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Experimental Evidence on the Impact of Replacing the Incurred Credit Loss Model of Bank Loan Loss Provisions with the International or US Accounting Standards Boards' Expected Credit Loss Models

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Abstract

Our objective is to test-bed the new Expected Credit Loss (ECL) and Current Expected Credit Loss (CECL) models for bank credit loss accounting to identify the potential consequences of their implementation. In particular, whether and how ECL and CECL approaches could lead to divergence in credit loss accounting practices in the U.S. relative to the rest of the world is an unanswered question. To do this, we develop a stylized bank-loan setting in a controlled laboratory environment with eight different secured personal-loan portfolios. Fifty-six senior accounting students take the role of loan managers responsible for making annual loan-loss reserve decisions in a between-subjects design under the rules of either the ECL or CECL models. We examine the effects of mandating the ECL or CECL model in terms of their impacts on the *adequacy* of loan-loss reserves, the *comparability and predictability* of loan-loss reserves and the *volatility* of reported profit.

Key words: Credit-Loss Rule Changes; Test-bedding; Adequacy of Reserves; Excess of Reserves; Accounting Comparability; Accounting Predictability

JEL codes: M48, C63, C91, M52

Experimental Evidence on the Impact of Replacing the Incurred Credit Loss Model of Bank Loan Loss Provisions with the International or US Accounting Standards Boards' Expected Credit Loss Models

1. Introduction

For more than four decades, the traditional accounting standards for loan-loss provisioning was governed by the incurred credit loss (ICL) model.[1] This model was severely criticized by politicians and policymakers as one of the causes of the 2007-2009 financial crisis and for exacerbating its intensity (Vyas, 2011; Kothari and Lester, 2012).[2] The two foremost concerns are: (i) it requires entities to delay the implementation of loan-loss allowances until objective evidence indicates that an impairment is highly probable (i.e., imminent) and (ii) it requires that the *estimation* of the loan loss allowance be based only on past loss experiences and current conditions.[3] These stipulations tend to create *insufficient* reserves during good times, which are needed to absorb loan impairment losses expected during downturns. This could lead to a rapid accumulation of allowances very near to when expected losses are realized. These features often result in building up "too little" loan-loss reserves "too late" in times of recession, increasing the volatility of reported income and reinforcing a pro-cyclical bias by skewing income to the "boom" portion of the cycle (O'Hanlon et al., 2015; Hashim et al., 2019).[4]

To address the weaknesses of the ICL model, in 2014 the International Accounting Standards Board (IASB) issued its final version of the Expected Credit Loss (ECL) model to be effective on or after January 1, 2018. Similarly, in 2016 the Financial Accounting Standards Board (FASB) issued its Current Expected Credit Loss (CECL) model to be effective on or after December 15, 2019. In developing these new standards, the two Boards adopted a more flexible principle-based and forward-looking approach.[5] The two models introduce, among other things, two major changes: (i) removing the minimum "probable" threshold condition that a default is

[1] The Financial Accounting Standards Board (FASB) Statement no. 5 (1975), "*Accounting for Contingencies",* established the GAAP concept behind the incurred credit loss model. The International Accounting Standard (IAS) 39 was mandated by the International Accounting Standards Committee (IASC) in 1998.
[2] A G20 Communique was produced on April 2, 2009 by the G20 leaders from their London Summit mandating the two main accounting standard-setting bodies (the FASB and the IASB) to consider an alternative model to the existing accounting standards. https://www.imf.org/external/np/sec/pr/2009/pdf/g20_040209.pdf
[3] The rational for mandating this strict model for such long time was to minimize the opportunities for aggressive earnings management and to maintain a high degree of *comparability* of loan-loss provisioning related information among entities.
[4] In this paper we use the terms "loan-loss allowance", "loan-loss reserve", and "reserves" interchangeably.
[5] In this paper, we use the terms "model", "standard" and "regime" interchangeably.

imminent (its probability is at least 70%) for the recognition of financial asset impairment, and (ii) requiring bank managers to incorporate all reasonable and supportable forward-looking information into their periodic estimates of loan-loss provisions. The objective of mandating these new models is to promote higher-quality reserve information. Managers would have the flexibility to exercise discretion in incorporating forward-looking information when estimating periodic loan-loss provisions. The two Boards argue that these changes are expected to increase the adequacy (sufficiency) of loan loss reserves and recognize them on a more timely basis, to promote higher-quality reserve information,[6] and to reduce the volatility of reported profit (IASB 2014; FASB 2016).

Early anecdotal evidence from professionally conducted surveys provides partial support for the predictions of the standard-setters. For example, KPMG (2014, p. 62) reported results of a field survey conducted by the IASB in 2013 which indicated participants anticipate substantial increases in allowances under the forward-looking approaches. Curry (2013) states that "There is no question that implementation of the FASB proposal will require most banks to boost their allowance… the increases would be … perhaps in the neighbourhood of 30 to 50 per cent system-wide if applied today". Results from a survey by Deloitte (2017) of senior executives at 31 US banks indicated that most banks anticipate an increase in their allowances for credit losses ranging between 10% to 50%.

The main differences between the ECL and CECL models are: (i) the *time-horizon* over which the expected credit losses are measured, and (ii) the *timing* of recognizing them. The FASB (2016, p. 282) states that "… while the IASB's stakeholders strongly prefer an impairment model that utilizes a *dual* credit-loss measurement approach, the U.S. stakeholders strongly prefer a *single* credit-loss measurement approach". The CECL model requires entities to estimate and recognize the expected credit loss allowance for the *lifetime of the loan* at its origination. At the end of each subsequent reporting period, the entity should update the loan loss allowance from the previous reporting date to reflect changes in the credit quality, but the loan loss allowances will continue to be measured at the present value of expected credit shortfalls over the remaining life of the loan. However, under the ECL model, entities are required to measure and recognize, at the initiation of a new loan, an expected credit loss for the first *12 months*. At the end of each subsequent reporting period, entities are required to determine whether the default risk of the loan has significantly deteriorated since its initial recognition. If the answer is yes, the entity should

[6] In this study, we mainly focus on predictive ability and comparability of reserve information.

recognize loan loss reserves for the remaining *lifetime* of the asset; otherwise it should continue with a *12-month* estimate of reserves.[7]

Our primary objective is to examine the effects of mandating the ECL or CECL model in terms of their impacts on the *adequacy* of loan-loss reserves, the *comparability and predictability* of loan-loss reserves and the *volatility* of reported profit. In particular, whether and how ECL and CECL approaches could lead to divergence in credit loss accounting practices in the U.S. relative to the rest of the world is an unanswered question. Although the applications of the new standards are expected to overcome the ICL's weaknesses, the inherent flexibility and discretion provided by the new models could potentially threaten the quality and comparability of reserve information and may dampen some of their expected benefits. For example, in practice, bank managers can choose from a wide variety of available methods (techniques) to incorporate forward-looking events into periodic estimates of loan-loss allowances. Kellar and Schell (2015) and PwC (2015) discuss several approaches including discounted-cash-flow, vintage and static-pool analyses, as well as the average charge-off, roll-rate and probability-of-default methods. Each method is based on distinct assumptions and is likely to yield different estimates. Neither the FASB nor the IASB imposes restrictions, guidelines, or prescribes which specific procedures should be used. Furthermore, the two Boards allow entities to estimate the expected credit losses either collectively or individually. Moreover, the regimes allow the same entity to apply different methods to both different and similar financial instruments – and at varying points in time. These multiple approaches could potentially impair some of the properties of decision-usefulness, such as comparability and predictive ability.

We examine the potential differences between ECL and CECL models, using a controlled laboratory test-bedding exercise.[8] This platform enables us to enact and analyze the proposed policies advanced by a regulatory authority or a private or public interest group.[9] We do this by designing a controlled laboratory environment to study the management of loan portfolios in a stylized business cycle environment that contains both growth and recessionary periods. Within this environment, we test-bed the effects of mandating the ECL or CECL models, relative to the

[7] It is interesting to note that the IASB does not provide bank managers with guidelines on how to operationalize the term "significant deterioration of credit quality of a financial instrument since initial recognition". The Board left it to the discretion of bank managers.

[8] "a … test-bed … is a platform for conducting rigorous, transparent, and replicable testing of scientific theories, computational tools, and new technologies. The term is used across many disciplines to describe experimental research and new product development platforms and environments". See https://en.wikipedia.org/wiki/Testbed.

[9] The CECL model comes into effect in 2020, hence archival data to test any predictions will only be available well-after this date.

ICL model, in terms of their impacts on the *adequacy* of loan loss reserves,[10] the *comparability* of reserves across banks, the *ability* of current reserves to predict future write-offs, and the *volatility* of reported profit.

To achieve this, we developed eight secured personal-loan portfolios, each for a 3-year term and with different credit risk characteristics. We used 56 senior accounting students in a between-subjects design to take on the role of loan managers. They were tasked with the responsibility of making annual loan-loss reserve decisions under either the ECL or CECL requirements. To mitigate the effects of potential earnings management behavior, we designed a managerial compensation scheme that aligned the interest of the manager with the interest of shareholders. We compared our laboratory results to baseline simulations in which hypothetical loan managers make risk-neutral loan-loss reserve decisions within the rules governing the ICL, ECL and CECL models.[11] The laboratory environment relaxes the requirement that decisions be risk-neutral within the context of the simulations, and this introduces the possibility of variation across managers in the implementation of loan-loss reserves under the ECL and CECL models. Given the characteristics of a manager's loan portfolio, the ICL model will generate the same loan-loss reserves across all managers facing the same portfolios. Because our controlled environment presents all managers with the portfolios that have the same characteristics, there was no value in implementing the ICL model in the laboratory setting.

Our results generally support the objectives of the IASB and FASB. Within our controlled laboratory environment, mandating the ECL or CECL models results in substantial increases of loan-loss reserves (i.e., over-reserves) and the CECL model shows more excessive reserves than does ECL model. While the comparability of reserves deteriorates under the two new regimes relative to the ICL model, the CECL model shows relatively more comparable reserves than the ECL model. The ECL model exhibits a modest but statistically insignificant increase in predictability but the CECL model shows significant declines. Finally, profit volatility falls significantly under both ECL and CECL models relative to the ICL model. A particularly important policy issue is the increase in excess reserves under both the ECL and CECL models relative to the ICL model. This suggests that the new rules may result in trading off reserves that

[10] Reserves are measured with respect to their inadequacy (the ratio of uncovered write offs relative to total write-offs) and with respect to their excess adequacy (the ratio of total reserves during a year less write-offs relative to total write offs).

[11] Requiring decisions to be risk-neutral forces a specific amount of reserves to be associated with each rule in each decision round. This will be discussed further when the presentation of predictions of results are introduced in Section 4.

are "too little too late" for reserves that are "too much too soon". This last situation could impair the capital buffer of the lenders and could have an adverse effect on the economy in the form of reduced lending.

2. Institutional background and the stylized loan environment

2.1. Institutional background

Prior to mandating the ICL model, the accounting standard-setters were concerned about the aggressive earnings management practices that characterized the managerial actions in many financial institutions (Beatty and Liao 2014). To discourage these undesirable practices, the standard setters promulgated the ICL models[12] that imposed rigid requirements to maintain a high degree of objectivity in the implementation of loan loss accounting, and to enhance comparability across entities and over time (Gebhardt and Novotny-Farkas 2011). The ICL model requires banks to delay recognition of loan-loss reserves until the impairment of a financial asset is highly probable (i.e., default or delinquency in interest or principal payments) and that the reserves should be based on only past events and current conditions. These requirements often result in a rapid accumulation of allowances very near to the time in which expected losses are realized and reinforce a pro-cyclical bias by skewing income to the "boom" portion of the cycle. This increases the volatility of reported income (O'Hanlon et al. 2015; Hashim et al. 2019).

In response to the criticisms of the ICL model, that was blamed for too little reserves at the onset of the financial crisis, the FASB and IASB worked together on a joint project for almost four years (2009 to 2012), with the goal of developing a single (*common*) flexible and forward-looking model to overcome the ICL model's weaknesses. On January 31, 2011, the FASB and the IASB proposed a common solution for impairment accounting, based on a "dual-measurement approach", to better reflect the changes in the credit quality of financial assets.

From February 17, 2011 to July 18, 2012, 14 joint meetings of the IASB and FASB boards were held, with the latter distributing minutes under the heading "Accounting for Financial Instruments: Impairment".[13] The FASB had received adverse concerns from its constituencies against the "dual-measurement credit impairment model" that was under development. At a meeting of only the FASB on August 1, 2012, its members unanimously

[12] The FASB issued Statement no. 5 (1975) and the International Accounting Standards Committee (IASC) issued the International Accounting Standard (IAS) 39 in 1998.

[13] These minutes and others from the period November 10, 2010 through September 17, 2013 are posted at http://www.fasb.org/jsp/FASB/FASBContent_C/ProjectUpdatePage&cid=1176159268094 (accessed on April 3, 2018).

directed their staff "to explore an alternative expected loss model that (a) does not utilize a dual-measurement approach and (b) reflects all credit risk in the portfolio."[14] Subsequently, both the IASB and FASB proceeded to independently develop their new impairment models.

In July 2014 the IASB issued its impairment model in *Financial Instruments* 9 (IFRS 9), which came into effect for the accounting periods beginning on or after January 1, 2018.[15] We refer to the IASB's new impairment model for loan losses as the ECL model. The IASB followed a dual credit-loss measurement approach in which entities measure and recognize the expected credit losses for only the next 12 months. At the end of each reporting period, entities are required to assess the changes in the credit quality to determine whether or not the default risk of the loan portfolio has significantly deteriorated since the initial recognition of the loan. If the answer is yes, the entity should recognize reserves for the remaining *lifetime* of the asset; otherwise, they should continue with a *12-month* estimate of reserves. The ECL model requires management to base its decision on whether the credit risk quality has significantly deteriorated since the origination of the loan on all available reasonable and supportable information. However, it does not provide entities with clear guidelines or criteria of what constitutes significant deterioration in credit quality, and how this is determined is left up to the discretion of bank management.

In June 2016, the FASB issued its final version of the accounting standard on financial instruments, which introduced the current expected credit losses methodology (the CECL model) for estimating allowances for credit losses.[16] The FASB based its new accounting standard on a single credit-loss measurement approach, in which entities measure and recognize lifetime expected credit losses at the initiation of a new loan. At the end of each reporting period, the entity should update the loan loss allowance to reflect changes in the credit quality since the previous reporting period. It will also continue to measure loan loss allowances at the present value of expected credit shortfalls over the loan's remaining lifespan.

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[14] See http://www.fasb.org/cs/ContentServer?c=Document_C&cid=1176160222921&d=&pagename=FASB%2FDocument_C%2FDocumentPage

[15] The IASB issued the IFRS 9 in three phases: the classification and measurement requirements (in 2009 and 2010), the hedge accounting model in 2013, and finally, the expected credit loss model is issued in July 2014. http://www.ifrs.org/current-projects/iasb-projects/financial-instruments-a-replacement-of-ias-39-financial-instruments-recognitio/documents/ifrs-9-project-summary-july-2014.pdf.

[16] FASB (2016), Accounting Standards Update (ASU) No. 2016-13, *Financial Instruments—Credit Losses* (Topic 326). The new accounting standard is effective for the accounting periods beginning on or after December 15, 2019.

The FASB and IASB anticipate that mandating the new forward-looking models are expected to overcome the weaknesses of the ICL model and increase adequacy of loan loss reserves. More specifically, mandating the ECL and CECL models are likely to improve the magnitude of estimated loan-loss allowances, recognize them earlier, enhance the decision-usefulness of reserve information and mitigate the volatility of reported earnings [17]

2.2. Stylized loan environment

In order to examine the effects of the replacing the ICL model with the ECL or CECL models in a bank loan environment, we construct an environment in which loan managers must make periodic decisions regarding the reserves necessary to be held in anticipation of loan losses. This environment includes eight different secured personal-loan portfolios, each for three-year terms, for a total of 24 years of experimental trials. Each portfolio has different risk characteristics. The 24 years represent two economic cycles of 12 years, where each cycle consists of eight years of economic growth and four years of recession (see Figure 1).

Periodic changes in the risk characteristics of the loan portfolios are clearly specified and conveyed to loan managers prior to making year-end reserve decisions. These characteristics include changes in the borrowers' credit-worthiness, employment status, and the market value of the collateral. We also clearly describe the rules that govern the implementation of the ICL, ECL and CECL models. Finally, we describe the preferences of the loan managers, and how this will lead to the decisions they make regarding the setting aside of reserves. To mitigate the potential for opportunistic earnings management behavior, we design a compensation scheme that aligns the interest of the managers with the interest of the shareholders.

Given the loan management environment we create, the compensation scheme we implement and the ways that the ICL, ECL and CECL models control the reserves that the loan managers may select, we expect loan managers to try to maximize the payoffs they receive that result from their reserve-setting decisions. We will first describe a baseline simulation of the ICL model that assumes risk-neutral loan managers who may only set aside reserves if credit losses are highly probable (which will be clearly defined for them), and when this occurs, they must set aside reserves equal to the 12-month discounted expected credit loss based on their risk

[17] It is important to note that the empirical evidence on the economic consequences of mandating the new accounting standards is very limited. The earliest archival data that measure the actual responses of business entities to the new accounting rules will not be available for researchers until 2022.

neutrality.[18] The baseline simulations of the ECL and CECL models are carried out in a similar manner with two major changes: (i) the expected credit loss is calculated based on, not only experience and current conditions, but also on all forward-looking information, and (ii) the minimum probable threshold condition is no longer required. For the ECL model, the loan manager must set aside reserves equal to the 12-month expected credit loss, and switch to the lifetime expected credit loss only if there is a significant deterioration in credit quality. For the CECL model, the loan manager must set aside reserves equal to the lifetime expected credit loss, regardless of the probability of the loss.

Our baseline simulations do not permit loan managers the flexibility to deviate from the risk-neutral expected credit loss under the ECL and CECL models. This constraint is relaxed when the loan management environment is moved into the laboratory setting that allows loan managers to select reserves from a range of values centred on the expected credit loss imposed in the baseline simulations. With many people participating as loan managers making reserve decisions in a controlled laboratory setting – and when the risk-neutral constraint is relaxed for the ECL and CECL models – the simulations provide a baseline for our evaluation of the effects associated with replacing the ICL model with these two alternative models.

While the baseline simulations provide several reserve features, such as a unique set of their values, their adequacy, predictability and the volatility of net profit for each model, the results from the laboratory sessions will not necessarily be unique.[19] Sections 3 and 4 describe how the loan management environment is created, details of the managers' compensation scheme, and the rules governing the choice of reserves under the ICL, ECL and CECL models.

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[18] Risk neutrality in this context means that loan managers will compute the 12-month expected credit loss based on the probability of default and the loss given default for their portfolios that are provided to them each year by their banks' research staff. The formula proposed by the ISAB and FASB to calculate the expected credit loss (ECL) is

$$ECL = PD \times EAD \times LGD$$

where PD is the probability of default (a value between 0 and 1). EAD is the exposure at default (the principal of the loan plus any interest due). LGD is the loss given default (the proportion of the EAD that cannot be recovered, which is equal to 1 minus the recovery rate). If EAD is $10,000, LGD is 0.4 (sixty percent of the EAD can be recovered by the sale of collateral) and PD is 0.3 (there is a thirty percent chance of a default), the expected credit loss is $1,200. Note that this is identical to our definition of expected credit loss. However, we use the words "loss given default" to represent the EAD x LGD, as defined above. It is important to note that the probability of default in our environment increases over the term of the loan (see Table 1; note that 12-month discounted probabilities of default fall from years 1 to 2 to 3).

[19] We eventually describe the comparability of reserves across participants year-by-year under the ECL and CECL regimes. However, because the baseline simulations lack the flexibility introduced into the laboratory sessions for the ECL and CECL regimes, the baseline ICL, ECL and CECL regimes will display perfect comparability. Once flexibility is introduced into the laboratory environment, comparability may be less than perfect. This is discussed in more detail in Section 3.

Section 4 ends with the presentation of the baseline simulation values for reserves, their adequacy, predictability, and the volatility of profits against which the results of the laboratory sessions are evaluated.

3. Research method and design

3.1. Lending environment

We construct a controlled laboratory environment for a hypothetical bank called the North Atlantic Bank (NAB), whose main activity is to make personal loans to residents. Each participant will take the role of a *Loan Manager* at one of the NAB's many local branches. We consider a series of decision periods (years). At the end of each year, the *Loan Manager* will make a loan-loss reserve decision. The decision affects the annual reported *net profit* of the manager's local branch, as well as the manager's annual compensation. First, we describe the environment in which participants will make decisions regarding the reserves to be set aside in order to absorb the expected losses related to the loan portfolio. Second, we describe the rules that govern managers' reserve decisions under the ICL, the ECL, and the CECL models. Third, we summarize the differences in the reserves held, their adequacy, predictability, and the volatility of net profit, under baseline simulations of the ICL, ECL and CECL models.[20] Finally, we introduce a flexible version of the rules associated with the ECL and CECL models in the controlled laboratory environment. We engage participants to take the role of the *Loan Manager* and make decisions about reserves,[21] for which they receive salient rewards. We compare the outcome regarding reserves held and their adequacy, comparability, predictability, and the volatility of net profit in the flexible environment, against outcomes in the baseline simulations where the rigid rules for ICL, ECL and CECL models were implemented.

[20] The desired ending balances of reserves held in the simulation exercises are always equal to the expected credit losses. These are based on the probabilities of default, and the losses given default that characterize the loan portfolio in the specific year that a reserve decision must be made, under the rules that govern the ICL, ECL or CECL model. In each case, the expected credit loss can be viewed as the reserves that would be held by a risk-neutral Loan Manager who is trying to maximize total income for the shareholders of the bank, given the characteristics of the portfolio and the prevailing model.

[21] It is important to note that the IASB and US FASB guidelines do not present specific guidelines with respect to possible ranges of reserves that may be appropriate, given possible credit loss scenarios. While these ranges may emerge more clearly in future practice, they are not provided for consideration to financial institutions at the time the ECL and CECL models are implemented.

3.2. Loan portfolio

We wish to study how managers set aside reserves for anticipated credit losses. To do this we create an environment in which a manager is provided with a portfolio of loans. At the beginning of every three-year period, the NAB Head Office provides each local branch manager with 100,000 laboratory dollars (L$) to be lent to 10 borrowers who have the same credit history and share similar risk characteristics. We will refer to the 10 loans together as the *Loan Portfolio*. Each of the 10 borrowers will receive a L$10,000 loan that is repayable after three years. The interest rate is determined by the NAB Head Office at the time the loans are granted and will remain fixed throughout the lending period. Each of the 10 borrowers will be charged the same interest rate, as they have the same degree of credit risk and are borrowing the same amount for the same duration. Interest is paid twice during each year of the three-year terms (on June 30 and December 30). The principal of the loan is repaid to the NAB at the end of the third year.

Although the credit risk for the 10 borrowers is the same at the origination of the loan portfolio, the credit risk profile for the individual borrowers may change during the term of the loan due to possible changes in the primary risk factors that can affect the individual borrowers' creditworthiness. We assume that a borrower's credit score is based on the following four factors: 1) the market value of the borrower's collateral, 2) the borrower's past creditworthiness, 3) the borrower's employment status, and 4) the general macroeconomic outlook.[22]

Our environment spans two 12-year economic cycles. This means that each loan manager will make decisions about 8 different portfolios over 24 decision rounds.[23] We simulate outcomes for the 24 years of these two business cycles given different rules that may govern the reserves that are selected by the loan managers. These are our baseline results. We then extend our environment into a laboratory setting.

[22] Appendix B describes how these portfolios are initially constructed, and how the four credit-score factors change over time, is available to the reader upon request. The effect on the managers' loan portfolios after the first and second years of their terms is also included. It is important to note that the interest rate stated at the initiation of the loan will not change over the term of the loan regardless of the changes in the individual borrowers' credit risk.

[23] We created eight different portfolios each with different credit risk exposures. Each participant manages the same set of eight portfolios in the same sequences over 24 loan years and two economic cycles. The details of the eight portfolios and the information presented to loan managers and is presented in Appendix C and is summarized in Table 2. Each manager receives the same information (details underlying credits scores, credit scores and probabilities of default at the end of each decision round). Their decisions regarding desired ending balances do not affect these values over the course of a simulation or laboratory session. Figure 1 describes the first lending cycle of a session.

3.3. Implementing the Environment

What has yet to be described is the role of the loan manager in our environment. For baseline simulations, our loan managers are assumed to set aside reserves equal to a signal determined by the rigid implementation of the ICL, ECL and CECL models that will maximize the income of the bank (and its shareholders). Within the context of this simulation, the loan managers have no discretion. If they select desired ending balances of reserves consistent with the signal provided by the ICL, ECL or CECL model across the 24 years of the eight loan portfolios, we would identify a stream of income earned by the bank. This would be based on the interest schedule described in Table 1, and the associated probabilities of default consistent with the credit scores in the manager's portfolio. However, loan managers can make decisions that could affect the timing of the stream of income realized from these portfolios (the volatility of income) and this can impact the value of the bank.[24] These decisions will be studied within a laboratory implementation of our environment. We next describe the alternate rules under the different credit-loss models that may govern the loan managers' roles and decisions. In addition, we present the results from the baseline simulations and subsequent predictions against which we will evaluate the laboratory session results.

4. Development of the Simulation Baselines and Research Predictions

4.1. Alternative rules and the role of the loan manager

The pattern of interest payments or defaulted interest payments and foreclosures is determined by random draws for each loan in each period in each portfolio before the simulations or controlled laboratory sessions are run. The pattern of values that characterize the loan portfolios are identical for each baseline simulation and each laboratory session. In our environment, the only decision the loan manager has to make is the ending balance of reserves (the *Desired Ending Balance*) to be held at the end of each year of the manager's session. The rules governing this decision are provided by the model being studied.

The *baseline simulations* for the ICL, ECL and CECL models require the following:

[24] In our environment the manager's decision to hold reserves in any Year *t* will reduce the profit reported in Year *t* but will not reduce the profit the manager reports over the years for which decisions are made. Reserves held in any year *t* will be reported as profit in some future year, or years when reserves are used to offset write-offs. Reserves do, however, affect the volatility of reported profit over the course of a number of years (or over a business cycle, or in the case of our lab environment over the two business cycles).

1. Under the ICL model, managers must hold no reserves unless there is evidence of a *significant probability of a loss* supported by evidence of a *highly probable default*[25] and, in this situation, managers will hold reserves equal to the 12-month discounted expected credit loss.[26]
2. Under the ECL model, managers must hold reserves equal to the *12-month discounted expected credit loss* based on the credit grade of their portfolios and the associated probabilities of default, unless there is evidence of a *highly probable default*, in which case reserves must equal the *lifetime discounted expected credit loss*[27] associated with the years remaining in the term of the portfolio, based on the credit grade of their portfolios and the associated probability of default.
3. Under the CECL model, managers must always hold reserves equal to the *lifetime discounted expected credit loss,* associated with the years remaining in the term of the portfolio, based on the credit grade of their portfolios and the associated probabilities of default (the FASB's CECL model).

For our laboratory environment, a *significant probability of a loss* is associated with (i) a credit grade of C or C-, or with (ii) a drop in the credit score of 12% or more from the credit score

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[25] In the case of the ICL model, we will consider the *significant probability of a loss* for our environment to be comparable to the 70% likelihood of a loss that governed the ICL model which was replaced by the IASB ECL model in 2018.

[26] The *12-month discounted expected credit loss* at the start of Year *t* in the three-year term of a portfolio is equal to the expected (historical) loss given default multiplied by the 12-month discounted probability of a default at the end of Year *t*. Referring to Table 1, assume that we are concerned with the second of three years in the life of a loan portfolio that began with a credit grade of B. The annual interest on the L$100,000 portfolio would be 16%. Suppose the credit grade fell to B- at the end of year 1: the probability of a loss would not be significant at the end of the second year. The 12-month discounted probability of default at the end of year 2 for a loan portfolio with a B- credit grade is 14.55% (see Table 1). The expected (historical) loss given default for a L$100,000 loan portfolio that was initiated as a credit grade B portfolio is L$21,000. The *12-month discounted expected credit loss* is equal to L$3,055.50 (0.1455×L$21,000). This would be the reserve that must be set aside by the loan manager at the end of year 1 for this loan portfolio under the ECL model. Values derived this way assume that the loan manager is risk neutral and they provide baseline results for the ECL and CECL models against which the decisions made by participants in our test-bed environment will be compared. The alternatives to the risk-neutral outcomes are presented in subsection 4.3.1.

