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Modelling of corporate exposure at default (EAD) in emerging financial markets: The case for counters listed on the Zimbabwe stock exchange (ZSE) in the dollarization era

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Abstract
This study explores the exposure at default (EAD) emanating from credit events undertaken by listed banking corporations trading on emerging markets, such as Zimbabwe's Stock Exchange (ZSE) or Market in the dollarization era, namely period 2010-12. The dollarization of the Zimbabwean economy in 2009 coincided with the recovery of the global financial economy from the worst worldwide economic recession ever experienced in this world. The study used audited and published data drawn from financial statements of two banking corporations for the period 2010 to 2012 that were accessible on ZSE website. These data were presented and analyzed using Eviews7. The study revealed that there was a lot of non-performing loans drawn from EADs of banking corporations trading on the ZSE in the period under review. The study further noted that credit exposures issued by commercial banks in the period 2010-2012 were also exposed to risk from the nature of the borrowers, banks' internal and external market variables. The variables that impacted on banks' credit exposures include political, social, industrial, unemployment, technological challenges, state of financial markets, their capitalization and liquidity statuses. We therefore conclude that banks in emerging markets need to efficiently and effectively manage their credit portfolios in their desire to grow towards sustainable development. The study also concludes that banks in emerging markets that are into lending activities should adopt and implement financial econometric (EAD) models that are easy to apply, practical, pragmatic and adjusted for market friction. The study recommends that listed banking corporations in emerging markets need to adhere to the requirements of the Basel II and III Capital Accords if they are to make meaningful business out of their credit exposure operations. It also recommends that banks should come up with capitalization and investment strategies that suit their economic conditions if they are to grow and develop sizeable market shares and wealth from their lending businesses. Finally the study recommends that banks in emerging economies should adapt to international business standards, strategies, ethics and corporate governance parameters if they are to grow towards greater similarity with those in developed nations in their service delivery to the stakeholders and contribution to nation building and sustainable development.

Keywords: Exposure at Default (EAD), dollarization, credit exposures, global economy, financial econometric model, sustainable development, ethics, corporate governance

Introduction
The term EAD can be defined as the specific exposure that a financial organization or corporation does have in the hands of its borrowers, comprising out standings and commitments at the time of occurrence of a credit event (Barakova and Parthasarathy, 2013). Therefore in the event that the obligor (or borrower) fails to deliver on the obligation, the bank or financial institution becomes exposed to the total of such out standings and commitments. The term out standings refers to the part of credit exposures that have already been issued by a bank or similar financial institution to a borrower but remain unpaid at the time of default. On the other hand commitments are the exposures the financial corporation or entity has promised to lend to the obligor or borrower at own request and would comprise drawn and undrawn constituents in the time period before default occurs. Therefore in the event that the obligor fails to deliver on the obligation, the bank or financial institution becomes exposed to the total sum of such out standings and commitments. The out standings and commitments therefore refer respectively to the portions of credit exposures that have

already been issued but outstanding and promised to be lent to the borrower on request. These commitments are made up of drawn and undrawn components of credit exposures in the period before the credit event happens (Barakova and Parthasarathy, 2013).

The EAD of a financial corporation is therefore defined as the economic value of the claim made on a counterparty at the time of a credit event (default) coming into existence. The modelling of EAD was explored by the study based on the loan portfolios (or credit portfolios) and total liabilities assumed by the banks issued in the period 2010-2012. The EAD specifies the exposure the corporate financial organization or institution has in the hands of its obligors over a given time period. In general, a financial institution or bank's exposure is made up of two major components, namely out standings and commitments. By definition out standings refer to the portion of the credit exposure drawn from the financial institution or bank by the obligor. In financial practice, EAD is assumed to be a deterministic variable or quantity, hence the rationale for the study at hand to deal with incomes ignoring the underlying variables. The study was motivated by the voluminous nature of non-performing loans that were accumulated by banks and financial institutions in the period under review and hence the need to redress the situation if such firms were to grow and develop in their service provision to their clients and the nation at large. Therefore the study considered the EAD of a commercial bank as a random variable based on income drawn from audited financial statements for the period 2010-2012, credit worthiness of the corporate borrower and the types of facilities involved, to come up with a new EAD model that suited the nature and volume of credit exposures of emerging markets.

Background to the Study

One of the major causes of challenges faced by Zimbabwe in the economic meltdown period, 2001-2008 was the deviation of the Central Bank (Reserve Bank of Zimbabwe) from its core functions, roles and activities. The Central Bank's operations in the period in question culminated into printing of the domestic currency (seignorage) which was worsened by introduction of a family of bearers' cheques to beef up notes and coins in circulation which could not suffice to meet public demand. The continuous printing of the bearers' cheques especially in the period 2006-2008 massively eroded the purchasing power of the Zimbabwean dollar and saw shelves of shops and supermarkets nationwide g*et al*most empty. The monetary authorities ended up eliminating a chain of twelve zeros from the currency but could not combat successfully the rate of inflation in the period 2006-2008. The country's rate of inflation soured to an unprecedented level of 89.7 zillion percent (%) by November 2008 (Hanke and Kwok, 2009) [5] which left all hope of livelihood of citizens shattered and potential for growth of the economy as of then became oblique. The formation of the Government of National Unity (GNU) by the country's 3 main political parties and dollarization of the economy in 2009, ushered in a new social, political and economic dispensation in Zimbabwe (Kwenda and Matanda, 2014) which saw the above rate of inflation falling to 6.216% by end of 2009 (MPS 2012) [9]. However before dollarization of the economy in February 2009, the country's Real Gross Domestic Product (RGDP) had declined significantly and cumulatively by about 47.3% over the period 1999-2007(International Monetary Fund, IMF, 2009).

