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Impact of Basel II Capital Accord on Small and Medium Size Enterprises (SME): An Empirical Study on a Group of Export Oriented SMEs

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Abstract

The purpose of this study is to find the relationship between lending to Small and Medium-size Exporter Enterprises (E-SMEs) and the use of Basel II Capital Accord for the first time in the banking system of Iran. Results showed that 96.69 percent of small firms were in the very low risk category of credit portfolio. This proof explains a consistent and balanced

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relationship between risk- weighted assets distribution system (RWA) in Basel II Capital Accord and firms' size. In other words, the smaller the size of the firm, the smaller their risk-share in the credit portfolio would be. Furthermore, according to the results found by Probit regression with an endogenous covariate, the higher ratings the firm recovers, the less risk-share in bank's portfolio the firm will enjoy. Thus, it is indispensable that banks, chiefly specialized banks, should take action towards the allocation of parts of the credit portfolio to SME exporter financing. Accordingly, it is essential to design particular credit scoring models for these firms.

Keywords: *Exporter SMEs, Basel II, Capital Requirements, Probit Model, Credit Risk*

JEL Classification: *G28, G21*

1. Introduction

The role and importance of the small and medium enterprises (SME) is discussed, not only in developing but also in developed countries. This concept has created the main advantages of these firms that can be used to stimulate and encourage entrepreneurship, dynamism and flexibility, rapid growth potentials, high efficiency, and high impact on the growth of GDP. The prosperity of small and medium enterprises depends on investments in innovation and service quality.

Currently, in addition to the significant role of SMEs in economic growth and the stability of the economy, it is crucial for financial institutions to allocate a major portion in their credit portfolio for financing low risk SMEs, in order to maximize their profit margin. This will help financial institutions to create a protective shield (buffer) to minimize the risk in all areas which they are active in.

On the other hand, the laws and regulations which are relevant to the capital requirements of banks, impact upon the SME credit. The most important effects of an increase in the requirements of the SMEs are the changes in the management structure and the collateral accepted as a tool.

In general, the Basel II includes a set of pillars and principles that will be assigned to improve the structure of the banking systems. The three basic pillars are: the minimum capital requirements, supervisory review process, and market discipline. Minimum capital requirements can be calculated on the operational risk and credit. The regulatory process can be found by examining the compatibility between a bank's capital structures and strategies and the overall risk characteristics. Thus, the necessary precautions are compiled to improve the regulatory structure.

To avoid a systematic crisis and credit risks, banks must consider the amount of capital to offset losses stemming from the payment of their loans.

Hence, Basel II with capital requirements has an impact on the small and medium enterprises via an increase in their requirements.

In this research we are aiming at two main purposes; firstly to investigate the probable impact of Basel II Capital Accord on the distribution of Risk Weighted Assets of export oriented SMEs in financial institutions' credit portfolios, and secondly to provide a specialized model for measuring the default risk of SMEs, considering their export oriented structure.

The main argument for this special treatment is that SMEs are typically more affected by idiosyncratic shocks than systemic factors. SMEs are certainly riskier than larger firms, but their riskiness tends to be scarcely influenced by systemic drivers; in other words, asset correlation is lower and the defaults tend not to be related to each other. Banks can therefore diversify such risks by pooling a large number of claims on SMEs in their loan portfolios. The issue of the capital requirements attached to the exposure of SMEs is important for three reasons: First, in some countries, SMEs play a crucial role in the economy, in terms of contribution to both GDP and employment levels. Secondly, some banks have devoted a large part of their activities to finance this category of firms. Thirdly, after the crisis, some observers have blamed Basel II for allowing banks to drive with insufficient capital levels, while others have raised serious concerns for a possible crisis of credit, particularly for the SMEs.

In this paper, in order to quantify the expected effect on the bank's capital requirements when considering a small firm as either retail or corporate; we use data from a sample of large Iranian banks. In Section 2, we show the bank's capital requirements using formulas and the profile from the Advanced Internal Rating Based (A-IRB) approach. In Section 3, we review the extant Iranian and other countries' research literature on the expected effects of Basel on SMEs. In Section 4, we have estimated the probability of defaults, maturity, loss given default (LGD), and exposures. In order to perform our analysis, we develop the Probit model to assign focus on the evaluation of exporter SMEs' PD in our samples. In Section 5-6, we

submit our model performance. Finally, we summarize our results and derive our main findings, focusing on the possible changes in the relationship between the Basel II framework and SMEs.

2. Lack of Finance for SMEs

Concerns have been raised that Basel II will change the viewpoint of banks about analyzing credit and this concept has created new credit risk management techniques and possibly reduced the focus of lending activity towards SMEs. This is due to banks' potential perception that SMEs carry higher risk and, hence, higher capital requirements than under Basel I. Many SME associations in different countries have publicly complained about the new rules and many governments are concerned.

The SMEs, particularly in developing countries, compared to larger firms, are facing significant financial constraints. In fact, these firms, compared to large firms, do not have access to appropriate banking credits and therefore, do not have the appropriate credit policy, whereby access to financial resources, in the lower and medium income countries, is more limited. Many studies show that for these firms, facing a lack of access to external financing has caused their limited growth. When the economy is under monopoly conditions, the SME problems of financing will be exacerbated. The lenders avoid providing financial resources to special types of SMEs, especially in the case of emerging and newly established firms with no adequate collaterals and firms with a high default risk. In a competitive market, suppliers of financial resources have powerful incentives to fix these limitations and obstacles. For financing SMEs, banks will have to develop a credit line in order to increase the performance and effectiveness of these corporations. However, in several countries, there are financing markets for supplying the required financial resources to SME businesses (OECD, 2006).

