DEPOSIT INSURANCE FOR NEW ZEALAND: NEW SCHEME FOR THE BANKING INDUSTRY

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Abstract

Using recent data from the New Zealand banking industry, this paper examines the most important factors that determine bank risk. We use a sample of 24 banks in New Zealand from the period from 2012 to 2021, using quarterly data. The risk-based deposit premium is preferable to be implemented in New Zealand as it calculates the risk attached to each bank as the flat rate is simpler yet imposes moral hazard. Thus, we use a weighting method based on statistical learning models using gradient boosted model to predict the most important variable that explains bank risk. The result shows that capital equity is the most important variable that can predict bank risk that weighs more than 40%. This research indicated that a risk-based premium is preferable and fairer than a flat-rate premium to reduce moral hazard (Bloecher et al., 2003). This study supports the deposit insurance schemes in New Zealand as a part of the system to maintain banking stability (Cerrone, 2018).

Keywords: Deposit Insurance Scheme, Bank Risk, Capital Adequacy, Gradient Boosted Model

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1. INTRODUCTION

New Zealand has been one of the developed nations not to have a deposit guarantee scheme[1]. If a financial crisis happened and banks in New Zealand fail (or if a bank makes a bad decision) people can lose their savings. The deposit insurance (DI) scheme has been recommended for years by the Organisation for Economic Co-operation and Development (OECD), the International Monetary Fund (IMF), and the International Association of Deposit Insurers (IADI). Finally, by 2023, New Zealand will follow much of the rest of the world in having a bank explicit deposit guarantee scheme. It is planned that by 2023, the scheme (known as the Deposit Takers Act) protect deposits of up to $100,000 in banks and financial institutions starts. People (their money) will be covered by a deposit guarantee up to a cap of $100,000 per depositor in each eligible institution in the event of a failure[2]. It means that accounts held at multiple banks by one individual will be covered. Should depositors minimize the default risk, they can diversify by putting their money across a number of banks and therefore achieve greater coverage than the $100,000 limit[3]. The scheme will fully protect approximately 93 percent of depositors.

The reason to establish DI in New Zealand is to strengthen the regulation and supervision of

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[1] As of 2021, 143 countries have deposit insurance schemes.

[2] The deposit protection limit is double the initial proposal of up to $50,000.
[3] If a couple have a joint account they will have coverage of $100,000 per person.

the financial system. It also bolsters depositor confidence in the industry after the health crisis (COVID-19 pandemic). This new scheme will help protect New Zealand's financial system and wider economy from damage that could be caused by excessive risk-taking by the deposit-taking sector and any resulting failures of institutions. Moreover, during the pandemic, most countries face financial problems, and post-pandemic the inflation rate hikes. It is well known that most other developed nations have DI to make the banking system safer. Deposit insurance aims to protect small depositors and enhance banking system stability (Demirgüç-Kunt & Detragiache, 2002). However, moral hazard can also appear as the reverse effect of DI that reduces the monitoring effect (Cooper & Ross, 2002). We aim to fill the gap in the literature regarding the benefits of deposit insurance, especially in New Zealand.

As a significant milestone, DI in New Zealand also occurs cost. An increase in banks' costs, as a result of funding or operating, under a depositor protection regime might be passed on to depositors through higher interest for credits or lower term deposit rates. Learning from what have learned in the past and for any future events (pandemic, crisis, etc.) the reforms ensure the Reserve Bank is better equipped to protect and promote financial stability in the future, even though New Zealand's financial system is considered good and well positioned to withstand the stress posed by the pandemic and other global events (such as Rusian-Ukrainian War, supply chain stress, and exchange rate risk). Especially, default risk as the retail deposit market in New Zealand is dominated by a small group of large banks. Thus, too big to fail an issue that might face the New Zealand banking system.

In this study, our goal is to propose a calculation to find the most important variables that affect bank risk in New Zealand. We use a weighting method that is based on statistical learning models using gradient boosted model. Using 70 variables and also using bank-level panel data and analyse using data-driven from more than 20 banks in New Zealand, the results show that equity capital is the most important variable that affects bank risk. Thus, we suggest that risk-based deposit insurance premium is suitable for the New Zealand banking industry as the flat rate is simpler yet impose more moral hazard problem, supporting a study by Bloecher et al. (2013). The implementation of the capital adequacy requirement can also reduce risk-taking at banks. We depart our analysis from the existing literature, in which we focus on a developed country that has not adopted deposit insurance.

The remaining structure of this paper is organized as follows. Section 2 reviews the related literature and the New Zealand deposit insurance scheme. Section 3 describes the data and methods used in the empirical analysis. The results are presented in Section 4, followed by a discussion in Section 5. Section 6 concludes and discusses the policy implications of our study.

2. LITERATURE REVIEW

Banking crises have become factors that accelerate deposit insurance scheme adoption in many countries. Diamond and Dybvig (1983) stated that deposit insurance is a system to ensure the financial stability of an economy by increasing depositor confidence and reducing the likelihood of bank runs. However, they still have potential cons and problems as they reduce depositors' incentive to monitor the banks (Anginer et al., 2014), thus banks might engage in the riskier project and be a cause of bank crisis (Cooper & Ross, 2022).