The Zimbabwean economy has remained stagnated, deteriorated and falling in capacity utilization from 57% in 2011 to 36% in 2014 and continued sharply on a slowdown economic trend. However, despite the annual inflation rate ranging from 3.1% in 2010, through 3.5% and 3.7% in 2011 and 2012 respectively, 1.6% and - 0.2% in 2013 and 2014 consequently, due to dollarization, the levels of EADs in banks have continued to increase (Monetary Policy Statement, MPS, 2012) [9]. On the other hand the country's liquidity crunch and n0n-performing loans (NPLs) have become a serious cause for concern to all economic players in banking and similar financial institutions. The contemporary economic challenges threatening the economy manifest themselves in the form of skyrocketing levels of unemployment, mushrooming of vendor activities in Central Business Districts (CBDs) of towns and cities, closure of parastatals, banks, other financial institutions and private sector firms, as well as delisting of some of the ZSE operating and licensed corporations. The manifestation of the challenges elaborated above in the domestic economy's banking sector was the basis and rationale for this study to be undertaken in order to redress the evils in banks and similar financial organizations that were hampering their growth and development in the dollarization era.

The University of Edinburg Business School (2013-2014) argues that the modelling (or prediction) of EAD was a two stage mixture model that needed thorough scrutiny and study. The modelling of options and option like portfolios for instance was assumed to follow a Poisson process until the EAD equation was attained. For Commitments EAD was measured as a percentage of the outstanding notional balance of a credit exposure in the hands of the obligor at the end of the predetermined repayment period of time. For other credit exposures, EAD assumed the total value of the credit exposure. The Risk-Weighted Assets (RWAs) for credit risk analysis were calculated for both on and off-balance sheet exposures that were not reflected on the firm's financial statements. In other words EAD was taken to be the amount owed by a borrower to the lending institution at the time of the credit event (default) multiplied by the risk weight of each counterparty. Therefore under the Basel II Advanced Internal Rating Based (AIRB) approach, the counterparty's risk weight (RW) grading is given by the formula,

$$RW = PD \times LGD \times T$$

Where
PD = Probability of Default,
LGD = Loss Given Default, and
T = Maturity of Trade or Portfolio of Trades.

The emphasis laid on the need for adoption and implementation of the Basel II Accord in emerging financial markets was based on the fact that the accord's requirements allowed for considerable flexibility in banks in choosing models for estimation of EAD (Barakova and Parthasarathy, 2013). However it was not clear as to how much these internal estimates could be impacted on by the choice of the modelling approach used in estimation of EAD. The two authors used several estimation approaches based on alternative EAD measures, data treatments, risk drivers and

modelling techniques that used data drawn from large corporate syndicated lines of credit maintained by Shared National Credit over 1997-2009 for both public and private owned firms. One of the study's major findings was that EAD increased when a firm's default was harder for banks to participate in lending businesses. It was also found out that obligors with good credit ratings had low lines of credit utilization and high limits or when credit cycle conditions varied. The study concluded that the modelling choice had a large influence on EAD estimates, based on an in and out of sample performance of models that were used in predicting net additions to Outstanding balances in the hands of obligors at the time of the credit event. Literature on wholesale EAD reveals that banks could benefit from EAD modelling and regulatory and supervisory guidance, business ethics and corporate governance.

According to the requirements of the Basel Committee's Basel II and III Capital Accords, the successful management of EADs facing banks and similar financial institutions in Zimbabwe had the capacity to improve their capitalization, NPLs, lending business operations, risk management and wealth generation for their shareholders. The study also proposed a new financial econometric model that was meant to suit the management of EADs of banking and similar financial corporations in emerging markets like Zimbabwe, in their desire to be well capitalized, invested and positioned to generate shareholders' wealth. It was also envisaged that such a financial econometric model would lead to improved financialisation of the whole economy, resuscitation of public and private firms, formal job creation and elimination of self-employment currently employing more than 80% of the country's labour force. The EADs of two listed financial corporations, one indigenous and one international listed on the ZSE were used in coming up with the financial model for comparison of performance in the period under review. The model that the study came up with was meant to be user-friendly, realistic and suited very well the lending business operations of banking corporations in emerging markets like Zimbabwe, if they were to grow towards sustainable development in terms of nation building and service provisions to the intended beneficiaries.

Literature Review

Michael (2010) [12] in his Academic Journal Article came up with an empirical investigation of the determinants of EAD. He generated an econometric model for Moody's related defaulted firms that were involved in revolving credits. Michael extended the works by Moody's by considering alternative determinants of EAD risk in addition to traditional variables such as credit rating weights. The study derived various measures of EAD and compared them based on the Classical Multiple Linear Regression Model and examined the comparative rank ordering and predictive accuracy of such properties. The major conclusions of the study were that there was a weak counter-cyclicality in EAD and EAD risk decreased with default risk. The study also concluded that utilization as a determinant had a strong inverse relationship with EAD. The study also reached the conclusion that EAD was low for greater leverage levels, liquidity and more debt cushions. It also concluded that company size, higher collateral rank, and use of more debt in the capital structures of obligors led to higher probability of default by such borrowers. The model used was rigorously validated through resampling experiments in a rolling out-of-time and sampling set of experiments.

The implications of credit risk management study by Michael (2010) [12] were that there was use of quantification of EAD for banks through Advanced IRB Approach in the regulatory framework of the Basel II Capital Accord in particular. In other words the factoring of the requirements of the Basel II Accord into the model propounded by Michael made it realistic in terms of its potential to address the EADs of all banks on the global arena and more specifically the plight of those operating on emerging markets. In a recent Journal by Yang and Tkachenko (2012) [13] it was concluded that Basel II and III Accords had created the dire need to develop and implement Probability of Default (PD), Loss Given Default (LGD) and Exposure at Default (EAD). The paper further concluded that although PD had been well researched, LGD and EAD lagged behind in terms of both theoretical and practical insights. Therefore the two authors proposed some applications to LGD and EAD modelling and provided technical insights into the implementations of the models in accordance with the requirements of the works of the Basel Committee as set out in the requirements enshrined in the Basel Capital Accords. It was expected that approaches forwarded in the paper by Yang and Tkachenko (2012) [13] were going to be helpful to financial econometric modelling of EADs. Risk managers in banking corporations and similar financial institutions in emerging markets were also expected to adopt and implement such models in their quest to grow and develop their organizations towards sustainable development levels.