[27] The *lifetime discounted expected credit loss* at the start of Year *t* in the three-year term of a portfolio is equal to the expected (historical) loss, given default multiplied by the lifetime-discounted probability of a default at the end of Year *t*. Referring to Table 1, assume that we are concerned with the second of three years in the life of a loan portfolio that began with a credit grade of B and a credit score of 80. The annual interest on the L$100,000 portfolio would be 16%. If the credit grade fell to C (with a credit score of 61) at the end of Year 1 (a drop of three credit grades and of 24%), then the reserve should be equal to the *lifetime discounted expected credit loss*. The lifetime discounted probability of default at the end of Year 2 for a loan portfolio with a C credit grade is 42.60% (see Table 1). The expected (historical) loss given default for a L$100,000 loan portfolio that was initiated as a credit grade B portfolio is L$21,000. The *lifetime discounted expected credit loss* is equal to L$8,946.00 (0.426×L$21,000). This would be the reserve that must be set aside by the loan manager at the end of Year 1 for this loan portfolio under the ECL model. As with the *12-month discounted expected credit loss* calculation, this assumes the loan manager is risk neutral.

at the initiation of the loan (e.g., if the credit score in Year 1 is 82 and it falls to 75 in Year 2 and again falls to 72 for year 3; the first drop is 8.5% but the second drop is 12.2% from the Year 1 score), or with (iii) a drop in the credit grade by two grades (e.g., the grade in Year 1 is B and in year 2 is C+). Generally, a drop of less than 9% is reported to the manager as "normal", a drop that is at least 9% but less than 12% is reported as "large", while a drop of 12% or more is "very large".

To simulate baseline impacts of the ECL and CECL models relative to one another and to the ICL model, we will assume that the permissible level of reserves that may be set aside from profit is clearly defined for each of the three models and that the loan managers have no discretion in the reserves that are set aside. We later relax this constraint for the controlled laboratory sessions.

Regardless of the regime governing reserves (ICL, ECL or CECL), the loan managers will know what the risk character of their portfolios will be for Year $t+1$ and this will determine the specific expected credit loss that applies to the manager's loan portfolio for the next year. These are described in points 1 through 3 above.

Based on the information provided in Table 2 for each of the eight loan portfolios that characterize our controlled environment, we can determine the required reserves for each year in our simulation. We further assume that the NAB closes at the end of Year 24, and so the loan managers are not required to set aside any reserves from Year 24 profit. Table 3 provides the reserves the loan managers must carry in each year for our simulations of the ICL, ECL and CECL models. The results of these simulations provide a baseline for the laboratory test-bedding environment in which the loan managers are able to make a decision about their *Desired Ending Balance* (DEB) of reserves each year, given the same information that is available in the baselines. But the choice they make in the laboratory test-bedding environment is from a range that extends above and below the reserves imposed in the baseline simulations. The introduction of a choice within this range is an attempt to implement the flexibility described in Section 1 through the unwillingness of the FASB and IASB to prescribe specific methods to financial institutions for estimating expected credit losses.

4.2. Simulations

The results of the baseline simulations are presented in Table 4. Dropping the highly probable default constraint imposed on the ICL model results in a substantial increase in mean desired ending balances (DEB) of reserves over the 24 years in our simulation under the baseline ECL

model (L$2,674 versus L$1,433). The increase in reserves under the baseline CECL model is even greater (L$5,065 versus L$1,433). Note that because of the requirement under ICL that reserves are held only if there is a highly probable default, reserves are held under ICL in only 4 of the 24 years. Under the ECL and CECL models, reserves are held every year except year 24.

The baseline ECL and CECL models reveal a reduction in the inadequacy of reserves relative to the ICL model, and the excess balance of reserves shows an increase with the implementation of the ECL and CECL models. The adequacy of reserves is measured by the ratio of uncovered to total write-offs (an inadequacy index) and a measure of the excess of reserves over write-offs (an excess adequacy index). Under the baseline simulations, the predictability of write-offs by the DEB increases under the ECL model from the ICL model, but falls under the CECL model.[28] Finally, the mean volatility of profit falls when the ECL replaces the ICL model, and this reduction is much greater than the very small drop that results from the introduction of the CECL model. These results provide the bases for the predictions of outcomes we anticipate from the laboratory implementation of the ECL and CECL models.

4.3. Development of predictions for the laboratory implementation

4.3.1. Theoretical Considerations

Conceptually, maintaining adequate loan-loss reserves on a timely basis enables bank managers to reduce the volatility of reported income by avoiding large write-offs of future losses. Following the formula proposed by the IASB and FASB to estimate the expected credit loss, we have simulated the effects on the amount and adequacy of reserves, their predictability and the volatility of profits associated with the ICL, ECL and CECL models under the assumption that loan managers are risk-neutral expected income maximizers.[29]

However, the decisions made by the participants in our test-bed environment are not constrained by the assumption that they are risk neutral. According to agency theory, managers who make periodic decisions about loan loss reserves (acting as agents for their employers who are considered the principals in the relationship) are risk-averse individuals. This suggests that we should expect participants acting as loan managers to make, on average, loan loss reserve decisions that exceed the risk-neutral expected credit losses that are at the center of the permissible reserve range.

[28] Predictability is measured by the correlation coefficient for a regression with write-offs in period t as the dependent variable, and DEB in period t-1 as the independent variable. The greater the correlation coefficient, the better reserves predict future write-offs.

[29] The expected credit loss corresponds to the expected (mean) value of the credit loss distribution.

Alternatively, within the context of prospect theory (Kahneman and Tversky, 1979), when individuals make decisions under uncertainty and face possible losses (which is the case in the loan loss reserve decision), the individuals tend to behave as risk takers and will set aside loan loss reserves that are less than those associated with risk-neutral behavior.

Because it is not obvious that the conventional expected utility model of individual behaviour or the agency model or the prospect theory model will characterize the attitudes of the people participating in our laboratory environment, the test-bedding environment provides a mechanism to assess the impact that the ECL and CECL models may have relative to the baseline (risk-neutral) simulations. A further complication with regard to the outcome from the laboratory environment is that the flexibility that is introduced by the standard setters by not formally specifying the rules for computing expected credit losses will likely lead to differences across the choices made by individual managers even if they have the same risk attitudes.

We rely on the simulation results to provide baselines for the differences between the ECL and CECL models implemented in our laboratory environments. These are comparable to generating comparative statics predictions for rule changes that apply to decisions made within a theoretical model for which all parameters are specified. The ECL and CECL models are introduced to overcome the weaknesses of the ICL model of reporting "too little" reserves "too late". More specifically, the FASB and IASB argue that adopting a more flexible forward-looking approach is anticipated to (i) increase the adequacy (sufficiency) of loan loss reserves and recognize them on timelier bases, (ii) enhance the decision-usefulness of loan loss reserves in terms of their comparability and predictability, and (iii) reduce the volatility of reported profit.

We develop a set of predictions for the impact that the ECL and CECL models will have on reserves and profit volatility if either replaces the ICL model based on the available limited empirical evidence and the results of our baseline simulations that assume loan managers make risk-neutral decisions when they select desired ending balances of reserves and that they all use the same method to estimate their expected credit losses.

The risk-neutral decisions will result in the managers always selecting the baseline reserves presented in Table 3. These values are used to determine the predicted values or the predicted differences in outcomes under the alternative models in our analysis of the laboratory outcomes. Generally, deviations from predicted values will provide support for outcomes consistent with agency theory or prospect theory rather than risk-neutral expected income maximization which provides the basis for our predictions.

4.3.2. Adequacy of loan-loss reserves

The FASB and IASB claim that bank managers will be able to more accurately estimate loan-loss allowances when the ICL model's "probable" threshold condition is removed and banks base their periodic estimates of loan loss reserves on historical experience, current conditions, and all reasonable and supportable forward-looking information. Gomaa et al. (2019) provide experimental evidence supporting this claim. They find that, under the simplified version of the ECL model, applied to short-term financial instruments, the combined effects of eliminating the minimum "probable" threshold condition together with allowing managers to incorporate forward-looking information increase both the amount and adequacy of periodic accounts receivable reserves.[30]

KPMG (2014, p. 62) reported results of a field survey conducted by the IASB in 2013 which indicated participants anticipate substantial increases in credit allowances under both the dual-measure (12-month) approach as well as the single-measure (lifetime) approach. Curry (2013) states that "There is no question that implementation of the FASB proposal will require most banks to boost their allowance… the increases would be … perhaps in the neighbourhood of 30 to 50 per cent system-wide if applied today". Results from a survey by Deloitte (2017) of senior executives at 31 US banks indicated that most banks anticipate an increase in their allowances for credit losses ranging between 10% to 50%.

Based on the above discussion, and on the results of the simulations of the ICL, ECL and CECL models presented in Table 4 we predict that:

P1a: Loan loss reserves will be higher under both the ECL and CECL models than under the ICL model.

P1b: Fewer write-offs will be uncovered by reserves under both the ECL and CECL models than under the ICL model.

P1c: Excess reserves will be greater under both the ECL and CECL models than under the ICL model.

[30] This study differs from Gomaa et al. (2019) in three important ways. First, Gomaa et al. (2019) is set in a very different environment (accounts receivables) whereas this study closely resembles a bank loan environment (multi-period secured loans). Given that all banks will be using one of the new rules for determining their loan-loss reserves, our environment captures the major industry that will implement and be affected by these new credit loss rules. Second, whereas Gomaa et al. (2019) compare ICL with the simplified ECL rule, our focus is on the difference between ECL and CECL. Third, Gomaa et al. (2019) examine earnings management behavior under the simplified ECL model relative to the ICL model. We are attempting to minimize earnings management by designing a manager compensation scheme that will encourage this.

While the CECL model requires banks to recognize, at the origination of a new loan, all future credit losses expected to occur over the loan's lifetime, the ECL model uses a dual-measure approach which require banks to measure and recognize the loan loss reserves only for the next 12 months.[31] The ECL model does not require lifetime expected credit losses unless there is evidence of significant credit quality deterioration since the origination of the loan.[32] This will lead banks that follow the CECL model to recognize larger loss reserves at the time of origination of loans, relative to banks under the ECL model. Brunel et al. (2015) argue that determining whether credit risk has significantly deteriorated since initial recognition is subject to the subjective interpretation of bank managers and to their subjective choices in terms of credit risk quantification method.

Based on the above discussion, and on the results of the simulations of the ICL, ECL and CECL models presented in Table 4 we predict that:

P1d: Loan loss reserves will be at least as large under the CECL model as under the ECL model.

P1e: The proportion of write-offs that are uncovered will be greater under the ECL model than under the CECL model.

P1f: The reserves held under the CECL model will be more excessive than the reserves held under the ECL model.

4.3.3. Decision-usefulness of loan-loss reserves: comparability and predictability

The primary objective of financial reporting is to provide useful information to investors and creditors to help them make investment, credit, and similar resource allocation decisions (FASB 2010; IASB 2010). To improve the decision-usefulness of accounting information, the two Boards identify two essential characteristics (relevance and representational faithfulness) and four enhancing characteristics (comparability, verifiability, timeliness and understandability). In this study, we focus only on comparability and predictability (an aspect of relevance) of loan loss reserves.

4.3.3.1. Comparability of loan-loss reserves

According to the FASB (2010) comparability enables users to identify similarities in, and dissimilarities among items in the financial reports of different entities at the same point in time

[31] Both regimes require banks to recognize and update loan loss reserves at each reporting date to reflect credit risk changes.

[32] It is important to note that neither the IASB nor FASB provide guidance or clear conditions of what constitute "significant deterioration of credit quality since origination".

and for the same entity over time (SFAC 8, QC 21-23). To maintain a high degree of comparability, banks should use the same estimation method to measure reserves for loan portfolios that have similar risk characteristics at any given point in time as well as from period to period. Thus, two sets of comparable financial statements would be similar under the same set of economic conditions (Franco et al. 2011).

The rules-based ICL model imposes uniformly rigid conditions on when loan-loss allowance can be booked, thus facilitating comparability of loan-loss reserves across entities. Gebhardt and Novotny-Farkas (2016) find that the loan-loss allowances measured under the ICL model are more comparable than those measured under the more discretionary forward-looking impairment models that were in place prior to 2005.

On the other hand, the ECL and CECL are principle-based standards that allow managers to use subjective judgment to select from numerous estimation methods to incorporate forward-looking information into periodic measurement of loan-loss reserves.[33] Each method is based on different assumptions and is expected to yield different estimates. As mentioned earlier, neither the FASB nor the IASB provides specific guidelines, imposes restrictions on managerial choices, or prescribes mechanisms on how to use these methods. For example, the FASB (2016, p 243) states that it does not prescribe specific estimation methods to be used in any specific circumstance but, rather, allows an entity to apply judgment to develop estimation methods that are appropriate, practical, and consistent with the principles of the guidance. Furthermore, the two Boards allow entities to estimate the expected credit losses either collectively (for the total loan portfolio) or individually (for each loan). They also allow the same entity to apply different approaches to different financial instruments.

These multiple approaches could lead to increased variability of estimated loan-loss allowances measured for similar loans that share the same credit-risk characteristics for banks operating under a common accounting model as well as between banks across the two models. Thus, in practice, bank managers can base their measures of the expected credit losses for similar loans using multiple methods, making different assumptions, and considering numerous scenarios. The outcome of this process is a *range* of possible estimates, from which the manager selects only one value.[34] This, in turn, may dampen the comparability of the reported loan-loss

[33] Examples of such methods include the discounted-cash-flow analysis, the average charge-off method, vintage analysis, static-pool analysis, the roll-rate method and the probability-of-default method (Kellar and Schell 2015: PwC 2015).

[34] For example, the IASB explicitly requires entities to base their estimates of expected credit losses on an "unbiased and probability-weighted" consideration of a range of possible outcomes.

reserves. Writing with respect to the ECL and CECL models that have recently been developed, Chae et al. (2018) point out that the deviations in chosen forecasts as well as different inputs and methods in proprietary models could make loan loss reserves less comparable across entities for the ECL and CECL models relative to ICL. We posit that the above features of the two new accounting models could lead to an increase in the variability of managerial reporting choices for banks under a given model as well as across models.

Based on the above discussion, we expect that the increased flexibility under the ECL and CECL models that permit entities to measure the same item using alternative methods could undermine the comparability of loan-loss allowances. Because the ICL model is rigidly applied by all managers who have no flexibility it its interpretation, the managers' choices of reserves will be perfectly comparable. Consequently, we predict that:

P2a: Accounting comparability of reserves across banks will be lower under the ECL and CECL models than under the ICL model.

While CECL requires managers to always hold reserves based on an estimate of the lifetime expected credit losses, the ECL managers are not permitted to use the lifetime estimate unless they can demonstrate that the credit quality of their loans have deteriorated since their initiation. For each reporting period, the ECL manager must determine if there has been a significant deterioration in credit risk since initiation. The rules governing this decision are flexible. One manager may decide the deterioration is significant while another may not. The CECL manager does not have this degree of flexibility. Therefore, this extra flexibility allowed by ECL suggests that the variability of reserves carried by managers holding loans with similar risk characteristics will be less comparable than the reserves carried by CECL managers in similar circumstances. Based on the above discussion we predict that:

P2b. Accounting comparability of reserves will be higher under the CECL model than the ECL model.

4.3.3.2. Predictive ability of loan-loss reserves

An essential qualitative attribute of relevant accounting information is its ability to help users *predict* the amounts, timing and uncertainty of future cash flows (FASB 2010 and IASB 2010). Predictability refers to the capacity of the current period value of an accounting item to predict its own future value and/or the future value of other related constructs. Harris et al. (2018) note that predicting credit losses are important for both market participants and regulators. Given the ICL model allows bank managers to create loan-loss reserves only when contractual payments are in

default or delinquency and restricts them from using relevant forward-looking information, reserves tend to be less informative than users would like and often yield "too little" reserves "too late". This suggests that there is weak association between current period reserves and next period write-offs.

On the other hand, the ECL and CECL models require bank managers to base their estimates of loan-loss reserves on all supportable forward-looking qualitative and quantitative information as well as historical experience and current conditions. These features enable bank managers to create more relevant and accurate reserves and recognize them on a timelier basis. Consequently, one can argue that mandating the ECL and CECL models is expected to increase the ability of the current period loan-loss reserves to predict next period write-offs, relative to the ICL model. Using archival data prior to 2005, Gebhardt and Novotny-Farkas (2016) provide evidence that loan-loss allowances from forward-looking models provide higher predictability of future write-offs than do data from the ICL model after 2005. Harris et al. (2018) suggest that the predictability improves when available forward-looking information is incorporated into the current period's loan loss estimates.

Our baseline simulations suggest that the reserves set aside by risk-neutral managers will be better predictors of future write-offs under ECL model than under the ICL model, while the reverse will be the case for the CECL model versus the ICL model.

Based on our simulation results, we predict that the loan-loss allowances created under the ECL model will have more predictive ability of next period's loan-loss write-offs, but the reverse will be the case for the CECL model.

P3a: The predictability of the next period's write-offs using the current period's reserves will be higher under the ECL model and lower under the CECL model than under the ICL model.

However, as we discussed earlier, while the CECL model requires entities to hold reserves based on the lifetime discounted value of the expected credit loss, the ECL model requires entities to base reserves on the 12-month discounted value of the expected credit loss, and only switch to lifetime estimates if there is a significant change in the credit quality. These features suggest the while banks under the CECL model are expected to hold excessive reserves, managers under the ECL model are expected to smooth income via discretion in periodic reported reserves. Our simulation results support the prediction that the predictability of reserves under the ECL model will be greater than under the CECL model.

P3b: The predictability of the next period's write-offs using the current period's reserves will be higher under the ECL model than CECL model.

4.3.4. Volatility of reported earnings

Previous literature suggests that backward-looking provisioning practices under the ICL model increase the severity of procyclicality of bank lending and contribute to financial instability. Laeven and Majnoni (2003) empirically document that banks using the ICL model delay provisioning for bad loans until cyclical downturns have already set in, thereby magnifying the impact of the economic cycle on banks' income volatility. Compared to the ICL model, the discretion permitted by the ECL and CECL models could allow a buildup in loss reserves during good times that can be drawn down during bad times. This will result in less volatile earnings (Bushman and Williams 2012).

We argue that under loan loss recognition rules specified by the ECL and CECL models, the increased flexibility allows bank managers to exercise judgment by allowing them to select from alternative methods of incorporating forward-looking information into periodic estimates of loan-loss reserves. Such an option can lead to more adequate periodic reserve decisions and to a reduction of income volatility. While early anecdotal evidence, based mostly on surveys, suggests that bank managers anticipate an increase in their earnings volatility with the introduction of the new expected credit loss rules (Deloitte 2017; Levy and Zhang 2018), our baseline simulations suggest that earnings volatility will not increase under the ECL or CECL models. Based on the above arguments we predict that

P4a: Profit volatility will be lower under both the ECL and CECL models than under the ICL model.

According to the dual-measurement approach, the ECL model requires banks to switch back and forth between lifetime and 12-month measures of reserves, depending on the changes in the credit quality of loans. Due to this feature, the ECL model is expected to exhibit high profit volatility particularly when the economic conditions significantly deteriorate or improve (Frykström and Li 2018). However, when comparing the ECL with CECL models, one can argue that under CECL the recognition of lifetime losses at the origination of a loan and the related excessive reserves that will be carried will make CECL earnings relatively more volatile. This outcome is supported by the baseline simulations of the ECL and CECL models for risk-neutral managers. Consequently, we predict that:

P4b: Profit will be less volatile under the ECL model than under the CECL model.

5. Laboratory implementation

5.1. Experimental design

In order to move beyond the baseline simulations of the ECL and ECEL models we generated, we will implement our loan management environment in a controlled, computer-mediated laboratory setting. This will allow us to discover how people may respond to the alternatives to the ICL model, which provide incentives and introduce more flexibility in the selection of reserves. We are not implementing the ICL model in the laboratory because it is typically interpreted to be inflexible with regards to the desired ending balances that managers may set aside at the end of each year (i.e., the loan managers' reserve decisions are prescribed by the model).

While the ECL and CECL models are meant to be flexible, it is important to note that the lack of guidelines from both the FASB and IASB leaves banks vulnerable when they need to incorporate forward-looking information into the process of estimating expected credit loss allowances. For example, the FASB (2016, p 243) states that "… the board does not prescribe specific estimation methods to be used in any specific circumstance but, rather, allows an entity to apply judgment to develop estimation methods that are appropriate, practical, and consistent with the principles of the guidance". Kellar and Schell (2015) and PwC (2015) provide examples of models from which bank managers can currently choose: these include the average charge-off and probability-of-default methods, as well as analyses such as discounted cash flow, vintage, static pool, the roll-rate method (migration analysis), and regression.[35] Our experimental design consists of two sequences of three treatments. Each of the two treatments that capture the ECL and CECL models, which provide reserves for loan-related losses, require the participants acting as loan managers to make decisions about desired ending balances (DEBs) over 24 decision rounds, representing two business cycles. This collection of decision rounds is the same as that described in the discussion of the baseline simulations and presented in Table 2. In addition to facing an ECL and a CECL treatment, each loan manager will first complete one business cycle or 12 decision rounds. This initial business cycle consists of the Years 13 through 24 in the ECL and CECL treatments (this business cycle consists of the portfolios 5 through 8 that are listed in Table 2). We refer to this initial treatment as the PreICL treatment. It will differ from the ECL and CECL treatments by having no limits on the DEBs that can be carried by the loan manager. Two different *sequences* of treatments will be considered. The first sequence will consist of 12

[35] In our analysis, we use the discounted cash flow method to develop the periodic expected credit loss amounts.

decision rounds of PreICL, followed by 24 rounds of ECL and 27 rounds of CECL. The second sequence will consist of 12 decision rounds of PreICL, followed by 24 rounds of CECL and 27 rounds of ECL.[36] The research design is summarized in Table 5.

Managers are compensated for each decision round with a fixed payment of L$100, plus a compensation bonus, based on the net profit generated by the portfolio they are managing. The annual compensation bonus is initially equal to 20% of the portfolio's net profit (or loss) for the year. However, if the portfolio incurs a loss in any of the three years of the portfolio's term, the compensation bonus for the subsequent portfolio will drop to 10%. The bonus remains at 10% until the manager completes three years with a new portfolio without incurring a loss.[37] The lab dollar earnings are converted to Canadian dollars at the end of the session at the exchange rate L$100 = C$0.15.

Twenty-eight participants complete each sequence. This permits us to conduct a between-participants evaluation of the ECL and CECL models, as well as a within-participants evaluation of replacing one regime with the other. The PreICL treatment is intended to provide an opportunity for those taking part to learn about the environment, generate data that will permit us to evaluate the similarity of the participants in each sequence, and provide a baseline for how they manage reserves when there are no bounds placed on their DEBs.

Before beginning the 63 decision-round session, each participant is introduced to the loan management environment in a separate session, the first of which introduces an environment in which there is no opportunity to set aside reserves. This is then extended to include reserves similar to the baseline environments. Finally, participants experience a simulation in which

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[36] The third treatment in each sequence has an extra three decision rounds. These are included to avoid generating end-game effects in the 24th round of the third treatment in a sequence and will permit us to better compare within-participant effects of replacing ECL with CECL or CECL with ECL. Within-participant effects are not reported in this paper.

[37] We adopt the following compensation scheme:

$$C_t = 100 + \alpha \Pi_t$$

where C_t is compensation in period t, Π_t is the branch's net profit in period t and $\alpha = 0.20$ unless the loan manager reported a loss during any year of the previous portfolio, in which case $\alpha = 0.10$. We want the manager to recognize that reducing volatility is important to the NAB because given profit, reducing volatility will increase the stock price of the NAB because

$$P_{st} = f(\Pi_{t,}, v)$$

where P_{st} is the price of the NAB's stock in period t and v is the historic volatility of the stock) and stock price is positively related to profit and negatively related to volatility.

This will benefit shareholders and provide an incentive to them to reward managers for reducing volatility as well as increasing profit. Managers can use reserves to avoid reporting losses and avoid very high profit in any given year. Thereby they are able to reduce the volatility of profit over time. Our compensation scheme is a simple way to provide an incentive to managers to try to smooth profit (particularly by avoiding losses).

DEBs can be chosen from a prescribed range of values. After this first session, participants return for the second session from which data is generated for our analysis.[38]

5.2. The reserve range

To implement our environment in a controlled laboratory setting, it is necessary for the loan managers to have some discretion regarding the reserves they hold. This is consistent with the absence of a "recommended" formulation for determining the expected credit loss under the guidelines developed by the IASB (for the ECL model) and the FASB (for the CECL model). Providing discretion means that we must replace the baseline requirement that the loan managers set aside reserves equal to either the *discounted 12-month expected credit loss* or *discounted lifetime expected credit loss* (according to the model governing the loan manager's decisions) with a requirement that instead the reserve amount be selected from a well-defined range that includes the two *discounted expected credit loss* values. Introducing this range as a requirement, when our laboratory environment participants select their DEBs, enables us to attempt to capture the divergent measurements of expected credit losses that may be generated in the field by loan managers who work for financial institutions with slightly different rules for estimating expected credit losses. By considering alternate ranges, we can test the robustness of the variation in magnitudes that we implement in the laboratory on the outcomes of desired ending balances of reserves and their adequacy, the comparability and predictability of reserves, and the volatility of profits.

We wish to avoid presenting guidance that will bias the loan manager's choice of DEBs, while at the same time refrain from restricting the loan manager's choice to a single targeted value of the expected credit loss corresponding to a particular model. The PreICL treatment enables loan managers to make decisions about DEBs that are unrestricted, and participants are presented with a reserve range unique to each year of the loan portfolio. They will have a minimum value equal to zero (the absence of a loan default) and a maximum value equal to the loss given default (which is the manager's largest possible loss conditional on the characteristics of the loan portfolio and its interest rate). The ranges, by year, for PreICL DEBs are presented in Table 6.[39] The loan managers are endowed with beginning balances of reserves equal to L$291

[38] Instructions are presented in Appendix D.

[39] Note that if the PreICL treatment is followed by ECL or CECL, the period 12 DEB range is defined by the portfolio and treatment that will follow Period 12. For both sequences, the next portfolio is Portfolio 1 from the 1st business cycle. The ranges for the ECL or CECL treatments are substantially restricted relative to the PreICL treatment.

for both sequences. This is the 12-month discounted expected credit loss associated with the first year of portfolio 5.

The reserve range for the ECL and CECL treatments is more restrictive. For ECL and CECL we introduce a range of values that are centred on the baseline values for the two models but extend from 75% below to 75% above the baseline values. These values are presented in Table 7 for the two 12-year business cycles experienced by participants under the ECL model in sequence 1 and the CECL model in sequence 2. In addition to the range, managers are provided with values for the expected credit losses that are implemented in the baseline simulations for the different models.[40] For the PreICL treatment, participants are provided with the ECL baseline expected credit losses.

6. Laboratory Results

Fifty-six participants were recruited from fourth-year accounting classes at a Canadian university. The laboratory session in which they made decisions about their desired ending balance of reserves lasted between 45 to 70 minutes in which they completed 63 decision rounds. The average earnings for the participants was C$31.33, with the standard deviation being C$2.44. The payoff range was between C$26.39 and C43.5 1. The average time for reading the instructions and performing the practice trials was 27 minutes, with an average payoff of C$11.25.[41] We present a brief analysis of the desired ending balances (DEB) of reserves held in the PreICL treatments of Sequence 1 and Sequence 2 to provide an indication of the similarity between the two groups of participants. After this, we describe the results from the ECL and CECL treatments that directly followed the PreICL treatments. We compare these results to one another, and to the baseline results for the ICL, ECL and CECL treatments. Only comparisons for the between-participants results will be presented.