New Zealand does not have a formal recovery and resolution regime for banks or a depositor insurance scheme. If a bank fails in New Zealand, depositors could lose all or some of their savings. However, The Reserve Bank of New Zealand (RBNZ) has had in place the Open Bank Resolution[4]. Bank deposits (i.e., customer savings) are used to bail out the bank. The process is the RBNZ would temporarily close and determine the minimum capital required to keep the failing bank functioning. Then, The RBNZ would then cut all depositors by this amount to "bail in" the bank (Hoskin & Woolford, 2011). Unlike retail depositors in other countries who are protected by deposit insurance, New Zealand retail depositors would have to bail out their banks (the cost will be faced primarily by the bank's shareholders and creditors rather than by taxpayers). Banks should meet the pre-positioning requirements for Open Bank Resolution (OBR) to take place. Part of a retail depositor's savings may be frozen and used to recapitalize the bank if shareholder and subordinated creditor funds prove insufficient. After this process, The RBNZ will reopen the bank and allow depositors to gain access to their accounts depending on the level of the freeze, whilst an appropriate long-term solution to a bank's failure is applied.

However, New Zealand is setting up a state-run insurance scheme to guarantee deposits in banks as the new scheme of explicit deposit insurance in the country. Deposit insurance would guarantee savings, like other types of insurance. If disaster strikes and a bank fails, depositors' savings would be repaid up to a set limit $100,000. The deposit insurance scheme will cover bank deposits, finance companies taking deposits, building societies, credit unions and the equivalent products offered by non-bank deposit takers. Like any other countries, there are type of assets that will not be covered such as bonds, debentures, capital notes, and equities. This scheme would be funded by levies on deposit-takers. Chiaramonte et al. (2020) find the existence of non-linearities in the relationship between bank stability and limit coverage. They find that the higher limit is not linear with bank risk, even though in time of crisis moral hazard has a reversal effect to bank stability.

Moral hazard is problem of excessive risk-taking when deposit-takers take more risk in places where deposit guarantee schemes exist. Thus, deposit insurance entails costs and affects the ex-ante behavior of market participants. If there is an option not to guarantee the deposits (in return getting a higher return on the money), people with deposits will spread the risk between deposit-takers. Some studies report the presence of an explicit deposit insurance scheme tends to increase

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[4] Locally incorporated banks with retail deposits in excess 1 billion of the New Zealand dollar (NZD) are subject to the RBNZ's Open Bank Resolution (OBR) policy. The OBR policy does not apply to any New Zealand registered bank that operates in New Zealand as a branch of an overseas-incorporated bank.

the probability of a moral hazard and can increase the risk of imprudent behaviour by individual banks (Demirgüç-Kunt & Huizinga, 2004; Yilmaz & Muslumov, 2008; Ioannidou & Penas, 2010; Hwang et al., 2009). Deposit insurance tends to be detrimental to bank stability and creates a lack of market discipline. The RBNZ's view was opposed deposit insurance as it would discourage depositors from monitoring their banks. They discipline the banks by withdrawing their savings if banks engage in overly risky activities showing. However, it requires advanced knowledge (literacy) of finance. Abundant research also finds the risk of systematic bank failure.

Suljić Nikolaj et al. (2022) find that systemically important banks take riskier projects which deviate from the aim of the deposit insurance scheme and decrease financial stability in the EU. The hypothesis is if taxpayers bear the risks without any returns, depositors and bank managers will probably chase higher returns. The moral hazard issue particularly exists in high-leverage and large-size banks (too big-to-fail argument).

A risk-based approach is used to set levies that depend on risk. A fixed-rate deposit insurance scheme triggers moral hazard (Santos, 2006; Lee & Kwok, 2000). The risk-based premiums are more equitable and economically fair than those employing flat rates (Bloecher et al., 2003). Higher the risk of an entity, the higher premium that the entity needs to pay the insurer. Some issues raise on this approach as it would give banks an unfair advantage over non-bank competitors. Deposit protection schemes are typically funded with levies calculated based on the number of protected deposits individual institutions hold. In New Zealand, the credit ratings for most of its banks are A and BBB credit ratings as shown in Table 1. It is perceived the healthy capitalization of banks in New Zealand, strong asset quality, and stable profitability will offset existing risks.

Table 1. Bank rating in New Zealand

Insitution name	Primary market sector	Default rating
ANZ Bank New Zealand Limited	Universal Commercial Banks	A+
ASB Bank Limited	Universal Commercial Banks	A+
Bank of Baroda (New Zealand) Limited	Retail & Consumer Banks	BBB-
Bank of China (New Zealand) Limited	Universal Commercial Banks	Unrated
Bank of India (New Zealand) Limited	Universal Commercial Banks	Unrated
Bank of New Zealand	Universal Commercial Banks	A+
Blackwell Global Holdings Limited	Retail & Consumer Banks	Unrated
China Construction Bank (New Zealand) Limited	Universal Commercial Banks	A
Cooperatieve Rabobank U.A. New Zealand Banking Group	Bank Holding Companies	Unrated
Deutsche Bank New Zealand Banking Group	Universal Commercial Banks	Unrated
Heartland Bank Limited	Retail & Consumer Banks	BBB
Heartland Group Holdings Limited	Retail & Consumer Banks	BBB
Industrial and Commercial Bank of China (New Zealand) Limited	Universal Commercial Banks	Unrated
Kiwibank Limited	Retail & Consumer Banks	AA-
National Nominees Limited (New Zealand Branch)	Bank Holding Companies	Unrated
Nelson Building Society	Retail & Consumer Banks	BB+
New Zealand Post Group Finance Limited	Universal Commercial Banks	Unrated
Police & Families Credit Union	Retail & Consumer Banks	Unrated
Rabobank New Zealand Limited	Universal Commercial Banks	Unrated
Southland Building Society	Retail & Consumer Banks	BBB
The Co-operative Bank Limited	Retail & Consumer Banks	BBB
The Hongkong and Shanghai Banking Corporation Limited, New Zealand Banking Group	Universal Commercial Banks	Unrated
TSB Bank Limited	Retail & Consumer Banks	A-
Unity Credit Union	Retail & Consumer Banks	BB
Wairarapa Building Society	Retail & Consumer Banks	BB+
Westpac Banking Corporation New Zealand Branch	Universal Commercial Banks	Unrated
Westpac New Zealand Limited	Universal Commercial Banks	A+