The purpose of modelling of EAD in listed financial corporations was to build an easy to implement, pragmatic and parsimonious and yet accurate model to determine EAD distribution for CCF portfolios (The Journal of Risk Finance, 2012). The study used an algorithm approach to modelling, Credit Risk, CR+ and Fourier Transforms and arrived at an EAD portfolio level of usage. The paper used a simulation experiment which illustrated the convolution of two portfolio segmentations to derive an EAD distribution, randomly drawn from Moody's Default Risk Survive (DRS) database of Contingent Credit Lines (CCLs) that were so rated as 12 March 2008. The standard deviation of usage distribution was found to be decreasing with increase in the number of put options while on the other hand the arithmetic mean remained relatively stable as the extreme points or values converged towards the mean to produce shrinkage in the spread of the distributions. It was also further observed that for the sample portfolio, increases in additional usage level led to increases in standard deviation of the associated expected distribution.

One of the practical implications of the study was that the proposed model in conjunction with internal bank financial research could be used for estimation of EAD as mandated by the Basel II Accord for bank CCL portfolios or implemented as part of the Solvency II process for insurers exposed to credit sensitive and unfunded commitments. The other implication drawn from the study was that apart from regulatory requirements, distribution of stochastic exposures could be used as input variables for different economic capital models and stress and scenario testing procedures used in capturing accurate risk profiles of credit portfolios. Stochastic exposures could also be used for provisioning of better insights into the problem of managing liquidity risk of a portfolio of CCLs and similar exposures which was a common challenge in banking institutions in emerging

economies. It was also argued that in spite of large volumes of CCLs in portfolios of insurance companies and financial markets, all sophistications of existing EAD models, unsuitability of external data and inconsistent internal data with partial, draw-down, were found to be some of the major challenges faced by risk managers and regulators of CCL portfolios.

The Bank of International Settlement (BIS) as cited by Pinaki (2010) [14] in its Basel II Capital Accord guidelines describes Capital as a function of PD, LGD and EAD with all three parameters playing an equal and vital role in management of lending activities of financial institutions. Loan Commitments or CCLs are contractual promises made by banks to specific obligors to lend up defined amounts of funds on the basis of predetermined rates and maturity terms or conditions. The terms are accompanied by different fees to be paid over the life of the Commitment and some Material Adverse Change (MAC) clauses which stipulate that the bank or lender may cancel the line of credit from time to time if its quality deteriorates for a given obligor. The Basel II Accord guidelines calculated regulatory capital charges of CCL or Commitments based on variables such as:

1. Credit Conversion Factors (CCFs) whose scores ranged from 0 to 50%, and
2. Risk Weights, based on a proportional scale of 0 to 100%.

The valuation of EAD can be done in both conventional and structured or derivative financial market frameworks. According to Hull (1989) CCFs for small banks however, were known for underestimation of banks' capital requirements because 'fat tails` had the effect of increasing capital requirements and more proportionally for Off-Balance Sheet parameters. Therefore in Advanced Internal Rating Based (AIRB) methodology, Basel II Accord allowed banks to compute own estimates of CCFs, as well as EADs for CCLs. The modelling of EAD for CCL portfolios takes each CCL as a portfolio of options with the obligors that they can exercise with a bank at predetermined terms and conditions. Pinaki (2010) [14] in his paper on EAD for Contingent Credit Line (CCL) came up with a simple, pragmatic and accurate model that suited well the determination of CCL portfolios issued by banks.

Therefore Pinaki (2010) [14] postulates that EADs for derivative securities were based on two forms of equations namely:

1. EAD = CCF×TL, where CCF and TL were Credit Conversion Factors and Total Limits respectively and/or secondly;
2. EAD = CE+ $\propto$L, representing Credit Exposure, $\propto$ (Appropriate Conversion Factor) and L, Limits in that order respectively.

According to Moral (2006) the two equations by Pinaki (2010) [14] would yield some results for EADs serve for the case where full utilisation would have taken place. On the other hand the study further argues that the Basel CCF was equivalent to $\propto$ in equation 2 and the equation could be used for all subsequent analysis (Miu and Ozdemir, 2008) [11]. The Basel CCF model argues that the size of each put option contract was given by the formula:

$$Q_A = \frac{LA}{n}$$

Where n = The number of put options constituting the CCL portfolio.

The put option exercise function is therefore given by the formula;

$$F_A(Z) = p(r=0) + p(r=1) + - - - - - + p(r=n).$$

Assuming expected usage of CCL is $\propto_A$ the average number of put options used by firm A,

$$\propto_A = \frac{\propto A \times LA}{QA}$$

Hence using a Poisson Process of exercise of each option the put option general formula reduces to

$$\text{FA(Z)} = \frac{e^{-mia} \times m^0}{0!} + \frac{e^{-mia} \times m^1}{1!} + \frac{e^{-mia} \times m^2}{2!} + - - - + \frac{e^{-mia} \times m^n}{n!}.$$

.

The formula can be reduced to give the simpler general form,

$$\text{FA(Z)} = e^{-ma} \times e^{-maz}.$$

According to Miu and Ozdemir (2008) [11] the calculation of EAD on derivative contracts was fairly easy and straight forward. In this respect EADs were considered to be a measure of losses in credit lending business in the event that counterparty defaults on a credit contingent obligation. In other words by EAD we mean the amount of money that counterparty owes to a bank or financial institution at the time of default at a certain level of confidence, L at a time period, T. However since there were no derivative markets in existence in Zimbabwe as of then the study proposed an AVM valuation model for EAD for banking corporations based on two independent variables, namely the banks' credit exposures and their total liabilities. The calculation of EADs from option contracts was said to be relatively easy especially for single contracts with single underlying risk factors, r and when the MTM of the contracts was monotonic in the risk factor, r as well as when the chosen model for r(1) was analytically tractable.

