

Information: Hard and Soft

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Abstract

Information is an essential component of all financial markets and transactions. However information can arrive in multiple forms. In this paper, I begin to define what is meant by hard and soft information. Hard information is quantitative, easy to store and transmit in impersonal ways, and its content is independent of the collection process. Technology is changing the way we communicate and thus must fundamentally change the way financial markets and institutions operate. One of these changes is a greater reliance on hard relative to soft information in financial transactions. This paper discusses the advantages and costs of this substitution and the possible consequences of the hardening of information on both financial markets and institutions as well as those who study them.

I. Introduction: The History of Soft and Hard Information.

A major purpose of financial markets and financial institutions is to collect, process, and transmit information. Given the importance of information and communication to finance, as technology changes the way we communicate information, it must fundamentally change financial markets and institutions. However, newer technologies (i.e. those developed in the last forty years) are more adept at transmitting and potentially processing information which is easily reduced to numbers. I will call this hard information. Information which is difficult to completely summarize in a numeric score is what I will call soft information.

The transformation of banking over the last four decades, has been partially propelled by the different types of information up which credit decisions are made. Banks have historically been a repository of information about borrowers credit worthiness and the kinds of projects available to them. This information was collected over time through frequent and personal contacts with the borrower. Over time the banks built up a more complete picture of the borrower than was available from public records. Since banks focused on borrowers which were most difficult to observe and monitor (for example small and private firms), much of the information that they collected was soft information. This was source of the banks competitive advantage relative to arms length lending markets. As technology and competitive pressure (which make the push to lower costs greater) have increased the opportunities for using hard information, the competitive landscape for banks as repositories of soft information has changed.

In this paper, I want to discuss what is meant by hard versus soft information. Before defining the terms, I want to briefly discuss the use of these ideas in the literature. Then after discussing what is meant by hard and soft information, the paper examines the potential benefits and

costs of using hard instead of soft information in financial decisions. Finally, the paper considers the possibility of hardening soft information and what implications this has for both financial markets and finance research.

II. Soft and Hard Information in the Finance Literature

A. The Theoretical Literature

The finance literature has been exploring the distinction between soft and hard information for awhile. The distinction has not often been explicitly stated and even when it has been the definition has been incomplete. In the theoretical literature the distinction between the role of banks (or other private lenders) versus the public bond market is driven in part off the superior ability of banks to collect and process information (Diamond (1984), Diamond (1991), Ramakrishnan and Thakor (1984)). However, the public debt markets with the help of rating agencies have the same job description. The difference is the type of information each specializes in collecting and understanding. The public bond markets and the rating agencies collect financial disclosures, accounting reports, and default histories. Each of these has the feel of hard information. They can all be reduced to a series of numbers. Banks on the other hand, especially as described by the lending relationship literature, collect information which is neither initially available in hard numbers (the ability of the manager, their honesty, the way they react under pressure), nor are they easily or accurately reducible to a numerical score. Once the relationship is established, even then this information isn't hard. The firm is still unable to communicate this information to the broader lending markets and thus negotiate a lower loan rate from its bank (see Petersen and Rajan, 1994).

The literature on organizational form has also begun to exploit the distinction between hard and soft information to help explain the scope of the firm (Stein 2002). In many industries both small

and large firms co-exist. One might think that a dominant production technology would lead to a uniform firm size. However, if the information collection, processing, and communication is fundamentally important to the production process (e.g. banking or drug research), then firms may specialize in different sectors of the market depending upon the type of information (hard or soft) which is an input into their production process. Some firms may specialize in a production processes based on soft information and others in a production process that is based on hard information. Stein argues that larger, more hierarchical firms, where the decision maker is further from the information collector, are more likely to use production technologies which rely on hard information.

B. The Empirical Literature.

The distinction between soft and hard information has also been used to the empirical literature to explain organizational structure and access to capital. Due to the organizational diseconomies described in Stein (2002), large banks are expected to be less efficient at making relationship loans – i.e. those loans which depend upon soft information. Information in a large bank is potentially collected by one individual or group and a decision made by another. Thus the decisions must be made on information that is easy to transmit across physical or organizational distances. The information must also have a uniform interpretation which does not depend upon the context under which it was collected. Large banks are also more likely to have multiple layers of management – i.e. be hierarchical. Thus the oversight of loans in this context again implies that larger banks rely more on hard information.

