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COMPREHENSIVE AUDIT OF THE CRITERIA USED FOR SCORING APPLICANTS FOR CONSUMER CREDIT

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This paper presents a comprehensive audit of the criteria used for scoring applicants for consumer credit. The audit consists of two parts: the first part focuses on the criteria used in customized models, while the second part deals with those used in Fair-Isaac and Co (FICO) or generic models. This paper shows that most of the sets of criteria variables used in lending institutions and in literature are poorly selected and poorly defined.

INTRODUCTION

Consumer credit is any form of transaction under which an individual obtains money or goods or services on condition of a promise to pay for them along with a fee (or interest) at some specific future date or dates. The history of consumer credit dates back to 1730 when Christopher Thornton, a furniture merchant, created the first advertisement for credit by offering furniture on credit so that weekly payments could be made until it is totally paid off. This introduced the idea that people who could not afford to make immediate payments for items purchased could make regular installment payments until the full cost of the items were paid (2005). This idea grew steadily until it took a real turn in 1914 when Western Union introduced a metal card. From then on, the idea started to spread rapidly to many financial institutions. Today, the consumer credit industry is a booming business. The intensity of the boom is being heightened daily by the continuing explosive growth of e-business. Between 1946 and 1996, consumer lending in the United States grew from $9.8 billion to $1226.3 billion (see Cauvette et al., 1998). Today, it is a two-trillion dollars industry.

Consumer credit is beset with profound risks. As consumer lending has soared in recent years so too have consumer bankruptcies, defaults and delinquencies (witness Average, 1996; Barnett, 1972; BBC News, 2001; Caouvette et al., 1998; Daysog, 1996; Deluca, 1996; Moser, 2000; Orgler, 1975; Raybin, 2003; and Starvin, 2000, to mention a few). In developed economies, most credit grantors use one form of credit scoring or the other in their credit decisions to reduce these risks (see Asch, 1995; Lewis, 1994; Mester, 1997; Orgler, 1975; Overstreet et al., 1992; Saunders, 1997; and Thomas, 2000, for examples). However, the soaring cases of bankruptcies, defaults, and delinquencies call the predictive abilities or effectiveness of these scoring systems to question.

Credit scoring is a method of evaluating the credit risk of loan or consumer credit applicants. It involves the process of converting some information about a credit applicant or credit account into numbers that are added to obtain a score. The score so obtained is a measure of credit worthiness of the applicant or account. The general procedure for developing a credit-scoring system or model can be summarized in the following five major steps, some of which are performed simultaneously:

1) acquisition of sample data
2) identification of the key elements that differentiate between good and bad loans
3) assessment of proper weight to each of the key elements or criteria identified in step 2
4) preparation of scorecard
5) determination of the cut-off level

Steps 2 and 3 are performed simultaneously. The two steps and, partially, step 1 involve the identification, selection, and processing of scoring criteria. Also, the major inputs in step 4 are the scoring criteria or criteria variables. Despite their profound importance, little or no work has been done on the auditing and reviews of the criteria used in credit scoring and how effective the criteria have really been. A research of this nature is highly needed for the improvement of the existing credit-scoring systems and the developments of more efficient and effective ones.

In this research, we will undertake and present a comprehensive audit of the criteria used for scoring applicants for consumer credits. The audit of the criteria will be done in two parts. The first part will focus on the criteria used in customized scoring systems while the second part will deal with the ones used in generic scoring systems. The various sets of criteria used in the scoring systems developed and/or applied in literature and in the credit industries surveyed will be critically reviewed with respect to their quality, adequacy, and predictive abilities. Our survey of literature will cover a large number of articles from journals of credit, finance, operations research, management science, banking, economics and many other relevant journals. We will also review available official documents from credit industries and from credit-related web sites from many parts of the world. The criteria variables used in the literature and documents surveyed will be classified under some major credit criteria, particularly the C's of credit. We will compare the criteria commonly used in customized and generic scoring systems.

Furthermore, we will discuss the possible impacts of the United State's Regulation B on the effectiveness of the scoring systems used in the United States. The implications of the results obtained in our research for the developed, developing, and underdeveloped economies will be discussed.

Step 2. Audit of the Criteria Used in Customized Scoring Models: A customized credit-scoring model is a scoring model that is empirically derived, using a credit or loan grantor's history of paying and non-paying accounts. The use of data from the grantor's own credit or loan portfolio makes the model to be customized to the creditor's specific risk exposure.

Step 2.1. Data Collection: We have collected a number of different sets of criteria used in customized models in financial institutions, trading companies, and other credit-granting organizations to score applicants for consumer credits. This is done through thorough and extensive searches and reviews of a large number of relevant journal articles on credit scoring, behavioral scoring, and credit management. We also surveyed the internet extensively and reviewed relevant information, documents and internet publications. Furthermore, we collected information on the criteria used in some credit industries (in a number of developed and developing economies) in their customized models. Unfortunately, most of the models used in these industries are fully proprietary. This makes it somehow difficult to obtain information from them. But, fortunately, the criteria used in these industries are not different from those that are available or used in the publications and web documents reviewed. Many of the publications and web documents reported the developments and practical applications of customized credit models. These publications and web documents have been very useful. We must mention here that data on the criteria used in customized scoring models in developing and underdeveloped countries are few. Most financial institutions in these countries still depend on the use of subjective methods. They have not embraced the use of quantitative techniques.

Step 2.2.1. Classification of Criteria: We collected 24 different sets of criteria from various publications, documents, and credit-granting organizations and classified them under the C's of credit. (Due to lack of space, each set of criteria collected cannot be separately listed here). The Six C's of credit - Character, Capital, Capacity, Condition, (Economic condition or, specifically, Cycles), Collateral, and Credit history provide a good basis for evaluating an applicant. (Witness De Silva, 2005 and Longhi, 1996). (See appendix B for the definitions of the six C's of credit).