However if we happen to have many contracts with counterparties or contracts that depended on multiple risk factors, it was going to be impossible to determine EAD analytically. One way of calculating EAD on a complex portfolio of contingent credit exposures would be to use market simulation which is an advanced Monte-Carlo Simulation. The EAD model discussed above was centered on valuation of derivative securities but will be extended to cover credit exposures issued by listed corporate (conventional) financial organizations in the dollarization era. The study therefore made the above contingent EAD models its starting point in order to come up with a conventional AVM financial econometric model proposed for adoption and implementation by banks in emerging markets. in their desire to improve their lending business operations in the dollarization era. The proposed AVM financial econometric model would be based on the

fundamental requirements of the Basel II Capital Accord is expected to go a long way in improving quantification and management of banks' credit portfolios in the dollarization era.

Problem Statement

Financial institutions or corporations that were known for successful management of their Exposures at Default (EADs) were popular, efficient and effective when it came to their financial strength, capitalization, broadening and deepening endeavours, and *et al*. one contributions to market growth, shareholders' wealth, and social responsibility in an economy in the form of infrastructural development, research and development and human capacity building. However in the 21st century, the amounts of non-performing loans (NPL) in banking corporations and similar financial institutions in emerging markets have massively accumulated to very unprecedented levels that could lead such organizations being delisted, suspended, put under the Central Bank's curatorship, liquidated or having operating licences withdrawn. It was therefore the interest of this study to examine the total EAD of a listed financial corporation in the period under review in order to come up with financial strategies that could be employed to redress the level of such non-performing loans (NPL) that constrained such firms' growth and development. The study also sought to come up with a new financial econometric (EAD) model that banks and financial institutions in emerging markets in particular could adopt and implement if they were to grow towards sustainable development in their management of lending business activities in the dollarization era.

Justification of the EAD Model Adopted by the Study

The majority of financial econometric models used the world over were derived based on the major assumption that there existed perfect capital financial markets in economies of the world. However in practice most capital markets in less-developed countries (LDCs) are away from being perfect markets. On the counter (OTC) products for instance are not availed on capital markets in LDCs and therefore cannot be hedged in such emerging economies. Countries of the world that trade in derivative securities such as forwards, futures, options and swaps rely on implementation of Delta-Neutral hedging strategies in coming up with derivative pricing models. In practice a Delta-Neutral hedging strategy on a derivative security, such as an option written on its reference asset cannot be taken to be totally risk free on the market of operation. Hence the maintenance of such a Delta-Neutral financial position over a defined space of time would require an active strategy of continuously rebalancing the investment.

The inclusion of a liquidity variable in the derivation of contemporary financial econometric models on LGD and EAD models or its exclusion from such models may be a major source of risk in financial modelling. As if thus not enough most financial models in circulation further assume that underlying stocks or assets upon which derivative securities are written can be traded on both short and long terms bases at current market prices assuming that prices will not vary drastically when trading is finally undertaken. In reality these assumptions are a cause for concern as stock or security prices are known for following a random process on the market of operation. Hence the need therefore to factor variables such as liquidity in our new financial models in order to align new financial models to be used in LDCs towards reality or practical situations that characterised capital markets in emerging markets today.

The model advanced by the study was based on the assumption that as a company moves towards default in conventional finance, it will normally increase its leverage (lend more) because default generated liquidity problems. The concept of EAD looks at the company's ability to increase its exposure while default products are categorized into three components, namely loans, working capital facilities and potential exposures. It is critical to note that in financial econometric modelling:

1. Loans were modelled using the expected credit loss formula, E_i(CL)=∑E(bi)xCE_ix (1-fi) where; b_i=Bernoulli random variable which takes value 1 if default occurs and 0 otherwise, CE_i= Credit Exposure and f_i =Recovery rate if default occurs, while (1-f_i) is loss given default (LGD). The EAD of a firm at the time of default based on loans is given by the formula;
   EAD = Current Exposures + Scheduled Payments in the next 6 months – Scheduled Repayments Next 3 Months + 3 Months of Missed Interest Payments.
2. Using the working capital facilities (WCF) model, Borrowing Room = (Limit-Current Exposures). Given for instance that a bank's Limit = $10 000 and Current Exposures = $5 000, Borrowing Room = $10 000 – $5 000 = $5 000.
   The usage of borrowing room $\frac{(EAD-Current\ Exposures)}{Borrowing\ Room}$ x 100% = $\frac{(8\,000-5\,000)}{5\,000}$ x 100% = 60%.
   In other words based on the WCF formula, the bank's EAD = CE_i+0.60CE_i = 5 000 + 0.60x5 000 = 8 000.
3. Under the potential exposures approach, certain products lead to some specific exposures, for instance guarantees, that banks can give to customers or a third parties. Guarantees translate into an exposure if a third party goes on to request payment under the guarantee ship. To determine the exposures equivalent of potential exposures we can use the Cash Conversion Factor (CCF) given the standardized valuation approach propounded by Yang and Tkachenko (2012) [13]. The CCFs of a lending institution can be calculated from its given financial statements. The working capital facilities model (WCF) can be combined with CCF so as to determine the following variables:

1. The expected amount of guarantees issued in a given time period using WCF model and
2. Convert expected potential exposures into expected exposures using suitable CCF approach.

Therefore from the EAD models presented above, the study adopted a multiple linear regression financial econometric EAD model that was similar to the equations postulated by Pinaki (2010) [14] which were of the following general forms:

1. EAD = CF×TL, where CF and TL were Conversion Factors and Total Limits respectively and;

2. EAD = CE + $\propto$L, representing Credit Exposure, $\propto$ (Appropriate Conversion Factor) and Credit Limits in that sequence.

The reason for coming up with a financial econometric model similar to the above was that the study wanted to come up with a simple model for banks to apply in EAD modelling of wholesale lending activities. The proposed model was consistent because it was compatible with the requirements of the Basel II Capital Accord for risk weighted assets of banking corporations. An econometric model related to the EAD ones above by Pinaki (2010) [14], adjusted for a liquidity variable was expected to go a long way in assisting Zimbabwean banks and similar financial institutions in coming up with the correct credit exposure amounts resulting from their lending activities. Therefore the interest rates to be levied on a firm's credit business should be sensitive to both the amounts issued to obligors and limits set on corporate credit exposures issued by lending institutions. One of the major sources of lending institutions' failure to successfully manage their credit exposures was their inability to factor quantify and set caps to their credit exposures issued to the obligors.