6.1. PreICL

The mean desired ending balances of reserves for the PreICL treatment are summarized in Table 8. The baseline mean per period desired ending balance of reserves over the 12 periods for the

[40] We assume that a risk-neutral manager will likely choose a value close to the expected value, the risk-averse individual will choose amounts substantially higher than the expected value, and the risk-taking individuals will likely select amounts far below the expected value.

[41] Participants were paid for reading the instructions and performing the practice trials at a rate of C$25.00 per hour.

four portfolios is L$2,402.[42] The mean per period DEBs from 28 participants in Sequence 1 and the 28 participants in Sequence 2 are L$2,570 and L$2,883.

The discussion in sub-section 4.3.1 suggests that depending upon the preferences of the loan managers, the laboratory results for DEBs could be greater than or less than the DEB consistent with a risk-neutral baseline choice. Agency theory asserts loan managers would be risk averse, which implies DEBs greater than the baseline DEBs. However, prospect theory asserts that loan managers would be risk seeking and select DEBs less than the baseline DEBs. Because there is not an unambiguous alternative to the risk-neutral outcome in the baseline scenario, we will evaluate the lab generated reserves with respect to the null hypothesis that the loan managers make a risk-neutral decision against the alternative that the decision is not risk neutral.

We are unable to reject the null hypothesis that there is no difference between the baseline PreICL mean DEBs and those generated in the laboratory environment ($p > 0.275$ for both Sequence 1 and Sequence 2). Furthermore, we are unable to reject the null that the results generated by the two groups of participants differ from one another ($p = 0.707$). This suggests that when presented with the same PreICL environment, the decisions of participants in Sequence 1 and Sequence 2 were comparable, and not significantly different from the baseline value.

6.2. Desired ending balances of reserves (DEB)

Figure 2 presents the mean value of desired ending balances of reserves over 24 decision rounds for eight portfolios in two business cycles from the baseline ICL, ECL and CECL simulations and from the laboratory sessions in which ECL and CECL are implemented following the PreICL environments in Sequence 1 and Sequence 2 respectively. Table 9 provides summary statistics across the 24 years of the two business cycles, as well as the t-statistics and associated p-values for hypotheses tests that there are no differences between the baseline and the laboratory means. Both the laboratory ECL and CECL treatments lead to more reserves being carried over the two business cycles than under the ICL baseline (these differences are statistically significant with $p = 0.000$). The reserves carried in the laboratory environment under the CECL exceeds those under the ECL ($p = 0.000$). These results support Predictions P1a and P1d.

Although the laboratory ECL and CECL reserves are significantly greater than those under ICL, the reserves carried in the laboratory environment are significantly different from

[42] This baseline value is generated by assuming the loan manager will select DEBs in each year equal to the expected credit loss provided in the central column of Table 7.

those carried in the baseline simulations of ECL and CECL ($p = 0.008$ and $p = 0.000$, respectively). If the expected credit losses associated with the baseline results are consistent with risk-neutral managers, it appears that the participants in the laboratory environments are more risk seeking than risk neutral. This would provide support for the prospect theory prediction that managers making decisions regarding losses will be risk takers.

These laboratory results suggest that the new models proposed by the IASB and FASB will result in increased reserves relative to the ICL baseline. However, to effectively evaluate these changes, it is necessary to consider how well the reserves held are related to the write-offs loan managers face over time. This requires the development of adequacy indices.

6.3. Adequacy of Reserves

We measure the adequacy of reserves using two complementary measures that are based on the write-offs in each year (WO_t) and the beginning balances of reserves in each year (BB_t):

(i) The first adequacy measure, the inadequacy measure (UWO/WO), is equal to the sum of the uncovered write-offs in each of the 24 years of the two business cycles ($UWO_t = WO_t - BB_t$ if $UWO_t > 0$ and 0 otherwise) divided by the sum of the write-offs in each year within that time span. It summarizes the proportion of the write-offs realized over the 24 years *not* covered by the reserves carried by the loan manager.

(ii) The second adequacy measure, the excess adequacy measure (ExBB/WO), is equal to the sum of the excess beginning balances of reserves in each of the 24 years of the two business cycles ($ExBB_t = BB_t - WO_t$ if $ExBB_t > 0$ and 0 otherwise) divided by the sum of the write-offs in each of the 24 years. It summarizes the extent to which reserves held are in excess of what is needed as a proportion of the write-offs realized during that time frame.

6.3.1. The inadequacy measure: uncovered write-offs relative to write-offs (UWO/WO)

Figure 3 presents the values of the UWO/WO inadequacy measures over 24 decision rounds for eight portfolios in two business cycles from the baseline ICL, ECL and CECL simulations, and the mean values from the 56 laboratory sessions in which the ECL and CECL models are implemented. Table 10 provides summary statistics across the 24 years of the two business cycles, and the t-statistics and associated p-values for hypotheses tests that there are no differences between the baseline values and the laboratory means. The baseline values for uncovered write-offs show that both ECL and CECL lead to greater reductions in uncovered write-offs than does ICL. Both the laboratory ECL and laboratory CECL results are consistent with the baseline result. Both the laboratory ECL and CECL lead to a substantially greater

reduction in uncovered write-offs than under the ICL baseline. While the ICL baseline indicates that nearly 59% of write-offs are not covered by reserves over the two business cycles, the proportions of write-offs not covered under the laboratory ECL and CECL fall to 43% and 29%, respectively. These variations from the ICL value are highly significant ($p = 0.000$ for a one-sided test for both). The reduction in the uncovered write-offs displayed by the laboratory CECL relative to the laboratory ECL is also significant and consistent with the prediction that reserves will be greater under CECL than ECL ($p = 0.007$ for a one-sided test). These results support Predictions P1b and P1e.

However, neither the laboratory ECL nor CECL models matched the reduction in uncovered write-offs from the baseline ICL displayed by the baseline ECL or CECL simulations. The UWO/WO values for the laboratory models were significantly higher than for their baselines ($p = 0.003$ for ECL and $p = 0.001$ for CECL, for one-sided tests). This is consistent with the prospect theory prediction that managers will hold less reserves than would the risk-neutral manager.

6.3.2. The excess adequacy measure (ExBB/WO)

Figure 4 presents the values of the ExBB/WO indices over 24 decision rounds for eight portfolios in two business cycles from the baseline ICL, ECL and CECL simulations, and the mean values from the 56 laboratory sessions in which the ECL and CECL models are implemented. Table 11 provides summary statistics across the 24 years of the two business cycles and the t-statistics, and associated p-values for hypotheses tests that there are no differences between the baseline values and the laboratory means. The baseline values for excess reserves show that both ECL and CECL lead to greater excess reserves than does ICL. Both the laboratory ECL and laboratory CECL results are consistent with the baseline result. Both the laboratory ECL and CECL lead to increases in excess reserves from those under the ICL baseline. While the ICL baseline indicates that excess reserves are equal to only about 6% of write-offs over the two business cycles, the proportions of excess reserves under the laboratory ECL and CECL rise to 16% and 48% respectively. These differences from the ICL value are highly significant ($p = 0.000$ for a 1-sided test for both). The increase in the index displayed by the laboratory CECL relative to the laboratory ECL is also significant ($p = 0.000$ for a 1-sided test). These results support Predictions P1c and P1f.

The ExBB/WO values for the laboratory models are significantly lower than for their baseline ($p = 0.001$ for ECL and $p = 0.000$ for CECL, for one-sided tests). These results are consistent with the prospect theory prediction about reserves.

6.3.3. Summary of adequacy results

The inadequacy measure is consistent with the results regarding the desired ending balances of reserves generated by the laboratory ECL and CECL models relative to the simulated ICL model's desired ending balances. The new credit-loss models recommended by the IASB and FASB lead to increased reserves and increased adequacy (reduced inadequacy) of reserves relative to the ICL model they are designed to replace. The inadequacy measure is also consistent in identifying the CECL model as having a greater adequacy measure than the ECL model. The difficulty is evaluating the extent to which reserves are excessive relative to write-offs. The UWO/WO index addresses the concern about measuring the inadequacy of reserves, and its result show that the inadequacy of reserves exhibited is indeed diminished under the laboratory ECL and CECL models. This is a positive finding with respect to the new models, particularly within the context of the flexible range of reserves made available to loan managers in the laboratory environment. The ExBB/WO index complements the UWO/WO index by providing insight into the extent to which excessive amounts of reserves are held under the three models. This index demonstrates that although the introduction of ECL and CECL results in increased adequacy of reserves over the ICL model, they also introduce increased excessive reserves.

6.4. Comparability of desired ending balances of reserves

When financial institutions are governed by rigid rules regarding the setting aside of expected default loss reserves from loan portfolios, these reserves provide comparable information across financial institutions. However, if there is flexibility within the framework established by the regulating body on how the setting of reserves can be interpreted, some comparability across financial institutions may be lost. In order to measure the comparability of the desired ending balances (DEBs) set aside by the loan managers in our laboratory environments, we introduce two alternate indices.

The first index (Comparability Index 1) is adapted from an index to measure the comparability of financial statements used by companies in different industries within a country, or in different countries and in different industries. The original index is presented in Taplin (2017). We have adapted and extended this method to examine the extent to which loan-loss allowances captured by the DEBs that loan managers select are comparable across managers who

face identical portfolio characteristics, and who operate under a specific credit-loss model which allows them some flexibility in the DEB selection.

The second index we consider is the coefficient of variation of DEBs selected by different loan managers during a specific time period. In our environment, the index is applied, in each period, to a well-defined portfolio managed by all the loan managers under a given set of rules (a credit-loss model) that govern their selection. We use these measures to examine the comparability of decisions the loan managers make both within and across models in a controlled laboratory environment.

6.4.1. Comparability Index 1 (the Risk-Related Index)

To develop this comparability index, we first characterize the choices of DEBs managers make according to where these decisions are located in the possible range permitted by the ECL or CECL model under which they are governed. Remember that this range has a low value equal to 25% of the risk-neutral expected credit loss associated with the manager's portfolio in any specific year, and a high value equal to 175% of the risk-neutral expected credit loss. If the credit-loss model permitted no flexibility, then every manager would have to set aside reserves equal to the risk-neutral expected credit loss for the next year. This would be based on a well-defined set of estimates of the credit scores for the loans in the portfolios, as well as the probability of default in each year of the terms of the loans. This value is the expected credit loss at the centre of the DEB range.

To generate a comparability index under a flexible model, the range of possible DEB choices it prescribes – and by which it is defined – is divided into three equal sub-ranges. Each portion of the range can be identified as being associated with the risk attitudes of the loan manager and the research staff of the financial institutions that provide guidance to loan managers on the evaluation of credit scores and probabilities of default by borrowers. Because the value of the expected credit loss at the centre of the DEB range is based on a specific set of rules for measuring credit scores and default probabilities, we are identifying DEB choices that fall within the middle range as risk-neutral choices. DEB choices in the bottom third and top third of the range are identified as risk-seeking and risk-averse respectively. Decisions in these ranges are interpreted as reflecting the preferences of the financial institutions and their loan managers when determining where within the range their DEBs will be selected. Note that because the portfolio characteristics change from year to year, a loan manager may face a different range associated with each year of each portfolio.

To produce a comparability index, we generate a measure that identifies the degree of comparability of the loan managers' decisions within each sub-range. We then total the number of comparable decisions made from the maximum possible comparable decisions. If any two loan managers select a level of DEBs within the same range, their choices will be interpreted as following from a comparable interpretation of the model, and their choices viewed as comparable. If there are three (four) loan managers who select a level of DEBs within the same range, we can identify three (six) comparable pairs of DEBs selected.

The example below is based on the DEBs reported by each of the 56 participants in the first decision rounds of the ECL and CECL treatments. It provides a summary version of a comparability measure that can be used to characterize and compare the degree of comparability between loan managers operating under either the ECL or CECL. Table 12 presents the three ranges for DEBs for the ECL and CECL treatments. The mid-point of the middle range is the risk-neutral expected credit loss established by for Year 1 and the values are in lab dollars (L$). The results in Table 13 identify the ECL and CECL DEB range within which the loan managers' decisions fall in the first decision round. Eleven of the 28 loan managers operating under the ECL treatment are making decisions that could be categorized as risk-averse. On the other hand, 16 of the 28 loan managers operating under the CECL treatment are making decisions that could be categorized as risk seeking. The ECL distribution is skewed to high values, while the CECL distribution is skewed to low values.

Table 14 presents the number of pairs of loan managers whose choices of DEBs were comparable by sub-range and regime. For each group of 28 participants, the maximum possible pairs of loan managers are 378 (there are 378 combinations of 28 managers taken two at a time). The numbers reported in Table 14 are based on the frequency distributions presented in Table 13. Note that whenever there is only one observation in a range in Table 13, the number of comparable pairs in that range will necessarily be zero. The comparability index is equal to the sum of the frequencies of comparable pairs divided by 378.

The comparability index for the ECL model is less than the index for the CECL model. Using the test of proportions, the difference between the ECL comparability index is significantly lower than that for CECL ($p = 0.000$ with a two-sided test) in the first year of the laboratory environment. This result supports Prediction P2a.

Figure 5 shows the time series of comparability indices for the ECL and CECL treatments over the 24 years that cover the eight portfolios. Over the 24 periods, the means (standard

deviations) of the comparability indices for ECL and CECL are 0.417 (0.1004) and 0.531 (0.2217). Using a test of proportions, these are different ($p = 0.002$ with a two-sided test) and using a t-test these are different ($p = 0.018$ with a two-sided test). Finally, a t-test on the mean per period difference of 0.1145 between the indices for the ECL and CECL regimes supports the alternative hypothesis (to the null that the mean difference is 0) that under CECL the managers' decisions are more comparable than those under the ECL treatment. The results from these comparability indices pooled over the 24 periods support Prediction P2a.

Note the spikes in the CECL indices. There are some periods in which all 28 observations fall in the low DEB range, and seven periods in which there are obvious "peaks" in the CECL index. Six of these are in the last year of a portfolio and correspond to the DEBs that are set aside for the first year of a new portfolio. The comparability index for CECL exceeds that of ECL in 17 of the 24 periods.

6.4.2. Comparability index 2 (the coefficient of variation of DEBs)

The second comparability index is the Coefficient of Variation (CoV) of DEBs during a given period across the 28 loan managers following either ECL or CECL. The greater the CoV, the less comparable the observations. The greater CoV is associated with a wider distribution of observations normalized by the mean observation. The more closely the observations are clustered, the greater the comparability of the DEBs. The implication is that for comparability, regardless of the method the loan managers employ, many of them are using this relatively common interpretation of the guidelines set down by the governing model.

In any one period, the CoVs for a model can provide a comparability index, but we cannot test the statistical significance of the difference between the ECL and CECL values. As we obtain more observations from different years of different portfolios, we can ask whether the mean CoVs differ. The CoVs for ECL and CECL are presented in Figure 6. Although the values presented below the time-series figure are rounded to the first decimal place, the results show that in 22 of the years, the CoV for CECL is lower than for ECL. Over the 24 periods, the mean (standard deviations) of the CoVs for ECL and CECL are 0.638 (0.1356) and 0.511 (0.1587). Using a t-test, these are different ($p = 0.003$ with a two-sided test). Finally, a t-test on the mean per period difference of 0.1268 between the indices for ECL and CECL supports the alternative hypothesis (to the null that the mean difference is 0) that under CECL, the decisions made by the managers are more comparable than those under ECL ($p = 0.000$ for a one-sided test). These results support Prediction P2b.

6.4.3. Summary of comparability results

Comparability Index 1 supports observations from the data that the managers under CECL tend to make DEB decisions that are more comparable than those made by managers under ECL. Comparability Index 2 generates the same conclusion.[43]

6.5. Predictability

The predictability of DEBs selected by loan managers is measured by the r^2 value associated with the OLS regression:

$$Write\text{-}offs_t = a + b\ DEB_{t-1} \qquad (1)$$

where $Write\text{-}offs_t$ are those realized in Year t, and DEB_{t-1} are the desired ending balances set aside by the loan managers in Year $t\text{-}1$. The predictability of DEBs for a model is summarized by the mean of the r^2 values for loan managers operating under the rules of the model.

Figure 7 summarizes the predictability of write-offs by DEBs in the baseline simulations and presents the mean predictability values for loan managers who made DEB decisions in the laboratory under ECL and CECL. There is a small increase (8%) in the predictability of DEBs under ECL implemented in the laboratory over the baseline ICL model, and a large decrease (20%) under CECL. The performance of the loan managers under ECL was not as good as expected, given the baseline results, but not as bad as expected under CECL. Table 15 presents the mean values of the predictability measures and the results of a series of hypothesis tests. The 8% increase in predictability under the ECL model is not statistically significant ($p = 0.127$ for a 1-sided test), but the 20% reduction in predictability under the CECL model *is* significant ($p = 0.006$ for a 1-sided test). These results support Prediction P3a with respect to CECL, but not for that of ECL.

The difference in the laboratory between the DEB write-off predictability for the ECL loan managers and those under CECL is significant ($p = 0.0041$ for a 1-sided test). These results are robust to non-parametric analysis. Using a Mann-Whitney test, the distribution of the 28 r^2 values of the ECL treatment compared with that of the 28 values from the CECL treatment yields a U-statistic of 227, with a p-value of 0.0035. The distribution of r^2 values for the ECL model is shifted to the right of the values for the CECL model. These results support Prediction P3b.

The laboratory findings do not suggest that moving from ICL to ECL will result in desired ending balances of reserves being better predictors of write-offs. However, they do

[43] Note that greater index values imply greater comparability with Comparability Index 1, while smaller index values imply greater comparability with Comparability Index 2.

confirm that predictability will fall with the introduction of CECL. On the positive side, however, the loss of DEB predictive power under CECL does not deteriorate as much as the 68% suggested by the baseline simulations.

6.6. Profit volatility

Each loan manager generates a time series of net profits for each of the 24 decision rounds that comprise a treatment. Because of the relationship between the reserves that managers set aside and their net profit, carrying these holdings provides a mechanism for reallocating net profit over time. Profit volatility over a specific period of time can be measured by the Coefficient of Variation (CoV), which is the standard deviation of net profit over this period of time divided by the mean net profit. The larger the CoV, the more volatile the net profit.

For each of the 56 loan managers governed by either the ECL or CECL simulations and for the three baseline treatments (ICL, ECL and CECL), we have net profit values across 24 years (eight portfolios and two business cycles). We can compute the volatility of net profit for each loan manager taking part in the laboratory sessions, as well as for the three simulated baseline environments. Figure 8 presents the mean volatility of profit for these baseline simulations and for the laboratory ECL and CECL treatments. Volatility is relatively high under the ICL baseline and falls by 34% under the ECL baseline. Moving from the ICL to the CECL baseline will also result in a reduction in the volatility of profit, but only by about 6%. The laboratory results show the reduction in the volatility of the ECL treatment slightly exceeds its baseline reduction, with a 37% reduction from the ICL baseline (volatility for ICL is greater than for ECL, $p = 0.000$). The CECL model reduction of 35% is substantially greater than its baseline reduction, and not significantly different from the volatility of the ECL model (volatility for ICL is greater than for CECL, $p = 0.000$; volatility for ECL is not different from that for CECL, $p = 0.958$). These results support Prediction P4a – but do not support Prediction P4b. Table 16 presents volatility measures for the baseline and laboratory environments, as well as a series of hypothesis tests related to them. The tests strongly support the result that replacing ICL with either ECL or CECL will reduce the volatility of profit over substantial periods of time given the compensation scheme that we have provided to loan managers that rewards profits and encourages reducing volatility. These results support the replacement of ICL by either the ECL or CECL models.

7. Conclusions

The main objective of this research is to use the experimental economics methodology to examine the effects of mandating the ECL or CECL model in terms of their impacts on the adequacy of loan-loss reserves, the comparability and predictability of loan-loss reserves and the volatility of reported profit. We do this within the context of a controlled laboratory environment in which we induce incentives consistent with the current ICL and proposed ECL and CECL models that allow managers to use information about situations from past and current, as well as in the specific expected future.

The main result from test-bedding the credit-loss rule changes is that moving to the expected credit loss models from the ICL model leads to substantial increases in loan-loss reserves. This was the objective of the accounting standards boards. Our results also demonstrate that although the introduction of the ECL and CECL models results in increased adequacy of reserves over the ICL, they also lead to excessive reserves in early years of the life of a portfolio, i.e., too much reserves too soon. But these excessive reserves are much more prominent under the CECL regime. Our laboratory results support a conclusion that managers under the CECL model tend to make more comparable decisions on reserves than those made by managers under the ECL model. Although the predictability measure increases by about 8% for the ECL model, the laboratory results do not suggest that moving from the ICL model to our ECL model will result in desired ending balances of reserves being significantly better predictors of write-offs. However, the laboratory results confirm that predictability will fall with the introduction of the CECL model. Finally, earnings volatility falls substantially under the ECL and CECL models, compared to the ICL model. The difference between the volatility under ECL and CECL in the laboratory test-bed environment is not statistically significant.

An implication of our findings is that the new expected credit loss models affect the desired accounting properties of comparability and predictability differently. Comparability deteriorates to a greater degree under the ECL model, whereas predictability suffers more under the CECL model. Given these important differences, the users of accounting reports will have to be cautious when comparing financial statements of different entities. For the real effects, holding too much in reserves too soon under the expected credit loss models, in particular under CECL, can impair a lender's capital buffer.

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Table 1. Risk Premia (r), Interest Rates (i), Bank's Discount Rate (d), Discounted Default Probabilities (DDP), Losses Given Default and Discounted Expected Credit Losses

Credit Score	100-96	95-91	90-86	85-81	80-76	75-71	70-66	65-61	60-55
Credit Grade	A+	A	A-	B+	B	B-	C+	C	C-
Risk premia (r)	2%	3%	4%	6%	7%	8%	10%	11%	12%
Interest Rate (i)	11%	12%	13%	15%	16%	17%	19%	20%	21%
Discount Rate (d)	10%	10%	10%	10%	10%	10%	10%	10%	10%
12-month DDP Year 1	1.82%	2.73%	3.64%	4.55%	5.45%	6.36%	7.27%	8.18%	9.09%
12-month DDP Year 2	3.64%	5.45%	7.27%	10.91%	12.73%	14.55%	17.27%	19.09%	20.91%
12-month DDP Year 3	6.36%	10.91%	14.55%	20.91%	23.64%	25.45%	30.91%	32.73%	34.55%
Lifetime DDP Year 1	10.01%	15.76%	20.60%	28.41%	32.12%	35.10%	40.75%	43.42%	45.98%
Lifetime DDP Year 2	9.19%	14.78%	19.44%	27.64%	31.21%	33.98%	40.03%	42.60%	45.09%
Lifetime DDP Year 3	6.36%	10.91%	14.55%	20.91%	23.64%	25.45%	30.91%	32.73%	34.55%
Expected (Historical) Loss Given Default (LGD)	16000	17000	18000	20000	21000	22000	24000	25000	26000
LGD (best case)	0	0	0	0	0	0	0	0	0
LGD (worse case)	25500	26500	27500	29500	30500	31500	33500	34500	35500
12-month Disc ECL Year 1	291	464	655	909	1145	1400	1745	2045	2364
12-month Disc ECL Year 2	582	927	1309	2182	2673	3200	4145	4773	5436
12-month Disc ECL Year 3	1018	1855	2618	4182	4964	5600	7418	8182	8982
Lifetime Disc ECL Year 1	1601	2679	3708	5683	6746	7721	9781	10855	11956
Lifetime Disc ECL Year 2	1470	2512	3499	5527	6553	7476	9608	10649	11724
Lifetime Disc ECL Year 3	1018	1855	2618	4182	4964	5600	7418	8182	8982

Notes: Risk Premium for Credit Grade α = 100×(14000×Lifetime DDP Year 1 for Credit Grade α)/(100000×(1 – Lifetime DDP Year 1 for Credit Grade α)) rounded to nearest whole number (see Appendix A for the derivation); DDP = discounted default probability; Disc = discounted; ECL = expected credit loss.

Table 2: Portfolio Details

Loan Portfolio #1 in Years 1-3														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 VG	11,000	Modest	Booming	89	A-	NA	4%	NA	13%	
Updated Credit Score at the END of Y1	3	0	10	7 VG & 3 G	11,000	Modest	Booming	87.8	A-	-0.013	8%	Normal	13%	
Updated Credit Score at the END of Y2	1	1	9	5 VG & 4 G	9,600	Modest	Booming	73.2	B-	-0.177	28%	Very Large	13%	
Activities of the Loan during Y3	2	1	8	NA	9,600	NA	NA	NA	NA	NA				

Loan Portfolio #2 in Years 4-6														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 VG	11,000	Low	Booming	86	A-	NA	4%	NA	13%	
Updated Credit Score at the END of Y1	4	0	10	6 VG & 4 G	11,000	Low	Booming	84.4	B+	-0.019	12%	Normal	13%	
Updated Credit Score at the END of Y2	1	2	8	4 VG & 4 G	9,400	Low	Booming	68.0	C+	-0.209	34%	Very Large	13%	
Activities of the Loan during Y3	2	2	8	NA	9,000	NA	NA	NA	NA	NA				

Loan Portfolio #3 in Years 7-9														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 E	10,400	High	Mixed	85	B+	NA	5%	NA	15%	
Updated Credit Score at the END of Y1	2	0	10	8 VE & 2 VG	10,000	High	Mixed	80.2	B	-0.057	14%	Normal	15%	
Updated Credit Score at the END of Y2	3	0	10	5 E & 5 VG	10,000	High	Mixed	79.0	B	-0.071	26%	Normal	15%	
Activities of the Loan during Y3	2	3	7	NA	9,200	NA	NA	NA	NA	NA				

Table 2. Portfolio Details (continued)

Loan Portfolio #4 in Years 10-12														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 G	10,400	High	Recession	72	B-	NA	7%	NA	17%	
Updated Credit Score at the END of Y1	3	0	10	7 G & 3 F	10,000	High	Recession	66.8	C+	-0.072	19%	Normal	17%	
Updated Credit Score at the END of Y2	3	2	8	4 G & 4 F	9,200	High	Recession	58.0	C-	-0.194	38%	Very Large	17%	
Activities of the Loan during Y3	1	4	4	NA	9,000	NA	NA	NA	NA	NA				

Loan Portfolio #5 in Years 13-15														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 O	10,600	High	Booming	96	A+	NA	2%	NA	11%	
Updated Credit Score at the END of Y1	1	0	10	10 O	10,600	High	Booming	96	A+	-0.000	4%	Normal	11%	
Updated Credit Score at the END of Y2	2	0	10	8 O & 2 E	10,200	High	Booming	91.2	A	-0.050	12%	Normal	11%	
Activities of the Loan during Y3	2	1	9	NA	10,000	NA	NA	NA	NA	NA				

Loan Portfolio #6 in Years 16-18														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 VG	10,600	Modest	Booming	85	B+	NA	5%	NA	15%	
Updated Credit Score at the END of Y1	2	0	10	18VG & 2 G	10,200	Modest	Booming	80.6	B	-0.052	14%	Normal	15%	
Updated Credit Score at the END of Y2	1	2	8	6 VG & 2 G	10,000	Modest	Booming	78	B	-0.082	26%	Normal	15%	
Activities of the Loan during Y3	3	1	7	NA	10,000	NA	NA	NA	NA	NA				

Table 2: Portfolio Details (continued)

Loan Portfolio #7 in Years 19-21														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 E	11,000	High	Mixed	91	A	NA	3%	NA	12%	
Updated Credit Score at the END of Y1	0	0	10	10 E	10,600	High	Mixed	87	A-	-0.044	8%	Normal	12%	
Updated Credit Score at the END of Y2	1	1	9	8 E & 1 VG	10,000	High	Mixed	80.6	B+	-0.114	23%	Large	12%	
Activities of the Loan during Y3	3	1	8	NA	9,400	NA	NA	NA	NA	NA				

Loan Portfolio #8 in Years 22-24														
			Components of the Credit Scores for the Portfolio of 10 Loans											
	# of Borrowers Who Missed 1 Payment	# of Borrowers Who Missed 2 Payments (Foreclosed)	#of Loans Remaining in the Portfolio by the End of the Year	Past Credit-worthiness	Market Value of Collateral for Each Borrower	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	Change in Credit Risk Exposure Since Loan Origination	Probability of Missing Payments Next Year on the Remaining Loans	Significance of the change in Credit-worthiness Since Loan Origination	Interest Rate based on Risk Grade at the start of the first year	Bonus Rate (10% if a loss in previous 3 years, otherwise 20%)
Original Credit Score at the Start of Y1	NA	NA	10	10 VG	10,200	Modest	Recession	71	B-	NA	7%	NA	17%	
Updated Credit Score at the END of Y1	2	0	10	8 VG & 2 G	10,000	Modest	Recession	68.2	C+	-0.039	19%	Normal	17%	
Updated Credit Score at the END of Y2	3	2	8	3 VG & 5 G	9,600	Modest	Recession	62.5	C	-0.120	36%	Very Large	17%	
Activities of the Loan during Y3	2	3	5	NA	9,200	NA	NA	NA	NA	NA				

Note: Past Creditworthiness: O = outstanding, E = excellent, VG = very good, G = good, F = fair

Table 3. Desired Ending Balance of Reserves Held in Simulated ICL, ECL and CECL Baselines

Year	ICL	ECL	CECL
1	0	1309	3499
2	4581	4581	4581
3	0	655	3708
4	0	1964	4975
5	5564	5564	5564
6	0	909	5683
7	0	2546	6242
8	0	4728	4728
9	0	1400	7721
10	0	3799	8807
11	7601	7601	7601
12	0	291	1601
13	0	582	1470
14	0	1746	1746
15	0	909	5683
16	0	2546	6242
17	0	4728	4728
18	0	464	2679
19	0	1236	3305
20	0	3555	3555
21	0	1400	7721
22	0	3799	8807
23	7201	7201	7201
24	0	0	0

Note: Significant probabilities of a loss were anticipated in years Y3, Y6, Y12 and Y24. Accordingly, reserves were transferred from profits only in years Y2, Y5, Y11 and Y23 for the ICL model. Significant probabilities of a loss were realized only for the third years of the loan portfolios #1, #2, #4 and #8. In each simulation the branch's beginning balance of reserves at the start of year 1 was equal to 0 for ICL, 655 for ECL and 3708 for CECL. These are the expected credit losses for year 1 corresponding to each of these scenarios.