It must be mentioned that the most common variety of the C's of credit in literature are the Five C's of Credit, not the Six C's (see De Silva, 2005; Investorwords.com, 2005; LOANUNIVERSE.com, 2005; Lonier et al., 2003; and Triad Financial and Investment Corporation, 2005, for a few examples). Cases in which the Six C's of Credit are discussed or used are very scanty. In most of the cases where the Five C's of Credit are discussed or used, Credit History is not included as one of the Five C's (see Business Loan ORG, 2005; Investorwords.com, 2005; Lonier et al., 2003; and Triad Financial and Investment Corporation, 2005). Oftentimes, it is included as an item under Character.

Listing Credit History under Character as just a criteria variable grossly discounts its importance in consumer lending. Today, creditors can hardly approve credit for any applicant without evaluating the applicant's Credit History. According to Lewis (1994), many managers (if not most) find it difficult to accept an application, no matter how high its score on the customized scorecard, if the credit report or history is seriously negative. Many creditors make quick credit decisions mainly on a person's credit history or FICO score. Thijssen et al. (1999) deserves credit for recognizing the importance of Credit History by including it in their own list of Six C's.

We have selected the remaining five C's of credit included in our own Six C's after a thorough study and review of the different major criteria included in the different varieties of the C's of credit that we saw in literature. In classifying a criteria variable under a C of credit, we make sure that the variable is a part of what defines the C of credit and that it is one of the relevant variables that can be used to evaluate a credit application under the C of credit.

Table 1 shows the classifications of the criteria variables under the Six C's. The total number of criteria variables collected and classified under the Six C's are 119. This does not include their attribute variables. If attribute variables are included, we can have up to 180 criteria and attribute variables. The list of 119 criteria variables in table 1 is the biggest list of credit-scoring criteria we have ever come across in any literature.

For a more detailed study, we have tabulated the number of criteria variables that come under each of the C's of credit from each set of criteria. The first column of the table shows the serial number for each of the 24 sets of criteria.

Step 2.2.2. Comments on the Tables: Table 1 in appendix B shows that the number of criteria variables that relate to Character, Capacity, Capital, Credit history, Collateral, and Condition are 52, 29, 20, 13, 3, and 2 respectively. These respectively amount to 43.7%, 24.4%, 16.8%, 10.9%, 2.5% and 1.7% of the 119 criteria variables. These results show that the number of criteria that can be used to judge or evaluate the character of a credit applicant are far more than the number of those that can be used to evaluate him under the remaining five C's of credit. The results reveal two important facts. First, that credit or loan grantors are eager to have a very good understanding of the characters of a credit or loan applicant. Second, that credit or loan grantors understand that man is a very complex entity and, therefore, to have a good understanding of his character, a wide range of criteria covering his biological, social, and psychological characteristics and economic conditions are needed to evaluate him.

While it may not be exhaustive, the list of criteria variables under character contains most of what a creditor needs to evaluate an applicant's character. Therefore, table 1 provides a good source from which character variables can be selected and tested for inclusion in any credit-scoring model being newly developed.

Similarly, the list of variables under character and capacity contain almost all what are needed to evaluate a credit applicant with respect to his/her character and capacity to pay. Hence, the table also shows a source from which capacity and character variables can be selected and tested for inclusion in a new scoring model.

The table shows that Condition (or Cycles) has only two variables listed under it. This is a very good example of the inadequacies of most of the scoring systems. There are four major economic cycles, namely: depression, recession, recovery, and boom. The economic fortunes of many households change with these different cycles. It is a common knowledge that many families find it difficult to honor their credit obligations during the periods of economic depression and recession while many others lose their jobs. These usually result in massive pile-ups of credit-debts by these families and, consequently, crushing problems for creditors (see BBC News, 2001; Mueller, 1995; Palley, 1996; Thomas, 2000; and Wudumn, 1998).

The fact that Economic Condition is not a human characteristic may have been responsible for the absence of its defining variables on many scorecards. Many model developers see it as an environmental or exogenous factor. Therefore, they do not see how it can be defined to make it more relevant for evaluating an applicant's credit risk. If it is to be used for evaluating an applicant's risk, it must be made to be more of a personal characteristic through the use of surrogate criteria. Characteristic variables like the stability of an applicant's job, his profession, area of specialization, skill and income level can be used as surrogate variables under Economic Condition.

Due to the relationship between Collateral and Capital, the criteria variables listed under the former are among the ones listed under the latter. According to Bartels (1967), collateral is a special form of capital which is usually negotiated or readily represented by conveyance of claim or title. It is a specific security offered for credibility of the credit (or a special form of assets pledged for security in a credit transaction). The variables listed under Collateral are still parts of what define Capital. However, if a borrower has used any of the variables as collateral for a credit, he cannot use it again as a part of Capital or Collateral for a new credit. It must be noted that all the variables listed under Collateral may not all be used as collaterals for a single credit. The number of variables used will depend on the actual values of the collaterals. Despite its relationship with Capital, Collateral is listed as a separate C of credit for the following reasons:

1) It is a very important factor in making credit decision. Hardly can any creditor approve a major credit for any applicant without collateral. Due to its importance, adequate attention needs be given to it by listing it as a separate C of credit
2) It is one of the popular C's of credit in literature. It is frequently listed among the various C's of credit, namely: the 3 C's, 4 C's and 5 C's of credit
3) The variables listed under Collateral are special types of Capital variables that can be negotiated or represented as conveyance of claim or title or security. No Capital variables can serve their purpose

Capacity is considered to be the most critical of the six C's (De Silva, 2005). Therefore, one expects some of its variables to appear on every scorecard. However, contrary to expectation, two sets of criteria collected in our study have no capacity variable (see table 2). The number of capacity variables included in some others are too few. The number of Character variables included in each of the sets of criteria is more than the number of Capacity variables included. This has indirectly given more weight to Character than to Capacity. In fact, table 2 clearly shows that Character variables dominate all other criteria in every one of the sets of criteria collected. This is one of the drawbacks of most scorecards. The fact that the criteria variables for Capital and Credit history are much less frequently used while those of Economic Condition and Collateral are rarely used, show that most of the variables used in customized scoring system are Character variables. This is another major inadequacy of the customized scoring models.