The quantification and management of credit exposures was central in minimizing the amount of non-performing loans (NPL) in Zimbabwean banks and similar financial institutions as per the stipulations of the Basel II Capital Accord. The accumulation level of NPLs in Zimbabwe's banking sector in the dollarization era was very frightening and unmanageable in most banks and similar financial institutions. It was therefore the interest of this study to adjust the EAD model proposed by Pinaki (2010) [14] and Yang and Tkachenko(2012) [13] for transaction costs to make it practical and more inclusive in terms of funds involved in a firm's lending business operations.

The EAD Model and its Implementation

The financial econometric EAD model adopted for implementation was based on the ones postulated by Pataki (2010) which were two forms of related algebraic equations namely:

1. EAD = CF×TL, where CF and TL were Conversion Factors and Total Limits respectively and/or secondly;
2. EAD = CE+ $\propto$L, representing Credit Exposure, $\propto$ (Appropriate Conversion Factor) and L, Credit Limit in that order.

The financial EAD model postulated by the study was adjusted for liquidity variables and therefore took the general form, EAD = α + β_1CreExpos + β_2TLiabs where CreExpos and TLiabs represented Credit Exposures (or Total Loans Issued) and Total Liabilities respectively borne by the Corporation respectively in the period under review. The proposed financial econometric model was expected to go a long way in assisting banks and similar financial institutions in coming up with the correct credit exposure amounts resulting from their lending activities with corporates. In other words the interest rates to be levied on obligors should be sensitive to both the credit amounts issued and liquidity or networking capital needs of issuing such credit exposures required by the lending institution at the time of giving out credit. The proposed EAD financial econometric model above would go a long way in balancing the corporations' credit exposures and periodic net working capital or liquidity requirements which were extremely critical in driving them towards sustainable development in the dollarization era.

The proposed model was then applied to modelling of financial data drawn from two ZSE listed banking Corporations for the period 2010 to 2012 in order to take the study to finality. The majority of banks or financial institutions operating in emerging markets that were involved in lending activities were not conversant with the requirements of Basel II and III Capital Accords when it came to management of credit risk and EADs on a regular basis. Hence the need by the study to come up with a financial econometric EAD model that was realistic, simple and straight forward for adoption and implementation by banks and similar financial institutions in Zimbabwe in their desire to successfully manage their credit exposures and risks emanating from such lending activities in the period under investigation.

Presentation of Results, Findings and Discussion

The study used STATA package to come up with the following results from audited monthly financial statements of the two ZSE listed banking corporations for the period 2010-12.

Barclays STATA Results and Analysis

```
regress ead crexps tliabs

      Source |       SS       df       MS              Number of obs =      36
-------------+------------------------------           F(  2,    33) =       .
       Model |  31492.4222     2  15746.2111           Prob > F      =  0.0000
    Residual |  .888944473    33  .026937711           R-squared     =  1.0000
-------------+------------------------------           Adj R-squared =  1.0000
       Total |  31493.3112    35  899.808891           Root MSE      =  .16413

------------------------------------------------------------------------------
         ead |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      crexps |   .9923177   .0028466   348.60   0.000     .9865264    .9981091
      tliabs |   .0116089    .002643     4.39   0.000     .0062316    .0169861
       _cons |  -.7438989   .2139235    -3.48   0.001    -1.17913    -.3086683
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The EAD financial econometric model realized from STATA packages came out to be of the specific form, EAD = -7.439 + 0.9923Crexpos + 0.1161tliabs, based on two independent variables above, namely credit exposures (to obligors) and total bank liabilities (with bank depositors) respectively. The model found out that the bank's EAD had a strong positive relationship with credit exposures and a weak but positive connection with total liabilities due to bank creditors. The banking corporation was better placed for growth and development because its asset base (credit exposures) was almost 9 times as much as its indebtedness to the lenders.

The STATA package results were used to come up with the 95% confidence intervals for the betas of the constant and two independent variables used in the proposed financial econometric model for the bank. We were 95% certain that the coefficient of credit exposures fell in the range 0.997 to 0.998. On the other hand we were 95% confident that the effect of total liabilities on EAD was contained in the range 0.0062 and 0.0167 and that of the constant fell in the bounds 1.179 and -0.309. The credit exposures as an independent variable had a coefficient very close to 1 which meant that its impact on EAD was extremely significant. However the influence of the bank's total obligations was marginal and fell close to 0 as it lay in the range 0.0062 to 0.0167. The autonomous value of the bank was negative and was discovered to lie in the 95% confidence interval of -1.179 to -0.309. The study also went on to perform two statistical tests on the variables of the model, namely the student's t and ANOVA statistical tests.

The student's t distribution was used to test whether each of the independent variables' betas were significant or not relative to the dependent variable, EAD. The null (H0) and alternative (H1) hypotheses for the two independent variables under the t-test were stated as below:

H0: The bank's credit exposures and total liabilities had no effect on its proposed EAD financial econometric model ie $\beta_1 = 0$ and $\beta_2 = 0$.

H1: The bank's credit exposures and total liabilities had effect on its proposed EAD financial econometric model ie

$\beta_1 \neq 0$ and $\beta_2 \neq 0$.

The calculated t-values for the coefficients of the model, constant, credit exposures and total liabilities worked out to be -3.48, 348.60 and 4.39 respectively. The calculated student's t statistics were compared with the critical values drawn from statistical tables. The critical t-values for a one tailed test at 5% and 2.5% levels respectively were 1.645 and 1.96. Based on the t-values above we found out that the constant was not important while the bank's credit exposures and total liabilities were essential for inclusion in the model at both 5% and 2.5% levels of significance. liabilities in the model were found to be significant and insignificant respectively when it came to prediction of the bank's EAD values.

The study also used the Analysis of Variance (ANOVA) test to determine whether or not the two independent variables were significant in the banking corporation's proposed financial econometric model. The test was based on the 36 monthly observations drawn from the bank's audited financials for the period 2010-12. The starting point of the study was to come up with the null (H0) and alternative (H1) hypotheses below to test the relevance of the variables in the proposed model using ANOVA statistic:

H0: The bank's credit exposures and total liabilities had equal effect on the proposed EAD financial econometric model. H0 ie $\beta_1 = \beta_2$.

H1: The bank's credit exposures and total liabilities had effect on its proposed EAD financial econometric model ie H1: $\beta_1 \neq \beta_2$.

The ANOVA test was meant to examine the effectiveness of the two independent variables in predicting the bank's EAD. It was revealed that both credit exposures and total liabilities were significant. The variables were critical to be factored into the banking corporation's model because the calculated F-value of $\frac{15746.2}{0.02694} = 584491.5$ was far much higher than the critical F -values of 3.29 and 4.17 at 5% and 2.5% levels of significance. The p-value of the F–statistic was found to be 0.0000 which was far much less than the benchmark p-value of 0.005.

The major findings from the above tests were that the two independent values were worth including in the proposed EAD financial econometric model the international bank could use in its lending activities to corporates. These findings were further supported by the coefficients of determination drawn from the ANOVA test namely the R-squared and the adjusted R-squared which were equal to 1.0000. The two coefficients of determination implied that credit exposures and total liabilities explained 100% of the variability in the bank's EAD over the period under cover. In other words the proposed EAD multiple linear regression model was a very good one since its variables were robust enough to explain fully the dependent variable.

CBZ Stata Results and Analysis