Consistent with this intuition, Berger, Miller, Petersen, Rajan, and Stein (2001) find that larger banks are more likely to lend to more distance customers (greater physical distance between a firm and its bank) and communicate with the borrower more impersonally (by mail or phone

opposed to face to face). They also find that relationships between a firm and its banks are less durable and less exclusive the larger the banks. Most importantly, they find that firms which are forced to choose a larger bank than they would prefer (i.e. informationally opaque firms) are credit rationed. Such firms when they have the choice of which size bank to go to, choose to borrow from smaller banks and this matching alleviates much of the credit rationing.

More generally, the empirical literature has found that the access of firm's to capital depends upon how informationally transparent the firms are or how much hard information the financial markets have about the firms. We expect small firms to face greater credit rationing. This is why they are more reliant on banks which are better at extracting and using soft information. However, when we look among only small firms, we still find that a firm's access to credit is a function of how much information is available to the financial markets – not just the bank. Firms which are more informationally transparent, for example they maintain formalized records, find that they have a higher probability of their loans being approved (Petersen and Rajan, 2002).

For publicly traded firms, the amount of hard information available about the firm is much greater. However, even for publicly traded firms the existence of easy to access and evaluate information on their likelihood of default, i.e. a credit rating, appears to increase their access to debt capital. Controlling for traditional determinants of capital structure (e.g. taxes, asset tangibility, and growth opportunities), firms with a debt rating have 35 percent more debt than otherwise identical firms. Controlling for industry at the four digit level or controlling for firm characteristics using firm dummies does not change the result.

III. Characteristics which Define Soft and Hard Information

I do not have a simple definition of what information is hard and what information is soft.

Instead an objective of this paper is to begin to lay out what characteristics of information, its collection, and processing make it hard or soft. Like many labels in finance (e.g. debt and equity), there is no clear dichotomy. Instead, of two distinct classifications, I want to think of a continuum along which information can be classified. Thus my intent is to describe several dimension or characteristics that may be useful in this classification. This classification is important if researchers are to continue to explore this idea empirically.

Hard information is almost always recorded as numbers. Thus in finance we think of financial statements, the history of which payments were made on time, stock returns, and quantity output numbers as being hard information. Soft information is often communicated in text.¹ It includes opinions, ideas, rumors, economic projections, statement of management's future plans, and market commentary. The fact that hard information is quantitative means that it can easily be collected, stored, and transmitted electronically. This is why the advent of computers, large data base programs, and networking has been such a boon to production technologies which rely on hard information (quantitative lending and quantitative trading for example).

A second dimension of hard information is the way in which it is collected. The collection method need not be personal. Instead the information can be entered into a form without the assistance or significant guidance from a human data collector. This has the advantage of expanding the geographic and time dimensions across which data can be collected. With computers, telephones, and networks the information can be collected at any time and almost any place. The only required

¹ Can't text be converted to numbers and then stored and transmitted electronically? Text files can obviously be translated into numbers, this is how it is stored. Can't text files be processed electronically? Again the answer has to be yes, conditional on what one means by processed. Whether it can be interpreted and coded into a numeric score (or scores) is a hard question. This is what I mean by the hardening of information (see Section V). To the extent that text can be scored, then soft information can be hardened. The question is how much useful information is lost and how costly (or beneficial) this is. I will revisit this issue below.

input is access to the person with the required information. This collection method puts restrictions on what can be collected and how, and this forms one of the distinctions between hard and soft information.

There must be more to the distinction between hard and soft than the form in which the data is recorded. Hard information is also more comparable. Thus the person (or object) which collects the information can and often will be different than the person (or object) which evaluates the information and makes a decision. A firm's sales revenue for the year is an example of hard information. There is wide agreement as to what that means for a firm to have sales of ten million dollars last year. However, if we say the owner of the firm is honest, there is less agreement about what this means and why it is important. My interpretation of honest, may be different than yours.

