This is a difficult question whose scope transcends the bounds of the present paper. However, results from the literature on computational complexity since the 1930s do not portend well for mechanical formulas in general. According to Moret’s (1998) survey of this literature, «We shall see that, unfortunately, most problems of any interest are provably unsolvable and that, of the few solvable problems, most are provably intractable (that is, they cannot be solved efficiently).» Moret’s results are not directly applicable to the problem of capital, but they deal with computational issues that have potential relevance to the development of capital formulas.
So, where do we turn? A decision by the SUPREME COURT OF THE UNITED STATES (1933) may be useful in providing some sense of direction. In referring to the Sherman Anti-Trust Act of 1890, the Court stated that

As a charter of freedom in the public interest, the act has a generality and adaptability comparable to that found to be desirable in constitutional provisions. It does not go into detailed definitions which might either work injury to legitimate enterprise or through particularization defeat its purposes by providing loopholes for escape. The restrictions the act imposes are not mechanical or artificial.

Abstracting from the specific legal issue facing the Court on that occasion, the general economic principles are close in spirit to those that we address here. The suggestions are clear: strive for generality and adaptability in statute and regulation, avoid detailed definitions that may be inefficient and circumventable, stay away from the mechanical or artificial.

Do we want to say, in conclusion, that there is no role for mechanical formulas in regulatory capital? No, that would be dogmatic and inflexible. Even if formulas are problematic as constraints on banks’ decisions, they may still be useful in some circumstances, for instance, to convey certain kinds of information about the bank or to make some inter-bank comparisons. We do not want, however, to be unreasonably restrained by lingering mechanical formulas for years or decades at a time. It therefore seems advisable to avoid writing detailed mechanical formulas into statute and possibly even into regulation.

4. WHAT ELSE IS THERE?

If mechanical formulas hold very little promise of identifying appropriate levels of regulatory capital, what else is there for regulators to turn to? In announcing the sweeping changes in financial regulation and supervision that took place in the United Kingdom in 1997, Sir ANDREW LARGE (1997) indicated that «I don’t think we should lose sight of the fact that so much in regulation is not about structure but about attitude and management: the <how> of regulation; the way it is done.» The implications for regulatory capital seem clear. It is an important priority of supervisors to determine whether the appropriate «attitude and management» toward capital prevail in a firm, to focus on the way things are done. It is less clear that they need to provide the firm with mechanical formulas to estimate the appropriate level of capital.

Yet, mechanical formulas produce tangible results, whereas «attitude and management» seem quite fuzzy. If we were to rely less on formulas, is there any substitute for the determinacy they seem to provide, or are we inevitably thrust into an environment in

8. I am grateful to Arturo Estrella (Sr.) for this reference. The approach to antitrust regulation implicit in this citation seems analogous to EUCKEN’S (1990) concept of «Ordnungspolitik».
which there are no guideposts and only discretion prevails? This is potentially a serious
difficulty, certainly in practical terms, but especially in view of the arguable importance
for authorities to commit in advance to certain types of behavior in order to avoid prob­
lems of moral hazard and time inconsistency. However, in banking, there is a network
of informal constraints – as described in the preceding section – that can provide a solid
grounding for the capital decisions of firms and the informed judgment of supervisors.

These informal constraints or conventions may be quite specific in areas where a
strong consensus exists, for example when firms compute the potential future exposure
of swaps using standard simulation models. Or the constraints can be more diffuse, for
example in areas like operational risk, where there is less consensus among firms as to
methodology. There may also be diverse opinions concerning the overall level of capital
of a given firm, though extreme values are likely to be easily spotted by a knowledgeable
observer. Thus, there is substantial determinacy even in the absence of requirements
based on mechanical formulas. Moreover, there is nothing that prevents the use of me­
chanical formulas informally to assess capital levels, especially if they are used simply
to convey information in the context of current practices rather than to constrain the ac­
tivities of firms in an inflexible way.

Recent work in game theory shows how conventions can develop even in the absence
of formal rules or regulations, and how those conventions can often take the form of very
specific constraints. Young (1993), for example, defines a convention as «a pattern of
behavior that is customary, expected, and self-enforcing. Everyone conforms, everyone
expects others to conform, and everyone wants to conform given that everyone else con­
forms.» Young’s (1993,1995) results suggest that detailed regulations may be unneces­
sary in many cases, as long as there exist conventions that are both sufficiently specific
and consistent with the views of policy makers. In fact, the introduction of detailed reg­
ulations may drive the economy away from a socially acceptable equilibrium.