2.1. Bank capital requirements and SMEs

In this section, we derive bank capital requirements relating to SMEs for Iranian banks, which are the concern of this research. Methodologies, formulas, and profiles are clearly defined in order to allow better understanding of the final results. We first examine the definition of an SME in Iran.

We find that there is no common definition for the segment of SMEs across different countries. The explanation varies from country to country taking into account the variant quantitative and qualitative variables. We restrict our focus on the important economy of Iran. However, in Iran there is little unanimity regarding the definition of SMEs. Various ministries, institutions, and organizations connected to SMEs in one way or another have their own criteria to describe, categorize, or define SMEs.

As defined by the Ministry of Industry and Mines and the Ministry of Agricultural Jihad, Small and Medium Enterprises are (rural) industrial and service enterprises with less than 50 employees. The Ministry of Cooperatives alternately uses the criteria of the Ministry of Industry and Mines, or of the Statistical Office of Iran in describing SMEs. The Iranian Statistical Yearbook for 1999 categorizes businesses into four classes, i.e. businesses with 1-9 employees, 10 to 49 employees, 50 to 99 employees, and those exceeding 100 workers. Nevertheless, this categorization bears some likeness to the definitions used by the EU, as the Statistical Office of Iran only considers businesses with less than 10 employees to be Small and Medium Enterprises; all others are regarded as “Large Manufacturing Establishments”. Incidentally, the Central Bank of the Islamic Republic of Iran also describes establishments with less than 10 workers as SMEs. Reciprocally, SMEs in the EU are described as non-primary enterprises employing less than 250 employees” (Hassanzadeh, *et al*. 2012). They are sub-divided into:

Table 1: The Categorization of Medium and Small Enterprises in Iran

Micro enterprises	Small enterprises	Medium-size enterprises
1-9 employees	10-49 employees	50-250 employees

In addition, their turnover should be less than €40 million. With total turnover of less than € 27 million, ultimately, they should be economically independent, i.e. more than 51% privately owned (Iran Strategy Document, 2003).

This section provides the role of SMEs in Iran with regard to various important variables. "Activities of SMEs in Iran show that 98.43% of all businesses are retail enterprises with 1-9 employees, since the total of small businesses with 10-49 employees amounts to only 1.43%. There is an imbalance between the large number of retail enterprises and the marginal number of small and medium sizebusinesses. It may be noted that the lack of a moderate number of medium-size enterprises, amounting to only 0.11% of the total number of enterprises, is negatively affecting Iran's competency to produce an export market" (Hassanzadeh, *et al*. 2012).

In Pillar 1 of the new Basel II Capital Accord, the principles to calculate a bank's *Capital Requirements*[1] for each of the different segments are plainly expounded. We converge on the formulas that can be used for SMEs when the A-IRB approach is applied. As previously stated, banks can classify SMEs as retail, utilizing the formula for "other retail exposures", or as corporate, applying the corporate formula with the adjustment of firm-size. All formulas follow the same calculation steps involving inputs for correlation (R), capital requirement (K), and risk-weighted assets (RWA). There

1. To avoid a systematic crisis and credit risks banks must consider the amount of capital to offset losses stemming from the payment of their loans.

are three important input variables to be provided by the banks, [PDs, LGDs, and exposures at default (EADs)], while the asset correlation (R) is

Table 2: The last version of Basel Committee formulas

capital requirements (CR)

$$CR = \left\langle LGD \times N\left[\frac{G(PD)+\sqrt{R}\times G(0.999)}{\sqrt{1-R}}\right] - PD \times LGD \right\rangle . \left\langle \frac{1+(M-2.5)\times b}{1-1.5\times b} \right\rangle \quad ,$$

$$\boldsymbol{b} = \left(0.11852 - 0.05478 \times \mathrm{Ln(PD)}\right)^2$$

$$Correlation\ (R) = 0.12 \times \left(\frac{1-e^{-50\times PD}}{1-e^{-50}}\right) + 0.24 \times \left[1 - \left(\frac{1-e^{-50\times PD}}{1-e^{-50}}\right)\right] \quad ,$$

$$\mathrm{RWA} = \mathrm{K} \times 12.5 \times \mathrm{EAD}$$

SMEs as Corporate

$$R - 0.04 \times \left(\frac{1-(S-5)}{45}\right) \text{ for consolidated group (SME) less than 50 mil €}.$$

$$Correlation\ (R) = 0.03 \times \left(\frac{1-e^{-35\times PD}}{1-e^{-35}}\right) + 0.16 \times \left[1 - \left(\frac{1-e^{-35\times PD}}{1-e^{-35\times PD}}\right)\right]$$

SMEs as Retail

$$CR = \left\langle LGD \times N\left[\frac{G(PD)+\sqrt{R}\times G(0.999)}{\sqrt{1-R}}\right] - PD \times LGD \right\rangle$$