One can always create a numerical score for soft information. I can create an index of honesty from one to ten or an index of the transparency of financial markets across countries. This in and of itself doesn't make this information hard. It must be that my interpretation of a three on this index is the same as yours.² For the information to be hard, the meaning is dependent only upon the information which is sent. I code the information and transmit it to someone else to make the decision. They know all that I know, or at least the portion of what I know which is useful. With soft information the context under which it is collected and the collector of the information are part of the information. It is not possible to separate the two. This is why soft information is collected in

² One of my colleagues has suggested that the distinction between hard and soft information is related to the distinction in the contracting literature of whether a signal which is observable by outsiders is verifiable by outsiders (see Hart, 1995). For a signal to be verifiable, the interpretation of the signal by the two contracting parties – and any third party who may be required to enforce the contract – must be the same. This is a characteristic of hard information.

person and historically the decision maker was the same person as the information collector.³ It is also the intuition in Stein (2002) for why smaller less hierarchical firms are better able to use soft information in their decisions.

With hard information, the collection and use of information can be separate. It may also be possible to delegate the collection and possibly the decision making based on the information. However, this puts further restrictions on the information which can be used. It has to be predictable. Sometimes we know before we have collected the information what possible values it can take (i.e. a signal will be either good or bad; one, two, or three) and why it will be valuable in making a specific decision. There are other times when we go search for information, but are not sure what we may find or why it is valuable until after it has been collected -- sometimes much later. Think of this as experience. Later when we are confronted with a decision, we recall the collected information (the experience) and it is only then that it is apparent (hopefully) why the information we collected is useful. This is another characteristic of soft information. If we don't know what the information will be used for, or which parts of the information are relevant or useful, it is difficult to code and catalog it for it for future use.

Knowing what information you are looking for and why it is valuable (i.e. for what it will be used) is essential if information collection and possibly decision making based on the information is to be delegated. If we knew what information we were looking for, we could specify instructions for collecting it and then delegate the collection to an underlying or a web page. Part of the reason hard information is more efficient (consumes less expensive labor) is because the collection and

³ A typical example is that of a relationship based loan officer. The loan officer has a long history with the borrower and based on a multitude of personal contacts has built up an impression of the borrower's honesty, credit worthiness, and likelihood to defaulting. Based on this view of the borrower and the loan officers experience, the loan is approved or denied (see Uzzi, 2000 for descriptions of the interaction between borrowers and loan officers).

processing of the information can be delegated. It is necessary to have an expert write out the rules or procedures by which the information is collected and processed. However, once the rules are specified, it isn't necessary to have the expert be a part of the actual data collection. It must be feasible, however, to specify which pieces of information (numbers) must be collected and coded prior to the actual data being seen by the expert. In this way the expert's knowledge has been embodied into the data collection rules. If the information is hard and you know all possible answers, then the next step – automating the decision process – is also feasible. In this case, the expertise of how to make the decision given the possible inputs is also automated by embodying the decision rules into a computer program, for example. Automated loan approval is one such example. This type of automation works, however, only when the information is hard, i.e. easily concentrated into a fixed set of numbers that uniformly communicate their relevant information.

IV. Advantages and Disadvantages of Hard Information.

A. Lower Costs of Production.

The evolution of financial markets over the last forty years has been in part a replacement of soft information with hard information as the basis for financial transactions. The full ramifications of this transformation are only now beginning to become apparent, and (as always) there seem to be both advantages and disadvantages of the change. One of the major advantages of using hard information is lower transactions costs. These come from several sources. First, by its nature, production technologies (such as loan origination) which depend upon hard information are easier to automate. The job of collection and in some cases processing of information can be delegated to lower skilled workers or computers. Thus expensive labor can be replaced by relatively cheap capital. This has been the source of productivity gains in the manufacturing sector. The

substitution of soft information for hard information may offer similar productivity gains. The size of these is an empirical question (see Petersen and Rajan (2002) for one example).