Conventions are also useful in dealing with moral hazard and time consistency prob­
lems. Although formal economic models often imply that mechanical rules are necessary
for those purposes, the work of Williamson (1983) and North (1990), among others,
suggests that conventions are sufficient to achieve «credible commitments» in real­
world situations. A particularly relevant case is presented by North, Weingast (1989).
They argue that, following the Glorious Revolution in seventeenth-century England, the
Crown and Parliament agreed to abide by credible commitments that led to new institu­
tional arrangements. These new institutions, in turn, made possible the development of
modern financial markets.

The foregoing considerations suggest that, in designing regulatory capital require­
ments, it is desirable to avoid excessive detail in statute and regulation. However, to de­

9. Formal economic models are frequently used to argue that mechanical rules are preferable to discretion,
for instance in the conduct of monetary policy. See, e.g., Kydland, Prescott (1977). The basic intui­
tion provided by such results is useful, although the formalistic simplicity of the models leads to unreal­
istic extreme conclusions.
termine how much capital a bank should have, detail is ultimately unavoidable. One solution to this regulatory dilemma is to ensure both that firms delve into whatever level of detail is necessary and that supervisors have the necessary expertise to determine whether the details are properly handled by the firm. In terms of the initial question of this paper, less weight could be placed on the development of mechanical formulas, and more weight could be devoted to supervision.

We should note that, in this regard, there is no immediate cause for alarm. For example, the present system in the United States contains many features that are consistent with those goals. Among those features are a long-standing reliance on informed supervision, both on- and off-site, and the existence of a series of enforcement mechanisms to ensure that supervisory decisions are implemented. More recently, the introduction of the market risk rules provided greater flexibility to institutions and supervisors to make use of the state-of-the art in the measurement and management of risk. The principal concerns, however, are not with the present, but with the future evolution of the system. How do we make further progress, and how do we avoid allowing the dynamic environment to elude us? Using the general principles outlined so far in this paper, let us review a few recent ideas.

a. Refining the Basle Accord

There is much current discussion about refining the Basle Accord, although there is no single current proposal that can be identified specifically with this idea. One of the suggested refinements consists of increasing the number of «risk buckets». The Accord classifies instruments into essentially five risk categories and assigns risk weights to each one, ranging from zero to 100 percent. The current idea assumes that greater accuracy may be obtained by having a larger number of buckets, each one of which would be calibrated more finely than the original. This assumption seems somewhat heroic, given the large degree of uncertainty regarding the appropriate weights, even for the few original categories.

Another related idea is to use banks’ own internal credit ratings to calibrate the risk weights. Although this seems like a step in the right direction, it still lacks the flexibility to include portfolio effects and it may capture a concept of credit risk that is much narrower than that envisioned in the original Accord.

A problem shared by all such refinements to the Accord is the ultimate reliance on mechanical formulas, which do not allow for the incorporation of state-of-the art features in the measurement of risk. These refinements may serve as short-term palliatives to deal with the inflexibility of the current rules, but do not squarely confront the limitations of these rules with a view to long-term application. Furthermore, in many cases, the proposals create an illusion of precision by introducing many new parameters, none of which are necessarily more accurate than the original ones.
b. A full models approach

The success of the 1996 market risk amendments to the Basle Accord has suggested to some that it may be possible to continue further along the model-based route. Now that we have a model-based treatment for market risk, why not focus next on credit risk models, then on operational risk models, and so on? Alternatively, we could try to find aggregative models to measure the risk of the organization as a whole, rather than trying to break the problem down into various component risks. This idea, if correctly implemented, is not necessarily subject to the critique of mechanical formulas, since the models may be adjusted dynamically. However, the basic question in this case is: how feasible is a «full models approach» now, and how feasible is it likely to be in the future?