```
regress ead crexps tliabs

      Source |       SS       df       MS              Number of obs =      36
-------------+------------------------------           F(  2,    33) =       .
       Model |  6902.0652      2  3451.0326            Prob > F      =  0.0000
    Residual |  .000121765    33  3.6898e-06           R-squared     =  1.0000
-------------+------------------------------           Adj R-squared =  1.0000
       Total |  6902.06533    35  197.201866           Root MSE      =  .00192

------------------------------------------------------------------------------
         ead |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      crexps |   .8510943   .0000426  2.0e+04   0.000     .8510076    .851181
      tliabs |   .0000638   .0000376     1.70   0.099    -.0000126   .0001403
       _cons |   7.200419   .0015062  4780.39   0.000     7.197355    7.203484
```

The indigenous bank's financial data, namely EAD, credit exposures and total liabilities values for the period 2010-12 were fed into the STATA package into to come up with an EAD financial econometric model. The STATA package came out with coefficients that were related through the specific model, EAD = 7.2004 + 0.8511Crexpos + 0.0001tliabs, based on the two independent variables namely credit exposures (to obligors) and total bank liabilities (with bank depositors). The proposed model showed that the bank's EAD had a strong positive relationship with credit exposures as represented by the 0.8511 coefficient in the model. On the other hand a coefficient of 0.0001 meant that there was a very weak but

positive connection between the EAD and total liabilities due by the bank to its creditors in the period under review. The study discovered that the bank's EAD was from credit exposures made in the period which however were mainly from its own resources rather than from deposits or borrowings from the investing players.

The STATA package was used to set the 95% confidence intervals for the betas of the constant and two independent variables used in the proposed model for the bank. We were 95% level sure that the coefficient of credit exposures fell in the range 0.8510076 to 0.851181, while that of total liabilities was contained in the range -0.0000126 and 0.0001403. The credit exposures as an independent variable had a coefficient of more than 85% which meant that its impact on EAD was significant. However the influence of the bank's total obligations with creditors was marginal and fell very close to 0 as it was 0.0001. However the autonomous value of the bank was 7.200149 and fell in the 95% confidence interval of 7.197355 to 7.203484. The positive autonomous constant meant that the bank managed to recover part of its EAD in the period under investigation.

The study also proceeded to perform two statistical tests on the variables included in the indigenous bank's proposed EAD model, namely the student's t and ANOVA statistical tests.

The student's t statistic was used to test whether each of the independent variables' betas was significant of not. The null (H0) and alternative (H1) hypotheses were formulated for the two independent variables and stated as below:

H0: The bank's credit exposures and total liabilities had no effect on the proposed EAD financial econometric model that is $\beta_1 = 0$ and $\beta_2 = 0$.

H1: The bank's credit exposures and total liabilities had effect on the proposed EAD financial econometric model that is $\beta_1 \neq 0$ and $\beta_2 \neq 0$.

The calculated t-values for the coefficients of the model were found out to be 4 780.39, $2.0^{e^{04}}$ and 1.70 respectively for the constant, credit exposures and total liabilities faced by the indigenous banking corporation in the period under review. These values were compared with the critical values of 1.645 and 1.96 drawn from tables at 5% and 2.5% respectively under one tailed t-tests. At 5% both variables and the constant were found to be significant for inclusion in the model. The study however found out that total liabilities of the bank were not important in the model while the constant and credit exposures were very essential at 2.5% level. In other words the betas of credit exposures and total liabilities were found to be significant and insignificant respectively when it came to prediction of the bank's EAD values for the period 2010-12.

The study also went on to apply the ANOVA statistical test to evaluate the relevance of the two independent variables in the banking corporation's proposed AVM financial econometric model. The study came up with the null (H0) and alternative (H1) hypotheses stated below in order to test the importance of the variables in the proposed model:

H0: The indigenous bank's credit exposures and total liabilities had same effect on the EAD of the proposed financial econometric model. H0: $\beta_1 = \beta_2$.

H1: The bank's credit exposures and total liabilities had different effects on the EAD of the proposed financial econometric model. H1: $\beta_1 \neq \beta_2$.

The ANOVA test found out that the two independent variables were critical to be factored into the banking corporation's model because the model's calculated F-value of $\frac{3451.0326}{3.6898 \times e^{-06}} = 377\ 323$ was far much higher than the critical F- values of 3.29 and 4.17 drawn from tables at 5% and 2.5% respectively. The p-value of the F-distribution was found to be 0.0000 which was far much less than the benchmark p-value of 0.005, implying that the variables were important in the model.

The above ANOVA findings depicted that the two independent values were essential for inclusion in the proposed EAD financial econometric model for the indigenous bank. The above ANOVA test results were further supported by the coefficients of determination for both R-squared and the adjusted R-squared which were equal to 1.0000. The two coefficients of determination showed that credit exposures and total liabilities together accounted for 100% of the variability in the bank's EAD over the period under consideration. In other words the proposed model was a suitable multiple linear regression model for the bank because its independent variables were able to explain the EAD dependent variable under investigation to a greater extent.

Conclusions and Recommendations