Hard information is also more standardized. By construction it arrives in the same format and is processed in the same way, for each application or transaction. This standardization introduces savings into the production process due to economies of scale. Once the computer system is designed and built to retrieve credit scores from the credit bureau and then make an approval decision on a credit application, adding additional applications to the system has a small incremental cost. This is one reason why lending based on hard information (credit cards) has come to be dominated by large lenders much more so than traditional relationship lending.

The greater reliance on hard information may also increase the competitiveness of these markets. First the standardization of information and the resulting lower transactions costs, can expand the size of the market. For small business loans and consumer loans, the size of the loans isn't large. Thus large fixed costs can make such loan prohibitively expensive.⁴ One of the advantages of hard information, and thus automation, is it can lower the transactions costs sufficiently to expand the number of suppliers who can profitably offer such loans. In addition to expanding the number of suppliers in a given market, a reliance on hard information can also increase the geographic reach and competitive impact of existing suppliers. The evolution of the mortgage and signature loan (now called the credit card) market is an example. In the fifties, the market was local and based on soft information obtained through personal contact. It is now national and based on hard information often obtained through impersonal contact. This has led to a wider availability and arguable cheaper capital to the middle class (Nocera, 1995).

⁴ For small business loans, the size of the fees are independent of the size of the loan. Thus the percentage fee declines with loan size (see Petersen and Rajan, 2001).

The nature of the information may also increase the competitiveness of the markets. Once the information is systematized and easy to communicate (hard), it also becomes more difficult to contain. In the early years of the credit reporting agencies (e.g. Bradstreets or R.G. Dun) , only a summary of the information they had on borrowers was published in their quarterly books (Carruthers and Cohen, 2001). This disclosed information was quantitative and easy to compare. Merchants in need of more detailed and in depth reports would purchase the detailed reports on specific customers. By keeping the information difficult to pass along, by maintaining its softness, the credit reporting agencies hoped to maintain their control over the information and thus extract greater rents from the information they had collected. Once information is hard, passing it along and appreciating its full value is easier. Information in electronic form can easily be passed along. Information which is hard can be understood independent of the collector. If the collector is not necessary, once the user has the data, this makes charging high rates to others for the data less feasible.

B. Durability of Information.

The durability of information is also potentially greater when it is hard. The fact that it is easily stored, means that the cost of maintaining it for future decisions is low. The fact that the information can be interpreted without context means that it is possible to pass it along to individuals in different parts of the organization (Stein, 2002). They no longer need to be part of the data collection process to be part of the decision making process. This is especially important if the people involved in data collection are not expected to be around later. Given the increased turn over in many finance professions (loan officers or investment bankers), the substitution toward hard information seems inevitable. As described in Crane and Eccles (1998), junior investment bankers

use to rise through the bank as junior employees of their clients rose through the ranks of the client. By the time a junior banker became a senior banker, they had developed a relationship with the people who were now the senior finance official of their bank's clients. There is no need to rely on formal records (hard information) in the presence of these long term relationships. However, when bankers turn over more frequently, the new bankers must rely on the records left behind by the previous banker. This creates a greater reliance on hard information.

C. Lost Information.

Part of the reason that hard information is less costly to communicate is there is less information. The replacement of soft with hard information inevitably results in a loss of information. This is why it is possible to use a smaller bandwidth to transmit the information. As an example, compare two methods of making a loan approval decision. First the stereotypic credit scoring decision. A finite number of quantitative variables are weighted and summed to obtain a credit score. Based on that score, a decision is made to approve or deny the loan. Compare this to the traditional lending relationship story of how a loan is made. After spending several hours discussing the borrowers investment plans and using the loan officers years of experience with the borrower, a decision is render. Both production technologies lead to a loan decision, but the first requires less information as an input to the decision.

The reduction of information is never good, as long as processing costs are zero. However, in reality the loan approval committee or risk management committee of a bank has a limited amount of time and attention to devote to each decision. Thus to prevent information overload, they need

the information to be concentrated down to what is important.⁵ The larger the organization and the higher we go in the organization, the more the information needs to be concentrated (or decision making delegated). When soft information is replaced with hard information, this concentration occurs. Granted information is lost – in some sense this is unavoidable (as when an analog signal is converted to a digital signal). The question is how much and what type of information is lost.