As can be seen in table 2, the number of criteria variables contained in many of the sets of criteria collected are too small to cover important variables from each of the C's of credit. For example, only 33.3% of all the sets of criteria contain more than 15 criteria variables. With this small numbers of variables, it is impossible for all the major criteria of the C's of credit to be adequately represented on any scorecard.

Other reasons relate to the procedures used for selecting criteria variables and attaching weights to them. These procedures have serious drawbacks (witness Eisenbels, 1978; Glennon, 2001; Lewis, 1994; Nelson, 1997; and Wigington, 1980). These drawbacks result in selections of wrong variables, and in erroneous values of criteria weights. Procedures or models that can efficiently select important variables from each major criterion of the C's for inclusion on scorecards need be developed.

Step 2.2.3. Further Results and Comments: Based on the results in table 3, we have categorized the criteria variables collected in our research according to their usage rates, namely: most frequently used category, frequently used category, and slightly frequently used category. The criteria variables in each of these three categories and their usage rates are as follows:

Most Frequently Used Category

1) Income/Salary (87.5%)
2) Credit bureau information/credit history: (79.2%)
3) Length of time at present job (75%)
4) Employment/occupation (70.8%)
5) Length of time at present address (58.3%)
6) Number of dependants/children (45.8%)

Frequently Used Category

1) Age (41.7%)
2) Residential status (41.7%)
3) Years at bank (37.5%)
4) Number of checking accounts (33.3%)
5) Previous loan outstanding (33.3%)
6) Marital status (29.2%)
7) Own telephone (29.2%).

Slightly Frequently Used Category

1) Postal code (16.2%)
2) Assets (12.5%)
3) Installment rate/monthly payment (12.5%)
4) Outstanding mortgage bond/balance (12.5%)
5) Purpose of loan (12.5%)
6) Spouse's income (12.5%)

The percentage usage rate of each of the remaining criteria variables are less than (12%). These are variables that are used in only one or two of the 24 sets of criteria variables. (See table 3). For our purpose, we define the percentage usage rate of a criteria variable as the percentage of the number of the different sets of criteria variables in which it is used to the total number of the sets of criteria variables collected – which is 24 in this case. We assume that the usage rates of these criteria variables are functions of their predictive abilities. Thus, the criteria variables in the "most frequently used category" may have been found to be very predictive by the developers of the scoring models in which each of them is used. Our analysis and observations here agree with some literature results. For example, Leonard (1996) referred to a study that showed the most predictive criteria variables in credit scoring industries to be:

1) Number of bankruptcies
2) Number of credit or trade lines
3) Previous usage of credit or trade lines. (i.e., percentage of credit used to credit limits)
4) Credit history
5) Length of employment
6) Income
7) Occupation
8) Residential status
9) Length of time at address.

Steenackers et al. (1989) claimed that empirical evidence continues to suggest a strong statistical relationship between residential status, occupation, income, and previous payment behavior and the outcome of the current credit. Many other research reports show income, employment, residential status, bankruptcy, and serious delinquency as key predictors of credit risk. (See

O' Connor, 1992; O' Connor et al., 1999; Ozedmir et al., 2001; and Starvin, 2000;).

However, the pertinent question is how well the 19 criteria variables in the three usage-rate categories above cover the important factors of the C's credit. As predictive as each of them may be, putting all of the 19 on a single scorecard cannot ensure a good performance for a scoring system if their coverage of the C's is poor.

Out of the 19 criteria variables in all the three categories, 11 are associated with Character alone while the remaining 8 criteria variables are associated with Capacity, Capital, and Credit History. None is associated with Condition or Collateral. Thus, a scoring system that has these eighteen variables on its score card will have its prediction of credit risk based largely on Character, leaving all other major criteria poorly accounted for. Such a scoring system cannot be very effective. What we have here is indicative of the problems with most of the customized scoring systems used in credit industry.

There are obvious problems with the compositions of many of the sets of criteria variables collected. Variables that are known to be very good predictors of credit are absent in many of the sets. An example of these can be seen in the set from Crook et al., (1992) where applicant's employment status, his employment's category and years at present employment - all of which are known to be good predictors of risk - are dropped from the variables to be put on scorecard due to the problem of multi-colinearity. There are cases where major criteria and their variables appear together in the same set of criteria or on the same scorecard. Examples of these include cases where number of children and number of dependants, total income and salary, credit history and bankruptcy/delinquency appear together in the same criteria set as independent criteria variables. In Crook et al (1992), applicant's income was dropped from a selected set of criteria variables due to the problem of multi-co-linearity while spouse's income was retained! Other cases of these types of problems are too numerous to mention.

It should be noted that the use of age, marital status, and postal code in credit scoring are prohibited in the United States. The information presented on their usage in this paper is derived from published reports on the development and application of credit scoring models in countries where their uses are not prohibited. If the use of the variables were not prohibited in the United States, it is likely that they would be in the most used category.

Step 3. Audit of Criteria Variables Used in Generic Bureau Models: Generic bureau models are developed by using credit information that is available to credit bureaus or from other sources that may include or exclude credit information from the model's users. These models are generic and are not geared towards a specific industry or business. The generic scoring model with the most impact and influence in credit industries is the one that produces the FICO scores. FICO scores are calculated by feeding information from an applicant's bureau file into a statistical model.

Step 3.1. Data Collection: Our goal in this section is to audit the criteria variables used in generic scoring models. To achieve this we have reviewed several journal articles in the areas of consumer credit, finance, banking, management science, operations research, economics, and statistics. We have also reviewed articles and documents from the web sites of many credit bureau companies, credit consultants and developers of credit scoring models. A total of 62 criteria are collected from these sources. For convenience and for ease of reference, we will henceforth refer to these variables as bureau scoring criteria variables (BSCVs).