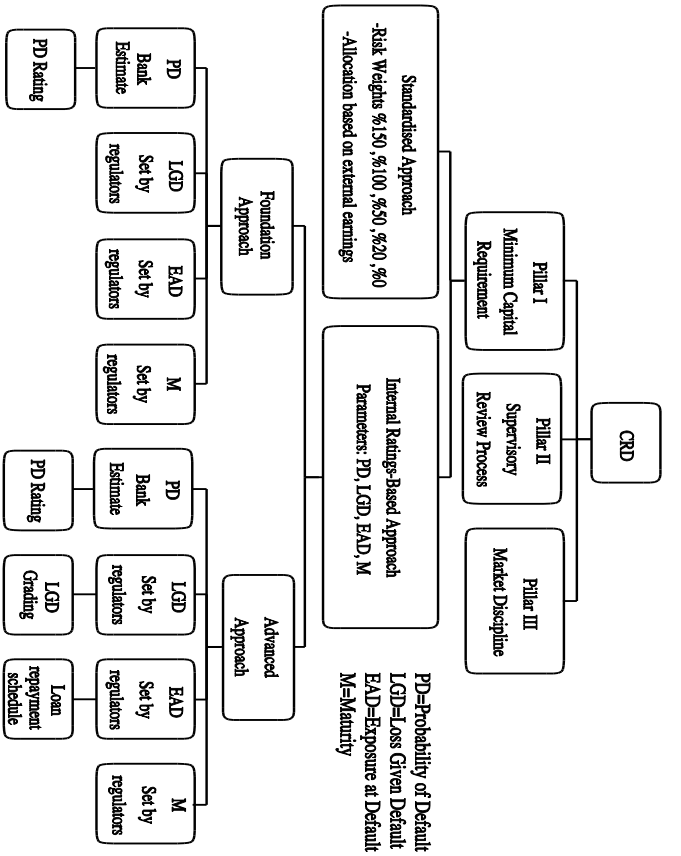
CR: Capital requirement or regulatory capital, as a percentage of the EAD
LGD: Loss given default
N(x) : Cumulative distribution function for a standard normal random variable
R: Asset Correlation
G(z): Inverse cumulative distribution function for a standard normal random variable
PD: Probability of default
M: Maturity of the operation
***b* :** Maturity adjustment
S: Total annual sales in million Euro

Source: Basel Committee on Banking Supervision / 2004

implicitly given by the Basel formulas. The exact formulas for SMEs from the final version of the Basel Capital Accord are shown in the table below.

Table (2) shows the formulas contained in the last version. For the SMEs classified as retail, the formulas are those for the "other retail exposures". When SMEs are classified as corporate, the formulas to be used are those for the corporate, considering the discount size (Basel Committee on Banking Supervision, 2004).

Profile 1. Capital Requirements Directive (Basel II Capital Accord)



Source: Basel Committee on Banking Supervision / 2004

A fixed LGD is estimated as 45% under the sample bank. We focus on one year's PD estimation, developing the Probit model for exporter SMEs' PD in the sample. Following this, we point out that the lower correlation value for the retail assets, incidentally assumed by the Basel formulas, is the "main driver" of the lower capital requirement for that segment.

3. Review of the Relevant Research Literature

In this section, we review some of the most important studies about the implementation of the Basel II on small and medium size enterprises and the possible effects thereof. The literature generally finds that the Basel Capital Accord will have beneficial effects on bank capital requirements (minimum) that are linked to the SME segment, if either the Standardized approach or one of the IRB (Advanced or Foundation) approaches is used.

The Basel Committee began a capital adequacy reform process in 1999. This committee paid particular attention to the SME segment, mainly by having changed the formulas to calculate risk weights linked to SMEs three times. In the latest version (June 2004), banks are able to consider small and medium size enterprises as retail or as corporate entities, primarily based on their total exposure to this entity. If total exposure is under €1 million, SMEs can be classified as retail, but another important qualitative requirement must be followed; the credit must be managed as a retail exposure. This means that "the exposure must be one of a large pool of exposures which are managed by the bank on a pooled basis". On the other hand, if SME credits are classified as corporate, a special "discount" in the asset correlation calculation is ensured for exposures to firms with under €50 million in sales. Both approaches specify "haircuts" which are based on the assumption that smaller credit firms' risks are less correlated to default risk than larger corporates and are less sensitive to the business cycle. We also expect that the benefits shown for SMEs have been motivated by nations' concerns

about lessening credit possibilities and the importance that SME owners and employees have for voting results.

Various studies have found that it is easier to assess the amount of the savings in banks' capital requirements with the standardized approach than with the internal rating based approach. Using the standardized approach to calculate capital requirements results in no savings if the SMEs are considered as corporate (the same ~ 8% as before); however, if they are considered as retail, the risk weight goes from 100% to 75% (Basel Committee on Banking Supervision, 2004), so the capital requirement impressively becomes 6%. The IRB approach, however, authorizes banks to personalize the capital requirement calculation, making their own models in order to estimate PDs (Basic) or even LGDs (Advanced) for each client. This means that it is not feasible to assess the exact savings in capital requirements for banks that will implement the Internal Rating Based approach, since these will be looped to the particular models utilized and to the characteristics of each portfolio of credit.

Most studies have tried to understand the most probable risk weights and their possible changes under Basel II using a generic sample of small and medium size enterprises and assumptions in order to estimate PD and LGD. Since we have estimated LGDs and PDs, we focus our analysis on the distribution of risk weighted assets in the sample bank of Iran.

More recently, the Basel Accord for bank capital adequacy (Basel II) has seen many analysts focus on the SME segment (see e.g., Udell, 2004; Schwaiger, 2002; Saurina and Trucharte, 2004; Jacobson *et al.*, 2005; Berger, 2006 and Altman and Sabato, 2005). The first empirical investigation on default prediction for SMEs was led by Edmister (1972) and applied a Multiple Discriminant Analysis approach on 42 firms comprising balanced observations and the researcher also used balance sheets and profit-loss statements as the principal source of information, and discovered that

seven financial ratios were significant as default predictors; the most significant were leverage and liquidity categories.

Altman and Sabato (2005) examined the effects of Basel II Capital Accord and the capital requirements of small and medium enterprises in the US, Australia, and Italy. In these countries, banks with less capital requirements audit small and medium enterprises to bring more benefits by using the advanced internal rating procedures. It was necessary to do the calculation of the probability of default and losses caused by default as being assuredly more about bank risk management.

According to the aforementioned statements**,** two World Bank inspections were conducted in recent years as part of an exertion to inquire into the status of banks' lending to SMEs. These inspections revealed some important routine elements, but also demonstrate important differences. Both inspections provide some deliberation of SME lending, consider the main stimulant and obstacles to additional SME lending, the pivotal business models developed, and the main risk management techniques approved, but with different emphasis on each of these ingredients.