Source: Bloomberg (data as of March 2022).

For non-bank institutions, most of them do not require by law to have a credit rating[5]. Thus, the levies to fund the scheme need to work for all participating entities. However, it needs lots of work as it would fall very heavily on the small institutions, and that's probably not the desired outcome.

Previous studies have been conducted in accordance with countries' experiences with an explicit deposit scheme. Bartholdy and Justesen (2021) study the risk difference between commercial banks and savings banks in Denmark after the implementation of a deposit insurance scheme. They find that commercial banks did not increase their risk under strong capital regulation in the Danish system. Cerrone (2018) examines whether the DI scheme increases banking stability and finds that deposit guarantee schemes form part of a system to maintain and enhance stability in Europe. On the other hand, Vernikov (2022) examines the cost related to social effect especially in the view of state-owned banks is very high in Russia, while bank stability in the country is not affected significantly as it leads to higher moral hazard.

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[5] Based on Reserve Bank of New Zealand, under Banking (Prudential Supervision) Act 1989, the Bank may, by notice in writing to any registered bank or to all registered banks or to all members of any class of registered banks require each of those banks to obtain a rating of its creditworthiness or financial condition by a person or organisation nominated or approved by the Bank.

3. RESEARCH METHODOLOGY

3.1. Data

We have collected all banks operating in New Zealand as our sample and we use quarterly bank-level panel data from the period from 2012 to 2021. Our sample includes 24 banks that are categorized as universal commercial banks and retail and consumer banks. The bank financial reports are collected from Osiris, Bloomberg, and the banks' financial reports, while macroeconomic data is collected from the World Bank and IMF.

We first select risk indicators and categorize the data. We use more than 70 independent variables (predictors) to be included in our model. We proxy risks as risk-weighted assets divided by total assets. The risk is our dependent variable or target variable. The list of our independent variables is presented in Table A.1 (see Appendix).

3.2. Methodology

We use several statistical approaches, including *neural networks, random forests,* and *gradient-boosted machines.* Our goal was to build a classification model to determine which important variables should be monitored to foresee bank risk. Before we apply the advanced system of machine learning to better represent large and complex data, we use generalized linear model. Finally, we choose the model that results in the least errors, as follows:

Figure 1. Results of relative error for each model
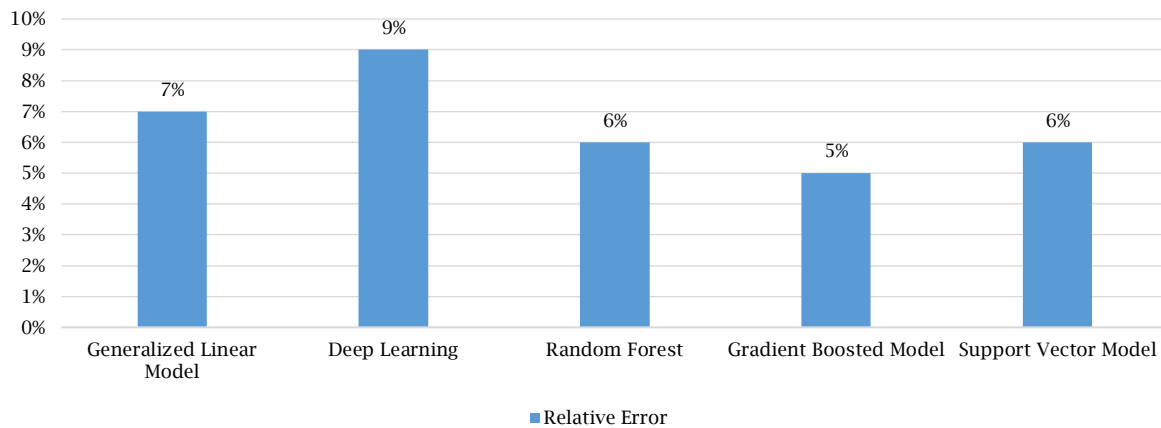
Source: Authors' calculation.