Table 4. Baseline Predictions for the ICL, ECL and CECL Models

	ICL Baseline	ECL Baseline	CECL Baseline
Mean Desired Ending Balances	1433	2674	5065
Mean Desired Ending Balances Inadequacy Measure	0.5875	0.3097	0.1635
Mean Desired Ending Balances Excess Adequacy Measure	0.0649	0.2377	0.8504
Predictability of Write Off by Desired Ending Balances	0.5153	0.7286	0.1648
Mean Volatility of Profit	2.87	1.89	2.71

Note: There is no baseline prediction for the comparability of Desired Ending Balances of Reserves across regimes because there is only one observation for each baseline simulation. Effectively, the baseline comparability prediction for each regime is unity.

Table 5. Experimental Design: Treatments by Sequence and Decision Rounds (Years)

		Treatments	
Decision Rounds	**Descriptions**	**Sequence 1**	**Sequence 2**
1 - 12	PreICL treatment serves as an introduction to the environment with no constraints on reserves	PreICL	PreICL
13 -36	ECL and CECL treatments generating data to conduct between-participant analysis in this paper	ECL	CECL
37-60	ECL and CECL treatments generating data to conduct within-participant analysis that is not included in this paper	CECL	ECL
61 - 63	Rounds introduced to avoid end-game behavior in round 60	CECL	ECL

Note: 28 participants complete each sequence.

Table 6. Expected Credit Losses and Maximum and Minimum Values Available for Desired Ending Balances for the PreICL Treatment by Year of the One-Business-Cycle Loan Management Environment

Period	Minimum	Expected Credit Loss	Maximum
1	0	580	16000
2	0	1746	16000
3	0	909	20,000
4	0	2546	20000
5	0	4728	20000
6	0	464	17000
7	0	1236	17000
8	0	3555	17000
9	0	1400	22000
10	0	3799	22000
11	0	7201	22000
12 (if followed by ECL)	164	655	1146
12 (if followed by CECL)	927	3708	6489

Table 7. Expected Credit Losses and Maximum and Minimum Values Available for Desired Ending Balances by Rule (IASB's ECL Sequence 1 and FASB's CECL Sequence 2) and Year of the Two-Business-Cycle Loan Management Environment

	Sequence 1 Beginning with ECL			Sequence 2 Beginning with CECL		
Period	Minimum	Expected	Maximum	Minimum	Expected	Maximum
13	327	1309	2291	875	3499	6123
14	1145	4581	8017	1145	4581	8017
15	164	655	1146	927	3708	6489
16	491	1964	3437	1244	4975	8706
17	1391	5564	9737	1391	5564	9737
18	227	909	1591	1421	5683	9945
19	637	2546	4456	1561	6242	10924
20	1182	4728	8274	1182	4728	8274
21	350	1400	2450	1930	7721	13512
22	950	3799	6648	2202	8807	15412
23	1900	7601	13302	1900	7601	13302
24	73	291	509	400	1601	2802
25	146	582	1019	368	1470	2573
26	437	1746	3056	437	1746	3056
27	227	909	1591	1421	5683	9945
28	637	2546	4456	1561	6242	10924
29	1182	4728	8274	1182	4728	8274
30	116	464	812	670	2679	4688
31	309	1236	2163	826	3305	5346
32	889	3555	6221	889	3555	6221
33	350	1400	2450	1930	7721	13512
34	950	3799	6648	2202	8807	15412
35	1800	7201	12602	1800	7201	12602
36	927	3708	6489	164	655	1146
37	875	3499	6123	327	1309	2291
.	.	.	.	.	.	.
.	.	.	.	.	.	.
61	875	3499	6123	327	1309	2291
62	1145	4581	8017	1145	4581	8017
63	0	0	0	0	0	0

Notes: Data are analyzed for years 13 through 36 for between-participant analysis of ECL and CECL regimes. Period 37 begins the first year of the CECL regime in Sequence 1 and the first year of the ECL regime in Sequence 2. At the end of year 63 all reserves are converted to profit and distributed to managers and shareholders. Desired Ending Balance for year 63 is always 0.

Table 8. PreICL Desired Ending Balances of Reserves: Baseline and Sequences 1 and 2

	Mean	Standard Deviation	t-statistic (p-value) versus Baseline	t-statistic (p-value) versus Sequence 2	Observations
PreICL Baseline	2402.000	NA	NA	1.1201 (0.275)	1
PreICL Sequence 1	2569.655	2904.338	0.4281 (0.672)	0.3776 (0.707)	28
PreICL Sequence 2	2882.798	3188.277	1.1201 (0.275)	NA	28

Table 9. Mean Desired Ending Balances of Reserves: ICL, ECL and CECL Baselines and ECL and CECL Laboratory Results

	ICL Baseline	ECL Baseline	CECL Baseline	ECL	CECL
Mean	1433	2674	5065	2169.66	3577.07
Standard Deviation	NA	NA	NA	917.83	1266.52
t-stat vs ECL (2-sided p-values)	4.1705 (0.000)	2.8552 (0.008)	NA	NA	4.6755 (0.000)
t-stat vs CECL (2-sided p-values)	8.7964 (0.000)	NA	6.1045 (0.000)	4.6755 (0.000)	NA
Observations	1	1	1	28	28

Table 10. Mean DEB Inadequacy Measure (UWO/WO): ICL, ECL and CECL Baselines and ECL and CECL Laboratory Results

	ICL Baseline	ECL Baseline	CECL Baseline	ECL	CECL
Mean	0.5875	0.3097	0.1635	0.4278	0.2881
Standard Deviation	NA	NA	NA	0.2070	0.1937
t-stat vs ECL (2-sided p-values)	4.0091 (0.000)	2.9641 (0.006)	NA	NA	2.5612 (0.013)
t-stat vs CECL (2-sided p-values)	8.0343 (0.000)	NA	3.3409 (0.002)	2.5612 (0.013)	NA
Observations	1	1	1	28	28

Table 11. Mean Excess Adequacy Index (ExBB/WO): ICL, ECL and CECL Baselines and ECL and CECL Laboratory Results

	ICL Baseline	ECL Baseline	CECL Baseline	ECL	CECL
Mean	0.0649	0.2377	0.8504	0.1554	0.4829
Standard Deviation	NA	NA	NA	0.1084	0.2678
t-stat vs ECL (2-sided p-values)	4.3376 (0.000)	3.9425 (0.001)	NA	NA	5.8896 (0.000)
t-stat vs CECL (2-sided p-values)	8.1106 (0.000)	NA	7.1301 (0.000)	5.8896 (0.000)	NA
Observations	1	1	1	28	28

Table 12. DEB Ranges for DEB by Model in Period 1 (in Lab Dollars)

	ECL	CECL
Bottom Third	327 ≤ DEB < 981	874 ≤ DEB < 2624
Middle Third	982 ≤ DEB < 1636	2625 ≤ DEB < 4373
Top Third	1636 ≤ DEB < 2291	4374 ≤ DEB < 6124

Table 13. Frequency Distribution of Mean DEBs by Sub-Range and Model for Period 1

	ECL	CECL
Bottom Third	7	16
Middle Third	10	11
Top Third	11	1
Total Sample	28	28

Table 14. Frequency Distribution of Comparable Pairs by Range and Model and the "Risk-Related" Comparability Index by Model for Period 1

	ECL	CECL
Bottom Third	21	120
Middle Third	45	55
Top Third	55	0
Sum of Pairs (max = 378)	121	175
"Risk-Related" Comparability Index	0.3201	0.4630

Table 15. Predictability of Write Offs by Desired Ending Balances of Reserves: ICL, ECL and CECL Baselines and ECL and CECL Laboratory Results

	ICL Baseline	ECL Baseline	CECL Baseline	ECL	CECL
Mean	0.5153	0.7286	0.1648	0.5578	0.4108
Standard Deviation	NA	NA	NA	0.1933	0.2068
t-stat vs ECL (2-sided p-value)	1.1634 (0.255)	4.6756 (0.000)	NA	NA	2.7462 (0.008)
t-stat vs CECL (2-sided p-value)	2.6739 (0.013)	NA	6.2945 (0.000)	2.7462 (0.008)	NA
Observations	1	1	1	28	28

Table 16. Mean Volatility of Profit: ICL, ECL and CECL Baselines and ECL and CECL Laboratory Results

	ICL Baseline	ECL Baseline	CECL Baseline	ECL	CECL
Mean	2.87	1.89	2.71	1.82	1.86
Standard Deviation	NA	NA	NA	0.4460	0.6529
t-stat vs ECL (2-sided p-value)	12.211 (0.000)	0.798 (0.434)	NA	NA	0.054 (0.958)
t-stat vs CECL (2-sided p-value)	8.005 (0.000)	NA	6.732 (0.000)	0.054 (0.958)	NA
Observations	1	1	1	28	28

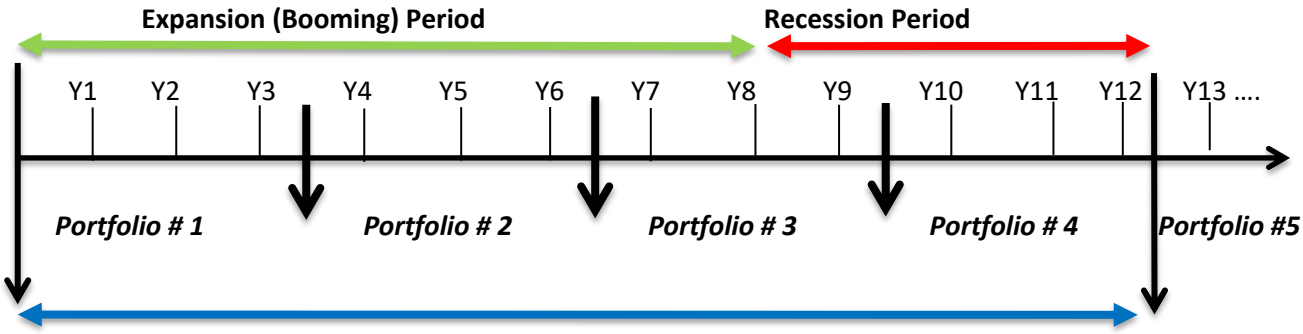
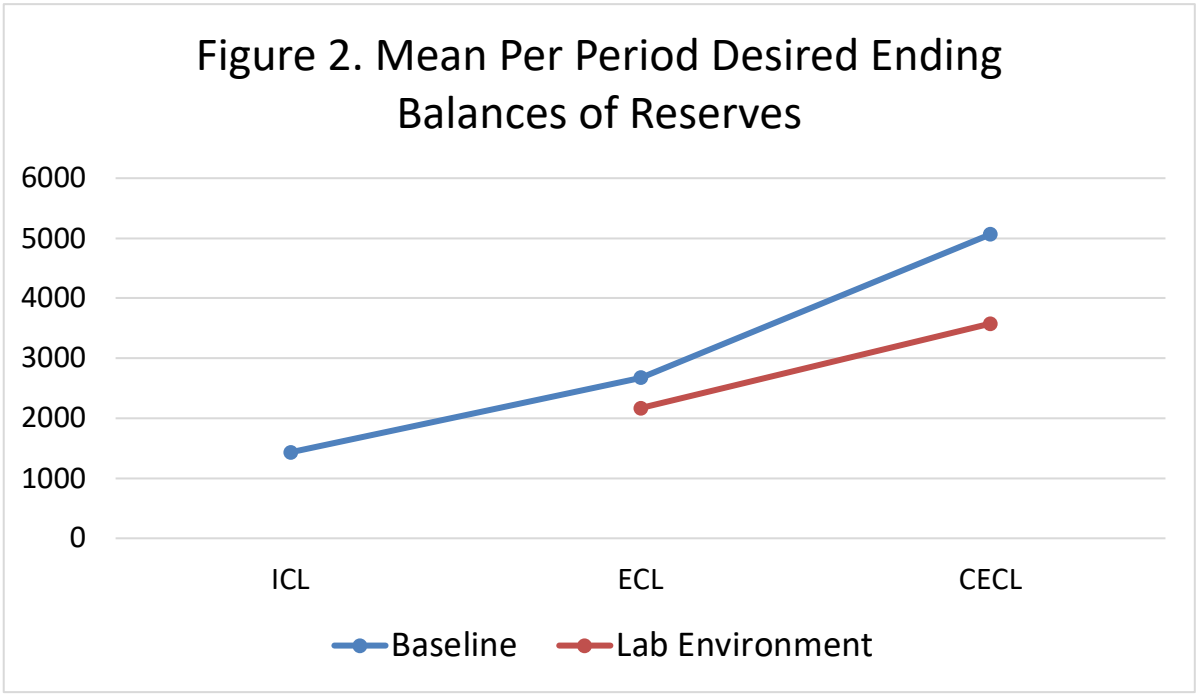


Figure 1. The First Lending Cycle of a Session



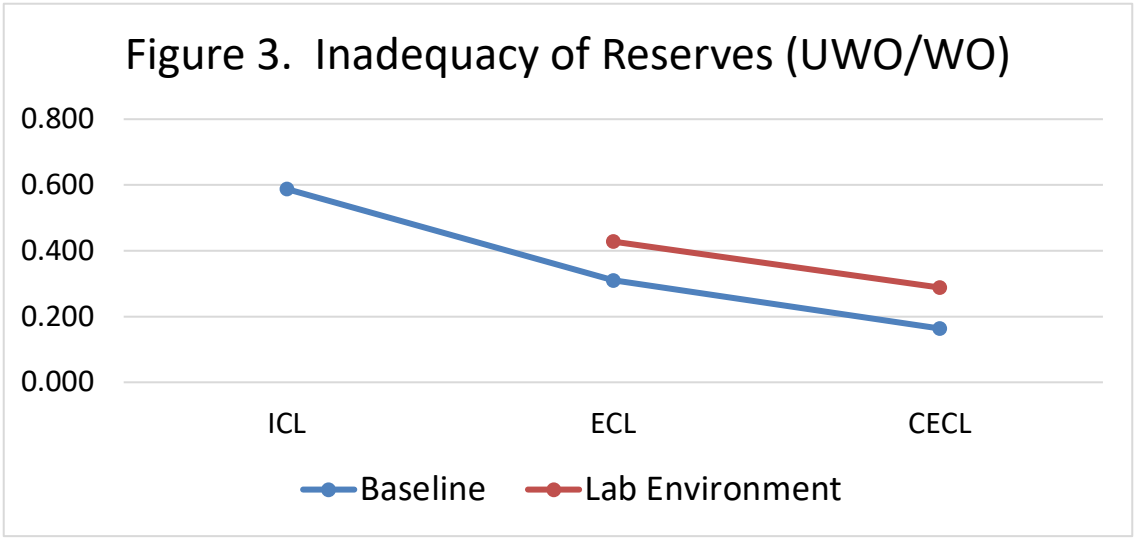


Figure 3. Inadequacy of Reserves (UWO/WO)
0.800
0.600
0.400
0.200
0.000
ICL
ECL
CECL
Baseline
Lab Environment

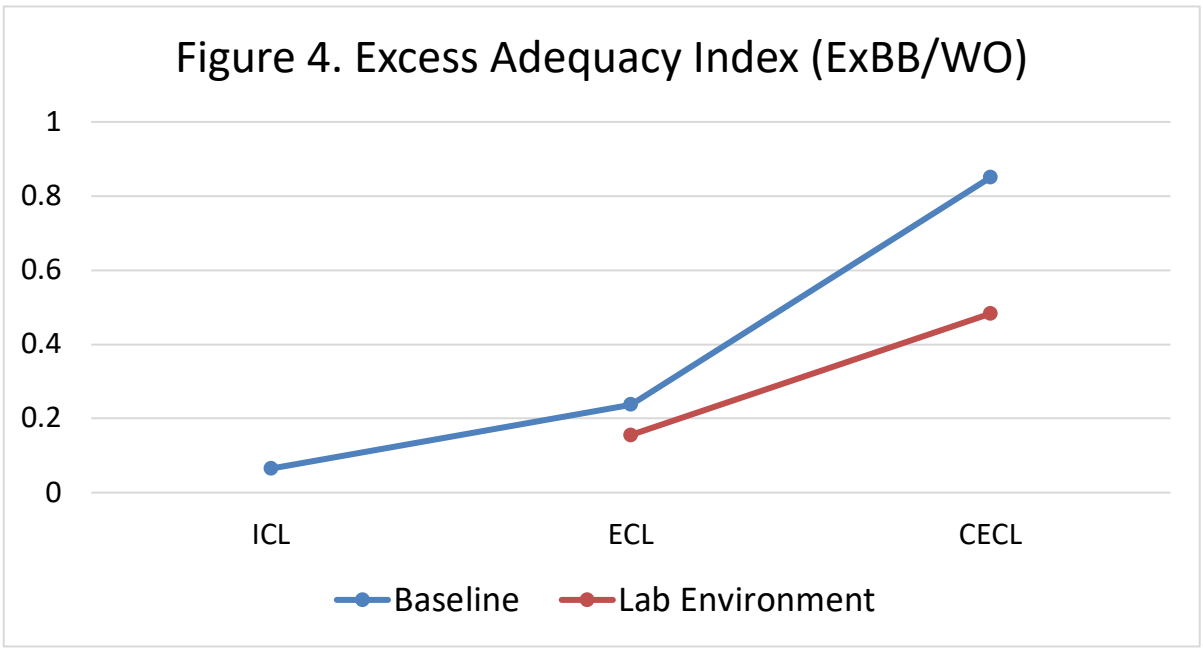
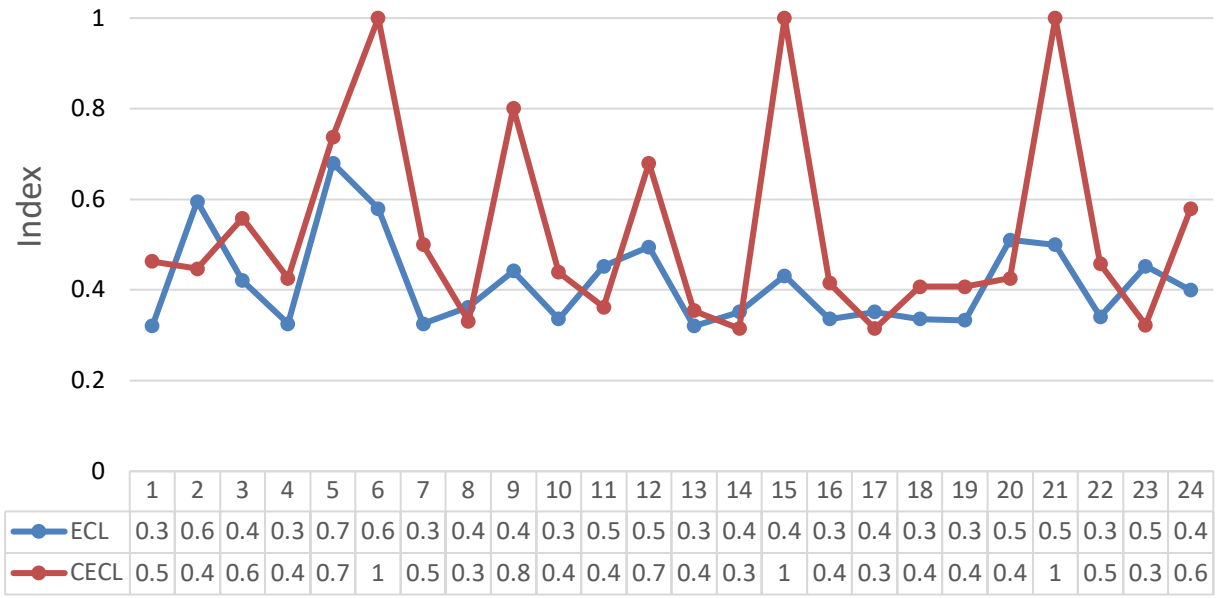


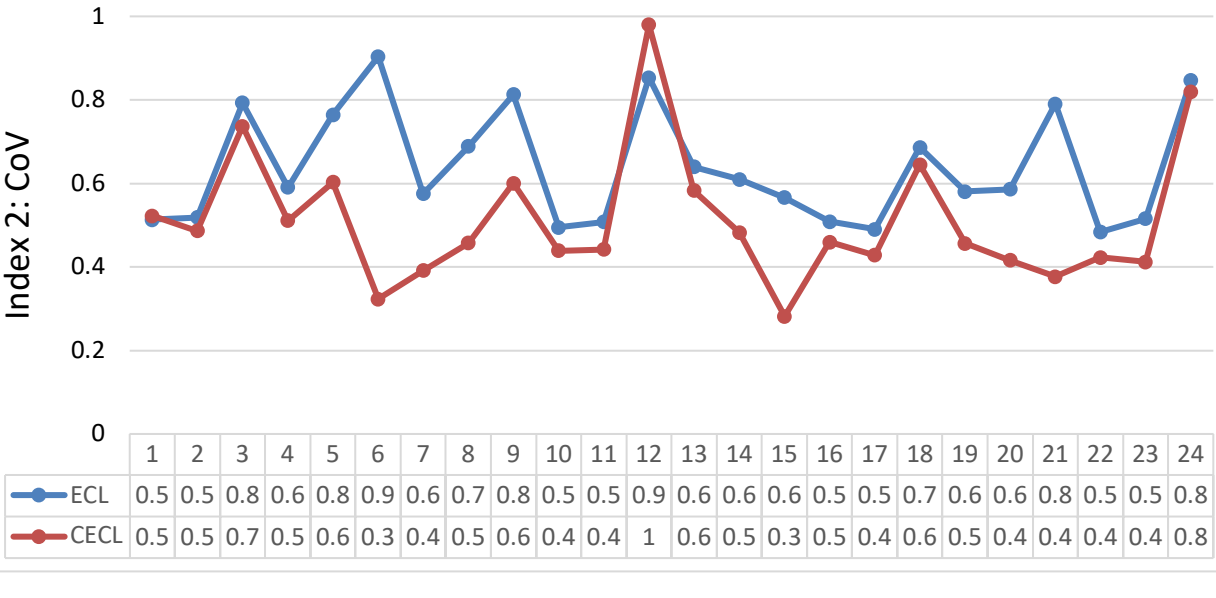
Figure 4. Excess Adequacy Index (ExBB/WO)
1
0.8
0.6
0.4
0.2
0
ICL
ECL
CECL
Baseline
Lab Environment

Figure 5. Comparability Index 1 by Year and Regime



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ECL	0.3	0.6	0.4	0.3	0.7	0.6	0.3	0.4	0.4	0.3	0.5	0.5	0.3	0.4	0.4	0.3	0.4	0.3	0.3	0.5	0.5	0.3	0.5	0.4
CECL	0.5	0.4	0.6	0.4	0.7	1	0.5	0.3	0.8	0.4	0.4	0.7	0.4	0.3	1	0.4	0.3	0.4	0.4	0.4	1	0.5	0.3	0.6

Figure 6. Comparability Index 2 (Coefficients of Variation for DEB) by Regime and Year



	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
ECL	0.5	0.5	0.8	0.6	0.8	0.9	0.6	0.7	0.8	0.5	0.5	0.9	0.6	0.6	0.6	0.5	0.5	0.7	0.6	0.6	0.8	0.5	0.5	0.8
CECL	0.5	0.5	0.7	0.5	0.6	0.3	0.4	0.5	0.6	0.4	0.4	1	0.6	0.5	0.3	0.5	0.4	0.6	0.5	0.4	0.4	0.4	0.4	0.8

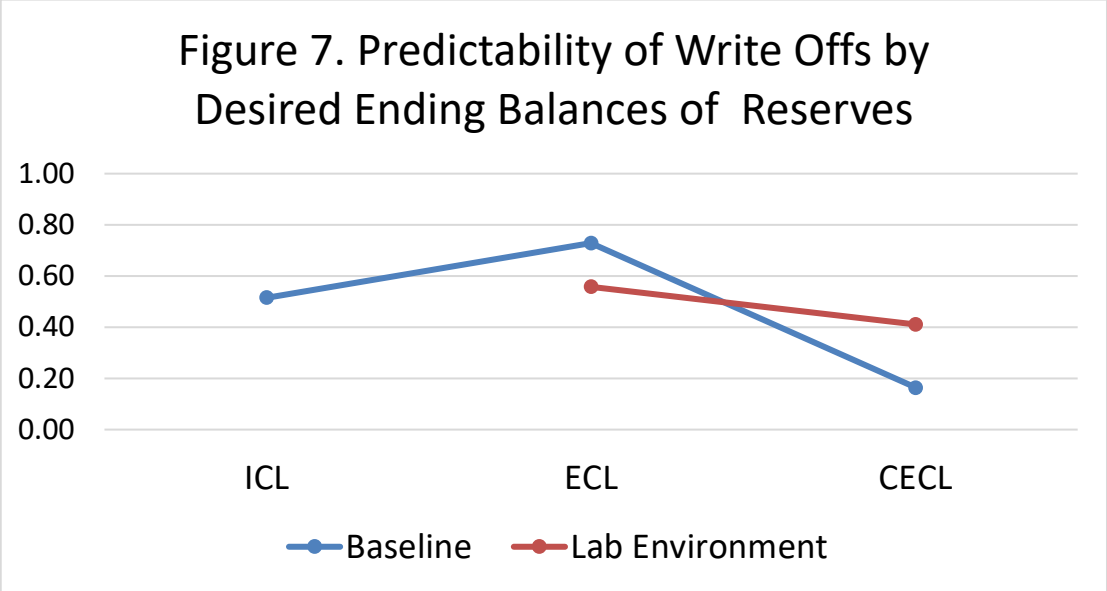


Figure 7. Predictability of Write Offs by Desired Ending Balances of Reserves
1.00
0.80
0.60
0.40
0.20
0.00
ICL
ECL
CECL
Baseline
Lab Environment

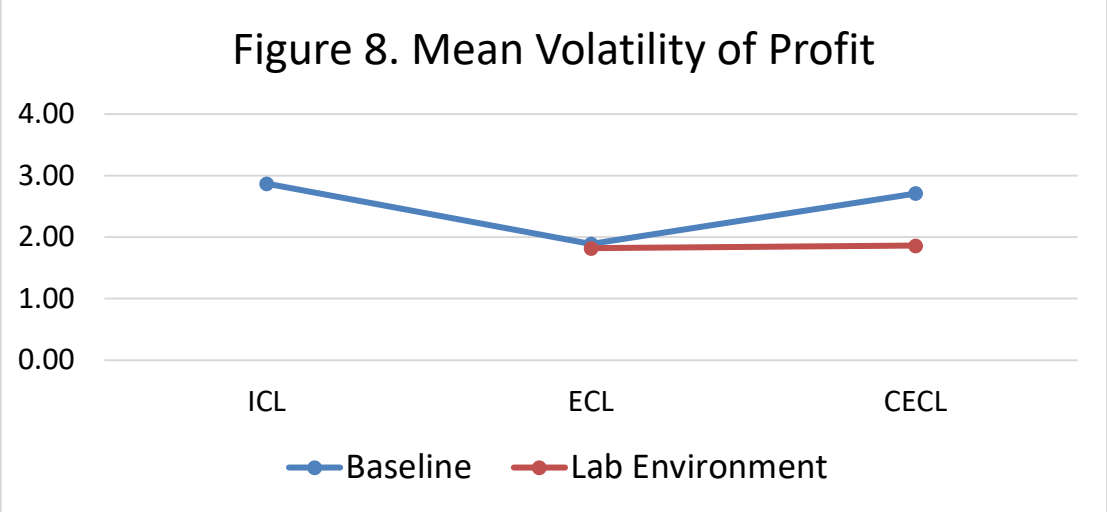


Figure 8. Mean Volatility of Profit
4.00
3.00
2.00
1.00
0.00
ICL
ECL
CECL
Baseline
Lab Environment

Appendix A. Determining Risk Premia and Reserves Allowances

1. Risk Premia

The NAB makes 10 loans of $10,000 to different borrowers. Each loan has a term of 3 years. Each borrower has the same credit score and credit grade. The risk premium for each loan will be the same and this will be the risk premium for the $100,000 loan portfolio.