The two surveys are also based on very distinct samples, regarding their dimension (size), the types of bank inspected, and the regional coverage. Demirguc-Kunt, Martinez Peria, and Beck in (2009) studied 91 expert banks in 45 countries providing the basis for two separate studies and a comprehensive evaluation of the inspection results, while the second provides an econometric analysis of the data-set**.** This study contained a quantitative component that obtained measures of the share of SME loans in total loans, the allotment of investment loans in SME loans, percentages of applications ratified, and loan fees and interest rates. Moreover, while comparing SME lending in developed and developing countries and auditing drivers and difficulties, the two studies also revealed the relationships between government, private, and foreign banks. Overall, their analysis recommended that the enabling environment is more important than firm dimension (Size) or bank proprietorship in shaping bank financing to SMEs.

Schiffer and Weder (2001), and Beck et al. (2005, 2006 and 2008) have shown that SMEs perceive access to finance and their cost of credit to be greater obstacles than large firms and these factors significantly affect their growth.

Beck, Demirguc-Kunt, and Martinez Peria (2009) have shown that the average share of SME lending is smaller in developing countries (16 percent of total lending) compared with the average share in developed countries (22 percent of total lending). Banks in both developing and developed countries are primarily attracted by the potential profitability of the SME sector and serve SMEs primarily through concentrated SME units. Administration programs are considered favorable and prudential regulations are not perceived as unpleasant. Scoring models are used by major banks but they are just one of the inputs in the loan decision. Large or expert banks in developing countries report that macroeconomic instability is the main challenge facing SME lending, rather than any fault in the legal and contractual framework.

De la Torre, *et al.* (2009) carried out on-site interviews with 37 banks in Argentina, Chile, Serbia, and Colombia. This survey focused on the questions covering the strategic approach to small and medium enterprises lending, business models, and risk management. The researchers supplemented the information from the interviews conducted through a survey by the International Finance Corporation (IFC) across 8 developed and developing countries and annual surveys from 7 countries.

Hahm. J. H. and D. Kang (2007) surveyed the effects of Basel II on small and medium enterprises in Korea. By using "*Sensitivity Analysis"* they indicate that there are positive effects on lending to SMEs. Chang and Chu (2005) have found that the risk weights for the internal rating method in the Basel II increased and so with these capital requirements of banks, the lending to small and medium enterprises is reduced.

Berger in (2006) studied the internal rating methods in Basel II in the US and demonstrated that the interest rates paid for loans to small and medium enterprises have not decreased.

Gottschalk in (2007) considered the effects of the implementation of the Basel II in developing countries and indicates that these countries will require specific regulatory and political regime to consider financial stability and sufficient credit for SMEs for the implementation of Basel II.

4. Model Specification

In this approach, we suppose that the response variable Y is binary; that is, it can have only two possible outcomes which we will denote as 1 and 0. For example, Y may represent the presence/absence of a certain condition, the success/failure of some device, the yes/no answer on a survey, etc. We additionally have a vector of regressors X, which is assumed to influence the outcome Y. Particularly, we assume that the model takes the form:

$$P(Y = 1|X) = \Phi(X'\beta)$$

Where P denotes probability, and Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution. The parameter β is typically estimated though maximum likelihood. It is possible to motivate the Probit model as a HID variable model. Suppose there exists an auxiliary random variable:

$$Y^* = X'\beta + \varepsilon$$

Where $\varepsilon \sim N(0,1)$. Then Y can be viewed as an indicator of whether this HID variable is positive:

$$Y = \begin{cases} 1 & if\ Y^* > 0\ \ i.e.\ \ -\varepsilon < X'\beta \\ 0 & otherwise. \end{cases}$$

The use of the standard normal distribution causes no loss of commonness compared to using an arbitrary mean and standard deviation because adding a fixed amount to the mean can be amended by lessening the same amount from the check, and multiplying the standard deviation by a fixed amount can be amended by multiplying the weights by that same amount. The relevant equation is as follows:

$$\mathrm{P}(Y = 1|X) = \Pr(Y^* > 0|x) = \Pr(X'\beta + \varepsilon > 0|x) = \Pr(\varepsilon > -X'\beta|x)$$

$$= \mathrm{P}(\varepsilon \leq X'\beta|x) \quad (by\ symmetry\ of\ the\ normal\ distribution)$$

$$\mathrm{P}(\mathrm{y} = 1|X) = \varphi(X'\beta)$$

Naturally, the fixed mode is:

$$\mathrm{P} = \varphi\big(f(x)\big) \rightarrow \ \varphi(0):\ Standard\ normal\ distribution$$

4.1. Construction of the sample data

In order to estimate the expected effects of Basel II on Iranian SMEs, the necessary data for the statistical analysis has been provided by a specialist bank of Iran. The original data set consists of approximately 1,637 firm-year observations spanning the time period 2012 to mid-2013. These have been extracted from the loan portfolio of all customers that had an exposure of less than €1 million (34 billion RLS) and those with less than €50 million (170 billion RLS) in sales. Due to missing data items, we used the final data set of 1,492 small and medium size firms. To create the binomial dependent variable (default/no default), we observed the condition of each firm at the end of the next financial year. Following Basel II definition, only if the past due of the company was 90 or more days, was the result considered as a default.

4.2. Selection of candidate variables

The table below shows how the variables entered in the final model has been selected. In the first column, candidate's financial ratios, established by Basel II, which likely affected SMEs are listed. In the second column, the thirteen financial ratios (at least one for each accounting ratio category) that presented the highest accuracy between all of the candidate financial ratios are shown. In the third column, the variables entered in the SME model are listed and grouped by their accounting ratio category.