It is generally believed that the next logical step in the search for model-based regulation is to look at credit risk. An interesting study of current practices by the Federal Reserve System (1998) suggests that basing regulatory capital on credit risk models is in general not currently feasible. Some components of credit risk may be more accurately estimated, but it is still very problematic to deal with some of the riskiest classes of risk. Furthermore, in this case also, the concept of credit risk implicit in the models is narrower than the one regulators had in mind when formulating the 1988 Basle Accord. While it seems appropriate for regulators and supervisors to provide inducements to the industry to continue to develop and improve credit risk models, it seems premature to conclude that a full models approach is feasible in the short- or long-term.

c. The pre-commitment approach

The «pre-commitment approach» is an attempt to do away with mechanical formulas for the calculation of capital for market risk and to replace them with penalties for firms whose decisions are proven wrong by experience\textsuperscript{10}. Under this approach, firms pre-commit a certain amount of capital for market risk at the beginning of, say, each quarter. This amount may be determined by whatever means the firm sees fit. At the end of the quarter, the supervisor compares the firm’s losses arising from market risk, if any, with the pre-committed amount. If the loss exceeds the amount, a penalty of some sort is imposed. Kupiec, O’Brien (1995b) consider a broad range of possible penalties, from monetary fines to supervisory disclosures.

The pre-commitment approach is attractive for several reasons. First, it provides considerable flexibility in the determination of capital amounts. Second, it is not intrusive; it is designed to allow the firm to pursue its business objectives with few distortionary effects from regulation. Third, it seems to require little knowledge or effort on the part of the supervisor. With regard to banks’ internal models, Kupiec, O’Brien (1995a) argue

\textsuperscript{10} See Kupiec, O’Brien (1995b).
that «It is virtually impossible for a regulator to verify the accuracy of the size of the losses associated with rare tail events.» They propose instead the easier task of comparing actual losses with a pre-committed amount.

Though theoretically attractive, there are potential problems in the implementation of the pre-commitment approach. One central issue is the design of the penalty structure. The approach circumvents the need for mechanical formulas in the initial determination of capital, but regulators must address the need for a «penalty formula» at the other end. Should this be a mechanical formula, which might suffer from the shortcomings described in the previous section? Should there be room for supervisory discretion? Some proponents of the method might be put off by the introduction of discretion in a method conceived as objective and non-discretionary. In a recent paper, KUPIEC, O’BRIEN (1998) conclude that: «In our judgment, the severity of the information requirements for optimal policy design has not been sufficiently appreciated in the banking literature. ... We are pessimistic that any single regulatory design, incentive-compatible or otherwise, can be shown to be optimal in a heterogeneous banking environment.» There are also other more mundane issues with the pre-commitment approach, such as defining what is meant by «the firm’s losses arising from market risk.» Thus, the pre-commitment approach is basically attractive, but is not without its share of practical problems.

d. The base plus approach

In SHEPHEARD-WALWYN, LITTERMAN (1998), the authors start off by presenting a compelling analysis of the relationship between the results of typical value-at-risk calculations and the capital needs of a firm. They point out, for instance, that a full models approach based on models for individual risks is unlikely to lead to a sufficient level of capital once the pieces are added up, unless it is supplemented by some form of scenario-based stress testing. Their application of financial theory to the problem of regulatory capital is instructive and insightful.

The authors also suggest, in very general terms, an approach to regulatory capital that they term «base plus». The idea is that there is a base level of capital that is implied, for instance, by value-at-risk calculations. Since this level is likely to be lower (perhaps much lower) than the optimal level of capital, they suggest that the pre-commitment approach could be used to allow the firm to pre-commit an additional amount of capital that would represent the difference between the base and optimum levels. They also suggest that regulators could introduce a simple regulatory formula for a minimum capital requirement that would hopefully lie somewhere between the base and the optimum.

Notwithstanding the theoretical soundness of the risk analysis in their paper, the base plus approach seems to present substantial implementation difficulties. First, pre-commitment plays a key role in the approach. Since the practical shortcomings of pre-commitment have been addressed in the foregoing discussion, there is no need to restate the problems that this feature entails. Second, the various concepts of capital used in the
paper are not very explicitly defined, and it is not clear that they would satisfy the requisite inequalities (base is less than regulatory minimum is less than optimum). The proposal is intriguing, but ultimately the use of pre-commitment proves to be a dominant difficulty in its implementation.

e. The supervisory approach

Another idea from the recent literature is the «supervisory approach,» whose rationale is to focus primarily on the determination of optimum capital by the firm, monitored by the supervisor, while limiting reliance on mechanical formulas to a simple well-defined role in which they are more likely to be useful11. Under this approach, the firm would be accountable in the first instance for determining its own appropriate level of capital, abiding by sound practices developed in the context of the business. Firms engaged in trading of complex financial instruments, for example, would need to apply sophisticated mathematical techniques, which they would be required by supervisors to have at any rate for risk management purposes. Firms that focus on small business lending would have to apply very different techniques, most likely emphasizing more traditional credit analysis.