For this example, the borrower's credit score is determined to be 84. The borrower has a credit grade of B+. If the credit grade does not change during the term of the loan, the borrower's probability of defaulting in the first year is 5%, in the second year it is 12% and in the third year it is 23% (see Table B6 in Appendix B for these numbers).

A borrower defaults on his loan obligations if he misses two consecutive interest payments. He must make a payment every 6 months. If he defaults, his collateral is sold and used to repay the principal of the loan and the unpaid interest obligations. In this example, the borrower will always repay the principal of the loan if he successfully completes the term without missing two consecutive interest payments.

The expected loss *given* default (LGD) is equal to the sum of the two missed interest payments plus the cost of liquidating the borrower's collateral. The value of the two missed interest payments depends upon the interest rate, i, and the value of the principal ($10,000). The expected recovery from the sale of collateral on foreclosure is $10,000 less a 5% liquidation fee. $500 is expected cost to the NAB of liquidating the collateral.

To calculate the lifetime discounted expected credit loss from the perspective of the start of the first year of the loan portfolio we calculate the expected loss given default in years 1, 2 and 3 from the perspective of the start of year 1.

The expected loss given default at the end of the first year ($ELGD_1$) is 5% of the expected loss given default (LGD) or

$$ELGD_1 = 0.05 \times LGD \qquad (1)$$

If there is no default in year 1, the probability of default in the second year is 12% and the expected loss given default at the end of the second year ($ELGD_2$) is

$$ELGD_2 = 0.95 \times 0.12 \text{ x } LGD \qquad (2)$$

where 0.95 is the likelihood that there is not a default by the start of year 2.

If there is no default in year 2, the probability of default in the third year is 23% and the expected loss given default at the end of the third year ($ELGD_3$) is

$$ELGD_3 = 0.836 \times 0.23 \text{ x } LGD \quad (3)$$

Where 0.836 is the likelihood that there is not a default by the start of year 3 (this is equal to the probability the loan makes it to the second year times the probability the loan makes it to the third year or 0.95 x 0.88).

To calculate the LGD we must have the interest rate. To calculate the interest rate we must know the risk premium associated with the loan. The risk premium is based on the *lifetime discounted expected credit loss measured at the start of the first year of the term of the loan* (LPD1× LGD) where

$$ELGD_1 \times (1.1)^{-1} + ELGD_2 \times (1.1)^{-2} + ELGD_3 \times (1.1)^{-3} = LPD1 \times LGD$$

and the values of $ELGD_t$ are discounted at 10% for each of the years t = 1, 2, 3.

$$LPD1 = 0.05 \times (1.1)^{-1} + 0.95 \times 0.12 \times (1.1)^{-2} + 0.836 \times 0.23 \times (1.1)^{-3} = 0.2843$$

The interest rate is

$$i = r + 0.09$$

where 0.09 is the rate of return to a risk-free loan.

$$\text{The LGD} = i \times 10{,}000 + 500.$$

The risk premium is defined as the proportion of the initial value of a loan, at the time it is awarded, accounted for by the *lifetime discounted expected credit loss measured at the start of the first year of the term of the loan*. This means that

$$r = (LPD1 \times LGD)/10{,}000$$

or

$$r = (0.2843 \times (10{,}000r + 900 + 500))/10{,}000$$

This can be reduced to

$$10{,}000r – (0.2843 \times 10{,}000r) = 0.2843 \times 1{,}400$$

and this can be reduced to

$$0.7157 \times 10{,}000r = 0.2843 \times 1{,}400$$

and

$$r = 0.0556$$

With a lifetime risk premium of 6% the interest rate on this loan should be 15%. This will let us calculate the expected loss given default (LGD) for each year of the loan. This is

$2,000 (calculated as 0.15 × 10,000 + 500). This can be extended to the entire loan portfolio of ten $10,000 loans. The expected loss given default for the portfolio is $20,000.

2. Reserve Allowances

Continuing with the example introduced above, we have a portfolio that has a credit grade of B+ on initiation. The interest rate is 15% and the interest that the NAB expects to receive each year of the term of the portfolio is $15,000. If the ECL model governs the reserves that may be held in anticipation of credit losses at the end of the first year of the 3-year term of the portfolio, the NAB may set aside reserves of $909. This is equal to the probability of default at the end of year 1 (5%) multiplied by the expected loss given default (LGD) for the portfolio ($20,000) and discounted by 10% (the 12-month discounted expected loss given default at the end of the first year). This desired balance of reserves at the start of the first year of the portfolio assumes that the loan manager has no discretion to select a value that may be less than or greater than $909.

Suppose there is no default at the end of the first year and there is no change in the average credit scores of borrowers the credit grade of the portfolio remains at B+. The probability of default at the end of the second year is 12%. The 12-month discounted expected loss given default at the end of the second year is $2,182 ($0.12 \times 20{,}000 \times 1.1^{-1}$). The loan manager's desired ending balance of reserves in year 1 will be $2,182.

If there is no default at the end of the second year and there is no change in the average credit scores of borrowers, the credit grade of the portfolio will be unchanged from B+. The probability of default, however, rises to 23%. Accordingly, the 12-month discounted expected loss given default at the end of the third year is $3,456 ($0.23 \times 20{,}000 \times 1.1^{-1}$). The loan manager's desired ending balance of reserves in year 2 will be $4,182.

Each credit grade is associated with a pattern of probabilities of default for each year remaining in the term of the portfolio. For instance, if at the end of year 1 when the borrowers' credit scores are re-evaluated that credit scores for some fall and for others they rise. If the average credit score falls to 80, the credit grade of the portfolio will be B. The probabilities of default for a B portfolio are 6%, 14% and 26% for years 1, 2 and three (see Table B6 in Appendix B). Therefore, for year 2 of the portfolio, the probability of default is 14%. We would then determine the appropriate reserve as $0.14 \times \$20{,}000 \times 1.1^{-1}$ or $2,545. If there is no change in the average credit score of the borrowers at the end of year 2, then the appropriate reserve for

year 3 would be 0.26 x \$20,000 x 1.1^{-1} or \$4,727. The ending balances that may be held as reserves increase as the credit grade of the portfolio falls.

Within the rules of the ECL model, if the credit score of the portfolio fell from 85 in year 1 to 73 in year 2, the credit grade of the portfolio would be B-. However, the drop from a score of 85 to 73 or by 14% would be judged to be a very large drop and indicate a significant increase in risk exposure. Accordingly, we would use the *lifetime discounted expected loss given default at the end of the second year* to determine the permitted reserves. The probabilities of default in years 2 and 3 for a B- portfolio are 16% and 28%. The lifetime probability of default at the start of year 2 is equal to

$$0.16 \times 1.1^{-1} + 0.84 \times 0.28 \times 1.1^{-2} = 0.1455 + 0.1944 = 0.3399$$

and the permitted reserves are 0.3399 x \$20,000 = \$6,798

Assume there is no not change in credit grade for year 3. In this case the permitted reserve balance that may be carried into year 3 is 0.28 x \$20,000 = \$5,600.

Relative to the first scenario presented, the substantial reduction in credit grade at the end of year 1 results in a substantial increase in permitted reserves. Unlike the earlier scenario, moving into the third year of the term of the loan portfolio results in a slight reduction in the reserve balance that can be carried into year 3.

Appendix B

Development of the Loan Manager Environment

1. The Characteristics of Creditworthiness

1.1. Collateral Requirement

When banks lend money, they take on the risk of losing some or all of the contractual obligations associated with the loan (i.e., some of the interest due on the loan and/or the loan principal itself). This risk is called *credit risk* exposure and always exists, even if the borrower has an excellent credit history. To minimize this *credit risk* and the resulting potential loss, most banks require borrowers to provide collateral in the form of an asset to secure the loan. In the case of foreclosure, the bank sells the asset and use the proceeds to recover all or some of the unpaid interests and loan.

The NAB requires that each individual loan must be backed by collateral with a market value of at least 90% of the value of the loan. In our laboratory setting, the market value of collateral at the time of granting a new loan ranges between L$9,000 and 11,000. This value is established by a random draw from among the eleven values in the range between L$9,000 and L$11,000, in increments of L$200 (see Table B1). The greater the market value of collateral, the more the collateral contributes to the credit score. For example, a market value of L$11,000 contributes 30 points to the credit score. The points fall by 2 for each L$200 drop in market value.

The market value of the collateral, however, may change during the term of the loan. At the end of each year, the Head Office of NAB will inform *Loan Managers* about the updated market value of the collateral. For simplicity in our environment, the market value of collateral for all the 10 borrowers whose loans make up a portfolio will be the same at the initiation of the loans. Furthermore, if the market value of the collateral changes during the term of the loan, the new market value will apply to all of the 10 loans in the portfolio. At the end of each year, a new random draw will be made and, according to Table B1, the value of collateral for the next year will be determined.

1.2 Credit Worthiness

Initial credit worthiness is based on a random draw that is similar to the one described above. There are five different categories into which the borrower can fall (see Table B2). We assume

that the likelihoods that are based on *historical data*. If we draw a number from the range 1 to 100 and obtain 42, then this means that the credit worthiness of our typical borrower is initially *very good* (to be in the *outstanding* category the draw would have to be a number between 1 and 15; to be *excellent*, the draw would have to be a number between 16 and 35). If the number were 83, then the credit worthiness would be *good*. *Outstanding* credit worthiness contributes 40 points to the borrower's credit score. As credit worthiness falls from *outstanding* to *fair*, the borrower's credit score falls by 4 points for each reduction in credit worthiness. *Fair* credit worthiness contributes 24 points to the final credit score.

At the end of each year of the term of a loan, the credit worthiness of each borrower is independently re-evaluated by the Head Office with reference to whether or not the borrower defaulted on an interest payment during that year. Each time the borrower misses an interest payment during the first and second years of a loan the borrower's credit score falls by 4 points. Whether an interest payment is missed or not missed during a year depends upon the borrower's credit score for that year. The higher the credit score, the lower the likelihood that an interest payment will be missed.

1.3. Borrower's Job Status

A borrower's job status is determined by salary and is assumed to take one of three values. It can be *high*, *modest* or *low*. The likelihood that it is *high* is 20%, that it is *modest* is 40% and that it is *low* is 40%. This is determined at the initiation of the loan and at the end of the first and second years of the term of the loan by a random draw from the values 1 through 100. A draw of a number between 1 and 20 will identify a *high* salary borrower and contribute 10 points to his credit score while a draw of a number between 61 and 100 will identify a *low* salary borrower and contribute 4 points to his credit score. These are summarized in Table B3.

1.4. Economic Condition

The economic condition will be either *good* or *bad*. The business cycle consists of 12 years. Years 1 through 8 are *good* years and years 9 through 12 are *bad* years. *Bad* years are characterized by relatively poor economic conditions and are generally associated with lower credit scores than are *good* years. New portfolios are created every three years. Borrowers who have loans during years 1-3 and 4-6 will experience only *good* years. Borrowers who have loans during years 7-9 will experience both *good* and *bad* years (years 7 and 8 are good years but year 9 is a bad year; the economic condition for this portfolio is identified as "mixed"). Borrowers

who have loans during years 10-12 will experience only *bad* years. Holding a loan during years 1 through 6 will contribute 20 points towards the borrower's credit score. Holding a loan during years 7-9 will contribute 17 points towards the borrower's credit score. This drops to 10 points for a borrower who obtains a loan in year 10. A banking business cycle is displayed Figure B1.

2. The Simulation (Baseline) Environment and its Parameterization

2.1. Constructing Loan Portfolios

A detailed explanation of how the first portfolio is created and its re-evaluation at the end of years 1 and 2 is presented in the next subsection.

2.2. The Characteristics of Loan Portfolios: Loan Portfolio #1

The first line of Table B4 presents the characteristics of Loan Portfolio #1 at its inception and as it evolves over the 3-year terms of its constituent loans. At the start of the first year of the business cycle (Y1) 10 borrowers receive L$10,000 loans. The initial credit worthiness of each borrower is determined by a draw from the numbers 1 through 100. For Portfolio #1, the draw was 36. From Table B2 we see that this is associated with a credit worthiness rating of *Very Good*. The total market value of collateral was determined to be *L$11,000* after a draw of 3 from the range 1 to 100 (see Table B1). The job status of each borrower is *Modest* following a draw of 38 from the range 1 to 100 (see Table B3). Finally, because this is the first year of a business cycle, the economic condition judged to be in a *Boom* phase. The characteristics *Very Good*, *L$11,000*, *Modest* and *Boom* have the values of 32, 30, 7 and 20 in the construction of a credit score for each borrower. The total credit score for each individual and the mean credit score that characterizes Portfolio #1 is 89. The corresponding Credit Grade is A-. These values are shown in the first row of Table B5. Finally, Table B6 presents the values that show the relationships between the credit scores and credit grades and the risk premia, interest rates and probabilities of default for the loans in a portfolio by the year of the term of the loan. For Portfolio #1 the risk premia associated with a Credit Grade A- is 4%, the interest rate is 13% and the probability that a borrower will default on a semi-annual interest payment in the first year is 4%.[44]

2.3. Changes in Characteristics of Loan Portfolio #1 Over Time

[44] The difference between the risk premium and the interest rate, given a credit grade, is 9 percentage points. This is equivalent to the risk-free return that would cover the opportunity cost of the loan portfolio.

Table B7 presents the numbers that were drawn randomly from the range 1 to 100 for each of the ten borrowers (Br 1 to Br 10) at the end of June and December of each year in the term of the loans. The probability of default (likelihood of missing payments next year) described for the first year of the term of the loans is shown on the first line of Table B4 as 4%. This appears in the right-most column of Table B7. If a number is drawn for a borrower in June of Y1 that is less than or equal to 4, this will indicate a defaulted interest payment. This happens for borrower 8 in June of Y1. However, in December of Y1 the draw for borrower 5 is 4 and the draw for borrower 10 is 2. Both of these borrowers miss the December interest payment. Because the draw for borrower 8 is greater than 4, this borrower does not miss the December interest payment and we assume that borrower 8 also makes the missed June payment. The missed payments by borrowers 5, 8 and 10 will affect their credit worthiness in Y2.

At the end of Y2 the credit score for each borrower is re-evaluated. The credit worthiness scores of borrowers 5, 8 and 10 fall from *Very Good* to *Good* because of the missed interest payments. The other seven borrowers continue with their *Very Good* credit worthiness scores. Table B4 also shows that there was no change in the market value of collateral, job status or the economic condition for any of the borrowers at the end of Y1. In this case, the value of the credit scores of three borrowers fall from 89 to 85 points and the average credit score for the 10 borrowers falls from 89 to 87.8 ((89×7 + 85×3)/10). This is also shown in the second row of Table B5. Because the credit grade of Portfolio #1 remains at A-, we can find the probability of a default in Y2 will be 8% from Table B6.

We follow the same process for Y2 to find which borrowers miss interest payments. Now the critical value for a default is a draw less than or equal to 8. From Table B7 we find that this occurs once in June (borrower 7) and twice in December (borrowers 3 and 7). Because borrower 7 defaults twice on the interest payments, the bank forecloses on this borrower's loan. At the end of Y2 the market value of everyone's collateral has fallen, but job status and the economic condition are unchanged (see Table B4). The drop in the market value of collateral plus the drop-in borrowers with *Very Good* credit worthiness from 70% to 55% of borrowers still with loans results in a reduction of Portfolio #1's credit grade from A- to B- (see Tables B4 and B5). This results in the probability of default in Y3 increasing from 8% to 23% (see Table B6). Note that because of the foreclosure, there are only 9 loans in the portfolio at the end of year 2.

The process above is repeated for Y3 and at the end of Y3, all of the loans in Portfolio #1 have either been repaid or the bank has foreclosed on them and sold the borrower's collateral to recover any default losses. At this time a new Portfolio is created for the next three years (Y4 through Y6). The components of the credit score for Portfolio #2 are presented in the bottom rows of Tables B4 and B5. The process described for years Y1, Y2 and Y3 are then repeated until eight Loan Portfolios have been created and evaluated. The characteristics of the eight loan portfolios that are generated by the random draws that determine the credit scores for each of the component loans in each of the three years of the term of each loan are presented in Appendix C.

Table B1. Market Value of Collateral

Market Value	Probability Distribution	Random Number	Contribution to Credit Score
11,000	5%	1-5	30
10,800	5%	6-10	28
10,600	10%	11-20	26
10,400	10%	21-30	24
10,200	10%	31-40	22
10,000	**20%**	**41-60**	**20**
9,800	10%	61-70	18
9,600	10%	71-80	16
9,400	10%	81-90	14
9,200	5%	91-95	12
9,000	5%	96-100	10

Table B2. Initial Credit Worthiness

Value	Probability Distribution	Random Number	Contribution to Credit Score
Outstanding	15%	1-15	40
Excellent	20%	16-35	36
Very Good	30%	36-65	32
Good	20%	66-85	28
Fair	15%	86-100	24

Table B3. Salary

Description	Probability Distribution	Random Number	Contribution to Credit Score
High	20%	1-20	10
Modest	40%	21-60	7
Low	40%	61-100	4

Table B4. Components of the Credit Scores for Loan Portfolio #1 Over Its Term and for Loan Portfolio #2 at Its Initiation

Time	Past Credit-Worthiness	Market Value of Collateral for each Loan	Job Status	Econ Condi-tion	Mean Credit Score	Credit (Risk) Grade	Mean Change in Credit Score Since Initiation	Significance of the change in Credit Risk Since Loan Initiation	Likelihood of Missing Payments NEXT Year	Interest Rate; Bonus Rate
Initiation of Portfolio #1	10=VG	11,000	Modest	Boom	89	A-	NA	NA	4%	13%; 20%
Updates at the End of Year 1	7=VG; 3=G	11,000	Modest	Boom	87.8	A-	-1.3%	Normal	8%	13%; 20%
Updates at the End of Year 2	5=VG; 4=G	9,600	Modest	Boom	73.2	B-	-17.7%	Very Large	28%	13%; 20%
Update at the End of Year 3	NA	9,600	NA	NA	NA	NA	NA	NA	NA	NA
Initiation of Portfolio #2	10=VG	11,000	Low	Boom	86	A-	NA	NA	4%	**13%; ?**

Note: Credit Worthiness is characterized as Outstanding (O), Excellent (E), Very Good (VG), Good (G) and Fair (F); Job Status is characterized as Good, Modest and Low; the Economic Condition is characterized as Boom, Mixed and Recession; the significance of the change in credit risk is related to the change in the credit score (Δcs) since initiation; $\Delta cs < 9\%$ is Normal, $9\% \leq \Delta cs < 12\%$ is Large and $\Delta cs \geq 12\%$ is Very Large. For Loan Portfolio #1, the Bonus Rate for manager compensation is 20% of net profit. The Bonus Rate at the initiation of subsequent loan portfolios is determined by the existence of a negative profit during the previous three years.

Table B5. Characteristics of Loan Portfolio #1 and Aggregate Value of the Components of Its Credit Score Over Its 3-Year Term

Time	Number of Borrowers	Total Credit-worthiness	Total Market Value of Collateral	Total Job Status	Total Economic Condition	Average Credit Score	Credit Grade	Change in Credit Score Since Loan Origination
Start of Y1	10	320	300	70	200	89	A-	NA
Start of Y2	10	308	300	70	200	87.8	A-	-1.3%
Start of Y3	9	272	144	63	180	73.2	B-	-17.7%
End of Y3	8	NA	NA	NA	NA	NA	NA	NA

Table B6. Credit Scores, Credit Grades, Probabilities of Default, Risk Premia and Interest Rates

Credit Score Credit Grade	100-96 A+	95-91 A	90-86 A-	85-81 B+	80-76 B	76-71 B-	70-66 C+	65-61 C	60-56 C-
Probability of Default in 1st year	2%	3%	4%	5%	6%	7%	8%	9%	10%
Probability of Default in 2nd year	4%	6%	8%	12%	14%	16%	19%	21%	23%
Probability of Default in 3rd year	7%	12%	16%	23%	26%	28%	34%	36%	38%
Risk Premia	2%	3%	4%	6%	7%	8%	10%	11%	12%
Interest Rate	11%	12%	13%	15%	16%	17%	20%	20%	21%

Table B7. Random Numbers for Loan Portfolio #1

Loan Number & Random Numbers	Br 1	Br 2	Br 3	Br 4	B r 5	Br 6	B r 7	Br 8	Br 9	Br 10	Probability of Default
Yr 1 June	16	30	75	85	16	84	75	2	31	98	4%
Yr 1 Dec	73	68	58	77	4	81	92	58	69	2	4%
June Missed Payment = 1 if # ≤ 4	0	0	0	0	0	0	0	1	0	0	
Dec Missed Payment = 1 if # ≤ 4	0	0	0	0	1	0	0	0	0	1	
Total # missed payments in Yr 1	0	0	0	0	**1**	0	0	**1**	0	**1**	
Yr 2 June	49	85	98	87	9	63	5	61	74	76	8%
Yr 2 Dec	90	10	1	52	76	51	2	68	38	54	8%
June Missed Payment = 1 if # ≤ 8	0	0	0	0	0	0	1	0	0	0	
Dec Missed Payment = 1 if # ≤ 8	0	0	1	0	0	0	1	0	0	0	
Total # missed payments in Yr 2	0	0	**1**	0	0	0	**2**	0	0	0	
Yr 3 June	3	92	76	9	43	98	NA	8	49	30	28%
Yr 3 Dec	35	51	54	42	50	60	NA	16	84	81	28%
June Missed Payment = 1 if # ≤ 28	1	0	0	1	0	0	NA	1	0	0	
Dec Missed Payment = 1 if # ≤ 28	0	0	0	0	0	0	NA	1	0	0	
Total # missed payments in Yr 3	**1**	0	0	**1**	0	0	NA	**2**	0	0	

Notes: Br = Borrower; the total number of missed payments for a borrower during a year is indicated in bold font. If this value is 2, then the borrower's loan is foreclosed.

Table B8. Risk Premia (r), Interest Rates (i), Bank's Discount Rate (d), Discounted Default Probabilities (DDP), Losses Given Default and Discounted Expected Credit Losses

Credit Score	100-96	95-91	90-86	85-81	80-76	75-71	70-66	65-61	60-55
Credit Grade	A+	A	A-	B+	B	B-	C+	C	C-
Risk premia (r)	2%	3%	4%	6%	7%	8%	10%	11%	12%
Interest Rate (i)	11%	12%	13%	15%	16%	17%	19%	20%	21%
Discount Rate (d)	10%	10%	10%	10%	10%	10%	10%	10%	10%
12-month DDP Year 1	1.82%	2.73%	3.64%	4.55%	5.45%	6.36%	7.27%	8.18%	9.09%
12-month DDP Year 2	3.64%	5.45%	7.27%	10.91%	12.73%	14.55%	17.27%	19.09%	20.91%
12-month DDP Year 3	6.36%	10.91%	14.55%	20.91%	23.64%	25.45%	30.91%	32.73%	34.55%
Lifetime DDP Year 1	10.01%	15.76%	20.60%	28.41%	32.12%	35.10%	40.75%	43.42%	45.98%
Lifetime DDP Year 2	9.19%	14.78%	19.44%	27.64%	31.21%	33.98%	40.03%	42.60%	45.09%
Lifetime DDP Year 3	6.36%	10.91%	14.55%	20.91%	23.64%	25.45%	30.91%	32.73%	34.55%
Expected (Historical) Loss Given Default (LGD)	16000	17000	18000	20000	21000	22000	24000	25000	26000
LGD (best case)	0	0	0	0	0	0	0	0	0
LGD (worse case)	25500	26500	27500	29500	30500	31500	33500	34500	35500
12-month Disc ECL Year 1	291	464	655	909	1145	1400	1745	2045	2364
12-month Disc ECL Year 2	582	927	1309	2182	2673	3200	4145	4773	5436
12-month Disc ECL Year 3	1018	1855	2618	4182	4964	5600	7418	8182	8982
Lifetime Disc ECL Year 1	1601	2679	3708	5683	6746	7721	9781	10855	11956
Lifetime Disc ECL Year 2	1470	2512	3499	5527	6553	7476	9608	10649	11724
Lifetime Disc ECL Year 3	1018	1855	2618	4182	4964	5600	7418	8182	8982

Notes: Risk Premium for Credit Grade α = 100×(14000×Lifetime DDP Year 1 for Credit Grade α)/(100000×(1 – Lifetime DDP Year 1 for Credit Grade α)) rounded to nearest whole number (see Appendix A for derivation); DDP = discounted default probability; Disc = discounted; ECL = expected credit loss.

Table B9. Desired Ending Balance of Reserves Held in Simulated ICL, ECL and CECL Baselines

Year	ICL	ECL	CECL
1	0	1309	3499
2	4581	4581	4581
3	0	655	3708
4	0	1964	4975
5	5564	5564	5564
6	0	909	5683
7	0	2546	6242
8	0	4728	4728
9	0	1400	7721
10	0	3799	8807
11	7601	7601	7601
12	0	291	1601
13	0	582	1470
14	0	1746	1746
15	0	909	5683
16	0	2546	6242
17	0	4728	4728
18	0	464	2679
19	0	1236	3305
20	0	3555	3555
21	0	1400	7721
22	0	3799	8807
23	7201	7201	7201
24	0	0	0

Note: Significant probabilities of a loss were anticipated in years Y3, Y6, Y12 and Y24. Accordingly, reserves were transferred from profits only in years Y2, Y5, Y11 and Y23 for the ICL model. Significant probabilities of a loss were realized only for the third years of the loan portfolios #1, #2, #4 and #8. In each simulation the branch's beginning balance of reserves at the start of year 1 was equal to 0 for ICL, 655 for ECL and 3708 for CECL. These are the expected credit losses for year 1 corresponding to each of these scenarios.