Figure 2. Results of root mean squared error for each model
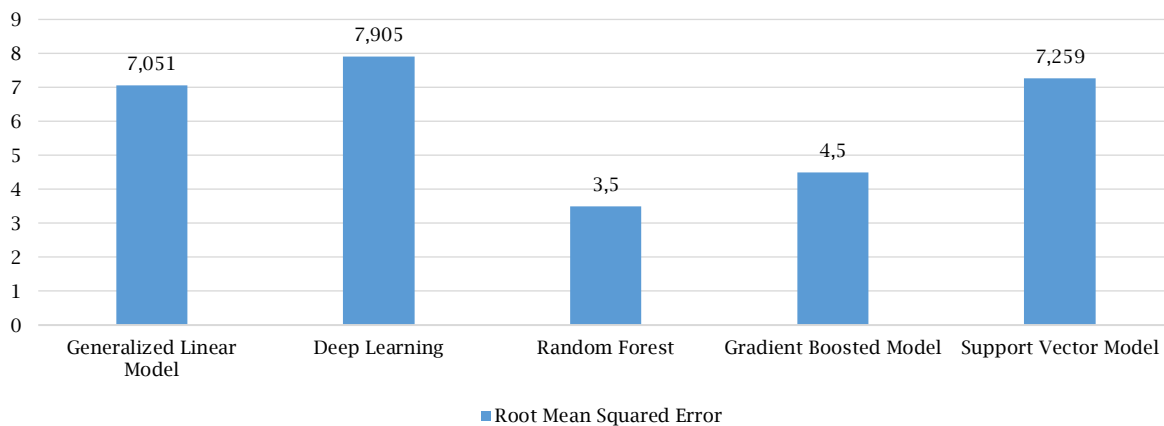
Source: Authors' calculation.

Table 2. Gradient boosted model

Model metrics type:	Regression
MSE:	0.35836658
RMSE:	0.5986373
R^2:	0.99876267
Mean residual deviance:	0.35836658
Mean absolute error:	0.35652423
Root mean squared log error:	0.034492046

Source: Authors' calculation.

Gradient-boosted model as data-driven approaches is becoming very important in many areas including finance (Chen & Guestrin, 2016). Boosting is to build a general ensemble learning models that aim to create a strong classifier from a number of weak classifiers which was originally proposed by Friedman (2001, 2002). This is done by building a model from the training data and is particularly useful to resolve classification problems as it minimizes errors by introducing supplementary models based on the errors from the first model.

4. RESULTS

The most important variables with a high relative influence on the target variable were *Equity to total assets* (40.03%), *Interest income to average earning assets* (15.81%), *Net income minus cash dividend to total equity* (14.07%), *Tier 1 capital ratio* (13.63%), and *Loans to deposits and short term funding* (10.40%). Figure A.1 in Appendix shows the weight for each variable in the model and Figure A.2 in Appendix shows the tree model. High percentages denote important features to predict the response variable (Chen & Benesty, 2016).

Depositors once put their money in the bank, it no longer belongs to them. As bank can use their money for commercial purposes. For example, lending or funding individuals and businesses than making a profit by net interest margin. Banks are high leverage because they borrow short and lend long. In the time of bank runs, most banks do not hold sufficient funds to repay all their liabilities at once. Equity to total assets shows the proportion of assets that have been funded with debt. By looking at the results, the most important variable to affect bank risks is the capital which is the same as in the study by Admati and Hellwig (2013) that find higher equity requirements could solve the moral hazard problem. They argue that when the bank has low capital, it will motivate the bank to take excessive risk. Liquidity is one of the risk management processes that banks should have in place to manage liquidity risk. New Zealand's one-week and one-month mismatch ratios are defined as the net expected cash inflow or outflow as a percentage of total funding. Banks are also required to report monthly to the RBNZ on their liquidity position and risk. However, the RBNZ has not implemented a leverage ratio. The liquidity buffer in New Zealand is also relatively limited.

We also run the prediction for New Zealand bank risk. The plot of prediction can be seen in Figure A.3 in Appendix. We suggest the calculation of risk-based premiums based on our weighted

variables that can predict bank risk. It also shows that the implementation of the capital adequacy requirement can reduce risk-taking for banks. Even though, banks in New Zealand are amongst the safest and remain "A" in rating. The sector is dominated by big Australian-owned banks which can trigger spillover problems.

5. DISCUSSION

Banks are required to maintain certain levels of capital and liquidity to provide protection from insolvency problems. One of the risks that face banks is when they can not raise capital, borrow money and sell assets due to perceived distress. The theory of moral hazard shows that banks with low levels of capital have incentives to increase risk-taking in order to exploit the value of their deposit insurance (Kane, 1995). Based on the results, the most important variable was the capital ratio. It means that, in New Zealand, banks would have to nearly double the minimum equity capital from 8.5 percent of risk-weighted assets currently to 16 percent, and the smaller banks to 14 percent. However, they are given a longer time to increase their capital (from 5 to 7 years) and use preference shares (2.5 percent of equity capital) rather than pure equity as it is cheaper. The RBNZ prefers measures of capital adequacy that differentiate between the risk of different banks' exposures. Thus, the regulator in New Zealand should take note of the tradeoff of higher levels of equity capital for risk assets. On the one hand, a higher level of risk assets may be associated with higher ROA or ROE (profitability). The results show that capital can absorb losses without interrupting the bank's business (Cihak et al., 2013) and support the view of the importance of capital for bank risk.