Step 3.2.1. Classification of the BSCVs: A credit applicant is evaluated under the following five major categories of BSCVs:

1) Payment history
2) Amount owed
3) Length of credit history
4) New credit established
5) Types of credit accounts.

Approximately 35% of the credit score is based on payment history, 30% is based on amount owed, 15 % is based on length of credit history, 10 % is on new credit established, and 10 % on types of credit accounts. (See appendix A.2 for brief definitions of these major categories). We have classified the BSCVs under these five major categories. Table 4 in appendix B shows the results of the classification.

Step 3.2.2. Comments on the results: A total of 62 BSCVs are listed in the table. This is the largest collection of BSCVs ever presented in any published paper, website, or document. The table shows that the number of BSCVs under payment history, amount owed, length of credit history, new credit established and types of credit accounts are 17, 17, 8, 9, and 11 respectively. Thus, Payment history and Amount owed have the largest number of BSCVs. From these classifications and by the percentage contribution of each of the major categories to the total credit score (as stated above) the following conclusions are obvious:

- That the relative importance of any criterion under Payment history is, at least, slightly more than the relative importance of any criterion under Amount owed
- That any criterion under Payment history or Amount owed is, at least, twice as important as any criterion under Length of credit history
- That any criterion under Length of credit history is, at least, one-and-a-half times as important as any criterion under New credit established or Types of credit accounts
- That any criterion under Payment history or Amount owed is about four times or, at least, three times as important as any criterion under New credit established or Types of credit accounts

The advantage of this classification is that it shows those variables that are very critical to good credit rating.

Step 3.2.3. Further observations and comments: A comparison of the types of variables in tables 1 and 4 shows that the BSCVs have a lot of inadequacies, much more than those used in customized scoring models. As can be seen in table 4 of appendix B, BSCVs do not include variables like income, employment status, length of time at present address, and number of dependants. These are just a few of the criteria that are generally known to be good predictors of risk but are not used in calculating bureau scores. With this shortcoming, it is obvious that any scoring model that is based on any set of criteria selected from table 4 will be less effective than the one based on criteria selected from table 1. This is one of the reasons why customized scoring models are generally more effective than generic scoring models.

Another problem with BSCVs is that they are mainly derived from bureau information. As a result, they have little or no relevance to the prevailing credit condition and culture of any specific industry or business. Therefore, one of the risks in using them for evaluating credit applicants is that the lenders are, in effect, substituting credit bureau system with their own system and culture.

The level of accuracy of information available on the BSCVs in the credit bureaus is another source of problem. Studies have shown that up to one third of credit reports could contain mistakes (2005).

According to Boyle et al. (1992), the natures of the generic scoring criteria variables and their associated generic bureau models give credit grantors the latitude to decide and choose which items in the credit history are acceptable and which items are not. The problem in this is that it leaves room for subjectivity.

The drawbacks highlighted above and several others, which are too numerous to mention here, are among the major causes of many reported cases of the failure of generic scoring systems to effectively predict the risks of credit applicants (see Johnson, 1992; Mester, 1997; Moser, 2000; and Simon, 2002, for examples).

Step 4. United State's Regulation B and Credit Scoring: In the United States, the Equal Credit Opportunity Act (ECOA) prohibits creditors from discriminating in any aspect of credit transaction because of an applicant's race, color, religion, national origin, gender, marital status, and age; and because all or part of an applicant's income derives from public assistance, or because the applicant has, in good faith, exercised any right under the Consumer Credit Protection Act. Altogether, regulation B prohibits the use of seven distinct criteria variables and two other items relating to an applicant's source of income and any action he might have taken in the past under the Consumer Credit Protection Act.

The objective of regulation B is to eliminate discrimination and inequity in lending. However, what the architects of regulation B did not realize is that there are surrogate variables that creditors can use in place of the prohibited variables for the same purposes that they (the prohibited variables) are intended to serve. Table 5 in appendix B shows the prohibited variables and some of the surrogate variables that can be used in their places. As indicated in the table, an applicant's race can be known through his name, physical appearance, or the area where he lives. It is a common trend for people of the same race to live in the same area. You can always know a person's race by his physical appearance. Similarly, the color of an applicant can be known through his name, physical appearance or home address. An applicant's gender can be known by his name, title or physical appearance. For example, only men use "Mr." as title and only women use "Ms." or "Mrs." as titles.

Answers to questions like: What is spouse's income? What is spouse's employment? What is your maiden name? etc. (see table 5) may indicate the marital status of an applicant.

An applicant's religion can be known through his name. People of some religious beliefs or persuasions have some typical or common names.

An applicant's age can be estimated through his response to the following question items: length of time at present job, length of time at previous job, length of time at present address, length of time at previous address, and occupation.

An applicant's response to question items like: occupation, salary, other income, and source of other income, can indicate whether or not a part or the whole of an applicant's income derives from public assistance.

As stated earlier in section 3, the nature of some scoring systems, particularly generic scoring systems, allows creditors the latitude to choose any item or variables they want to use to accept or reject a credit applicant. Having known an applicant's religion, age, gender, national origin and marital status through surrogate variables, his rejection for credit can be justified with any item or items where the applicant is found wanting in his credit report.

Another means by which lenders may have been factoring in the prohibited criteria into their credit scoring system is through the assessment of weights to surrogate variables. Weights may be assessed to surrogate variables in ways that allow the importance of prohibited variables to be reflected.