Finally, each of the selected ratios was studied from a credit risk point of view, testing its linearity and its behavior in predicting bankruptcy. All of them were consistent with our expectations and with those found in the literature (See Hayden, 2003, for a complete analysis of the most important accounting ratios and their expected behaviors in predicting bankruptcy).

In this section, the Univariate Logarithmic Discriminatory power of each candidate ratio is studied.

Table 3: Variables selection process

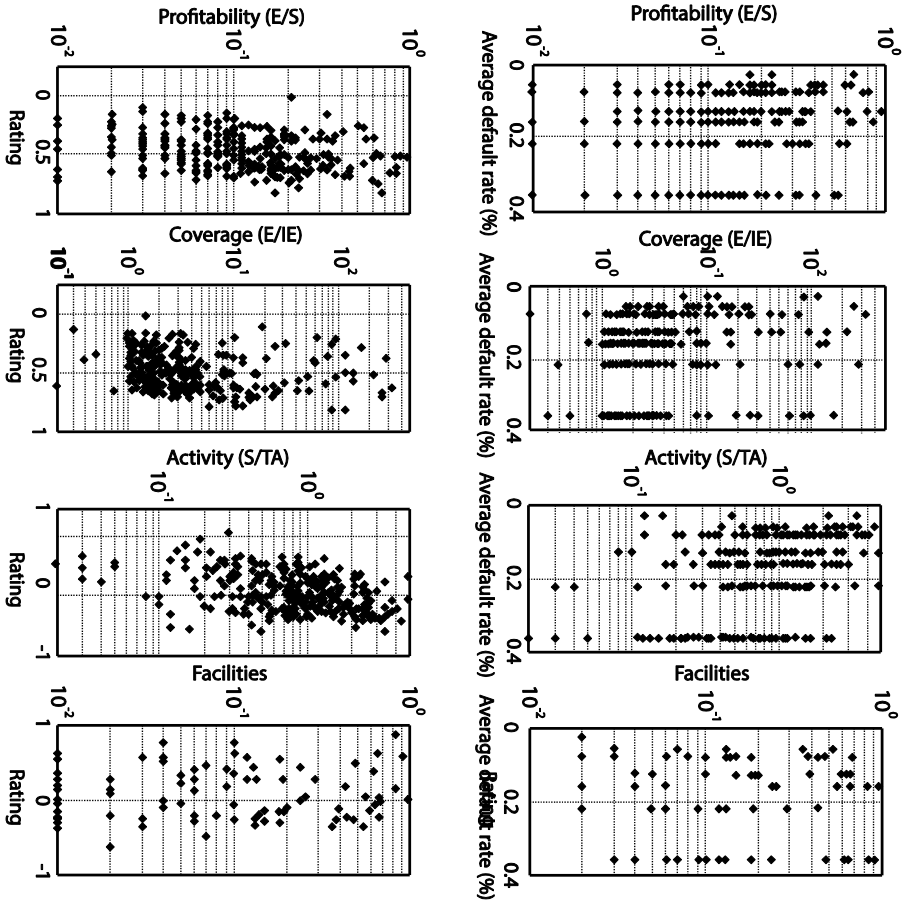
Variables examined	Variables manually selected	Variables entered in the model	Accounting ratio category
Short Term Debt/Equity (Book Value) Equity (Book Value)/Total Liabilities Liabilities/Total Assets	Short Term Debt/Equity (Book Value) Liabilities/Total Assets	Liabilities/Total Assets	Leverage
Cash/Total Assets Working Capital/ Total Assets Cash/Net sales Intangible/Total Assets	Cash/Total Assets Working Capital/ Total Assets Cash/Net sales	Cash/Total Assets Working Capital/ Total Assets Cash/Net sales	Liquidity

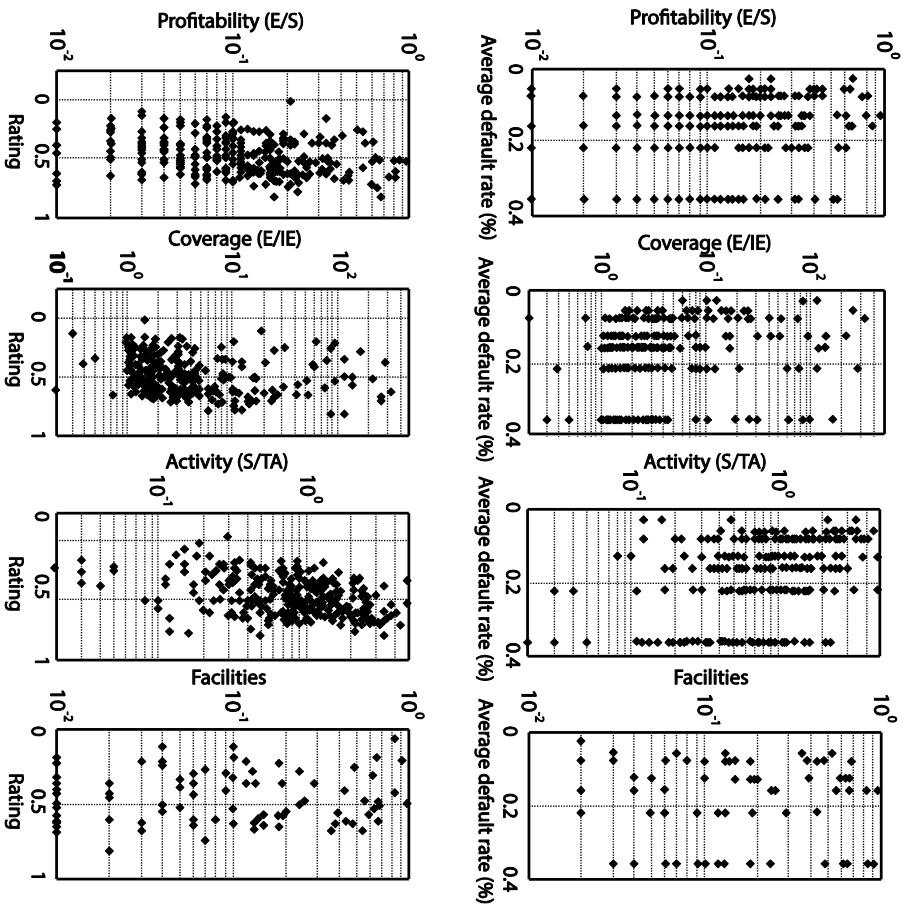
Variables examined	Variables manually selected	Variables entered in the model	Accounting ratio category
Ebit/Sales Ebitda/ Total Assets Net Income/Total Assets Retained Earnings/ Total Assets Net Income/Sales	Ebit/Sales Retained Earnings/ Total Assets Net Income/Sales	Ebit/ Sales	Profitability
Ebitda/Interest Expenses Ebit/Interest Expenses	Ebit/Interest Expenses	Ebit/Interest Expenses	Coverage
Sales/Total Assets Account Payable/Sales Account Receivable/Liabilities	Sales/Total Assets Receivable/Liabilities	Sales/ Total Assets	Activity
Facilities	Facilities	Facilities	Export Oriented (Supplement) [1]
SME (Accord Basel II)	SME	SME	Endogenous [2] Variables