The interest rate was recorded low before and during the pandemic and stayed that way for some time. However, inflation now hikes and it could lead many people to benefit from leaving large amounts on deposit with a bank as banks now give a sufficient return. However, when inflation is taken into account, possibly a negative return will be received. Interest income is the second most important variable of bank risk in New Zealand. Inflation can have a negative effect on financial assets when it leads to higher interest rates. To combat high inflation, central banks mostly increase their interest rate. This will cause a high cost of funds and reduce profit or income. However, New Zealand's target of zero to 2 percent inflation will help the cost of funds lower than other developed countries.

Figure 3. Consumer price index, annual percentage change (March 1990–March 2022)
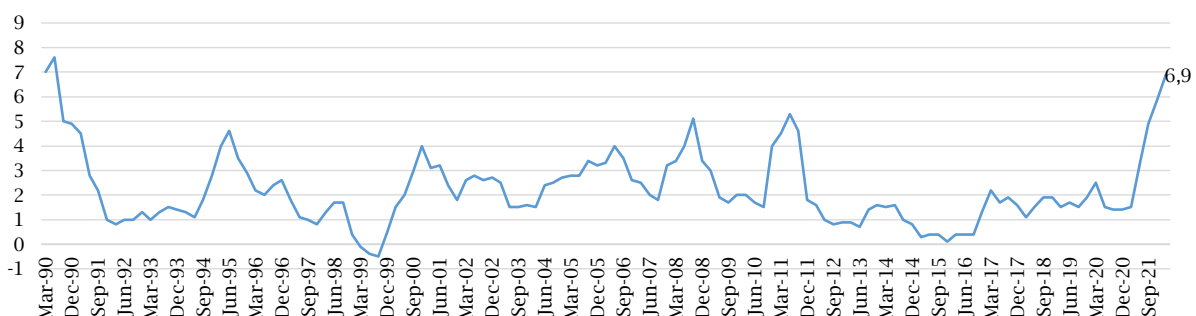
Source: stats.govt.nz.

Limit coverage is set by the regulator in order to prevent moral hazard issues (Diamond & Dybvig, 1983). However, when the limit is too low, the risk of pre-emptive bank runs increases. It also can not well protect banking stability and the economy. New Zealand sets $100,000 as the coverage limit but it is well below other comparable countries. According to Lambert et al. (2017), using data from the US deposit insurance system, the amount of deposit insurance coverage limit might increase risk-taking by lower capitalization banks.

Table 3. Bank deposit guarantees, GDP/capita

Countries	Bank deposit guarantees amount (in NZD)	GDP/capita (in NZD)	Bank deposit guarantees per GDP/capita
Australia	270,000.00	95,894.61	2.82
Canada	107,000.00	83,282.16	1.28
France	169,000.00	69,629.66	2.43
Germany	169,000.00	81,282.86	2.08
Norway	360,000.00	142,724.40	2.52
UK	161,500.00	75,734.97	2.13
USA	342,500.00	110,860.06	3.09
New Zealand	100,000.00	78,082.70	1.28
Indonesia	200,000.00	6,866.90	29.13
Hong Kong	20,526.00	79,457.01	0.26
Switzerland	167,570.00	149,531.90	1.12
Poland	168,000.00	28,545.47	5.89
Brazil	302,000.00	12,030.13	25.10

Source: IMF, World Bank.

A coverage limit of $100,000 is probably excessive for small depositors but not optimal for big ones. Substantially increasing the coverage limit probably will increase consumer confidence in a crisis situation. Based on the GDP per capita, the limit should be two to three times a country's per-capita GDP, which means that NZD100,000 is the lowest limit that New Zealand provides.

The flat rate is simpler yet imposes more moral hazard problems. Thus, the risk-based premium is preferable. In the event of a bank failing, the insurer needs to build a giant fund from the levies to cover the loss in crisis. It needs time 5 to 10 years (the common approach is over the decade) to get the fund. Otherwise, it would reduce industry profits by around 5 percent each year. Costs may be passed on to customers in the form of lower deposit rates or higher lending rates.

6. CONCLUSION

New Zealand will introduce a new deposit insurance scheme that will protect up to NZD100,000 per depositor, per institution in the event of bank failure in eligible institutions, and increase oversight of deposit takers. Following other OECD countries that have a bank explicit deposit guarantee scheme. This study proposes a calculation to find the most important variables that affect bank risk in New Zealand using gradient boosted model with a sample of 24 banks that categorized as universal commercial banks and retail and consumer banks. This paper also considers some major issues that need to be addressed for the new DI scheme in New Zealand. The results show that equity capital (more than 40% of all variables weight) is the most important variable that affects bank risk. Therefore, the banking regulator or New Zealand government should focus on capital requirements and consider risk-based premiums than flat-rate premiums for deposit insurance schemes in the country. The coverage limit is also below the comparable countries, but this coverage might increase market monitoring for banks thus decreasing moral hazard.

There are several limitations to this study. First, this study used only banks in New Zealand and focuses on banking characteristics in commercial banks and retail banks (not all types of banks in New Zealand) as the data is very limited. Second, this study uses only statistical learning (machine learning) for 70 variables. We understand that there will be more variables to capture bank risk. Therefore, further research could replicate the method using cross countries' datasets and test whether the regulation of the new deposit scheme, the limit coverage, and deposit premium, is affected by capital equity.