The concern about small firm's and individual's access to capital in the presence of bank consolidation and the growing use of credit scoring type lending decisions is driven by this question. If there are borrowers that are really good, but look bad on paper (i.e. when we look at only the hard information), then such borrowers would be incorrectly denied credit and thus credit rationed. The empirical evidence thus far is mixed. It is clear that some small borrowers are dislocated by their banks when the banks merge, but there is also evidence that existing and new small banks may be filling the gap. The underlying empirical question is how accurate can the hard information be. I want to return to this question when I discuss the hardened of information below.

D. Gaming the System

Thus far I have concentrating on the decision maker (e.g. the bank making a loan decision), not the target of the decisions (e.g. a loan applicant). By choosing to use hard versus soft information the decision maker is trading off the transactions costs of collection and processing the information with potential losses in accuracy of the information upon which they are basing their decisions. However, the way a decision is made and the type of information upon which the decision is made will also influence the actions of the target of the decision.

⁵ Friedman (1990) argues this is one advantage of a market economy. All of the information which is relevant to a consumer or producer about the relative supply of a good is contained in the price. He argues it is not necessary for a supplier to know whether the price has risen because demand has risen or supply has fallen. The supplier only needs to know that the price has risen and this will dictate his decision of how much to increase production.

Accounting numbers, a firm's income and balance sheet, are a classic example of hard information. The information is all quantitative, easy to store and transmit electronically, and there is uniform agreement about what numbers like revenues and costs mean. This is why quantitative decisions from asset allocation to credit approval rely on these numbers. However, reading the newspaper accounts of accounting manipulation and the manuals put out by the credit rating agencies make it clear, that these decisions are not simply a complicated function of the numbers the firms disclose. Neither do academic economists expect that mechanical trading rules based on the disclosed financial numbers can earn risk adjusted positive returns. The implicit assumption is that not all useful information is summarized by the numbers. Some of the relevant data is qualitative and requires a judgement call. It can not accurately be reduced to a number.

There is also an incentive effect for not making decisions such as credit rating depend only upon the numbers. Having a decision depend only upon the numbers can work, only if the cost of manipulating the numbers is sufficiently costly relative to the benefits. If a firm can raise its reported assets or sales by a small amount for a small cost and this would raise its credit rating and lower its cost of capital, it would have an incentive to inflate its reported assets or sales.⁶ The rules can not be direct functions of the hard numbers if the hard numbers are under the discretionary control of the market participants. In this case, the decision maker has an incentive to make the decision a fuzzy function of the inputs. The line between a AA and a A rating can be kept secret or

⁶ The importance of non-linearities in the return manager's receive to misstating their information is discussed in Jensen (2001). In his examples, the incentives to misstate ones information goes away if the payoff function is linear. Thus small changes in the reported information have only small changes in the manager's payoff. The fact that this information can not be verified is consistent with the intuition that the raw information is soft.

additional sources of soft information can be included.⁷ In practice this occurs, as models which try to fit the ratings as a function of the firms financial numbers don't have R^2 of one hundred percent.

V. Evolution of Information: Hardening Soft Information.

So far I have discussed the use of hard or soft information in making financial decisions. The idea has been that there are two types of production functions which use distinct inputs: hard or soft information. However, the nature of information is not exogenously fixed. This is a simplification. In practice, it is possible to change the nature of information. This is what I want to examine last: the ability to harden information. To do this, I want to consider two historical examples – the development of credit ratings and how the creation of the Center for Research in Security Prices (CRSP) influenced our understanding of how equity markets work.

Credit ratings originated in the U.S. during the nineteenth century. Prior to this time, most trade among merchants was local. The extension of trade credit was common and passed on repeated personal interaction among merchants (see Cohen (1998) and Carruthers and Cohen (2001)).⁸ However, with the development of the technology of communication and transportation it became feasible to sell ones goods to a geographically much larger market. The financial problem this opportunity exposed was the inability of the current method of evaluating credit worthiness to apply to the new customers. Merchants traditionally relied on soft information accumulated over time and repeated transactions. This wasn't possible with distant and unknown customers. Demand for new

⁷ There also may be strategic reasons to avoid a transparent mapping between the numbers and the credit rating. The business of credit rating agencies relies on market participants being unable to replicate the ratings at lower cost than the agency. If the mapping were a direct function of the inputs (income and balance sheet) and nothing else, some clever assistant finance professor would figure out the function.