On the other hand, it appears that regulation B may have denied creditors in the United States the use of variables that may be good predictors of risk. Some of the regulation B criteria like age and marital status have been shown to be good predictors of credit risk in countries where they are not prohibited. For example, it has been shown that married couples pay their debt on time and that default risk decreases with increase in age (Sexon, 1977). This fact was corroborated by Ozedmir et al. (2001) who inferred that married couples pay credit debts more regularly than unmarried couples. Starvin (2000) also concluded in his article that married or older individuals are less likely to file for bankruptcies. We have also shown in section 2.2.3 that age and marital status are among the frequently used criteria in literature and in the official and web documents we reviewed. This is despite the fact that these two variables are not used in the United States.

The above observations show that the protections given to consumers through regulation B may have been having some negative impacts on credit business. They also show that, technically, there are loop-holes that credit-grantors can use to minimize the effects of Regulation B on their operations.

Step 5.1. Implication of the Results for Developed Economies: The findings and results obtained in this paper have a lot of implications for the developed economies. The applications of scientific and quantitative methods are very widespread in developed economies. However, due to the quality - quality in terms of completeness, level of redundancy, and operationality - of the criteria used in most of the credit-scoring models, the scorecards developed from their applications may not be effective. The following are among our major findings in the paper:

1) Most of the sets of criteria used in credit-scoring models do not cover the six C's of credit
2) Most of the sets of criteria contain highly disproportionate number of variables from some C's of credit
3) Most of the criteria are poorly selected and poorly defined
4) Economic conditions are not explicitly considered

The six C's of credit provide a good basis for evaluating an applicant for credit. Any set of criteria that does not cover the six C's cannot be said to be complete. Putting such a set of criteria on a scorecard will not produce good results. When criteria are poorly selected and defined, they will not be operational. Many of the poorly selected and poorly defined criteria will be redundant.

Economic conditions have obvious effects on the ability of borrowers to fulfill credit obligation. The adverse effects of the non-inclusions of variables representing Economic conditions on a scorecard are very obvious.

The four major findings listed above portend serious problems for consumer credit industries in the developed economies. The risks associated with consumer credit in developed economies will never abate unless these four problems are taken care off. The existence of these problems shows that enough attention is not yet given to the composition and quality of criteria being put on scorecards. Model developers pay more attention on the models used to select the criteria than the criteria themselves. They tend to ignore the fact that choosing the correct objective or criteria to score is, at least, as important as the statistical techniques used.

The inherent and structural deficiencies of most of the models used for selecting and weighting these criteria, despite the big attention being paid to them (the models), are the source of many of the problems highlighted above (see Baesens et al., 2003; Eisenbels, 1978; Glennon, 2001; and Wiginton, 1980, for a few examples). What this means is that basing the selection and weighting of the criteria variable used on scorecards solely on the use of quantitative models may not produce desired outcomes. We should start complementing the use of quantitative techniques with human judgment and experience while selecting criteria to go on scorecards. Until this is done, the high rate of bankruptcies, delinquencies and defaults being experienced in most developed economies, despite the widespread applications of credit scoring methods, may never be curtailed.

Step 5.2. Implications of the Results for Developing and Underdeveloped Economies: One of our findings is that very few information or data is available on the use of credit scoring criteria in developing and underdeveloped economies. This means that the use of objective factors and application of quantitative techniques in evaluating credit applicants are not yet popular in these economies. It is therefore apparent that creditors depend on the use of subjective scoring methods in the developing and underdeveloped economies. This situation is a major cause of inefficiency and/or pervasive fraud affecting the success and growth of consumer credit industries in many of the countries in these economies. This has made consumer credit a very risky business and, consequently, hindered industrial and business growth in developing and underdeveloped countries. Creditors in these countries need to develop capabilities for selecting and using best objective factors and techniques for evaluating credit applicants.

CONCLUSION

Although the lists of criteria presented in this paper are far from complete, they contain the largest number of criteria variables ever presented in any literature or official/web documents. The lists will be a good data base of criteria variables for model developers and credit analysts. The classifications of the customized and bureau/generic variables respectively under the Six C's of credit and five major bureau criteria will enable creditors to see the need for balance while considering criteria variables to be put on scorecards. This will, in turn, enhance their ability to develop efficient and effective credit scoring systems.

REFERENCES

Average, R. 1996. Credit risk, credit scoring and the performance of home mortgages. **Federal Reserve Bulletin,** Washington, July: 12-18.

Asch, L. 1995. How the RMA/Fair, Isaac credit scoring model was built? **Journal of Commercial Lending,** January: 10-16.

Baesens, B. Setiono, R., Mues, C., & Vanthienen, C. 2003. Using neural network rule extraction and decision tables for credit-risk evaluation. **Management Science,** 49: 312-329.

Barnett, R. 1972. Anatomy of a bank failure. **Magazine of bank Administration,** April: 20-23.

Bartels, R. 1967. **Credit management.** New York: Ronal Press Company.

BBC news. 2001. **Japan bankruptcies surge.** http://new.bbc.co.uk/1/hi/business/1387813.stm.

Boyle, M., Crook, J., Hamilton, R., & Thomas, L. 1992. Methods for credit scoring applied to slow payers. In: L. Thomas, J. Crook., & D. Edelman, (Eds.), **Credit Scoring and Credit Control,** 75-90. Oxford: Clarendon Press.

Business Loan ORG. 2005. **The five C's of credit.** http://www.businessloan.org/22.html.

Caouette, J., Altman, E., & Narayanan, P. 1998. **Credit risk: The next great financial challenge.** New York: John Wiley & Sons.

Crook, J., Hamilton, R., & Thomas, L. 1992. A comparison of discriminators under alternative definitions of credit default. In L. Thomas, J. Crook, & D. Edelman, (Eds.), **Credit scoring and credit control,** 217-245. Oxford: Clarendon Press.

Dasog, R. 1996. Credit card bankruptcies set isle record: an economist says a loss of job is responsible. **Honolulu Star Bulletin Local New,** September, 18.

Deluca, C. 1996. Credit card bankruptcies - no end in sight. **Carl Deluca's Law Review**, October.