REFERENCES

1. Admati, A., & Hellwig, M. (2013). *The banker's new clothes: What's wrong with banking and what to do about it.* Princeton University Press. https://doi.org/10.1515/9781400851195
2. Anginer, D., Demirguc-Kunt, A., & Zhu, M. (2014). How does deposit insurance affect bank risk? Evidence from the recent crisis. *Journal of Banking & Finance, 48,* 312–321. https://doi.org/10.1016/j.jbankfin.2013.09.013
3. Bartholdy, J., & Justesen, L. G. (2021). Can strong capital regulation prevent risk-taking from deposit insurance? *The European Journal of Finance, 27*(12), 1164–1185. https://doi.org/10.1080/1351847X.2020.1860107
4. Bloecher, E. P., Seale, G. A., & Vilim, R. D. (2003). Options for pricing federal deposit insurance. *FDIC Banking Review Series, 15*(4). https://ssrn.com/abstract=883638
5. Cerrone, R. (2018). Deposit guarantee reform in Europe: Does European deposit insurance scheme increase banking stability? *Journal of Economic Policy Reform, 21*(3), 224–239. https://doi.org/10.1080/17487870.2017.1400434
6. Chen, T., & Guestrin, C. (2016, August). Xgboost: A scalable tree boosting system. In *Proceedings of the 22nd acm sigkdd international conference on knowledge discovery and data mining* (pp. 785–794). Association for Computing Machinery. https://doi.org/10.1145/2939672.2939785

7. Chiaramonte, L., Girardone, C., Migliavacca, M., & Poli, F. (2020). Deposit insurance schemes and bank stability in Europe: How much does design matter? *The European Journal of Finance, 26*(7–8), 589–615. https://doi.org/10.1080/1351847X.2019.1607763
8. Cihak, M., Demirgüç-Kunt, A., Peria, M. S. M., & Mohseni-Cheraghlou, A. (2013). Bank regulation and supervision in the context of the global crisis. *Journal of Financial Stability, 9*(4), 733–746. https://doi.org/10.1016/j.jfs.2013.10.002
9. Cooper, R., & Ross, T. W. (2002). Bank runs: Deposit insurance and capital requirements. *International Economic Review, 43*(1), 55–72. https://doi.org/10.1111/1468-2354.t01-1-00003
10. Demirgüç-Kunt, A., & Detragiache, E. (2002). Does deposit insurance increase banking system stability? An empirical investigation. *Journal of Monetary Economics, 49*(7), 1373–1406. https://doi.org/10.1016/S0304-3932(02)00171-X
11. Demirgüç-Kunt, A., & Huizinga, H. (2004). Market discipline and deposit insurance. *Journal of Monetary Economics, 51*(2), 375–399. https://doi.org/10.1016/j.jmoneco.2003.04.001
12. Diamond, D. W., & Dybvig, P. H. (1983). Bank runs, deposit insurance, and liquidity. *Journal of Political Economy, 91*(3), 401–419. https://doi.org/10.1086/261155
13. Friedman, J. H. (2001). Greedy function approximation: A gradient boosting machine. *Annals of Statistics, 29*(5), 1189–1232. https://doi.org/10.1214/aos/1013203451
14. Friedman, J. H. (2002). Stochastic gradient boosting. *Computational Statistics & Data Analysis, 38*(4), 367–378. https://doi.org/10.1016/S0167-9473(01)00065-2
15. Hoskin, K., & Woolford, I. (2011). A primer on open bank resolution. *Reserve Bank of New Zealand Bulletin, 74*(3), 5–10. https://www.rbnz.govt.nz/-/media/project/sites/rbnz/files/publications/bulletins/2011/2011sep74-3HoskinWoolford.pdf
16. Hwang, I., Kim, S., Kim, Y., & Seah, C. E. (2009). A survey of fault detection, isolation, and reconfiguration methods. *IEEE Transactions on Control Systems Technology, 18*(3), 636–653. https://doi.org/10.1109/TCST.2009.2026285
17. Ioannidou, V. P., & Penas, M. F. (2010). Deposit insurance and bank risk-taking: Evidence from internal loan ratings. *Journal of Financial Intermediation, 19*(1), 95–115. https://doi.org/10.1016/j.jfi.2009.01.002
18. Kane, E. J. (1995). Three paradigms for the role of capitalization requirements in insured financial institutions. *Journal of Banking & Finance, 19*(3–4), 431–459. https://doi.org/10.1016/0378-4266(94)00132-M
19. Lambert, C., Noth, F., & Schüwer, U. (2017). How do insured deposits affect bank risk? Evidence from the 2008 Emergency Economic Stabilization Act. *Journal of Financial Intermediation, 29,* 81–102. https://doi.org/10.1016/j.jfi.2015.07.001
20. Lee, W. S., & Kwok, C. C. (2000). Domestic and international practice of deposit insurance: A survey. *Journal of Multinational Financial Management, 10*(1), 29–62. https://doi.org/10.1016/S1042-444X(99)00018-3
21. Santos, J. A. (2006). Insuring banks against liquidity shocks: The role of deposit insurance and lending of last resort. *Journal of Economic Surveys, 20*(3), 459–482. https://doi.org/10.1111/j.0950-0804.2006.00286.x
22. Suljić Nikolaj, S., Olgić Draženović, B., & Buterin, V. (2022). Deposit insurance, banking stability and banking indicators. *Economic Research-Ekonomska Istraživanja, 35*(1), 1–18. https://doi.org/10.1080/1331677X.2022.2033130
23. Vernikov, A. (2022). Breakdown: What went wrong with deposit insurance in Russia. *Post-Communist Economies.* Advance online publication. https://doi.org/10.1080/14631377.2022.2104506
24. Yilmaz, E., & Muslumov, A. (2008). Deposit insurance and moral hazard problem: The case of Turkish banking system. *Applied Economics, 40*(16), 2147–2163. https://doi.org/10.1080/00036840600949306