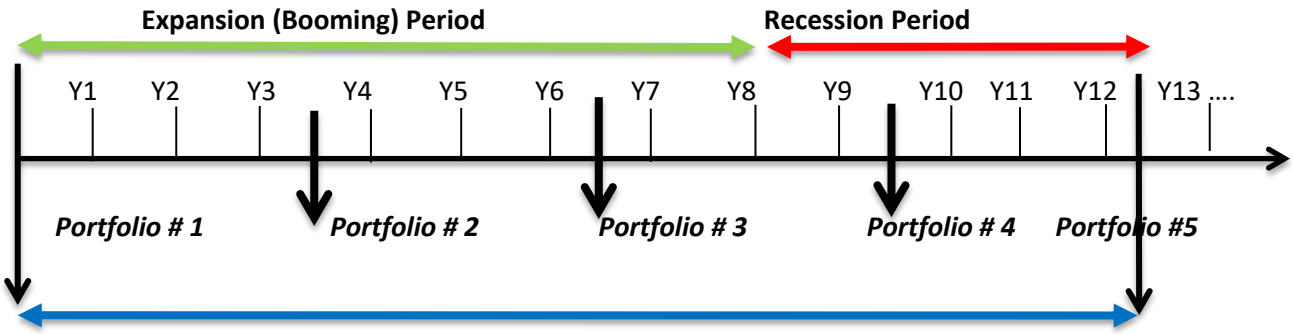


Figure B1. The First Lending Cycle of a Session

APPENDIX C: PARAMETERS FOR EIGHT LOAN PORTFOLIOS

Portfolio 1

Random Numbers for Loan # 1											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
Random Numbers for Year1_Interest 1	16	30	75	85	16	84	76	2	31	98	4%
Random Numbers for Year1_Interest 2	73	68	58	77	4	81	92	58	69	2	4%
Missed payment = 1 if the random number ≤ 4	0	0	0	0	0	0	0	1	0	0	
Missed payment = 1 if the random number ≤ 4	0	0	0	0	1	0	0	0	0	1	
Total # of missed payments in Y1	0	0	0	0	1	0	0	1	0	1	
Random Numbers for Year2_Interest 1	49	85	98	87	9	63	5	61	74	76	8%
Random Numbers for Year2_Interest 2	90	10	1	52	76	51	2	68	38	54	8%
Missed payment = 1 if the random number ≤ 8	0	0	0	0	0	0	1	0	0	0	
Missed payment = 1 the random number ≤ 8	0	0	1	0	0	0	1	0	0	0	
Total # of missed payments in Y2	0	0	1	0	0	0	2	0	0	0	
Random Numbers for Year3_Interest 1	3	92	76	9	43	98	77	8	49	30	28%
Random Numbers for Year3_Interest 2	35	51	54	42	50	60	25	16	84	81	28%
Missed payment = 1 the random number ≤ 28	1	0	0	1	0	0	0	1	0	0	
Missed payment = 1 if the random number ≤ 28	0	0	0	0	0	0	0	1	0	0	
Total # of missed payments in Y3	1	0	0	1	0	0	0	2	0	0	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed ONE Payment	3	1	2
# of Borrowers who missed TWO Payments	0	1	1

Note: All random number draws are from the range 1 to 100

Time	**Number of Borrowers**	**Total Creditworthiness**	**Total Market Value**	**Total Job Status**	**Total Economic Condition**	**Average Credit Score**	**Credit Grade**	***Change in Credit Risk Exposure Since loan Origination***
Start of Y1	**10**	**320**	**300**	**70**	**200**	**89**	**A---**	**NA**
Start of Y2	**10**	**308**	**300**	**70**	**200**	**87.8**	**A---**	**0.013**
Start of Y3	**9**	**272**	**144**	**63**	**180**	**73.2**	**B---**	**0.177**
End of Y3	**8**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

	Components of the Credit Scores for the Portfolio of 10 Loans												
	# of Borrowers Missed ONE payment	**# of Borrowers Missed TWO payments (*Foreclosed*)**	**# of Loans *Remained* in the Portfolio by the End of the Year**	**Past Credit---worthiness**	**Market Value of Collateral for Each Collateral**	**Job Status**	**General Economic Condition**	**Average Credit Score for the Portfolio**	**Risk Grade**	***Change in Credit Risk Exposure Since loan Origination***	**Probability of Missing Payments *NEXT Year* on the *Remaining Loans***	***Significance* of the change in Credit---worthiness Since Loan Origination**	**Interest Rate; Bonus Rate**
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	**10**	**All 10 Brs are VG**	**11,000**	**Modest**	**Booming**	**89**	**A---**	**NA**	**4%**	**NA**	**13%; 20%**
The Updated* Credit Scores at the *END OF Y1	3	0	**10**	**7 VG & 3 G = 10 Brs**	**11,000**	**Modest**	**Booming**	**87.8**	**A---**	**0.013**	**8%**	**Normal**	
The Updated* Credit Scores at the *END OF Y2	1	1	**9**	**5 VG & 4 G = 9 Brs**	**9,600**	**Modest**	**Booming**	**73.2**	**B---**	**0.177**	**28%**	**Very Large**	
Activities of the portfolio during Year Y3	2	1	**8**	**NA**	**9,600**	**NA**	**NA**	**NA**	**NA**	**NA**			

Portfolio 2

Random Numbers for Loan # 2											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
											4%
Random Numbers for Year1 Interest 1	57	52	75	13	3	26	1	40	80	13	
Random Numbers for Year1 Interest 2 Missed											
payment = 1 the random number ≤ 4 Missed	68	29	4	86	25	82	76	61	2	64	
payment = 1 if the random number ≤ 4											
Random Numbers for Year2 Interest 1	15	46	76	4	26	65	77	8	29	61	12%
Random Numbers for Year2 Interest 2	19	49	18	7	17	66	17	1	38	43	
Missed payment = 1 the random number ≤ 12											
Missed payment = 1 the random number ≤ 12	0	0	0	1	0	0	0	1	0	0	
Random Numbers for Year3 Interest 1	3	26	76	9	43	98	77	8	49	23	34%
Random Numbers for Year3 Interest 2	35	11	54	22	50	60	25	16	84	18	
Missed payment = 1 if the random number ≤ 34	1	1	0	1	0	0	0	1	0	1	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed **ONE** Payment	4	0	2

Time	**Number of Borrowers**	**Total Creditworthiness**	**Total Market Value**	**Total Job Status**	**Total Economic Condition**	**Average Credit Score**	**Credit Grade**	***Change in Credit Risk Exposure Since loan Origination***
Start of Y1	**10**	**320**	**300**	40	200	**86**	**A---**	**NA**
Start of Y2	**10**	**304**	**300**	**40**	**200**	**84.4**	**B+**	**0.019**
Start of Y3	**8**	**240**	**112**	**32**	**160**	**68**	**C+**	**0.209**
End of Y3	**6**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

				Components of the Credit Scores for the Portfolio of 10 Loans									
	# of Borrowers Missed ONE payment	**# of Borrowers Missed TWO payments (*Foreclosed*)**	**# of Loans *Remained* in the Portfolio by the End of the Year**	**Past Creditworthiness**	**Market Value of Collateral for Each Collateral**	**Job Status**	**General Economic Condition**	**Average Credit Score for the Portfolio**	**Risk Grade**	***Change in Credit Risk Exposure Since loan Origination***	**Probability of Missing Payments *NEXT Year* on the *Remaining Loans***	***Significance* of the change in Creditworthiness Since Loan Origination**	**Interest Rate; Bonus Rate**
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	**10**	**All 10 Brs are VG**	**11,000**	**Low**	**Booming**	**86**	**A---**	**NA**	**4%**	**NA**	**13%; ?**
The Updated* Credit Scores at the *END OF Y4	4	0	**10**	**6 VG and 4 G = 10Brs**	**11,000**	**Low**	**Booming**	**84.4**	**B+**	**0.019**	**12%**	**Normal**	
The Updated* Credit Scores at the *END OF Y5	1	2	**8**	**4 VG and 4 G = 8 BRs**	**9,400**	**Low**	**Booming**	**68.0**	**C+**	**0.209**	**34%**	**Very Large**	
Activities of the portfolio during Year Y6	2	2	**6**	**NA**	**9,000**	**NA**	**NA**	**NA**	**NA**	**NA**			

Portfolio 3

Random Numbers for Loan # 3											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
Random Numbers for Year1_Interest 1	15	7	75	14	52	97	76	26	68	9	5%
Random Numbers for Year1_Interest 2	31	97	41	45	3	4	84	39	28	72	5%
Missed payment = 1 the random number ≤ 5	0	0	0	0	0	0	0	0	0	0	
Missed payment = 1 if the random number ≤ 5	0	0	0	0	1	1	0	0	0	0	
Total # of missed payments in Y1	0	0	0	0	1	1	0	0	0	0	
Random Numbers for Year2_Interest 1	16	98	75	3	88	56	76	56	29	5	14%
Random Numbers for Year2_Interest 2	47	30	3	29	18	53	80	98	29	16	14%
Missed payment = 1 if the random number ≤ 14	0	0	0	1	0	0	0	0	0	1	
Missed payment = 1 if the random number ≤ 14	0	0	1	0	0	0	0	0	0	0	
Total # of missed payments in Y2	0	0	1	1	0	0	0	0	0	1	
Random Numbers for Year3_Interest 1	52	33	43	22	42	15	52	27	19	84	26%
Random Numbers for Year3_Interest 2	7	62	7	10	32	6	29	84	4	89	26%
Missed payment = 1 if the random number ≤ 26	0	0	0	1	0	1	0	0	1	0	
Missed payment = 1 if the random number ≤ 26	1	0	1	1	0	1	0	0	1	0	
Total # of missed payments in Y3	1	0	1	2	0	2	0	0	2	0	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed **ONE** Payment	2	3	2
# of Borrowers who missed **TWO** Payments	0	0	3

Time	**Number of Borrowers**	**Total Creditworthiness**	**Total Market Value**	**Total Job Status**	**Total Economic Condition**	**Average Credit Score**	**Credit Grade**	***Change in Credit Risk Exposure Since loan Origination***
Start of Y1	**10**	**360**	**240**	**100**	**150**	**85**	**B+**	**NA**
Start of Y2	**10**	**360**	**200**	**100**	**150**	**81**	**B**	**0.047**
Start of Y3	**10**	**348**	**200**	**100**	**150**	**79.8**	**B**	**0.06**
End of Y3	**7**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

	Components of the Credit Scores for the Portfolio of 10 Loans												
	# of Borrowers Missed ONE payment	**# of Borrowers Missed TWO payments (*Foreclosed*)**	**# of Loans *Remained* in the Portfolio by the End of the Year**	**Past Creditworthiness**	**Market Value of Collateral for Each Collateral**	**Job Status**	**General Economic Condition**	**Average Credit Score for the Portfolio**	**Risk Grade**	***Change in Credit Risk Exposure Since loan Origination***	**Probability of Missing Payments *NEXT Year* on the *Remaining Loans***	***Significance* of the change in Creditworthiness Since Loan Origination**	**Interest Rate: Bonus Rate**
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	**10**	**All 10 Brs are EX**	**10,400**	**High**	**Mixed**	**85**	**B+**	**NA**	**5%**	**NA**	**15%; ?**
The Updated* Credit Scores at the *END OF Y7	2	0	**10**	**8 EX and 2 VG = 10 Brs**	**10,000**	**High**	**Mixed**	**81**	**B**	**0.047**	**14%**	**Normal**	
The Updated* Credit Scores at the *END OF Y8	3	0	**10**	**5 EX and 5 VG = 10 Brs**	**10,000**	**High**	**Mixed**	**79.8**	**B**	**0.061**	**26%**	**Normal**	
Activities of the portfolio during Year Y9	2	3	**7**	**NA**	**9,200**	**NA**	**NA**	**NA**	**NA**	**NA**			

Portfolio 4

Random Numbers for Loan # 4											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
											7%
Random Numbers for Year1 Interest 1	72	3	75	15	56	44	76	4	96	85	
Random Numbers for Year1 Interest 2 Missed											
payment = 1 if the random number ≤ 7 Missed	56	12	41	1	94	9	59	98	20	94	
payment = 1 if the random number ≤ 7											
Random Numbers for Year2 Interest 1	40	12	98	6	47	37	66	47	10	41	19%
Random Numbers for Year2 Interest 2	67	5	7	7	70	7	78	49	21	83	
Missed payment = 1 if the random number < 19	0	1	0	1	0	0	0	0	1	0	
Random Numbers for Year3 Interest 1	30	42	76	6	54	21	27	100	9	47	38%
Random Numbers for Year3 Interest 2	14	58	62	46	96	17	26	60	3	16	
Missed payment = 1 if the random number ≤ 38	1	0	0	1	0	1	1	0	1	0	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed **ONE** Payment	3	3	1

Time	**Number of Borrowers**	**Total Creditworthiness**	**Total Market Value**	**Total Job Status**	**Total Economic Condition**	**Average Credit Score**	**Credit Grade**	***Change in Credit Risk Exposure Since loan Origination***
Start of Y1	**10**	**280**	**240**	**100**	**100**	**72**	**B---**	**NA**
Start of Y2	**10**	**268**	**200**	**100**	**100**	**66.8**	**C+**	**0.072**
Start of Y3	**8**	**208**	**96**	**80**	**80**	**58**	**C---**	**0.194**
End of Y3	**4**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

				Components of the Credit Scores for the Portfolio of 10 Loans									
	# of Borrowers Missed ONE payment	**# of Borrowers Missed TWO payments (*Foreclosed*)**	**# of Loans *Remained* in the Portfolio by the End of the Year**	**Past Creditworthiness**	**Market Value of Collateral for Each Collateral**	**Job Status**	**General Economic Condition**	**Average Credit Score for the Portfolio**	**Risk Grade**	***Change in Credit Risk Exposure Since loan Origination***	**Probability of Missing Payments *NEXT Year* on the *Remaining Loans***	***Significance* of the change in Creditworthiness Since Loan Origination**	**Interest Rate: Bonus Rate**
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	**10**	**All 10 Brs are Good**	**10,400**	**High**	**Recession**	**72**	**B---**	**NA**	**7%**	**NA**	**17%**
The Updated* Credit Scores at the *END OF Y10	3	0	**10**	**7 G and 3 F= 10 Brs**	**10,000**	**High**	**Recession**	**66.8**	**C+**	**0.072**	**19%**	**Normal**	
The Updated* Credit Scores at the *END OF Y11	3	2	**8**	**4 G and 4 F = 8 Brs**	**9,200**	**High**	**Recession**	**58.0**	**C---**	**0.194**	**38%**	**Very Large**	
Activities of the portfolio during Year Y12	1	4	**4**	**NA**	**9,000**	**NA**	**NA**	**NA**	**NA**	**NA**			

Portfolio 5

Random Numbers for Loan # 5											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
Random Numbers for Year1_Interest 1	43	61	75	64	40	21	76	62	72	19	2%
Random Numbers for Year1_Interest 2	43	75	72	2	32	34	34	31	43	64	2%
Missed payment = 1 if the random number ≤ 2	0	0	0	0	0	0	0	0	0	0	
Missed payment = 1 if the random number ≤ 2	0	0	0	1	0	0	0	0	0	0	
Total # of missed payments in Y1	0	0	0	1	0	0	0	0	0	0	
Random Numbers for Year2_Interest 1	32	39	76	10	1	46	77	12	77	22	4%
Random Numbers for Year2_Interest 2	23	49	55	17	17	4	99	12	60	90	4%
Missed payment = 1 if the random number ≤ 4	0	0	0	0	1	0	0	0	0	0	
Missed payment = 1 if the random number ≤ 4	0	0	0	0	0	1	0	0	0	0	
Total # of missed payments in Y2	0	0	0	0	1	1	0	0	0	0	
Random Numbers for Year3_Interest 1	1	48	75	52	8	91	76	5	36	55	12%
Random Numbers for Year3_Interest 2	23	87	48	58	96	89	39	2	20	92	12%
Missed payment = 1 if the random number ≤ 12	1	0	0	0	1	0	0	1	0	0	
Missed payment = 1 if the random number ≤ 12	0	0	0	0	0	0	0	1	0	0	
Total # of missed payments in Y3	1	0	0	0	1	0	0	2	0	0	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed **ONE** Payment	1	2	2
# of Borrowers who missed **TWO** Payments	0	0	1

Time	**Number of Borrowers**	**Total Creditworthiness**	**Total Market Value**	**Total Job Status**	**Total Economic Condition**	**Average Credit Score**	**Credit Grade**	***Change in Credit Risk Exposure Since loan Origination***
Start of Y1	**10**	**400**	**260**	**100**	**200**	**96**	**A+**	**NA**
Start of Y2	10	**400**	**260**	**100**	**200**	**96**	**A+**	**0.000**
Start of Y3	**10**	**392**	**220**	**100**	**200**	**91.2**	**A**	**0.050**
End of Y3	**9**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

				Components of the Credit Scores for the Portfolio of 10 Loans									
	# of Borrowers Missed ONE payment	**# of Borrowers Missed TWO payments (*Foreclosed*)**	**# of Loans *Remained* in the Portfolio by the End of the Year**	**Past Creditworthiness**	**Market Value of Collateral for Each Collateral**	**Job Status**	**General Economic Condition**	**Average Credit Score for the Portfolio**	**Risk Grade**	***Change in Credit Risk Exposure Since loan Origination***	**Probability of Missing Payments *NEXT Year* on the *Remaining Loans***	***Significance* of the change in Creditworthiness Since Loan Origination**	**Interest Rate: Bonus Rate**
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	**10**	**All 10 Brs are Out**	**10,600**	**High**	**Booming**	**96**	**A+**	**NA**	**2%**	**NA**	**11%; ?**
The Updated* Credit Scores at the *END OF Y13	1	0	**10**	**10 Out**	**10,600**	**High**	**Booming**	**96**	**A+**	**0.000**	**4%**	**Normal**	
The Updated* Credit Scores at the *END OF Y14	2	0	**10**	**8 Out and 2 EX = 10 Brs**	**10,200**	**High**	**Booming**	**91.2**	**A**	**0.050**	**12%**	**Normal**	
Activities of the loan during the Year	2	1	**9**	**NA**	**10,000**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**		

Portfolio 6

Random Numbers for Loan # 6											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
											5%
Random Numbers for Year1 Interest 1	24	45	76	8	29	27	77	82	16	98	
Random Numbers for Year1 Interest 2 Missed											
payment = 1 if the random number ≤ 5 Missed	41	65	33	53	78	19	34	36	69	2	
payment = 1 if the random number ≤ 5											
Random Numbers for Year2 Interest 1	5	47	80	81	57	1	43	5	62	76	14%
Random Numbers for Year2 Interest 2	77	16	76	21	27	9	77	7	98	54	
Missed payment = 1 if the random number < 14	1	0	0	0	0	1	0	1	0	0	
Random Numbers for Year3 Interest 1	12	52	56	44	33	10	18	11	45	30	26%
Random Numbers for Year3 Interest 2	95	89	38	79	51	23	9	15	12	16	
Missed payment = 1 if the random number ≤ 26	1	0	0	0	0	1	1	1	0	0	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed **ONE** Payment	1	1	3

Time	**Number of Borrowers**	**Total Creditworthiness**	**Total Market Value**	**Total Job Status**	**Total Economic Condition**	**Average Credit Score**	**Credit Grade**	***Change in Credit Risk Exposure Since loan Origination***
Start of Y1	**10**	**320**	**260**	**70**	**200**	**85**	**B+**	**NA**
Start of Y2	10	**316**	**220**	**70**	**200**	**80.6**	**B**	**0.052**
Start of Y3	**8**	**248**	**160**	**56**	**160**	**78**	**B**	**0.082**
End of Y3	**7**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

				Components of the Credit Scores for the Portfolio of 10 Loans									
	# of Borrowers Missed ONE payment	**# of Borrowers Missed TWO payments (*Foreclosed*)**	**# of Loans *Remained* in the Portfolio by the End of the Year**	**Past Creditworthiness**	**Market Value of Collateral for Each Collateral**	**Job Status**	**General Economic Condition**	**Average Credit Score for the Portfolio**	**Risk Grade**	***Change in Credit Risk Exposure Since loan Origination***	**Probability of Missing Payments *NEXT Year* on the *Remaining Loans***	***Significance* of the change in Creditworthiness Since Loan Origination**	**Interest Rate; Bonus Rate**
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	**10**	**All 10 Brs are Very Good**	**10,600**	**Modest**	**Booming**	**85**	**B+**	**NA**	**5%**	**NA**	**15%; ?**
The Updated Credit Scores at the END OF Y16	1	0	**10**	**9 VG and 1 G = 10 Brs**	**10,200**	**Modest**	**Booming**	**80.6**	**B**	**0.052**	**14%**	**Normal**	
The Updated Credit Scores at the END OF Y17	1	2	**8**	**6 VG and 2 G = 8 Brs**	**10,000**	**Modest**	**Booming**	**78.0**	**B**	**0.082**	**26%**	**Normal**	
Activities of the loan during the Year	3	1	**7**	**NA**	**10,000**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**		

Portfolio 7

Random Numbers for Loan # 7											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
Random Numbers for Year1_Interest 1	80	73	75	56	44	29	76	63	73	94	3%
Random Numbers for Year1_Interest 2	85	64	40	84	35	17	9	14	30	88	3%
Missed payment = 1 if the random number ≤ 3	0	0	0	0	0	0	0	0	0	0	
Missed payment = 1 if the random number < 3	0	0	0	0	0	0	0	0	0	0	
Total # of missed payments in Y1	0	0	0	0	0	0	0	0	0	0	
Random Numbers for Year2_Interest 1	5	21	75	31	42	69	76	54	2	70	8%
Random Numbers for Year2_Interest 2	49	16	18	40	69	85	42	75	6	86	8%
Missed payment = 1 if the random number ≤ 8	1	0	0	0	0	0	0	0	1	0	
Missed payment = 1 if the random number < 8	0	0	0	0	0	0	0	0	1	0	
Total # of missed payments in Y2	1	0	0	0	0	0	0	0	2	0	
Random Numbers for Year3_Interest 1	31	13	52	27	21	63	7	46	5	46	23%
Random Numbers for Year3_Interest 2	82	11	5	3	86	82	42	99	71	99	23%
Missed payment = 1 if the random number ≤ 23	0	1	0	0	1	0	1	0	1	0	
Missed payment = 1 if the random number < 23	0	1	1	1	0	0	0	0	0	0	
Total # of missed payments in Y3	0	2	1	1	1	0	1	0	1	0	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed **ONE** Payment	0	1	3
# of Borrowers who missed **TWO** Payments	0	1	1

Time	Number of Borrowers	Total Creditworthiness	Total Market Value	Total Job Status	Total Economic Condition	Average Credit Score	Credit Grade	*Change in Credit Risk Exposure Since loan Origination*
Start of Y1	10	360	300	100	150	91	A	NA
Start of Y2	10	360	260	100	150	87	A---	0.044
Start of Y3	9	320	180	90	135	80.5555556	B+	0.115
End of Y3	8	NA	NA	NA	NA	NA	NA	NA

				Components of the Credit Scores for the Portfolio of 10 Loans									
	# of Borrowers Missed ONE payment	# of Borrowers Missed TWO payments (*Foreclosed*)	# of Loans *Remained* in the Portfolio by the End of the Year	Past Creditworthiness	Market Value of Collateral for Each Collateral	Job Status	General Economic Condition	Average Credit Score for the Portfolio	Risk Grade	*Change in Credit Risk Exposure Since loan Origination*	Probability of Missing Payments *NEXT Year* on the *Remaining Loans*	*Significance* of the change in Creditworthiness Since Loan Origination	Interest Rate; Bonus Rate
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	10	All 10 Brs are Excellent	11,000	High	Mixed	91	A	NA	3%	NA	12%; ?
The Updated* Credit Scores at the *END OF Y19	0	0	10	10 Ex	10,600	High	Mixed	87	A---	0.044	8%	Normal	
The Updated* Credit Scores at the *END OF Y20	1	1	9	8 Ex and 1 VG = 9 Brs	10,000	High	Mixed	80.5555556	B+	0.115	23%	Large	
Activities of the loan during the Year	3	1	8	NA	9400	NA	NA	NA	NA	NA			

Portfolio 8

Random Numbers for Loan # 8											PD
Loan # & Borrower's Information	**Br1**	**Br2**	**Br3**	**Br4**	**Br5**	**Br6**	**Br7**	**Br8**	**Br9**	**Br10**	
											7%
Random Numbers for Year1 Interest 1	65	16	8	98	92	55	64	59	82	20	
Random Numbers for Year1 Interest 2 Missed											
payment = 1 if the random number ≤ 7 Missed	73	68	58	77	4	81	92	58	69	2	
payment = 1 if the random number ≤ 7											
Random Numbers for Year2 Interest 1	31	23	52	8	21	63	7	46	5	46	19%
Random Numbers for Year2 Interest 2	82	11	5	3	86	82	10	99	71	99	
Missed payment = 1 if the random number < 19	0	0	0	1	0	0	1	0	1	0	
Random Numbers for Year3 Interest 1	3	92	76	9	43	98	77	8	49	23	36%
Random Numbers for Year3 Interest 2	22	3	54	80	74	1	43	20	43	27	
Missed payment = 1 if the random number ≤ 36	1	0	0	1	0	0	0	1	0	1	

Summary of Interest Payments	**Year 1**	**Year 2**	**Year 3**
# of Borrowers who missed **ONE** Payment	2	3	2

Time	**Number of Borrowers**	**Total Creditworthiness**	**Total Market Value**	**Total Job Status**	**Total Economic Condition**	**Average Credit Score**	**Credit Grade**	***Change in Credit Risk Exposure Since loan Origination***
Start of Y1	**10**	**320**	**220**	**70**	**100**	**71**	**B--**	**NA**
Start of Y2	10	**312**	**200**	**70**	**100**	**68.2**	**C+**	**0.039**
Start of Y3	**8**	**236**	**128**	**56**	**80**	**62.5**	**C**	**0.120**
End of Y3	**5**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

				Components of the Credit Scores for the Portfolio of 10 Loans									
	# of Borrowers Missed ONE payment	**# of Borrowers Missed TWO payments (*Foreclosed*)**	**# of Loans *Remained* in the Portfolio by the End of the Year**	**Past Creditworthiness**	**Market Value of Collateral for Each Collateral**	**Job Status**	**General Economic Condition**	**Average Credit Score for the Portfolio**	**Risk Grade**	***Change in Credit Risk Exposure Since loan Origination***	**Probability of Missing Payments *NEXT Year* on the *Remaining Loans***	***Significance* of the change in Credit Score Since Loan Origination**	**Interest Rate; Bonus Rate**
***Original* Credit Risk Assessment at the *START* of the Portfolio**	NA	NA	**10**	**All 10 Brs are Very Good**	**10,200**	**odest Salar**	**Recession**	**71**	**B--**	**NA**	**7%**	**NA**	**17%; ?**
The Updated Credit Scores at the END OF Y22	2	0	**10**	**8 VG and 2 G = 10 Brs**	**10,000**	**odest Salar**	**Recession**	**68.2**	**C+**	**0.039**	**19%**	**Large**	
The Updated Credit Scores at the END OF Y23	3	2	**8**	**3 VG and 5 G = 8 Brs**	**9,600**	**odest Salar**	**Recession**	**62.5**	**C**	**0.120**	**36%**	**Very Large**	
Activities of the loan during the Year	2	3	**5**	**NA**	**9200**	**NA**	**NA**	**NA**	**NA**	**NA**			

Appendix D

Experimental Instructions and a sample of an actual portfolio.

Day 1

1. General Experiment Instructions
2. Illustrative Example 1
3. Practice Portfolio

Day 2

1. Brief General Experiment Instructions
2. Screenshots for the first experimental portfolio

Experiment Instructions – Day 1

GENERAL INSTRUCTIONS

You will participate in **two** separate sessions of an experiment in decision making. The first session is conducted today and the second session will be conducted in a few days on a day and at time of your choice, which will be determined at the end of today's session.

During the course of the two sessions, you will be presented with several INDPENDENT and different settings (situations), where each setting requires you to make simple decisions. Each session consists of several **independent** settings/situations, where each session will last approximately 120 minutes.

None of the decisions you will make require any specialized background knowledge. Also, there are no right or wrong responses. As researchers, we will learn from your decisions and the decisions of others who confront similar settings. The decisions you make will determine your earnings. These earnings will be paid to you in cash at the end of each session.