De Silva, R. 2005. **The five "C's" of credit.** http://www.vancouvermortgages.com/mortgage_articles2-htm

Eisenbels, R. 1978. Problems in applying discriminant analysis in credit scoring Models. **Journal of Banking and finance,** 2: 205-219.

Glennon, D. 2001. Model design and validation: Identifying potential sources of model risk. In E. Mays, (Ed.), **handbook of Credit Scoring,** 243-274. New York: Glenlake Publishing.

http://creditscoring.com.

http://www.didyouknow.cd.creditcards.htm.

Investorwords.com. 2005. **5 C's of credit.** www.investorwords.com.

Johnson, R. 1992. Legal, social and economic issues in implementing scoring in the U.S. In L. Thomas, J. crook, & D. Edelman, (Eds.), **Credit scoring and credit control,** Oxford: Clarendon Press.

LOANUNIVERSE.com. 2005. **The five C's of credit analysis.** http://www.loanuniverse.com/credit.html.

Leonard, K. 1996. **Information systems and benchmarking in the credit scoring industry: benchmarking for quality management and technology.** http://www.proquest.umi.com/pqweb.

Lewis, E. 1994. **An introduction to credit scoring.** San Rafael, California: Athena Press.

Longhi, D. 1996. **The three C's for evaluating a credit applicant.** www/aedent.org/ced/oct96/credit.htm.

Lonier, T., & Aldisert, L. 2003. The 5 C's of credit: What they mean to your business loan. **Quarterly Newsletter of the Small Business Administration of Southern Nevada Enterprise Community,** 1: 7-12.

Mester, L. 1997. What is the point of credit scoring? **Business Review, Federal Reserve Bank of Philadelphia,** Sep/Oct: 3-10.

Moser, N. 2000. The good, the bad and the inconsistent in credit scoring. **Credit Union Journal,** 4: 127-133.

Mueller, H. 1995. Cycle and credit culture. **Journal of Commercial Lending,** 78: 41-47.

Nelson, R. 1997. **Credit card risk management.** Dallas, TX: Warren Taylor Publishing.

O' Connor, M. 1992. The score the limit. In L. Thomas, J. Crook, & D. Edelman, (Eds.), **Credit scoring and credit control,** 247-253. Oxford: Clarendon Press.

O' Connor, J. & Weinman, A. 1999. Benchmarking small businesses credit-scoring and portfolio management practices. **Journal of Lending and Credit Management,** 81: 74-79.

Orgler, Yair E. 1975. **Analytical methods in loan evaluation**. Lexington, Massachussetts: Lexington Books.

Overstreet, G., Bradley, E., & Kemp, R. 1992. The flat maximum effect and generic linear scoring models: A test. **IMA J Math Appl Bus Indust**, 4: 97-109.

Ozdemir, O., & Baron, L. 2001. **Examining credit default risk: An empirical study on consumer credit client.** www.econ.metu.edu.tr/cong2001/abstracts.

Palley, T. 1996. The forces making for an economic collapse. **Atlantic Monthly,** 278: 44-58.

Raybin, M. 2003. **Excessive credit card debt drive increase in personal Bankruptcies.** http://xavier.cs.northwestern.edu:800/article.asp.

Saunders, A. 1997. **Financial institution's management: A modern perspective.** Boston: Irwin.

Sexon, D. 1977. Determining good and bad credit risks among high and low income families. **Journal of Business,** 236-239.

Simon, R. 2002. Looking to improve your 'credit score? Fair Isaac can help. **Wall Street Journal**, March 19: A1.

Starvin, J. 2000. Credit card borrowing, delinquency, and personal bankruptcy. **New England Economic Review,** July/August: 15-30.

Steenackers, A. & Goovaerts, M. 1989. A credit scoring model for personal loans. **Insurance: Mathematics and Economics,** 8: 31-34.

Thijssen, C., Anderson, M., Chang, R. & Chou, H. 1999. **Credit worthiness in consumer credit: Final report.** http://www.sis.pitt.edu~thijssen.

Thomas, L. 2000. A survey of credit and behavioral scoring: Forecasting the financial risks of lending to consumers. **International Journal of Forecasting,** 16: 149-172.

Triad Financial and Investment Corporation. 2005. **Five principals of credit.** www.onlineMortgage.net.

Wiginton, J. 1980. A note on the comparison of logic and discrimination models of consumer credit behavior. **Journal of Finance and Quantitative Analysis,** 15: 757-770.

Wudunn, S. 1998. Experts say some Asian countries are in depression. **New York Times,** September 16: A1.

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Appendix A

Appendix A.1: Six C's of Credit and their Definitions

1. Character

This is the general impression a borrower makes on the potential lender. The lender will form a subjective opinion as to whether or not the borrower is sufficiently trusting to repay the loan. The borrower's educational background, work experience, job stability and experience in business will be reviewed. The length of time at his current employment and his current residence will be considered. The longer he has been at both, the higher he will score on the character scale.

2. Capacity

This is the most critical of the five factors. This refers to how much debt a borrower can comfortably handle. The prospective lender will want to know exactly how the borrower intends to repay the loan. The lender will consider the borrower's income as it relates to the loan that he is applying for. If the monthly carrying cost of the loan represents less than or equal to 32% of his total income, the probability that he will successfully repay the loan is fairly high. Prospective lenders will want to know about the borrower's contingent sources of repayment if his steady income stream is interrupted.

3. Capital

Refers to current available assets of a borrower, such as real estate, savings or investment that could be used to repay debt if income should be unavailable. Capital is reflected by the borrower's ability and willingness to save money and accumulate assets. The higher his net-worth, the more he has as a cushion for repayment in the invent he run into a financial set-back.

4. Credit history

This is the record of a borrower's credit habits. A lender will like to evaluate a borrower's ability to maintain his (the borrower's) obligations and determine how well the borrower lives within his means. The information about a borrower's credit history is stored at the credit bureaus and indicates how well he pays his bills over the last six years. All major credit cards, auto loans, bank loans, leases, etc. are reported to the credit bureaus.