APPENDIX

Table A.1. List of indicators

Interest ratio
Net interest income / Avg. earning assets (%)
Interest income on loans / Avg. gross loans (%)
Interest exp. on cust. deps. / Avg. cust. deps. (%)
Interest income / Avg. earning assets (%)
Interest exp./ Avg. interest-bearing liabs. (%)
Net interest incomeless ln. imp. charges / Av. earning assets (%)
Net interest incomeless pref. stock div. / Avg. earning assets (%)
Profitability ratio
Operating profit / RWA (%)
Non-int exp / Total operating income (%)
Loans & Securities imp. charges / Pre-imp. op. profit
Operating ROAA (%)
ROAE (%)
Operating profit/ Average equity
ROAA (%)
Net income / RWA (%)
Non-interest income / Total operating income (%)
Non-interest exp. / Avg. assets (%)
Pre-imp. operating profit / Avg. equity (%)
Pre-imp. operating profit / Avg. total assets (%)
Pre-imp. operating profit / RWA (%)
Total comprehensive income / Average total equity
Total comprehensive income / Average total assets
Total comprehensive income / Risk weighted assets
Taxes / Pre-tax profit (%)
Capital adequacy ratio
Common equity tier 1 ratio
Fully loaded common equity tier 1 capital ratio
Basel iii leverage ratio
Tangible com. Equity / Tangible assets (%)
Imp. Loans less Loan Loss Allowances / Equity (%)
Equity / Total assets (%)
Tier 1 reg. cap. ratio
Total regulatory capital ratio
Intangibles + Def. taxes / Equity (%)
Cash divs. paid & dec. / Net income (%)
Cash dividend paid & declared/ Total comprehensive income
Cash divs. & share repurchase / Net income (%)
Net income - Cash divs. / Total equity (%)
Risk weighted assets - Standardised/ Risk weighted assets
Risk weighted assets - Advanced method/ Risk weighted assets
Asset quality ratio
Imp. loans (NPLs) / Gross loans (%)
Growth of gross loans (%)
Loan loss allowances / Imp. loans (%)
Loan imp. charges / Avg. gross loans (%)
Loan loss allowances / Gross loans (%)
Growth of total assets (%)
Net charge-offs / Avg. gross loans (%)
Imp. loans + Foreclosed assets / Gross loans + Foreclosed assets (%)
Funding and liquidity ratio
Loans / Cust deps (%)
Liquidity coverage ratio
Customer deposits/ Total funding (incl. Pref. shares & Hybrids)
Interbank assets / Interbank liabs. (%)
Growth of Total Customer Deposits
Net stable funding ratio
Loans / Deps. & ST Funding (%)
Liquid assets / Total assets (%)
Liquid assets / Wholesale funding (%)
Wholesale funding / Total funding & Cap. (%)
Off balance sheet
Managed securitized assets rep. off-B/S
Other off-B/S exposure to securitizations
Guarantees
Acceptances & Documentary credits rep. off-B/S
Committed credit lines
Other contingent liabs.
Other off-balance sheet items
Total business volume
Total weighted risks
Size
Total assets - Banks
Total weighted risks
Total equity

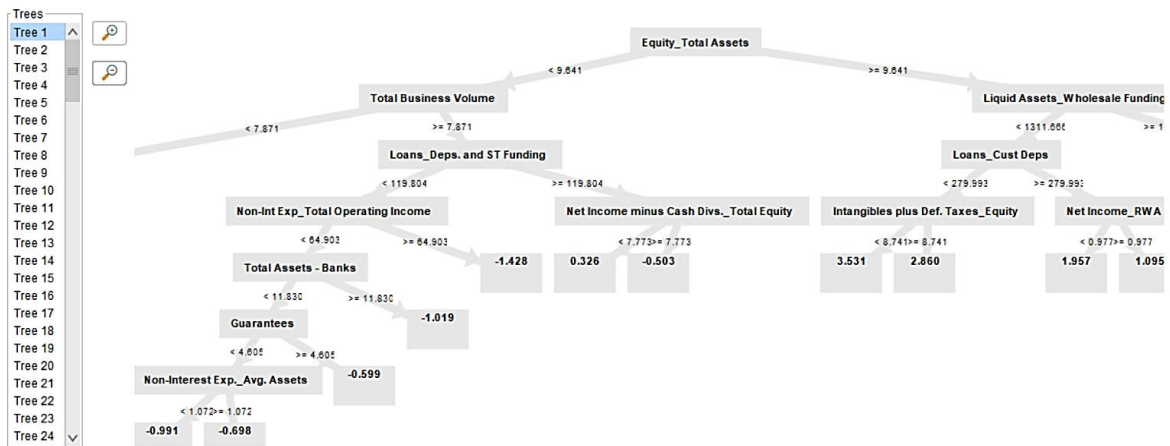*Source: Bloomberg, Osiris, Bank Financial Statement, IMF, World Bank, Authors' elaboration.*