The study used the STATA package to come up with a multiple linear regression model for EAD for analysing audited financial statements' data drawn from the two ZSE listed banking corporations for the period 2010-12. The study was intended to come up with an easy, realistic and Basel II Accord compliant financial econometric model for banks in Zimbabwe adjusted for market friction. The proposed AVM econometric model regressed EAD against two independent variables namely credit exposures and total liabilities to be discharged by the banking corporation in its credit exposure business. The study concluded that Zimbabwean banks needed to adopt a multiple linear regression financial model that was reliable and consistent when it came to quantification, monitoring and evaluation of their EADs as far as their lending activities were concerned. It was concluded that the model proposed for adoption and implementation by banks was going to go a long way in the management of non-performing loans (NPLs) and risk in general. The success story of the Zimbabwe Stock Exchange (ZSE) was entirely dependent upon the capitalization, investment and sustainability levels of listed banking corporations which were considered the engines of economic growth and development of the whole economy.

The study used financial data drawn from two ZSE listed banks namely indigenously and internationally registered banks. The study concluded that the indigenous Zimbabwean bank needed to be better capitalized and effective if it were to draw more of its growth and asset base from its lending business. The bank's capital, asset and equity bases, *et al*. one asset volatilities were lower than those of the international bank and constrained its growth and development prospects in the dollarization era. It was also concluded that the indigenous commercial bank's EAD model drawn from 2010-12 financial data had smaller coefficients for both credit exposures and total liabilities

than the international one, serve for constants which were positive and negative respectively. Hence the independent variables drawn for the proposed model were more relevant and effective in predicting the EAD model for the international bank than the indigenous one. The study also concluded that the negative and positive constants for the EAD models implied the recovery from NPLs and loss given default (LGD) from the indigenous and international banks respectively.

The study also used the STATA package results to perform two statistical tests, namely the student's t and ANOVA distributions on the regression coefficients of the two AVM multiple linear regression models for the listed banking corporations. Based on the student's t tests study concluded that the betas of the international bank for credit exposures and total liabilities were higher than those of the indigenous bank. This conclusion implied that the international bank was better capitalized on the ZSE and had issued out more credit exposures than the indigenous bank in the period under investigation. The study also concluded that the independent variables were significant to both banks' models at 5% level, while the constants were essential and insignificant for the indigenous and international banks respectively. However when the distribution was tested at 2.5% level there above conclusion was upheld serve for the total liabilities variable which was rejected for the indigenous bank. From the findings of the ANOVA tests for the coefficients of EAD models for the two banks, the study concluded that both independent variables were relevant at5% level of importance. However when the test was repeated at 2.5% level, both variables were important for the international bank while for the indigenous bank only credit exposures remained significant and total liabilities were relegated.

The study also concluded that the independent variables drawn into the banks' EAD models explained 100% of the dependent variable as evidenced by the R-Squared and Adjusted R-Squared values of 1.00 for both the student's t and ANOVA statistical tests. This meant that the indigenous bank had lower funding sources than the international bank in the period under review and hence its lower asset, equity and EAD base values relative to the other. It was also concluded that higher levels of EADs for both banks in the period under review if well managed were going to go a long way in enabling banks to draw nearer and nearer to meeting their Central Bank set minimum capital requirements in accordance with the stipulations of the Basel II Capital Accord. The study also concluded that the banks' performance in their lending activities in 2010-12 period could have been affected by government actions for example pending elections and economic policies such as the indigenization and economic empowerment act (IEEA).

However the other evils that could have impacted negatively on the banks' performance in the review period could have been rampant corruption, nepotism, unsustainable salaries and wages, crowding out of the private sector and lack of foreign direct investment (FDI) due to economy-wide and political risks facing the country. The domestic bank for instance was used by the Government to fund part of the Constitution Making Process in preparation for harmonized elections which development could have affected its investment and lending operations seriously. The banks' will to meet the Reserve Bank of Zimbabwe (RBZ)'s minimum capital requirements through improving their capitalization through retained earnings from interest income was retarded massively due to policy inconsistencies on property rights or private ownership of the means of production. The study finally concluded that all Zimbabwean banks needed to be independent and autonomous in order to be free to adopt and implement the proposed AVM financial EAD model in their lending business operations if they were to grow towards sustainable development in terms of asset and equity bases *et al*. one in their financial services provision to the nation.