5. Collateral

These are guarantees or forms of additional security a borrower can provide the lender. Giving a lender collateral means that a borrower has pledged an asset he owns, such as his home, to the lender with the agreement that it will be the repayment source in case he can't repay the loan. A guarantee, on the other hand, is just that someone signs a guarantee document promising to repay the loan if a borrower cannot repay it. Some lenders may require such a guarantee in addition to collateral as security for a loan.

6. Cycles (Economic conditions/Climate)

These are economic conditions and climate that can affect the borrower's ability to repay the loan. The most important economic conditions that should be considered by any creditor are the economic cycles. There are four major economic cycles, namely: depression, recession, recovery, and boom. The economic fortune of many households changes with different cycles. Many families find it difficult to honor their credit obligations during periods of economic depression and recession while many others lose their jobs. Lenders should find ways of determining the effects of economic cycles and other economic conditions on the ability of a credit applicant to fulfill credit obligations while evaluating him for credit.

Appendix A.2: Five Major Bureau Criteria and their Definitions

1. Payment history

Approximately 35% of the credit score is based on this category. The first thing any lender would like to know is if a borrower has been paying his bills on time.
Information about how an applicant has been paying his bill for the past five years can be obtained at the credit bureau.

2. Amount owed

This is the second most important factor. About 30% of an applicant's score depends on it. If an applicant's credit report indicates that he has high balances on several accounts, this may indicate to potential lenders that he is overextended.

3. Length of credit history

Approximately 15% of an applicant's score is based on this category. The longer the period of a borrower's credit history or experience, the better his score. Usually, the score considers the average age of the file, along with the average age of some of his important accounts.

4. New credit established

Approximately 10% of an applicant's score is based on this category. If an applicant's credit report indicates that he has opened several accounts in a short period of time, it may negatively affect his credit score. The actual accounts opened and inquiries posted on an applicant's credit file are taken into account.

5. Types of credit accounts

Approximately 10% of an applicant's score depends on this category. If an applicant's report shows a good mix of retail accounts, credit/Visa card accounts, etc., he will get better score. This is an indication that he has successfully managed various kinds of accounts satisfactorily.

Appendix B
Table 1: Classification of Customized Scoring Criteria Under the C's of Credit.

Character	**Character cont'd**
1. Full name	11. Geographical location
2. Age	12. Length of time at present address
3. Gender	13. Number of years since last home move
4. Marital status:	14. Length of time at previous address
➢ Married	15. Residential stability
➢ Widowed	16. Postal address
➢ Divorced	17. Personal status
➢ Single	18. Title/salutation
5. Age difference between man and wife	19. Foreign worker
6. Number of children	20. Nationality
7. Number of dependants	21. Number of years in the country
8. Type of marriage	22. Identification
➢ Community of property	23. Proof of residence
➢ Out of community of property	24. Proof of 1040 (if self-employed)
9. Residential status	25. Educational qualification
➢ Own home	26. Own a telephone
➢ Own apartment	27. Race
➢ Rent home	28. Profession
➢ Rent apartment	29. Group: minority or majority
➢ Living with somebody	30. Local references
10. Home address	31. Employment/Occupation

Table 1: Cont'd

Character cont'd	**Capacity cont'd**
32. Name of employer	7. Monthly bond payment
33. Position in employment/Company	8. Mortgage bond balance
➢ Unskilled	9. Debt/income ratio with or without mortgage debt
➢ Semi-skilled	10. Total monthly expenses
➢ Skilled	11. Percentage financial burden
➢ Managerial	12. Amount of loan applying for
➢ Executive	13. Duration of loan applying for
34. Previous employer	14. Other loans
35. Years with previous employer	15. Loan expenses
36. Length of time at present job	16. Monthly payment on estates
37. Employment stability	17. Money spent on dependants
38. Loan type	18. Bill/hire purchase discounted
39. Purpose of loan	19. Bonds stating to whom and property covered
40. Application type	20. Shares not fully paid up – amount of liabilities
41. Private or business loan	21. Bills payable
42. If applicant is known to loan manager	22. Previous credit/loan outstanding
43. Code of regular server	23. Terms of loan/credit
44. Number of years since last loan	24. A guarantor/surety to others. (Amount of liabilities
45. Spouse's occupation	25. Other parties. (Co-applicants)
46. Spouse's position	26. Duration of loans outstanding
47. Spouse's employer	27. Installment/monthly payment
48. Length of spouse's time with employer	28. Where automobile is financed
49. Years at bank	29. Pawn
50. How often you write bounced check	
51. Number of times of police arrests	**Capital**
52. Number of legal suits fought	1. Estimated value of property
	2. Landed property
Capacity	3. Bank balances
1. Salary	4. Medium/long-term investment
2. Total monthly income	5. Cash
3. Other income	6. Life stock
4. Discretionary income	7. Life insurance
5. Gross monthly salary of spouse	8. Make of automobile
6. Spouse's total income	9. Age of automobile

Table 1: Cont'd

Capital cont'd	**Credit history cont'd**
10. Value of automobile	6. Credit bureau information
11. Location of own home/state	7. Credit bureau inquiries
12. When home/estate is purchased	8. Debt to finance companies
13. First home trust	9. Number of bankruptcies
14. Second home trust	10. Checque-guaranteed cards
15. Other properties	11. Percentage usage of credit/trade lines
16. Net-worth	12. Pyramiding of debt
17. Number of savings account	13. Number of loan accounts
18. Number of checking accounts	
19. Number of deposit accounts	**Cycles (Economic condition)**
20. Number of investment accounts	1. Economic sector
	2. Interest rate
Credit history	
1. Credit rating	**Collateral**
2. Type of credit/loan outstanding	1. Landed property/estate
3. Have credit cards	2. Automobile
4. Number of credit lines	3. Other properties
5. Number of revolving lines of credit	