The currency used in this experiment is a **Laboratory Dollar (L$).** Your total earnings in L$s will be converted to Canadian Dollars (**C$**) and will be paid to you in cash. The conversion rate will differ in different settings. We will provide you with clear information about the conversion rate at the beginning of each setting and how many Canadian Dollars you earned at the end of each session. Please note that at the end of today's session you will receive **all but C$10** of today's earnings. The withheld C$10 will be paid to you at the end of the second session (together with all of your earnings from the second session).

Please note the following:

- All responses will be held in strict confidence. No individual responses will be reported in our research results.
- Each participant will read through these instructions individually and complete the different parts of the session privately. Some individuals will complete the session before others. If you finish before other, please leave your seat quietly and meet with one of the researchers to receive your earnings.

If you have any questions during the course of the session, please raise your hand; one of the researchers will come to you and address your questions in private.

Click here to Proceed

INFORMED CONSENT

Risks and discomforts:
We are not aware of any personal risk or discomfort from participating in this study, and there are no known risks (physical or otherwise) beyond those normally encountered in daily life.

Your rights:
Participation in this study is voluntary. You should decide on your own whether or not you want to be in this study. If you do decide to be in the study, you have the right to withdraw from the experiment at any time.

Review Board approval:
The Institutional Review Board at McMaster University has cleared this study on April 25, 2015. If you have questions about this, please contact McMaster University's IRB at ethicsoffice@mcmaster.ca.

PLEASE READ THE FOLLOWING STATEMENT, FILL OUT YOUR FIRST and LAST NAME and indicate whether or not you agree to participate in this Study.

I have had the chance to ask any questions that I have about this study and the questions have been answered. I have read the General Instructions presented above and the information in this consent form and I agree to be in the study.

Please note that if you decide to decline, we will pay you $5.00 as show up fee. If you decide to participate, we will pay you your total earnings for the two sessions as described earlier.

First Name:
Last Name:
Participant ID:

I Agree to Participate in this Study

SETTING 1.5

Instructions to the Loan Management Experiment

In this setting, as well as in Setting 2.2 in day 2 of the experiment), you will play the role of a ***loan manager*** for one of the many branches of a hypothetical bank called the "North Atlantic Bank" (NAB). The following instructions describe your role and the basic business environment.

It is important that you understand these instructions very well, as they will constitute the basis for the decisions that you will make in the next session (i.e., in day 2 of the experiment).

Because the decisions you will make at the end of this session are for training purposes and because you will have the opportunity to "redo" decisions that you make during this training portion, we will pay you for the time that you spend reading the instructions and making these "practice decisions" at a rate of C$25.00 per hour.

The computer will keep track of the time you spend reading the instructions and calculate your payoff for this portion of today's session. This amount will be added to your total earnings in the experiment thus far.

Click here to Proceed

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THE BASIC BUSINESS ENVIRONMENT

The North Atlantic Bank (NAB) is a hypothetical bank whose main activity is to make personal loans to local residents through its many branches in the northeast region of the country. You will take the role of a ***Loan Manager*** for one of the NAB's local branches. When you return to the lab to participate in a full session of the Loan Management Experiment, you will participate in many periods (years) in which you will make simple **loan** related decisions at the end of each year. The decisions that you make will affect **the annual *reported net profit* of your local branch** as well as **your annual *monetary compensation***. We will explain the decision you will make later in these instructions.

For simplicity, we assume that all of the loans managed by your branch are for L$10,000 and are payable in full at the end of a 3-year loan term. The interest rate that the NAB charges to each borrower will differ, depending on the borrower's creditworthiness as measured by the borrower's **credit score**.

The credit score reflects the likelihood that the borrower will default on the contractual obligations associated with the loan. These include making periodic interest payments and repaying the principal of the loan on their due dates. The credit score for each borrower is determined by the Risk Analysis Division at the head office of the NAB at the initiation of a new loan (this will be explained in more detail on the next page). Based on the credit score, the NAB determines the interest rate to charge a borrower. This rate will remain ***fixed*** for the duration of the loan even if the borrower's credit-score changes during the term of the loan. The interest rate is payable twice per year (on June 30th and December 30th).

As a manager for one of the local NAB branches, the NAB will allocate a ***"Loan Portfolio***" to you at the start of year 1 (Y1) that contains ten 3-year L$10,000 loans. All the ten borrowers have the same credit score at the start of Y1. At the end of Y3, when each loan has to be repaid in full to the NAB, you will receive another portfolio with ten new L$10,000 loans. The credit scores of the loans in the new portfolio may be different from those in the other portfolios. This process continues every three years during the session. **We will inform you one year in advance of the end of the session.**

Because the 10 borrowers have the same risk characteristics at the origination of the loans, the borrowers' ***credit scores*** will be identical, and each of the borrowers will pay the same ***interest rate.*** However, at the end of each of year, the risk characteristics of all borrowers are re-evaluated. The ***credit scores*** of the borrowers may change due to several factors that will be explained shortly. The ***interest rate***, however, is determined at the initiation of the loan by the NAB and will **remain fixed** during the 3-year term of the loan.

Click here to Proceed

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How the Borrowers' Credit Scores are Determined

Before approving a new loan (as well as at the end of each year of the loan term), the ***Credit Risk Division*** at the NAB conducts a thorough investigation to measure the ***credit scores*** for the prospective borrowers and the existing borrowers.

A **credit score** is a numerical value that reflects the likelihood that a borrower will be able to meet the contractual obligations of making the interest payments and principal repayments on their due dates. The credit score can take a value ranging from 48 to 100 points. The credit score for an individual is determined by the assessment of the following four input risk factors.

1) The borrower's **past creditworthiness**.
2) The market value of the borrower's **collateral**.
3) The borrower's **employment status**.
4) The general **macroeconomic outlook**.

The minimum acceptable credit score for a new borrower is 56 points. In general, a high credit score implies a low-risk borrower who should pay a lower interest rate than high-risk borrowers.

The credit scores assigned to new borrowers and the associated ***risk grades*** and interest rates paid by new borrowers are presented in Table 3.

Table 3
Credit-Score Categories
and Corresponding Risk Grades & Interest Rates

Credit Score	100-96	95-91	90-86	85-81	80-76	75-71	70-66	65-61	60-56
Risk Grade	A+	A	A-	B+	B	B-	C+	C	C-
Interest Rate	11%	12%	13%	15%	16%	17%	19%	20%	21%

If a loan applicant named JJ is assigned a credit score of 79 points, JJ's loan has a credit grade of **B** and JJ will pay interest at a fixed rate of 16% per year. The NAB will group JJ with 9 other borrowers whose credit scores are also 79 to form a loan portfolio. This portfolio will be assigned to a manager of one of the local branches. The annual interest revenues that the branch will receive from this portfolio should be L$16,000 (L$10,000 x 10 borrowers x 16%), payable in two equal installments (L$8,000 in June 30 and L$8,000 in December 30).
Please note that you should **not worry** about how the credit score is determined or how the interest rate is assigned to a risk grade. This is the responsibility of the head office of the NAB, which will provide you with detailed information about your loan portfolio at the initiation of a new loan portfolio as well as with the changes in this information prior to the start of each new decision period.

Click here to Proceed

Overview of the Branch-Related Events

A. Interest Revenues

The interest received from the borrowers is the *primary* source of revenues for the local branches. The interest rate charged to the borrowers in each portfolio is determined at the initiation of the loans by the NAB for each new portfolio as presented in Table 3 above.

B. Default Losses

When the NAB lends money to borrowers, it expects to collect all the contractual obligations of interest revenues and the principal loan on their due dates. Your branch, however, may encounter some borrowers who fail to pay back some or all their loan obligations. The amount of losses resulting from this failure is referred to as a "Default Loss". Default losses consist of two types of losses directly related to the loans: (a) Penalties the branch must pay on missed interest payments (L$50 for each missed payment) and (b) Deficits on Foreclosures.

The likelihood (probability) that a default loss occurs depends upon the credit score of the borrower. The lower the credit score, the greater is the probability that a borrower may default on an obligation on the due dates. The NAB will provide you with the probability that a default loss will occur in any particular year prior to the start of a decision period.

C. Operating Expenses

For simplicity, each year the local branches operating expenses will be fixed at L$9,100. L$100 is the fixed component of the Branch Manager's compensation and L$9,000 covers other operating expenses.

D. Net Profit and the Distribution of Net Profit

Interest revenues (A) minus the sum of operating expenses (C) and default losses (B) determine the **Net Profit or Loss (P)** for the year (i.e., P = A – (B + C)). Net Earnings returned to the NAB are equal to 80% of Net Profit or Loss. 20% of Net Profit or Loss is a compensation bonus received by the local branch manager.

The value for the above four sections (A, B, C & D) will be recorded in the "Annual Performance Report". The following is a sample template for the branch's "Annual Performance Report".

Important Note:
The following report will be generated every year for you by the computer. Upon clicking on any field, the computer will automatically calculate the value for you. However, for the purpose of making decisions when you return for the next session, you need to understand what determines the values in the Annual Performance Report for each branch.

Click here to Proceed

Annual Performance Report

Participant ID 1111111

Section A: Interest Revenue			
A1. June 30th Interest Revenue			
A2. December 30th Interest Revenue			
A3. **Total Interest Revenue** (A1 + A2)			L$100,000 x Interest Rate / 2 * *The interest rate will be provided to you at start of each new loan portfolio, which remains fixed during the 3-year loan term.*
Section B: Reserve Fund Account			
B1. Penalty for missed payments			
B2. Surplus/Deficit on Foreclosure			
B3. **Amount to Charge Against Revenue** (B1 + B2)			**# of missed payments * x L$50** * *This information will be supplied to you at the end of each year by the NAB. Note that this entry is negative.*
Section C: Operating Expenses			
C1. Annual Operating Expenses	-9000		This amount is the **same** throughout the experiment.
C2. Manager's Fixed Salary	-100		
C3. **Total Expenses** (C1 + C2)		-9100	
Section D: Distribution of Net Profit			
D1. Net Profit (Loss) (A3 + B3 + C3)			
D2. Manager's share (D1 * Bonus Rate)			
D3. **NAB Net Earnings** (D1 - D2)			

Please note the following:

- The values in Section "A" will vary from period to period depending upon the number of active borrowers remaining in the portfolio.
- The values in Section "B" may vary from period to period, depending on whether borrowers meet their interest payment obligations and principal repayments.

Click here to Proceed

Terms & Conditions of Loans

Borrowers are allowed to ***miss one*** interest payment. If they make the next payment on its scheduled due date, we assume that they also pay back the missed payment at this time.

Interest is reported as revenue earned regardless of whether the borrower did or did not make an interest payment on the due date.

If the borrower does not make a payment, the NAB will charge the branch L$50 for each missed payment. For example, if 3 borrowers missed one payment in Year 1, then the late payment charges to the branch are L$150 (3 x L$50).

If a borrower ***misses two*** consecutive payments, the loan is **foreclosed** and the borrower's collateral is sold and the proceeds from this sale are used to pay back the principal plus the two unpaid interest payments. The foreclosure fees are 5% of the value of collateral that is received upon its sale. This will be automatically deducted from the sales value.

The net cash from selling the collateral (after subtracting the 5% foreclosure fee) will be used to recover the borrower's ***total obligations*** (i.e., L$10,000 ***plus*** the two missed interest payments). Two possible cases may occur:

Case 1: The net cash from foreclosure may be ***less than*** the total Obligations; in this case, there is a "deficit" which will be charged to the local branch as a "***Loss from Foreclosure***".

Case 2: The net cash from foreclosure may ***exceed*** the total Obligations; in this case there is a "surplus" which will be paid to the borrower by the NAB.

Example:

Assume that you are managing a portfolio of grade A. Each borrower pays a 12% interest rate.

Case 1:

Assume in year 1, a borrower named JJ misses the June interest payment and pays it with the December payment. In this case, the NAB will charge your branch a penalty for one late payment (L$50).

Case 2:

Assume that in year 2 JJ misses the June and December interest payments. In this case, the NAB will charge your branch a penalty for two late payment (L$100). In addition, the NAB will foreclose JJ's loan and sell JJ's collateral. NAB will use the net proceeds to recover the loan principal of L$10,000 plus the two unpaid interest payments of L$1,200 (10,000 x 12%). Assume that the net proceeds from selling the collateral (after deducting the foreclosure fees) are L$9,500. Then the net deficit (i.e., loss) to be charged to your branch would be L$1,700, calculated as follows:

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	L$9,500
Minus: Loan Principal	10,000
Minus: Two Unpaid Interest	1,200
Surplus or Loss on Foreclosure	**-1,700**

Case 3:

Assume that everything is as in Case 2, except the net proceeds from selling the collateral were L$12,000. In this case, the result would be a surplus of L$800, which will be refunded to JJ by the NAB.

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	L$12,000
Minus: Loan Principal	10,000
Minus: Two Unpaid Interest	1,200
Surplus or Loss on Foreclosure	**800**

Click here to Proceed

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Your Annual Compensation Package

The goal of the senior management at the NAB is to maximize profits of their shareholders. The goal of individual branch managers is to maximize their paycheques. One way in which management can try to align these goals would be to compensate the branch managers by providing them a share of the annual reported profits & losses. Consequently, your annual compensation scheme will be calculated as follows:

1. You will receive a fixed annual salary of L$100 regardless of whether your branch reports a profit or a loss in any given year.

2. A performance compensation bonus equal to 20% of the reported ***profit*** or ***loss*** in a given year is added to (or subtracted from) your total compensation in that year. If your branch reports a net loss in a given year, your share of the net loss will result in a negative compensation bonus. Over the 3-year term of a portfolio you can never receive a total compensation bonus less than zero. In other words, the **minimum** total compensation (salary plus bonuses) that you will receive from a portfolio is your fixed salary of L$300.

3. If your branch shows a net loss in any year during the term of a portfolio, then your performance compensation bonus for the next portfolio will drop from 20% to 10%. If the next portfolio shows a Net Profit in all years, your performance compensation bonus will return to 20% of Net Profit for the next portfolio; otherwise it will continue to be 10% until you report profit in all three years of a portfolio.

Click here to Proceed

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Illustrative Example 1:

At the beginning of Y1, the NAB provides you with a L$100,000 portfolio of ten L$10,000 three-year loans. One loan is given to each of 10 different borrowers. Each borrower has the same credit score of 75 points and will pay interest at the annual rate of 17%. The credit score of 75 points is determined by the **Credit Risk Division** based on a thorough investigation and assessment of

1) the borrower's past creditworthiness,
2) the market value of the borrower's collateral,
3) the borrower's employment status, and
4) the general macroeconomic outlook.

The above information is supplied to you in the following table of your branch's annual activities report.

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%

* Note that for every portfolio, given its risk grade, the ***probability of default*** will increase over the durations of the loans in the portfolio. This is due to the fact that the principal is not payable until the end of the 3-year term.

Click here to Proceed

Illustrative Example 1: (Continued)

At the **end of Y1**, the Credit Risk Division provides you with the following updated report about the changes to the values reported in the table that characterizes your loan portfolio. Please note that three borrowers each missed one interest payment (Column 2).

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	7	C+	19%	17%	20%

Annual Performance Report: Loan Portfolio 1 for Y1

Participant ID 1111111

Section A: Interest Revenue		
A1. June 30th Interest Revenue	8500	
A2. December 30th Interest Revenue	8500	
A3. Total Interest Revenue (A1 + A2)		17000
Section B: Reserve Fund Account		
B1. Penalty for missed payments	-150	
B2. Surplus/Deficit on Foreclosure	0	
B3. Amount to Charge Against Revenue (B1 + B2)		-150
Section C: Operating Expenses		
C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. Total Expenses (C1 + C2)		-9100
Section D: Distribution of Net Profit		
D1. Net Profit (Loss) (A3 + B3 + C3)	7750	
D2. Manager's share (D1 * Bonus Rate)	1550	
D3. NAB Net Earnings (D1 - D2)		6200

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	NA
Minus: Loan Principal	NA
Minus: Two Unpaid Interest	NA
Surplus or Loss on Foreclosure	0

Click here to Proceed

Illustrative Example 1: (Continued)
At the end of Y2, you received from the NAB the following updated report.

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	**1**	**3**	**7**	**68**	**C+**	**30%**	**17%**	**20%**

Please note the following:

1. One borrower missed one interest payment (Column 2) and 3 borrowers missed two interest payments (Column 3). The loans of these three borrowers are foreclosed and the result of the foreclosure is presented in the table below. Consequently, at the end of Y2 you have in your portfolio only 7 loans (Column 4). Thus, the revenues for your branch in Y3 will be based on the interest collected from 7 borrowers.

2. The re-evaluation of the remaining 7 loans resulted in a reduction in the portfolio's credit score, but the credit grade remains at C+.

3. The market value of the collateral assets has declined to L$9,000 and so the proceeds from selling the collateral of the borrowers whose loans were foreclosed are L$27,000 minus 5% (i.e., L$25,650).

4. The deficit or surplus resulting from the disclosure is calculated in the following table:

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	L$25,650
Minus: Loan Principal	30,000
Minus: Two Unpaid Interest	5,100
Surplus or Loss on Foreclosure	**-L$9,450**

Click here to Proceed

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At the End of Y2

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	1	3	7	68	C+	30%	17%	20%

Annual Performance Report: Loan Portfolio 1 for Y2

Participant ID 1111111

Section A: Interest Revenue		
A1. June 30th Interest Revenue	8500	
A2. December 30th Interest Revenue	8500	
A3. Total Interest Revenue (A1 + A2)		17000
Section B: Reserve Fund Account		
B1. Penalty for missed payments	-200	
B2. Surplus/Deficit on Foreclosure	-9450	
B3. Amount to Charge Against Revenue (B1 + B2)		-9650
Section C: Operating Expenses		
C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. Total Expenses (C1 + C2)		-9100
Section D: Distribution of Net Profit		
D1. Net Profit (Loss) **(A3 + B3 + C3)**	-1750	
D2. Manager's share (D1 * Bonus Rate)	-350	
D3. NAB Net Earnings (D1 - D2)		-1400

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	25,650
Minus: Loan Principal	-30,000
Minus: Two Unpaid Interest	-5,100
Surplus or Loss on Foreclosure	-9,450

Click here to Proceed

0 Hours 19 Minutes 12 Seconds

Hide Timer

Illustrative Example 1: (Continued)

At the end of **Y3**, you received the following updated report from the NAB.

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	1	3	7	68	C+	30%	17%	20%
Defaults in Y3	2	0	NA	NA	NA	NA	NA	NA
Credit Risk Assessment at the START of Portfolio 2	NA	NA	10	90	A-	4%	12%	10%

Please note the following:

1. Two borrowers missed one interest payment (Column 2) and no borrower missed two interest payments (Column 3). There are no foreclosures in Y3. All loans are repaid in full.
2. The market value of the collateral assets for each borrower is still L$9,000.
3. Because there are only 7 loans in the portfolio, the total interest collected is L$1,700 times 7 or L$11,900 in two installments.
4. A new portfolio is provided to the manager for years Y4, Y5 and Y6. Note that the manager's bonus will be at 10% in years Y4, Y5 and Y6 because of the net loss reported in Y2.
5. The credit grade for the new portfolio is A-, therefore borrowers pay 12% interest each year and the probability of default in Y4 is 4%.

To complete the performance report for Y3 activities, click on the following button:

Click here to Proceed

At the End of Y3

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the START of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	1	3	7	68	C+	30%	17%	20%
Defaults in Y3	**2**	**0**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Credit Risk Assessment at the START of Portfolio 2	NA	NA	10	90	A-	4%	12%	10%

Annual Performance Report: Loan Portfolio 1 for Y3

Participant ID 1111111

Section A: Interest Revenue

A1. June 30th Interest Revenue	5950	
A2. December 30th Interest Revenue	5950	
A3. Total Interest Revenue (A1 + A2)		11900

Section B: Reserve Fund Account

B1. Penalty for missed payments	-100	
B2. Surplus/Deficit on Foreclosure	0	
B3. Amount to Charge Against Revenue (B1 + B2)		-100

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	NA
Minus: Loan Principal	NA
Minus: Two Unpaid Interest	NA
Surplus or Loss on Foreclosure	0

Section C: Operating Expenses

C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. Total Expenses (C1 + C2)		-9100

Section D: Distribution of Net Profit

D1. Net Profit (Loss) **(A3 + B3 + C3)**	2700	
D2. Manager's share (D1 * Bonus Rate)	540	
D3. NAB Net Earnings (D1 - D2)		2160

Summary of the Performance of this Portfolio

	Y1	Y2	Y3	Total	Mean
Net Profit or Loss	7750	-1750	2700	8700	2900
Manager's Compensation	1550	-350	540	1740	580

Click here to Proceed

Managing Volatility of Reported Profit

Because the amount of default losses is uncertain and can vary in magnitude from Zero to a very large amount, and because it is almost impossible to predict when they will occur, the reported annual net profit is subject to significant fluctuation from year to year. The shareholders of the NAB perceive high fluctuations of reported profits as an indicator of high-risk exposure for their investments and poor managerial performance, which in turn reduces their share prices.
In addition to the negative impact of high fluctuations on shareholders' wealth, the reported **loss** in Y2 that occurred in the Portfolio that was presented in Example 1 will result in reducing the manager's compensation bonus share from 20% to 10% for the next portfolio. Note that the reduced bonus rate will continue into the future until the branch reports positive profits during each of the entire 3 years of a loan portfolio.

How Can You Minimize Profit Fluctuations?

One possible way to reduce the fluctuations of reported profit and maintain the manager's bonus share at 20%is by setting aside reserves from current period interest revenues. The balance available in this reserve account will be used to absorb future default losses when they are realized. We will refer to this account as the "Reserve Fund Account". **The amount that you decide to transfer to the Reserve Fund Account is the only decision you will have to make in the session in which you will participate**. The amount you select to put into the Reserve Fund Account at the end of each year is called your "**Desired Ending Balance of Reserves**". The **Reserve Fund Account**, therefore, will serve as a mechanism to reduce the fluctuations in the Branch's reported net profit over time by offsetting future default losses.

Please Note the Following:

1. The amount that you decide to hold in the Reserve Fund Account is totally up to you. We will explain shortly some rules that can help you to determine the amount to hold.

2. You can move all or some of the money in the Reserve Fund and add them to current period revenues to increase net profit.

3. The amount transferred to the Reserve Fund will result in reporting ***lower*** profits for the **current year** by the amount that you decided to transfer to the Reserve Fund Account.

4. Also, your compensation bonus will ***rise or fall*** during the current year according to whether you reduce or increase your reserves.

The following is a discussion of the effects of reserve decisions on reported net profit in years 1, 2 and 3, using the same illustrative example we used in the previous section.

Suppose that in the previous illustrative example you decided to transfer L$4,000 to the **Reserve Fund Account** at the end of Y1 from the revenues collected during Y1. This, in turn, will result in reducing reported Y1 profit to L$3,750 (L$7,750 – L$4,000). In Y2, your branch reported total default losses equal to L$9,650 in **Section B** of the annual performance report and ended up with a Net Loss of L$1,750. However, if you have a Reserve Fund Account balance of L$4,000 you can transfer L$4,000 to Y2 revenues (which are equal to L$17,000) and convert the net loss of L$1,750 into a positive net profit of L$2,250 (-L$1,750 + L$4,000). In addition, your bonus share for the next portfolio will continue to be at 20%, rather than 10%, as you avoided reporting losses in Y2. Assuming that Y3 is exactly as in the first example and that the Desired Ending Balance at the end of Y2 is zero, net profit in Y3 will continue to be L$2,700.

One way to measure the fluctuation of net profit over the term of a portfolio is to compare the net profit or loss earned in one year to another year. When the manager carried no reserve from Y1 to Y2, profit fell from L$7,750 to a loss of L$1,750. When the manager carried a reserve of L$4,000 from Y1 to Y2, profit fell from L$3,750 to L$2,650. Although the total profit over the two years is unchanged, the fluctuation of profit from year to year is reduced substantially when the reserve was carried. Without the reserve, profit fell by 123% in Y2 but with the reserve profit fell by only 40%. In the following year, profit rose by 254% in the case when no reserve was held in Y2 but by only 20% when the reserve was held in Y2. In this example, although profit from the portfolio unaffected by carrying reserves, fluctuations are dramatically reduced and the manager is able to preserve the 20% compensation bonus moving into the next portfolio.

The summary of results from the Illustrative Example 1 without and with reserves are in Tables 4 and 5 below. The summary of results from the addition of L$4,000 reserves in

Table 4. Results with no Beginning Balance in Y2

	Y1	Y2	Y3
Net Profit or Loss	7750	-1750	2700
Fluctuation(%)	NA	-123%	254%

Table 5. Results with no Beginning Balance in any Year

	Y1	Y2	Y3
Net Profit or Loss	3750	2250	2700
Fluctuation(%)	NA	-40%	20%

How to Record Your Desired Ending Balance in the Annual Performance Report

The implementation of the **Reserve Fund** requires us to modify **Section B** in the Annual Performance Report from the table described as "Section B: Default Losses" to the new table described as "Section B: Reserve Fund Account". Examples are presented below.

Modified Section B: **Reserve Fund Account**	
B1. Beginning Balance (Endowed by the NAB in Y1 only)	0
B2. Penalty for missed payments	-150
B3. Deficit on Foreclosure (if any)	0
B4. Remaining Reserve on 31/12 (B1 + B2 + B3)	-150
B5. Desired Ending Balance of Reserves	-4,000

You input the amount that you wish to transfer to the Reserve Fund Account on line B5. The reported profit for the year will be reduced by this amount. Note that this is entered as a negative number. When the Desired Ending Balance is carried to the next year, it will appear as a positive value as the Beginning Balance.

The new section begins with the year's opening reserve balance (B1). Except for Y1, this is the **Desired Ending Balance of Reserves** from the previous year. In Y1 and only in Y1, the Beginning Balance is Zero. Starting with Y2, and in all subsequent years, the beginning balance is equal to the desired ending balance of the previous period.

The amount that will be charged against revenue received for the year will be equal to the amount in B4 minus the amount in B5. If you have a reserve deficit in B4 (as shown above) and if you want to have an ending balance of reserves equal to L$4,000, then L$4,150 will be subtracted from the revenues received during the year. If you have a reserve surplus, this will reduce the amount charged against revenues that will leave you with a desired ending balance of reserves of L$4,000.

Click here to Proceed

0 Hours 25 Minutes 18 Seconds

Hide Timer

Illustrative Example 2

To help familiarize you with this environment, we will repeat all the events for the loan portfolio presented in the illustrative example 1. The only thing new is that we will let you practice choosing different amounts of Desired Ending Balances reported in Row B5 for each of the three years to observe the impact of your decision on the annual reported net profit for each of the three years.

For the purpose of understanding how carrying reserves for possible use in subsequent years can affect the profit realized from a portfolio and the compensation bonuses you may receive from these profits over the 3-year term of the portfolio, you will be able to move back and forth across different years in this Illustrative Example to change your Desired Ending Balances in any particular year. This will permit you to check the table that summarizes the portfolio's performance over its 3-year term as you change the Desired Ending Balances. You will be able to do this only in this training session, but not once you begin the loan management decisions in Session 2 when you return to the lab.

Note that your Desired Ending Balances held at the end of each year is the only decision you will make in each period throughout the session. We will present a slightly more complex environment when you return for the next session and provide some hints as to how to make a decision about your Desired Ending Balances.

Click here to Proceed

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Hide Timer

Illustrative Example 2 (Continued)

At the beginning of Y1, the NAB provides you with a L$100,000 portfolio of ten L$10,000 three-year loans to 10 different borrowers. Each borrower has the same credit score of 75 points and will pay interest at the annual rate of 17%. The credit score of 75 points is determined by the **Credit Risk Division** based on a thorough investigation and assessment of

1) the borrower's past creditworthiness,
2) the market value of the borrower's collateral,
3) the borrower's employment status, and
4) the general macroeconomic outlook.

The above information is supplied to you in the following table of your branch's annual activities report.

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%

* Note that for every portfolio, given its risk grade, the probability of default will increase over the durations of the loans in the portfolio. This is due to the fact that the principal is not payable until the end of the 3-year term.

Click here to Proceed

0 Hours 28 Minutes 45 Seconds

Hide Timer

Illustrative Example 2: (Continued)

At the **end of Y1**, the Credit Risk Division provides you with the following updated report about the changes to the values reported in the table that characterizes your loan portfolio. Please note that three borrowers each missed one interest payment (Column 2).