The supervisor would monitor the performance of the firm in the determination of the appropriate level of capital. There is substantial potential synergy between the supervisory review of risk management activities, which is already an important part of bank examinations, and the monitoring of regulatory capital in the way described. Furthermore, the attention paid by supervisors to the process, not just to the final result, provides incentives for firms to refine their management of risk. In monitoring the determination of capital, the supervisors would also ensure that the views of the firm are consistent with the public goals of systemic safety and soundness, and that there is no attempt to take undue advantage of elements of the financial safety net, such as deposit insurance. Procedures to enforce compliance through supervisory sanctions would have to be in place, much as they are now in the United States and other countries.

Finally, mechanical formulas could be retained in a relatively modest role as rough indicators of severely inadequate capital. If an institution were to require closure, it is in the public interest to prevent any losses from having to be borne ultimately by taxpayers. A formula may be helpful in this regard as a trigger point, much in the same way that prompt corrective action regulation is implemented for U.S. banks.

One important issue in the supervisory approach is that it places a substantial burden on both firms and supervisors. Firms have to be ready to take the necessary steps to make an accurate assessment of their need for capital. For many of them, reliance on mechan-

11. Some thoughts on how a regulatory approach could be designed are found in ESTRELLA (1995).
ical formulas would not be an option. Supervisors would have to develop and retain human and other resources that would enable them to come to grips with the full diversity of methods employed by firms.

The supervisory approach is in many ways similar to the system in place in the United States prior to 1981, which regulators in the end found unsatisfactory. However, the similarities are only superficial, because a broad array of new conventions has been introduced in the financial markets since 1981. For instance, in the 1970s, many financial institutions were caught off guard by sudden bursts of inflation and sharp rises in interest rates, and the magnitude of the resulting losses was staggering. Today, even the smallest institutions are aware of interest rate risk and are required by supervisors to manage it prudently. In general, firms and regulators are much more cognizant today of risk and risk-management, and this awareness has led to a whole structure of conventions designed to deal flexibly with new risks as they are identified.

The approaches to regulatory capital described above are examples of methods that might help effect a shift from mechanical formulas to supervision in the context of regulatory capital. As these and other potential ideas are discussed, what criteria can be used to evaluate them? Based on the analysis of this paper, the following questions seem appropriate.

- Does the idea make sense in principle? Does it address the shortcomings of the current system and is it based on sound theoretical analysis?
- What are the practical implications of implementation? What exactly is required on the part of the institution and on the part of supervisors?
- Is it a short-term fix or a long-term solution? Is it capable of handling new instruments and practices?
- Is it applicable to the institution as a whole? Would other different – and potentially inconsistent – approaches have to be developed for other risks or other parts of the business?
- Does it provide a level playing field for firms of different size, with different specialties, or in different countries?

5. CONCLUSIONS

The business of banking – or the financial sector in general for that matter – is based on a social context of formal and informal constraints that are dynamic and complex. To determine the right level of capital for a given financial institution, the use of mechanical formulas designed for use by all institutions seems grossly inadequate. This is recognized in current regulatory and supervisory practice, which relies on supervision to appraise actual capital levels that can substantially exceed stated regulatory minima.

Looking ahead, a more adaptable approach could be obtained by a further shift in the focus of regulatory capital from mechanical formulas to supervision. Formulas may play a role as long as their limitations are recognized and their use is circumscribed. Howev-
er, at the margin, the best use of scarce public resources in the area of regulatory capital would seem to be in the enhancement of supervision.

LITERATURE


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SUMMARY

There is a risk of an increasing disconnect between regulatory capital and what banks and other financial institutions do. The last few decades have brought tremendous changes in the nature of financial firms, their activities, and their approaches to risk management. In such an environment, past regulatory achievements provide no guarantee of future success. This paper argues for increased reliance on informed supervision of compliance with sound practices. Mechanical formulas may play a role in regulation, but they are in general incapable of providing a solution to the question of how much capital a bank should have. The paper concludes by applying these general principles to examine a series of specific new approaches to regulatory capital that are currently being discussed.