Table 2: Number of criteria variables under each C of credit in each set of criteria collected

Criteria Set's serial number	Character	Capacity	Capital	Credit History	Collateral	Cycles (economic)	Total
1.	8	1	2	1	-	-	12
2.	9	1	-	1	-	-	11
3.	7	-	1	1	-	-	9
4.	4	1	-	4	-	-	9
5.	5	1	-	3	-	-	9
6.	2	3	1	1	-	-	7
7.	3	2	-	2	-	-	7
8.	6	3	-	-	1	-	10
9.	10	5	3	9	-	-	27
10.	2	3	-	2	-	-	7
11.	17	7	5	1	-	1	31
12.	20	4	11	-	-	-	35
13.	5	-	2	1	1	-	9
14.	6	4	2	2	-	-	14
15.	12	5	4	1	-	1	23
16.	5	3	1	1	-	-	10
17.	2	2	2	1	-	-	7
18.	10	1	1	-	-	-	12
19.	9	2	1	-	-	-	12
20.	3	5	3	7	-	-	18
21.	12	4	3	8	-	-	27
22.	10	5	3	6	-	-	24
23.	7	4	2	2	-	-	15
24	7	4	3	-	1	-	15
Total	181	70	50	54	3	2	360

Table 3: Criteria Variables and Their Usage Rates
(Note that variables that appear in less than two different criteria sets are not listed here)

Criteria variables	Number of sets in which variable appeared	Percentage usage rate
1. Income/salary	21	87.5
2. Credit bureau information	19	79.2
3. Length of time at present job	18	75
9. Employment status/employment category/occupation	17	70.8
4. Length of time at present address	14	58.3
5. Number of dependants/children	11	45.8
6. Age	10	41.7
7. Residential status	10	41.7
8. Years at bank	9	37.5
9. Previous loan outstanding	8	33.3
10. Number of checking accounts	8	33.3
11. Own telephone	7	29.2
12. Marital status	7	29.2
13. Postal code	4	16.2
14. Purpose of loan	3	12.5
15. Spouse's income	3	12.5
16. Outstanding mortgage bond/balance	3	12.5
17. Installment rate/monthly payment	3	12.5
18. Assets	3	12.5
19. Gender	2	8.3
20. Local reference	2	8.3
21. Discretionary income	2	8.3
22. Number of savings accounts	2	8.3
23. Number of deposit accounts	2	8.3
24. Value of outgoings	2	8.3
25. Financial assets	2	8.3
26. Type of bank accounts	2	8.3
27. Have credit cards	2	8.3
28. Number of bankruptcies	2	8.3
31. Number of loan accounts	2	8.3
32. Defaults/delinquencies	2	8.3
33. Value of mortgage/home	2	8.3
34. Amount of loan	2	8.3

Table 4: Classification of Generic Bureau Variables Under Five Major Bureau Criteria

Payment history
1. Account payment history too new to rate
2. Time since delinquency is too recent
3. Number of accounts with delinquency
4. Delinquency accounts- details on delinquents
5. Too few accounts currently paid as agreed
6. Time since derogatory public record for collection
7. Serious delinquency, derogatory public record or collection
8. Number of minor derogatory reports
9. Number of major derogatory reports
10. Number of public records
11. Too recent legal filing or collection
12. Tax liens
13. Foreclosures
14. Number of defaults
15. Number of bankruptcies
16. How many accounts show no late payments
17. Amount past due on delinquent accounts or collection items
Amount owed
1. Amount owed on all accounts
2. Too many accounts with balances
3. Proportion of balances to credit limits is too high on revolving accounts
4. Amount owed on revolving accounts is too high
5. Amount past due on accounts
6. Too many bank or national revolving accounts with balances
7. Proportion of loan balances to loan amounts is too high
8. Ratio of balances to line
9. Sum of bank card balances
10. Sum of bankcard lines
11. Sum of revolving balances
12. Sum of retail balances
13. Sum of installment balances
14. Sum of installment loans
15. Amount of total credit line being used on credit cards and other revolving accounts
16. Lack of some specific type of balances in some cases
17. No recent non-mortgage balance revolving information
Length of credit history
1. Length of revolving credit history
2. Length of credit history too short
3. Your credit reports shows that your recent credit transactions are too few
4. Time since first credit history
5. Age of oldest trade
6. How long your credit account has been established
7. How long specific accounts have been established
8. How long it has been since you used certain accounts
New credit established
1. Too many accounts opened in the last 12 months
2. Too many recent inquiries in the last 12 months
3. Date of last inquiry too recent
4. Number of promotion inquiries
5. Total number of credit inquiries and which companies inquired on your credit information
6. Age of youngest trade
7. Time since most recent account opening
8. Number of new accounts you have opened
9. Your most recent credit history
Types of credit accounts
1. Number of bank revolving accounts
2. Consumer finance accounts
3. Bank installment trades
4. Number of open trades
5. Sales finance trades
6. Finance company trades or number of finance company accounts
7. Lack of auto loans/lack of recent information on auto loans
8. Too few accounts now current
9. Lack of recent bank revolving information
10. Lack of recent revolving account information
11. Lack of recent installment loan information

Table 5: Prohibited Criteria and Their Surrogates

Prohibited criteria	Surrogate
Race	Name, home address, physical appearance
Color	Physical appearance, home address, name
Gender	Name, title (i.e. Mr., Mrs., Ms.), physical appearance
Marital status	Questions like: what is spouses income? What is spouse's employment? What is your maiden name? Title: Mr., Mrs., length of time spouse has been at present job? Length of time spouse was with previous employer? Total family income
Religion	Name
National origin	Name, accent, physical appearance
Age	Length of time at present job, length of time at previous job, length of time in address, length of time in previous address, occupation
Whether or not part of an applicant's income derives from public assistance	Occupation, salary, other income, source of other income