Note: The general framework of this table is from Altman and Sabato (2007)

1. In this survey, the loan limits used as a supplementary variable. the criteria for this selection was as bellow:
   the companies that their received loans in one year was beyond average amount of loans for each SMS in the bank's credit portfolio got (1), otherwise they got (0) value.
2. Categorizing of SMEs was based on Basel II framework for specialized banks. According to it, SMEs with less than 1 Million Euro turnover grouped in SMEs as Corporate category, and SMEs with the turnover between 1– 50 Million Euro counted in Consolidated Group.

Chart 1: Univariate Logarithmic Analysis Selected Ratios





As one can see from the results in the Chart above, each of the variable categories is described as follows: Generally, regarding leverage ratios, a company that finances its assets through a higher proportion of equity should have a lower default probability or a higher rating. These relationships seem to make sense in all cases. For the rating data set, we can see that the ratio of Liabilities/Total Assets seems to offer the best discriminatory power, as there are a lot of points grouped on a straight descending line between 0 and

1. For the default data set, both liabilities and assets seem to be the best performers. For liquidity ratios, the expected relationship is also a positive one: a higher liquidity should lead to a lower default probability or a higher rating. For profitability ratios, the expected relationship is a positive one: a higher profitability should lead to a lower default probability or a higher rating.

We can see that the global relationship between the ratio value and risk makes economic sense; for instance, the higher (Ebit / Sales) relates effectively to a lower average default rate and a better rating. Regarding coverage ratios, a company that produces cash flows that cover its financial debt many times should have a lower default probability or a higher rating. With activity ratios, in this model regarding company assets, these turnover ratios show the amount of the assets and the effect of circulation in the money earned. This comparison proves whether increases in assets have a relationship with increasing sales or not. Assuming that prices stay constant when production capacity will reach the firm’s limits, this ratio will be reduced to its maximum level which will probably signal a reduction in the size of the company's activities. Reduction in total asset turnover can be considered as a warning sign.

The ratio of facilities dedicated to long-term volume provided for export firms in the Export Development Bank depends on a number of factors. Regarding size variables (turnover), large firms may have a lower default probability or a higher rating. However, we have to be particularly careful when working with size variables, as they are especially sensitive to selection bias. Unlike ratios that are the result of a division, size indicators are absolute values. For various reasons, the collected databases may also be subjective, in the sense that the observations concerning large firms are different from those concerning small firms. For instance, one bias we can often encounter when working on a default data set is that default events relating to large firms are usually more notorious, more striking, and are more carefully recorded in the database than defaults on very small firms.

This can give an erroneous image of the relationship between default risk and size (this bias is less of an issue when working with ratios, as ratios of large firms are in principle not fundamentally different from those of small firms). We can see that all candidate ratios have some discriminatory power. Therefore, the developed model is shown as follows:

$$\begin{aligned} Probit(y) = \varphi\big(f(x)\big) \\ &= \beta_0 + \beta_1(LIQ - Sales) + \beta_2(Facilities) \\ &+ \beta_3(EBIT - Sales) + \beta_4(Turnover) + \beta_5(EBIT - IE) \\ &- \beta_6(TD - Tassets) - \beta_7(Cash - Tassets) \\ &- \beta_8(Wc - Tassets) - \beta_9(Sales - TA) \end{aligned} \tag{1}$$

Table 4 shows the variables used in the Probit regression to develop the final model.

Table 4: List of Selected Variables

Financial ratio	Categoria
+ Sales/Total Assets (Sales_TA)	ACTIVITY
+ Liabilities/Total Assets (TD_Tassets)	LEVERAGE
+ Ebit/Sales (EBIT_Sales)	PROFITABILITY
+ Cash/Net sales (LIQ_Sales)	LIQUDITY
+ Working Capital/Total Assets (WC_Tassets)	LIQUDITY
+ Cash/Total Assets (Cash_Tassets)	LIQUDITY
+ Fbit/Interest Expenses (FRIT_IF)	COVERAGE
+ Facilities	Supplement
+ SME	ENDOGENOUS VARIBLE

In the Iranian sample, there are 1,492 SMEs derived from the portfolio of a specialist sample bank of Iran. Approximately 19 financial ratios have been analyzed and 9 of them are considered the most important and predictive. These have been chosen to be featured in the Probit regression to develop the final model, which contains nine variables: one describing the

leverage structure, one the activity, one the coverage, one the supplement, one the profitability, and three for the liquidity condition of the firm.