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	**3**	**0**	**10**	**7**	**C+**	**19%**	**17%**	**20%**

Annual Performance Report: Loan Portfolio 1 for Y1

Participant ID 1111111

Section A: Interest Revenue

A1. June 30th Payment	8500	
A2. December 30th Payment	8500	
A3. Total Interest Revenue (A1 + A2)		17000

Section B: Reserve Fund Account

B1. Beginning Balance (Endowed by the Head Office)	0	
B2. Penalty for missed payments	-150	
B3. Surplus/Deficit on Foreclosure	0	
B4. Remaining Reserve on 31/12 **(B1 + B2 + B3)**	-150	
B5. Desired Ending Balance of Reserve		
B6. Amount to set-aside from Revenue (B4 + B5)		

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	NA
Minus: Loan Principal	NA
Minus: Two Unpaid Interest	NA
Surplus or Loss on Foreclosure	0

Note that this will be the primary decision you will make in each year. We will provide specific guidance for making this decision in Session 2.
For now, we want you to understand the effect of this number on your branch's **reported profit** and on your annual compensation **bonus** in this year and the next year.
For this example, you may try different amounts to experience the effects of this decision on reported profit and your bonus **before proceeding to the next screen**.

Section C: Operating Expenses

C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. Total Expenses (C1 + C2)		-9100

Section D: Distribution of Net Profit

D1. Net Profit (Loss) **(A3 + B6 + C3)**		
D2. Manager's share (D1 * Compensation Rate)		
D3. Distribution to Shareholders (D1 - D2)		

Click here to Proceed

Illustrative Example 2: (Continued)

At the end of Y2, you received from the NAB the following updated report.

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	**1**	**3**	**7**	**68**	**C+**	**30%**	**17%**	**20%**

Please note the following:

1. One borrower missed one interest payment (Column 2) and 3 borrowers missed two interest payments (Column 3). The loans of these three borrowers are foreclosed and the result of the foreclosure is presented in the table below. Consequently, at the end of Y2 you have in your portfolio only 7 loans (Column 4). Thus, the revenues for your branch in Y3 will be based on the interest collected from 7 borrowers.

2. The re-evaluation of the remaining 7 loans resulted in a reduction in the portfolio's credit score, but the credit grade remains at C+.

3. The market value of the collateral assets has declined to L$9,000 and so the proceeds from selling the collateral of the borrowers whose loans were foreclosed are L$27,000 less 5% or L$25,650

4. The deficit or surplus resulting from the disclosure is calculated in the following table:

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	L$25,650
Minus: Loan Principal	$30,000
Minus: Two Unpaid Interest	$5,100
Surplus or Loss on Foreclosure	**-L$9,450**

Click here to Proceed

0 Hours	35 Minutes	22 Seconds

Hide Timer

At the End of Y2

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	1	3	7	68	C+	30%	17%	20%

Annual Performance Report: Loan Portfolio 1 for Y2

Participant ID 1111111

Section A: Interest Revenue		
A1. June 30th Payment	8500	
A2. December 30th Payment	8500	
A3. **Total Interest Revenue** (A1 + A2)		17000
Section B: Reserve Fund Account		
B1. Beginning Balance (Endowed by the Head Office)	0	
B2. Penalty for missed payments	-200	
B3. Surplus/Deficit on Foreclosure	-9450	
B4. Remaining Reserve on 31/12 (B1 + B2 + B3)	-9650	
B5. **Desired Ending Balance of Reserve**	0	
B6. **Amount to set-aside from Revenue** (B4 + B5)		-9650
Section C: Operating Expenses		
C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. **Total Expenses** (C1 + C2)		-9100
Section D: Distribution of Net Profit		
D1. Net Profit (Loss) (A3 + B6 + C3)	-1750	
D2. Manager's share (D1 * Compensation Rate)	-350	
D3. **Distribution to Shareholders** (D1 - D2)		-1400

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	L$25,650
Minus: Loan Principal	-30,000
Minus: Two Unpaid Interest	-5,100
Surplus or Loss on Foreclosure	-L$9,450

Click Here to return to the Y1 Performance Report

Click here to Proceed

Illustrative Example 2: (Continued)

At the end of **Y3**, you received the following updated report from the NAB.

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	1	3	7	68	C+	30%	17%	20%
Defaults in Y3	**2**	**0**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Credit Risk Assessment at the START of Portfolio 2	NA	NA	10	90	A-	4%	12%	10%

Please note the following:

1. Two borrowers missed one interest payment (Column 2) and no borrower missed two interest payments (Column 3). There are no foreclosures in Y3. All loans are repaid in full.

2. The market value of the collateral assets for each borrower is still L$9,000.

3. Because there are only 7 loans in the portfolio, the total interest collected is L$1,700 times 7 or L$11,900.

4. A new portfolio is provided to the manager for years Y4, Y5 and Y6. Note that the manager's bonus will be at 10% in years Y4, Y5 and Y6 because of the loss in Y2.

5. The credit grade for the new portfolio is A-, so therefore borrowers pay 12% interest each year. The probability of default in Y4 is 4%.

To complete the performance report for Y3 activities, click on the following button:

Click here to Proceed

0 Hours 49 Minutes 13 Seconds

Hide Timer

At the End of Y3

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Loans *Remaining* in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	0	10	70	C+	19%	17%	20%
Defaults & Updated Credit Scores at the END OF Y2	1	3	7	68	C+	30%	17%	20%
Defaults in Y3	2	0	NA	NA	NA	NA	NA	NA
Credit Risk Assessment at the START of Portfolio 2	NA	NA	10	90	A-	4%	12%	10%

Annual Performance Report: Loan Portfolio 1 for Y3

Participant ID 1111111

Section A: Interest Revenue		
A1. June 30th Payment	5950	
A2. December 30th Payment	5950	
A3. **Total Interest Revenue** (A1 + A2)		11900
Section B: Reserve Fund Account		
B1. Beginning Balance (Endowed by the Head Office)	0	
B2. Penalty for missed payments	-100	
B3. Surplus/Deficit on Foreclosure	0	
B4. Remaining Reserve on 31/12 (B1 + B2 + B3)	-100	
B5. **Desired Ending Balance of Reserve**	0	
B6. **Amount to set-aside from Revenue** (B4 + B5)		-100
Section C: Operating Expenses		
C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. **Total Expenses** (C1 + C2)		-9100
Section D: Distribution of Net Profit		
D1. Net Profit (Loss) (A3 + B6 + C3)	2700	
D2. Manager's share (D1 * Compensation Rate)	540	
D3. **Distribution to Shareholders** (D1 - D2)		2160

Interest from the 7 borrowers that are still remaining in the portfolio.

(Surplus/Deficit) from Foreclosure	
Net Cash from Sales of Collaterals	NA
Minus: Loan Principal	NA
Minus: Two Unpaid Interest	NA
Surplus or Loss on Foreclosure	0

Click Here to return to the Y2 Performance Report

Click here to Proceed

0 Hours 50 Minutes 50 Seconds

Hide Timer

Summary of the Performance of this Portfolio With Reserve

	Y1	Y2	Y3
Net Profit or Loss	7750	200	2700
Fluctuation (%)	NA	-97%	1250%
Compensation (Salary + Bonus)	1550	-350	540

Click Here to return to the Y3 Performance Report

Click here to End Session 1 and Calculate your Payoff for the Session

SESSION 2 (Day 2)

Setting 2.2
GENERAL INSTRUCTIONS

In Setting 1.5 of Session 1, you were introduced to the Loan Management Environment. In today's experiment you will play the role of a ***loan manager*** for one of the many branches of a hypothetical bank called the "North Atlantic Bank" (NAB). During today's experiment, you will make loan related decisions for several portfolios and for many years. We will not tell you how many portfolios (each with 3-year loans) you will manage. However, we will **announce** the **end of** the experiment one year prior to the last period of the **last portfolio**.

Your payoff in the current setting will depend on the decisions that you will make. None of these decisions requires any specialized background knowledge. Also, there are no right or wrong responses. As researchers, we will learn from your decisions and the decisions of others who confront similar settings.

The currency used in this experiment is a **Laboratory Dollar (L$)**. Your total earnings in L$s will be converted to Canadian Dollars (C$) and will be paid to you in cash. The conversion rate today is **L$1000 = C$1.50**. After you complete the decision rounds of today's session, you will receive your earnings from both settings in today's session and the C$20 of your Session 1 earnings that were held back at the end of Session 1.

Your Annual Compensation Package

Branch managers will be compensated by providing them a share of the annual reported net profits and losses. Consequently, your annual compensation scheme will be calculated as follows:

1. You will receive a fixed annual salary of L$100 regardless of whether your branch reports a profit or a loss in any given year.

2. A performance compensation bonus equal to 20% of the reported ***net profit*** or ***loss*** in a given year is added to (or subtracted from) your total compensation in that year. If your branch reports a net loss in a given year, your share of the net loss will result in a negative compensation bonus. Over the 3-year term of a portfolio you can never receive a total compensation bonus less than zero. In other words, the **minimum** total compensation (salary plus bonuses) that you will receive from a portfolio is your fixed salary of L$300.

3. If your branch shows a net loss in any year during the term of a portfolio, then your performance compensation bonus for the next portfolio will drop from 20% to 10%. If the next portfolio shows a Net Profit in all years, your performance compensation bonus will return to 20% of Net Profit for the next portfolio; otherwise it will continue to be 10% until you report profit in all three years of a portfolio.

Click here to Proceed

Summary of the Basic Loan Environment

During the session, your branch will manage many loan portfolios. Each portfolio is for 3 years, which include 10 borrowers who have the same risk characteristics as measured by their ***credit scores*** at initiation of the loans.

A **credit score** is a numerical value that reflects the likelihood that a borrower will be able to meet the contractual obligations of making the interest payments and principal repayments on their due dates. The credit score can take a value ranging from 48 to 100 points. The credit score for an individual is determined by the assessment of the following four input risk factors.

1) The borrower's **past creditworthiness**.
2) The market value of the borrower's **collateral**.
3) The borrower's **employment status**.
4) The general **macroeconomic outlook**.

Because 10 borrowers in a portfolio have the same risk grade at the origination, the 10 borrowers will be charged the same interest rate, which will remain fixed during the 3 years duration of the loan. The interest is collected twice a year (June 30 and December 31). The principal will be paid at the end of the loan term.

Click here to Proceed

Terms & Conditions of Loans

- Borrowers are allowed to ***miss one*** interest payment. If they make the next payment on its scheduled due date, we assume that they also pay back the missed payment at this time.
- If a borrower ***misses two*** consecutive payments, the loan is **foreclosed** and the borrower's collateral is sold and the proceeds from this sale are used to pay back the principal plus the two unpaid interest payments. The foreclosure fees are 5% of the value of collateral that is received upon its sale. This will be automatically deducted from the sales value.
- If the borrower does not make a payment, the NAB will charge the branch L$50 for each missed payment. For example, if 3 borrowers missed one payment and 1 borrower misses two payments in Year 1, then the late payment charges to the branch are L$250 (3 x L$50 + 2 x L$50).
- The interest revenues for a year are determined based on the total number of borrowers who are in the portfolio at the beginning of the year **regardless of the number of missed payments or the number of loans foreclosed** during the year.
- The number of loans foreclosed in a particular year will be excluded from the interest calculation in the subsequent year.

Click here to Proceed

Fluctuations in Reported Profit

In the presence of uncertainty, the amounts and the timing of occurrences of default losses that your branch may encounter are unavoidable. They could vary in magnitude from Zero to a very large amount. Consequently, the annual reported profit could be subject to significant fluctuation from year to year. The shareholders of the NAB perceive high fluctuations of reported profits as an indicator of high-risk exposure for their investments and poor management of loan portfolios, which in turn reduces their share prices.

How Can You Minimize Profit Fluctuations?

One possible way to reduce the fluctuations of reported profit is by setting aside reserves from current period interest revenues. The balance available in this reserve account will be used to absorb future default losses when they are realized. We will refer to this account as the "Reserve Fund Account". **The amount that you decide to transfer to the Reserve Fund Account is the only decision you will have to make in the remainder of this session**. The amount you select to put into the Reserve Fund Account at the end of each year is called your "**Desired Ending Balance of Reserves**". The **Reserve Fund Account**, therefore, will serve as a mechanism to reduce the fluctuations in the Branch's reported net profit over time by offsetting future default losses.

Please Note the Following:

1. The amount that you decide to hold in the Reserve Fund Account is totally up to you. We will explain shortly some rules that can help you to determine the amount to hold.
2. You can move all or some of the money in the Reserve Fund and add them to current period revenues to increase net profit.
3. The amount transferred to the Reserve Fund will result in reporting ***lower*** profits for the **current year** by the amount that you decided to transfer to the Reserve Fund Account.

Click here to Proceed

Demonstrative Example

At the start of each new loan portfolio, the NAB head office will send to you a report that describes the basic risk characteristics of the borrowers in the new portfolio. Suppose that at the beginning of year 1 (Y1), your branch is assigned portfolio N:

Portfolio N
Borrowers' Risk Grade is "B-"
The Interest Rate for this Portfolio is "17%"

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Borrowers (BWRs) included in the Portfolio	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Risk characteristics on 1/1/Y1	NA	NA	10 BWRs	75	B-	7%	17%	20%

Although the credit scores for all borrowers in a portfolio are identical at the initiation of the loan, the creditworthiness for some borrowers may change during the loan term. Therefore, at the end of each year, the risk characteristics of all borrowers are re-evaluated by the ***Credit Risk Division.***

Based on this investigation, at the end of each year you will receive an updated report from the ***Credit Risk Division*** that shows i) the revised average credit score for the portfolio, ii) its revised risk grade and iii) the probability that a borrower is likely to miss an interest payment when it is due during the next year. This default rate applies to each of the borrowers.

Click here to Proceed

Demonstrative Example (Continued)

At the end of Y1, the 9-column table will include an additional line with the updated report that shows the major changes to the portfolio followed by a summary of this table called "Summary of Major Events this Year". The following is an **example** of this summary report.

Loan Portfolio #N
Borrowers' Risk Grade is "B-"
The Interest Rate for this Portfolio is "17%"

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments (*Fore-closed*)	# of Borrowers (BWRs) included in the Portfolio	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments *NEXT YEAR* on the *Remaining Loans**	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Risk characteristics on 1/1/Y1	NA	NA	10 BWRs	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	1	10 BWRs	70	C+	19%		

Summary of the Major Events this Year

# of Borrowers who Missed **One** interest payment is _3__

# of Borrowers who Missed **Two** interest payments are _1__

The market value of Collateral changed **From:** L$10,200 **To:** L$9,500

As a result of the above changes:

Your branch has been charged with ***FORECLOSURE LOSS*** an amount of **L$2,200**. (Show Details)

(Surplus/Deficit) from Foreclosure	
Cash from sales of collateral	L$9,500
Minus: Loan Principal	10,000
Minus: unpaid interest	1,700
Surplus (Deficit) on Foreclosure	**-L$2,200**

Click here to Proceed

In addition to the above analysis, the NAB will provide you with an Annual Performance Report which is accompanied by a report updating your portfolio's risk exposure. In addition, you are provided with a table including estimates of the Lower Bound and the Upper Bound of the Expected Credit Loss for your portfolio for the next year. This is provided to guide you with your decision about the Desired Ending Balance of reserves. The following is an **example** of the two reports that will accompany your Annual Performance Reports:

Sample of Updating Your Portfolio Risk Exposure

Based on the major changes that occurred during the year, the Head Office of the NAB provides you with the following conclusions:

1. The **Risk Grade** of the Portfolio is Downgraded **From:** B- **To:** C+
2. The ***Probability*** of Missing Payments **NEXT** Year has increased **From:** 7% **To:** 19%

Accordingly, the NAB estimated the following Range as the Guideline for your decision on the DEB

Allowable Range for Reserves for Next Year		
Lower Bound	Expected Credit Loss	Upper Bound
0	4180	22,000

Note that:

- **Lower Bound:** is the **Best Possible Case** that your branch may encounter next year.
- **Expected Credit Loss:** is the estimated overall average of default losses, based on the updated information of risk factors for next year at the end of the current year.
- **Upper Bound:** is the **Worst Possible Case** that your branch may encounter next year.

Because the amount you choose for your Desired Ending Balance will have an impact on your branch reported net profit as well as your bonus compensation (which could be either 20% or 10% of reported income), for your convenience, we will provide you with an "impact" table with the current net profit given your chosen Desired Ending Balance of reserves (the number you put into row B5 of your Annual Performance Report). As you consider different possible values for your Desired Ending Balance of reserves for the year, the impact of the amount you wish to have in the reserve fund on the net profit will appear in the updated impact table. Following is a sample of this table:

Impact of your decision on Net Profit	
Net Profit	

Click here to Proceed

Google Chrome

The following screen shows how all above tables are presented with the annual performance report:

Loan Portfolio N
Borrower's Risk Grade is "B-"
The Interest Rate for this Portfolio is "17%"

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Credit Risk Assessment at the *START* of Portfolio 1	NA	NA	10	75	B-	7%	17%	20%
Defaults & Updated Credit Scores at the END OF Y1	3	1	10	70	C+	19%		

Annual Performance Report: Loan Portfolio 1 for Y1

Participant ID

Section A: Interest Revenue		
A1. June 30th Interest Revenue	8500	
A2. December 30th Interest Revenue	8500	
A3. **Total Interest Revenue (A1 + A2)**		17000
Section B: Reserve Fund Account		
B1. Beginning Balance (Endowed by the Head Office)	0	
B2. Penalty for missed payments	-250	
B3. Surplus/Deficit on Foreclosure (Show Details)	-2200	
B4. Remaining Reserve on 31/12 **(B1 + B2 + B3)**	-2450	
B5. **Desired Ending Balance of Reserve**		
B6. **Amount to set-aside from Revenue (B4 - B5)**		-2450
Section C: Operating Expenses		
C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. **Total Expenses (C1 + C2)**		-9100
Section D: Distribution of Net Profit		
D1. Net Profit (Loss) **(A3 + A4 + B6 + C3)**	5450	
D2. Manager's share **(D1 * Compensation Rate)**	1090	
D3. **Distribution to Shareholders (D1 - D2)**		4360

Sample of Updating Your Portfolio Risk Exposure

Based on the major changes that occurred during the year, the Head Office of the NAB provides you with the following conclusions:

1. The Risk Grade of the Portfolio is Downgraded From: B- To: C+
2. The *Probability* of Missing Payments NEXT Year has increased From: 7% To: 19%

Accordingly, the NAB estimated the following Range as the Guideline for your decision on the DEB

⇩

Allowable Range of Reserves For Next Year

Lower Bound of Default Loss	Estimated Default Loss	Upper Bound of Default Loss
0	4180	22,000

Impact of your decision on Net Profit

Net Profit 5450

Click Here to Start the Experiment

The following is the first portfolio of the actual experiment under CECL.

At the beginning of Year 1 the participant receives the following form:

Loan Portfolio # 1 - Year 1
Borrower's Risk Grade is "A+"
The Interest Rate for this Portfolio is "11%"

Components of the Credit Scores for the Portfolio (Click here to Show/Hide) ▼

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Original Credit Risk Assessment at the START of the Portfolio	0	0	10	96	A+	2%	11%	??

Click Here to Proceed

At the end of Year 1 the participant receives the following form:

Loan Portfolio # 1 - Year 1
Borrower's Risk Grade is "A+"
The Interest Rate for this Portfolio is "11%"

Components of the Credit Scores for the Portfolio (Click here to Show/Hide) ▼

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Original Credit Risk Assessment at the START of the Portfolio	0	0	10	96	A+	2%	11%	20%
The Updated Credit Scores at the END OF Y1	1	0	10	96	A+	4%		

Summary of the Major Events this Year

The # of Borrowers who Missed **ONE** interest payment is **1**

The # of Borrowers who Missed **TWO** interest payments is **0**

The market value of Collateral Changed **From**: **L$10,600** **To**: **L$10,600**

As a result of the above changes:

Your branch has been charged with ***FORECLOSURE LOSS*** an amount of **L$0**. (Show Details)

Click Here to Proceed

Loan Portfolio # 1 - Year 1
Borrower's Risk Grade is "A+"
The Interest Rate for this Portfolio is "11%"

Components of the Credit Scores for the Portfolio (Click here to Show/Hide) ▼

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Original Credit Risk Assessment at the START of the Portfolio	0	0	10	96	A+	2%	11%	20%
The Updated Credit Scores at the END OF Y1	1	0	10	96	A+	4%		

Participant ID 22222222

Section A: Interest Revenue

A1. June 30th Interest Revenue	5500	
A2. December 30th Interest Revenue	5500	
A3. **Total Interest Revenue (A1 + A2)**		11000

Section B: Reserve Fund Account

B1. Beginning Balance (Endowed by the Head Office)	290	
B2. Penalty for missed payments	-50	
B3. Surplus/Deficit on Foreclosure (Show Details)	NA	
B4. Remaining Reserve on 31/12 **(B1 + B2 + B3)**	240	
B5. **Desired Ending Balance of Reserve**		
B6. **Amount to set-aside from Revenue (B4 - B5)**		-50

Section C: Operating Expenses

C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. **Total Expenses (C1 + C2)**		-9100

Section D: Distribution of Net Profit

D1. Net Profit (Loss) **(A3 + B6 + C3)**	1850	
D2. Manager's share **(D1 * Compensation Rate)**	370	
D3. **Distribution to Shareholders (D1 - D2)**		1480

Updating Your Portfolio Risk Exposure

Based on the major changes that occurred during the year, the Head Office of the NAB provides you with the following conclusions:

1. The **Risk Grade** of the Portfolio is Downgraded from " **A+** " to " **A+** ".
2.The ***Probability*** of Missing Payments **NEXT** Year has increased **From: 2%** **To: 4%**.

Accordingly, the NAB estimated the following Range as the Guideline for your decision on the DEB

⇩

Allowable Range for Reserves For Next Year

Lower Bound	Expected Credit Loss	Upper Bound
0	582	16,000

Impact of your decision on Net Profit

Net Profit in D1 1850

Click Here to Proceed

At the end of Year 2 the participants receives the following form:

Loan Portfolio # 1 - Year 2

Components of the Credit Scores for the Portfolio (Click here to Show/Hide) ▼

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Original Credit Risk Assessment at the START of the Portfolio	0	0	10	96	A+	2%	11%	20%
The Updated Credit Scores at the END OF Y1	1	0	10	96	A+	4%		
The Updated Credit Scores at the END OF Y2	2	0	10	91.2	A	12%		

Summary of the Major Events this Year

The # of Borrowers who Missed **ONE** interest payment is **2**

The # of Borrowers who Missed **TWO** interest payments is **0**

The market value of Collateral Changed **From**: **L$10,600** **To**: **L$10,200**

As a result of the above changes:

Your branch has been charged with ***FORECLOSURE LOSS*** an amount of **L$0**. (Show Details)

Click Here to Proceed

Loan Portfolio # 1 - Year 2

Components of the Credit Scores for the Portfolio (Click here to Show/Hide) ▼

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Original Credit Risk Assessment at the START of the Portfolio	0	0	10	96	A+	2%	11%	20%
The Updated Credit Scores at the END OF Y1	1	0	10	96	A+	4%		
The Updated Credit Scores at the END OF Y2	2	0	10	91.2	A	12%		

Participant ID 22222222

Section A: Interest Revenue

A1. June 30th Interest Revenue	5500	
A2. December 30th Interest Revenue	5500	
A3. **Total Interest Revenue (A1 + A2)**		11000

Updating Your Portfolio Risk Exposure

Based on the major changes that occurred during the year, the Head Office of the NAB provides you with the following conclusions:

1. The **Risk Grade** of the Portfolio is Downgraded from " **A+** " to " **A** ".
2.The ***Probability*** of Missing Payments **NEXT** Year has increased **From: 4% To: 12%**.

Accordingly, the NAB estimated the following Range as the Guideline for your decision on the DEB

⇩

Section B: Reserve Fund Account

B1. Last Year's Desired Ending Balance	582	
B2. Penalty for missed payments	-100	
B3. Surplus/Deficit on Foreclosure (Show Details)	NA	
B4. Remaining Reserve on 31/12 (B1 + B2 + B3)	482	
B5. **Desired Ending Balance of Reserve**		
B6. **Amount to set-aside from Revenue (B4 - B5)**		482

Allowable Range for Reserves For Next Year

Lower Bound	Expected Credit Loss	Upper Bound
0	1,746	16,000

Impact of your decision on Net Profit

Net Profit in D1 2382

Section C: Operating Expenses

C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. **Total Expenses (C1 + C2)**		-9100

Section D: Distribution of Net Profit

D1. Net Profit (Loss) (A3 + B6 + C3)	2382	
D2. Manager's share (D1 * Compensation Rate)	476	
D3. **Distribution to Shareholders (D1 - D2)**		1906

Click Here to Proceed

At the end of Year 3 the participants receives the following form:

Loan Portfolio # 1 - Year 3

Components of the Credit Scores for the Portfolio (Click here to Show/Hide) ▼

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Original Credit Risk Assessment at the START of the Portfolio	0	0	10	96	A+	2%	11%	20%
The Updated Credit Scores at the END OF Y1	1	0	10	96	A+	4%		
The Updated Credit Scores at the END OF Y2	2	0	10	91.2	A	12%		
Activities of the portfolio during Year Y3	2	1	9	NA	NA	NA		

Summary of the Major Events this Year

The # of Borrowers who Missed **ONE** interest payment is **2**

The # of Borrowers who Missed **TWO** interest payments is **1**

The market value of Collateral Changed **From**: **L$10,200** **To**: **L$10,000**

As a result of the above changes:

Your branch has been charged with ***FORECLOSURE LOSS*** an amount of **L$1,600**. (Show Details)

This is the Last Year of Portfolio # 1

Click Here to Proceed

Loan Portfolio # 1 - Year 3

Components of the Credit Scores for the Portfolio (Click here to Show/Hide) ▼

1	2	3	4	5	6	7	8	9
	# of Borrowers who Missed ONE payment	# of Borrowers who Missed TWO payments	# of Loans Remaining in the Portfolio by the End of the Year	Average Credit Score for the Portfolio	Risk Grade	Probability of Missing Payments NEXT YEAR on the Remaining Loans*	Interest Rate on next year's portfolio	Bonus Rate on next year's net profit
Original Credit Risk Assessment at the START of the Portfolio	0	0	10	96	A+	2%	11%	20%
The Updated Credit Scores at the END OF Y1	1	0	10	96	A+	4%		
The Updated Credit Scores at the END OF Y2	2	0	10	91.2	A	12%		
Activities of the portfolio during Year Y3	2	1	9	NA	NA	NA		

Participant ID 22222222

Section A: Interest Revenue

A1. June 30th Interest Revenue	5500	
A2. December 30th Interest Revenue	5500	
A3. **Total Interest Revenue** (A1 + A2)		11000

Section B: Reserve Fund Account

B1. Last Year's Desired Ending Balance	1747	
B2. Penalty for missed payments	-200	
B3. Surplus/Deficit on Foreclosure (Show Details)	-1600	
B4. Remaining Reserve on 31/12 (B1 + B2 + B3)	-53	
B5. **Desired Ending Balance of Reserve**		
B6. **Amount to set-aside from Revenue** (B4 - B5)		-53

Section C: Operating Expenses

C1. Annual Operating Expenses	-9000	
C2. Manager's Fixed Salary	-100	
C3. **Total Expenses** (C1 + C2)		-9100

Section D: Distribution of Net Profit

D1. Net Profit (Loss) (A3 + B6 + C3)	1847	
D2. Manager's share (D1 * Compensation Rate)	369	
D3. **Distribution to Shareholders** (D1 - D2)		1478

Your Next Portfolio is Approved

- Borrower's **Risk Grade** is "B+"
- The **Interest Rate** for the Loan is "15%"

Accordingly, the NAB estimated the following Range as the Guideline for your decision on the DEB

⇩

Allowable Range for Reserves For Next Year

Lower Bound	Expected Credit Loss	Upper Bound
0	909	20,000

Impact of your decision on Net Profit

Net Profit in D1 1847

Click Here to Proceed