Based on the conclusions above the study recommended that listed financial corporations in emerging markets needed to adhere to the requirements of the Basel II and III Capital Accords if they were to make meaningful business out of their credit exposure operations in the dollarization era. The study also recommended that Zimbabwean financial corporations should come up with capitalization, investment and lending strategies that suited their economic conditions if they were to grow and develop sizeable market shares and massive wealth for their shareholders. We also recommend that financial corporations in emerging markets should adapt to international business standards, strategies, ethics and corporate governance systems if they were to grow towards greater similarity with those in developed nations such as United Kingdom, Japan, France, United States of America and the rest of Europe. Such levels of development were going to go a long way in the Zimbabwean financial sector's quest to provide the much needed financial resources for investment purposes and contribution to nation building and sustainable development. It was also recommended that both public and private banks needed autonomy and independence if they were to operate in accordance with the traditional objectives of being well capitalized or meeting the Central Bank's minimum capital requirements, profit maximization and wealth generation for their shareholders. The study also recommended that policies such as IEEA which were retrogressive should not be effected targeting the financial sector if the domestic financial sector were to be conductive to lure FDI needed for growth and development of the economy as a whole.

The RBZ, as the regulator and supervisor of banks needed to be autonomous in order to direct the economic activities of the country in an integral, prudent, rational, accountable, transparent and effective manner. The status of an economy was as good as the tone of its financial sector hence the need to align the sector to sound policies, procedures, standards and economic incentives which had the capacity to motivate domestic savings and lure FDI for investment, industrial growth and development. Zimbabwean commercial banks on the other hand were encouraged to adhere to the Basel Committee recommendations, King II Stipulations on corporate governance and ethics in their desire to grow and develop market shares domestically and globally. It was finally recommended that all domestic banks should join the global financial market system in their desire to improve their capitalization, number of financial assets they owned through reaching out to foreign investors and shareholders' wealth. In other words banks needed to diversify and reach out to players in various sectors of the economy to avoid the risk of concentration on specific economic sectors. Zimbabwean banks were advised to put in place efficient and effective risk management models and Credit Rating Bureaus (CRBs) and policies that were to be adhered to in order to avoid issuing out NPLs to accredit worth corporate

borrowers.

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Appendices

Table A: Month 0n Month Market Values for Cbz Ltd for the Period 2010-12 ($ Millions)

DATE	EAD	CR. EXPS	T. ASSTS	T.EQUT	T. LIABS
Jan-2010	49.755	49.996	167.500	126.567	40.933
Feb-10	49.755	49.996	157.443	116.510	40.933
Mar- 10	49.755	49.996	157.235	116.305	40.933
APR-10	49.755	49.996	143.555	102.622	40.933
May-10	49.755	49.996	143.555	102.622	40.933
Jun -10	49.755	49.996	140.134	99.201	40.933
Jul-10	49.755	49.996	147.660	106.727	40.933
Aug-10	49.755	49.996	150.397	109.463	40.933
Sep- 10	49.755	49.996	129.872	88.939	40.933
Oct-10	49.755	49.996	139.450	98.517	40.933
Nov-10	49.755	49.996	153.871	112.884	40.933
Dec-10	49.755	49.996	150.397	109.463	40.933
Jan 2011	73.619	78.037	175.300	109.463	65.837
Feb-11	73.619	78.037	168.747	126.567	42.180
Mar-11	73.619	78.037	192.404	123.146	69.258
Apr-11	73.619	78.037	188.983	123.146	65.837
May-11	73.619	78.037	188.983	123.146	65.837
Jun-11	73.619	78.037	188.983	123.146	65.837
Jul-11	73.619	78.037	188.983	102.622	65.837
Aug-11	73.619	78.037	168.459	99.201	73.979
Sep-11	73.619	78.037	168.459	94.480	68.258
Oct-11	73.619	78.037	160.318	95.780	64.538
Nov-11	73.619	78.037	161.618	75.256	86.362
Dec-11	73.619	78.037	141.093	95.780	45.313
Jan-2012	82.559	88.535	161.593	61.573	100.020
Feb-12	82.559	88.535	141.633	47.890	93.743
Mar-12	82.559	88.535	128.000	37.628	90.372
Apr-12	82.559	88.535	117.594	44.469	73.125
May-12	82.559	88.535	124.554	54.732	69.822
Jun-12	82.559	88.535	134.841	62.257	72.584
Jul-12	82.559	88.535	142.367	68.414	73.953

Aug-12	82.559	88.535	148.524	68.414	80.110
Sep-12	82.559	88.535	148.729	68.620	80.109
Oct-12	82.559	88.535	162.207	82.097	80.112
Mov-12	82.559	88.535	148.524	68.414	80.110
Dec-12	82.559	88.535	148.524	68.414	80.110

Table B: Montyh on Month Market Values for Barclays Ltd for the Period 2010-12 ($ Millions)

DATE	EAD	CR. EXPS	T. ASSTS	T.EQUT	T. LIABS
Jan-2010	142.030	142.412	417.856	301.258	116.598
Feb-10	142.030	142.412	331.770	215.185	116.585
Mar- 10	142.030	142.412	353.300	236.703	116.597
APR-10	142.030	142.412	331.782	215.185	116.597
May-10	142.030	142.412	331.782	215.185	116.597
Jun -10	197.351	198.029	310.263	193.666	116.597
Jul-10	197.351	198.029	366.558	204.425	162.133
Aug-10	197.351	198.029	355.799	193.666	162.133
Sep- 10	197.351	198.029	366.628	204.495	162.133
Oct-10	197.351	198.029	373.086	210.953	162.133
Nov-10	197.351	198.029	355.865	193.732	162.133
Dec-10	197.351	198.029	355.865	193.732	162.133
Jan-2011	204.944	205.317	348.654	175.435	173.219
Feb-11	204.944	205.317	334.662	161.444	173.218
Mar-11	204.944	205.317	323.684	150.465	173.218
Apr-11	204.944	205.317	302.373	129.155	173.218
May-11	204.944	205.317	313.136	139.918	173.218
Jun-11	204.944	205.317	302.373	129.155	173.218
Jul-11	226.427	226.525	320.050	128.940	191.110
Aug-11	226.427	226.525	320.050	129.155	191.110
Sep-11	226.427	226.525	341.802	150.691	191.110
Oct-11	226.427	226.525	309.511	118.400	191.110
Nov-11	226.427	226.525	294.442	103.331	191.110
Dec-11	226.427	226.525	283.678	92.567	191.110
Jan-2012	216.788	216.823	286.030	90.415	195.615
Feb-12	216.788	216.823	292.512	96.888	195.624
Mar-12	216.788	216.823	282.097	85.907	196.190
Apr-12	216.788	216.823	275.853	79.663	196.190
May-12	216.788	216.823	271.331	75.142	196.190
Jun-12	216.788	216.823	260.781	64.592	196.190
Jul-12	240.888	240.998	286.962	68.898	218.064
Aug-12	240.888	240.998	284.809	66.745	218.064
Sep-12	240.888	240.998	277.215	62.439	214.776
Oct-12	240.888	240.998	277.215	62.439	214.776
Mov-12	240.888	240.998	269.738	51.673	218.064
Dec-12	240.888	240.998	274.044	55.980	218.064