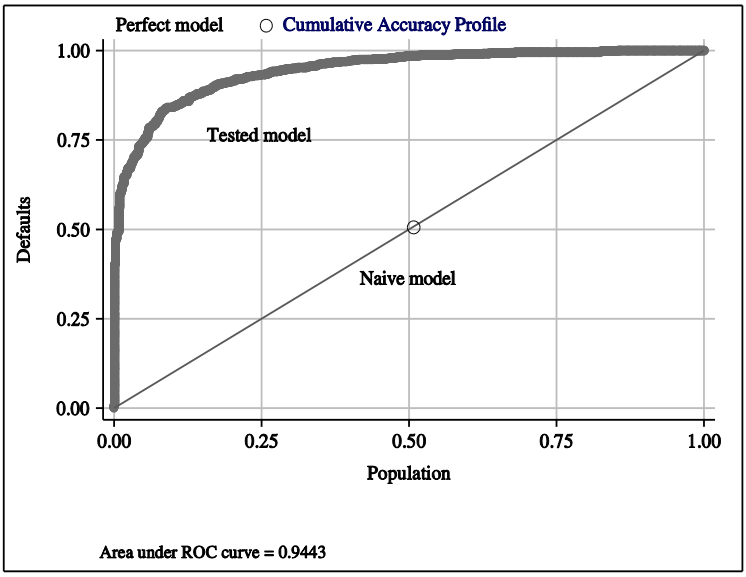
5. Model Performance

The figure below shows the cumulative accuracy profile of the developed model. The curved line shows the performance of the model being evaluated in sketching the percentage of the default captured by the model at various percentages of the data set, in cases where the thin straight line below describes the naive case of random assignment of default probabilities.

Hence, HR(C) is the hit rate for the cutoff C, N_P the total number of defaults in the sample, and H(C) the number of defaults correctly forecasted. We can therefore calculate an error measure:

$$\text{HR}\ (C) = \frac{H\ (C)}{N_D} \tag{2}$$

Chart 2: Cumulative accuracy profile of the sample bank in Iran (ROC Curve)



Additionally, FAR(C) is the false alarm rate for the cutoff C, N_{ND} the total number of non-defaulted firms in the sample, and F(C) is the number of non-defaulted firms that are classified in the bad firms.

$$\text{FAR (C)} = \frac{F\ (C)}{N_{ND}} \tag{3}$$

Consequently, the model of predictive power is:

$$\text{A} = \int HR\ (FAR) d\ (FAR) = 0.9443 \tag{4}$$

5.1. Misclassification rates and model predictive power for BPR methodology

Table 5 shows the misclassification rates and the predictive power (accuracy ratio) of the model developed using Probit regression methodology that was applied to the test sample fixing an arbitrary cut-off rate of 51 percent. The first row shows the type I error rate (false $+$ rate for true $\sim$ D), i.e. the percentage of defaulted firms classified as non-defaulted. In the second row, the type II error rate (false $-$ rate for true D) is illustrated. This rate represents the percentage of non-defaulted firms classified as defaulted. The third row shows the average accuracy of the model.

Table 5: Primary Results

16.44%	Type I error rate (+)
10.70%	Type II error rate (-)
94.43%	Accuracy ratio (model predictive power)
0.51	Cut-off (ROC Curve)

Table 6: Empirical Results on Effects of Risk-Weighted Assets in Basel II Capital Accord on SMEs

Elasticity $d(lny)/d(lnx)$	**Marginal Effects** $d(y)/d(x)$	**Random-Effects (RE)**	**Variables**
.354295	-.0688485	.387878 $z = 9.71$ $P > \|z\| = 0.000$	Sales / Total Assets $_{Activity}$
5.857742	1.903257	10.72255 $z = 21.41$ $P > \|z\| = 0.000$	Liabilities / Total Assets $_{Leverage}$
-.1722984	-.1116171	-.6288278 $z = -5.29$ $P > \|z\| = 0.000$	Ebit / Sales $_{Profitability}$
-.1487291	-.241084	-1.358217 $z = -4.99$ $P > \|z\| = 0.000$	Cash / Net Sales $_{Liquidity}$
.339376	.4366597	2.460051 $z = 9.85$ $P > \|z\| = 0.000$	Working Capital / Total Assets $_{Liquidity}$
.2004242	.8355409	4.707264 $z = 4.59$ $P > \|z\| = 0.000$	Cash / Total Assets $_{Liquidity}$
-.1045271	-3.60e-06	.0000203 $z = -1.80$ $P > \|z\| = 0.071$	Ebit / Interest Expenses $_{Coverage}$
-.3611973	-.189784	-1.069204 $z = -8.85$ $P > \|z\| = 0.000$	Facilities $_{Supplemen}$
-.5220836	-.0998005	-.5622552 $z = -3.50$ $P > \|z\| = 0.000$	SME $_{Endogenous\ V.}$
Pseudo $R^2 = 1 - \exp\left[-\frac{L^2}{n}\right] = 0.5451$ Log Likelihood $= n\ \varphi(\beta) = -464.88518$		-7.357318 $z = -19.20$ $P > \|z\| = 0.000$	Constant

As it is made clear in Table 6, there is a direct relationship between the size of SMEs and RWA. This means if the turnover of SMEs is smaller, their risk share in the Bank's credit portfolio will be lower.