⁸ The authors description of trade credit markets during this period is strikingly similar to Nocera's (1995) description of the consumer lending market of the nineteen fifties.

sources of information about credit worthiness, that did not rely on personal contact, was created. This led to the formation of such firms as the Mercantile Agency, R.G. Dun, and Bradstreets in the 1840s. These firms promised precise, standardized ratings which would allow merchants to avoid unprofitable loans.

The credit rating bureaus established local offices and relied on local merchants, lawyers, or banker as the source of their information. Thus the input to the process was the same soft information which had previously been the basis of the credit decisions.⁹ The credit agencies used this information to create two credit scores which were sold to merchants: pecuniary strength (essentially net worth) and general credit.¹⁰ In this way, the agencies were able to harden the soft information available to local merchants and provide it in a form which was not only accessible but useful to distant merchants. They could make lending decisions based on this number, even though they had no contact with the potential customer or the data collector. The standardization of the information in the form of the credit scores made this feasible.

The Center for Research in Securities Prices began as a database of monthly and then daily returns on all NYSE stocks – stereotypic hard information. There is rarely a disagreement about what a return of four percent means. Prior to the construction of the CRSP data bases, there was

⁹ “What went into the reports was a variable and unsystematic combination of facts and rumors about the firm, its owners, his personality, and family?” (Cohen, 1998)

¹⁰ Not all of the information which the credit reporting bureaus had was released in the form of the credit ratings. For additional fees, subscribers could visit the office of the agencies to view a detailed reports on a potential customer. The soft information which the credit rating bureaus had, they were either unable or unwilling to quantify an include in their reported credit scores. Interestingly information in these reports was better at predicting bad outcomes (business failures) than the published credit ratings (Carruthers and Cohen, 2001).

limited knowledge about what the returns on stocks were and what determined them.¹¹ The existence of a comprehensive data base containing the returns on all stocks, unleashed a torrent of research into the determinants of stock returns (the event studies). It was now possible to carefully document what announcements or events determined stock prices. The dependent variable was a unidimensional index of value, the stock price. The independent variables were also coded into numeric values. Initially the coding was rudimentary – dividends increased, decreased, or didn't change. Over time, the independent variable used to explain stock return in the event study became more elaborate. However, they were always quantitative simplifications of the underlying events.

Although the event studies often found important determinants of stock prices, even when they focused on the individual days when seemingly large announcements were made, the fraction of cross sectional variability which the models could explain was small. This omission could be due to daily movements driven by the trading process (market micro structure effects) or by the inadequacy of the right hand side variables. There are many forces that move stock price (rumors, news accounts, different interpretation of public releases) which are not easily and accurately converted to a numeric score. The market does converting this soft information into the hard information of stock prices, but the academic models have had difficulty replicating the process.

Part of the problem is that much of the information which drives stock prices, even when publicly available is in text form, not numbers. A typical firm's 10K filing can run into hundreds of pages. Its income and balance sheet, take up only half a dozen of those pages at most. However, the

¹¹ CRSP began with a question from bankers at Merrill Lynch. They wanted to know what the long run return on equities was. They turned to Jim Lorie at the University of Chicago, who didn't know either but was willing to find out for them. The process of finding out led to the creation of the CRSP stock return data base. The fact that neither the investment banks nor academic finance knew the answer to this question, illustrates how far we have come in depending upon hard information such as stock returns.

vast majority of studies which try to explain the changes in equity values with firm data rely on the accounting numbers. The reason academics haven't included the textual information in regressions, except in rudimentary ways is the difficulty of converting the text into numbers in a meaningful way. An first step in this direction is found in Das and Chen (2001). In their paper, they examine the effect of message board postings on the stock prices of Amazon and Yahoo. Although the algorithm is crude, it does show a potential way to begin incorporating the vast amount of textual data into our research. The markets are already doing this – how accurately is an interesting empirical questions – the next step is for academic research to catch up.

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