Figure A.1. Attribute weights
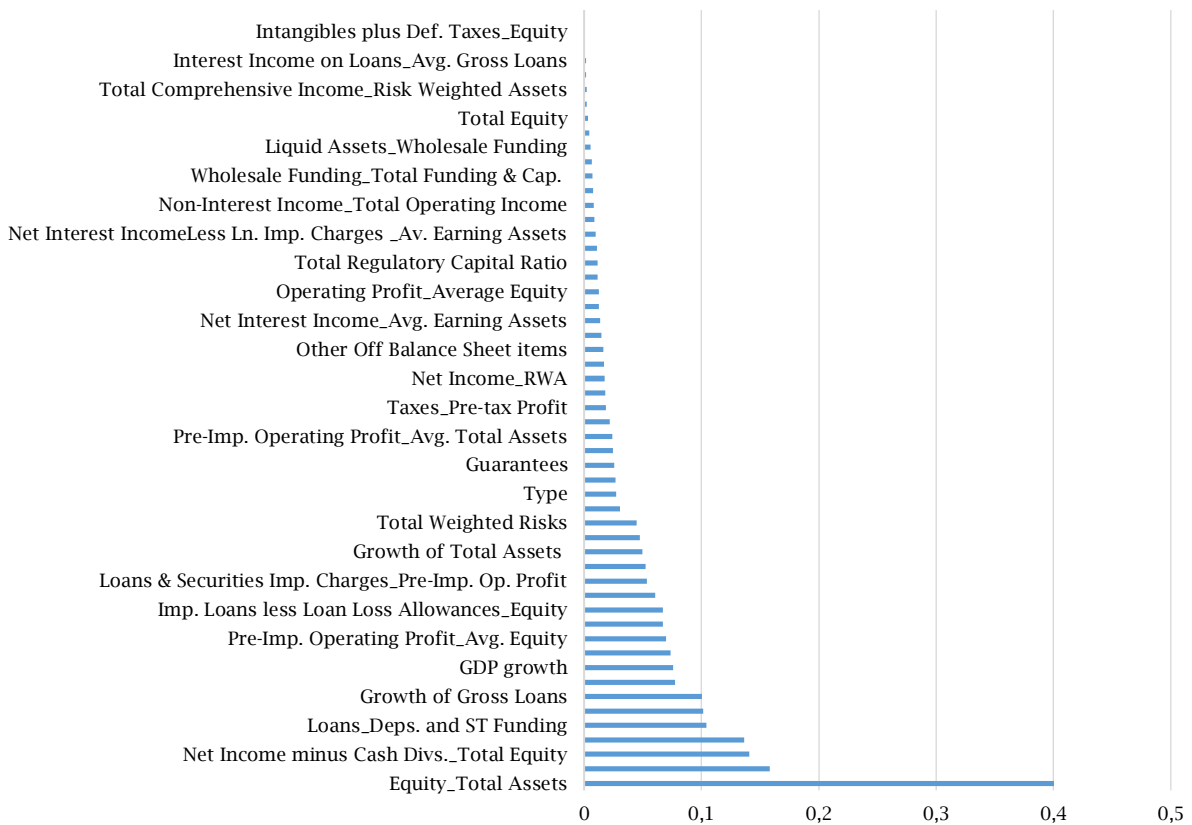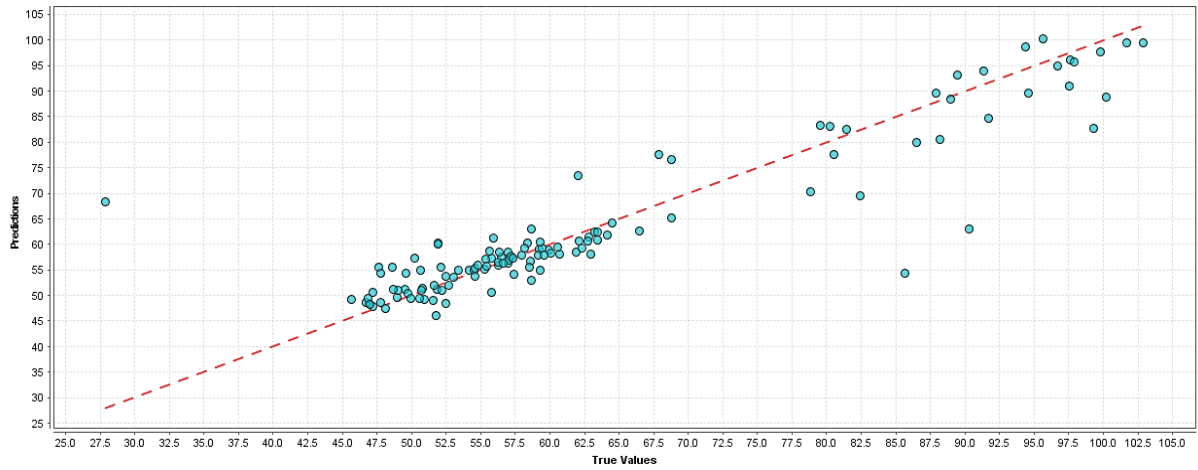

Source: Authors' calculation.

Figure A.2. Tree of gradient boosted model

Source: Authors' calculation.

Figure A.3. Prediction chart

Source: Authors' calculation.