Table 7: Secondary Results on Advance-Internal Rating Based on New Capital Accord (Basel II) in SMEs

Random-Effects (RE)	Variables
-7.137848 $z = -23.63$ $\mathrm{P} > \lvert z \rvert = 0.000$	$\mathrm{Advance} - \mathrm{Internal\ Rating\ Based}_{Exogenous\ V.}$
$\mathrm{rho'\ to\ SME} = 0.9863819$ $228.15\ \ Prob > Chi.square = 0.000$	Wald test of Exogeneity

As shown in Table 7, Advance-Internal Rating Based on Basel II in SMEs is counted as an exogenous variable. The results show that if the ranking of a corporation in bank's credit portfolio improves, its risk share will be reduced in the distribution of risk for banks' credit portfolio.

Because of significant variables and available elasticities, we aim to develop a model for identifying the export oriented SMEs default probability.

The final model in order to evaluate the exporter small and medium enterprises' probability of default is shown below:

$$Probit(y) = \varphi[f(x)]=7.357318+1.358217(LIQ\text{-}Sales)+1.069204(Facilities)+0.6288278(EBIT\text{-}Sales)+0.5622552(SMEs\ Turnover)+0.0000203(EBIT\text{-}IE)-10.72255(TD\text{-}Tassets)-4.707264(Cash\text{-}Tassets)-2.460051(Wc\text{-}Tassets)-0.387878(Sales\text{-}TA) \quad (5)$$

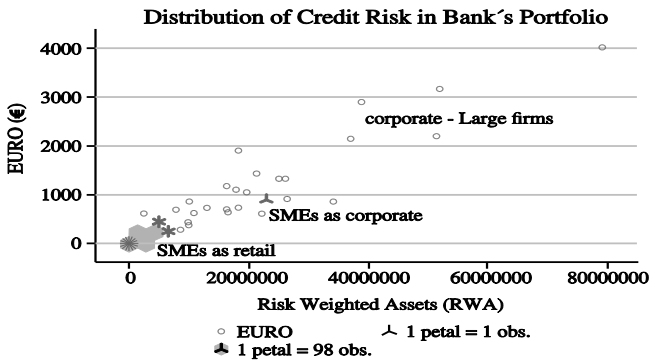
6. The effects of Basel II on SME exporters

In this section, we describe the credit portfolio of a specialized bank based on the Basel II framework, according to the credit portfolio of our samples bank categorized in to four quartiles as in Table 8.

Table 8: Empirical Results on Risk Weighted Assets Distribution in Bank´s Portfolio

Risk classification (low risk – category 1 up to high risk – category 4)					RWA Distribution
4	3	2	1		
> 75%	50%> 75%	25%> 50%	> 25%	Risk-weighted Assets	
0.00%	0.83%	2.48%	96.69%	≤ 1 million euro	1
7.61%	38.90%	38.79%	14.69%	≥ 1.01 up to ≤ 25 million euro	2
97.50%	2.50%	0.00%	0.00%	≥ 26 up to ≤ 50 million euro	3
100.00%	0.00%	0.00%	0.00%	≥ 50 million euro	3

Chart 3: The Profile RWA Distribution in Bank's Portfolio



96.69% of the distribution of the RWA of bank's portfolio for customers with less than 1 million Euro turnover, are in first category (low risk), is made clear in Table (8) above.

7. Conclusion

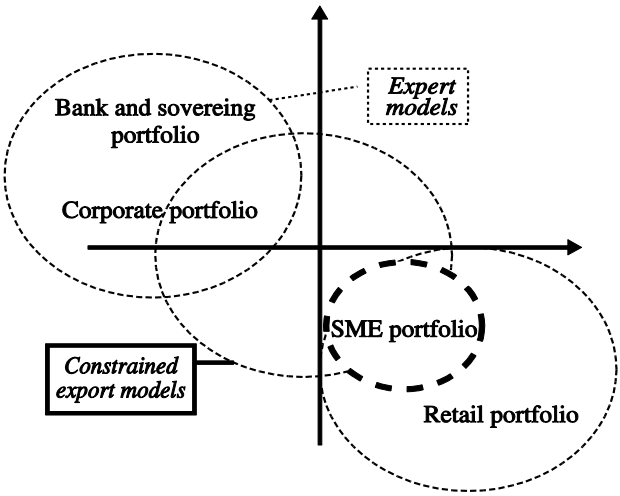
In this study, we created a model for measuring the credit risk of small and medium size companies and on this basis, the activity's variables, leverage, profitability, liquidity, covering, complementary variable (extended facilities), and the size of companies had a significant effect on default. The leverage variables (total debt/total assets) and liquidity variables (liquidity/ total asset) had the highest effect and the variable of company size had the highest reverse effect among other variables.

The Roc graph shows the acceptable accuracy of the model for forecasting default. On the other hand, on the basis of the designed model, the risk of all companies has been calculated and by applying "the advanced internal ranking model", the Basel reserve capital of the companies was calculated. The necessary capital of small, medium and other companies were also compared. Accordingly, 96.69% of small companies were placed in the low credit risk portfolio. This explains the harmonious and counterbalanced relationship of Basel II capital obligations and the size of companies with the weighted asset risk (RWA). In other words, the smaller the size of the company, the less its risk share in credit portfolio will be. In addition, according to the obtained results, with the improvement of the ranking of the company, the company will have a lower share in bank risk portfolio.

On this basis, according to the profile below, it is necessary to design specific credit scoring models for measuring these companies.

As the aim of Basel II Capital Accord was to improve Bank's risk management system, we can conclude that the probable impact of these regulations on export oriented SMEs was to increase the frequency of loans to this sector and raise the share of these groups of SMEs in Bank's credit portfolio. This will help financial institutions to create a protective shield (buffer) to minimize the risk in all areas which they are active in.

Profile 2: A Necessity of Constrained Expert Models



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