Stress Testing the Corporate Loans Portfolio of the Canadian Banking Sector

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Stress testing identifies potential vulnerabilities in a segment of the financial system under various scenarios. Financial institutions typically perform stress tests to assess possible short-term losses owing to various types of risk (e.g., credit risk, market risk).[1] From a macroprudential perspective, however, the focus of stress testing is on identifying circumstances that could impair the functioning of the financial system and have economy-wide (systemic) implications. The results of these stress tests can be used to assess the resilience of the financial system.

Our work (Misina, Tessier, and Dey 2006) is the first on aggregate-level stress testing in the Canadian context. The approach used builds on Virolainen (2004) but, in contrast to that study, uses sector-level rather than company-level information. The need for less data facilitates implementation, and is an important feature of our approach.

We assess the performance of the Canadian banking sector's aggregate loans portfolio as a function of the changing circumstances in the different industries in which these loans reside. These circumstances are captured by sectoral default rates, which are modelled as a function of a selected set of macroeconomic variables.

This model allows us to assess the historical interrelationship between the macroeconomic environment and sectoral defaults, and to perform a series of tests under various scenarios. The scenarios selected reflect the sources of risk commonly seen as "typical" for Canada, rather than "concerns of the moment." Different scenarios can be easily accommodated within the framework developed.

This article summarizes the key features of the model, the results obtained, and possible extensions, some of which are already under way.

The Model

The corporate loans portfolio of the banking sector consists of loans to businesses. The key source of risk in that portfolio is that borrowers may default, which would result in losses for the lender. From the viewpoint of financial stability, it is the circumstances under which a large number of borrowers may default that are of interest, since this could have a potentially large impact on financial institutions and/or the economy.[2] The key features of the model are summarized in Figure 1.

Model of the sectoral default rate

We assume that defaults in the Canadian corporate sector are driven by the level of domestic economic activity and the level of domestic interest rates. A strong economy (higher GDP growth rate) would be associated with fewer defaults. Higher interest rates could affect the ability of borrowers to meet their obligations, possibly resulting in a larger number of defaults. Therefore,

$$\pi^s = f\left(\underset{(-)}{GDP_{CAN}}, \underset{(+)}{r_{CAN}}\right),$$

where π^s is the default rate in industry s. In the empirical part of the work, the default rate is proxied by the bankruptcy rate: the ratio of

1. Aaron, Armstrong, and Zelmer (p. 39 in this issue) survey the risk-management practices of banks.

2. Large losses might be a consequence of defaults by a large number of small borrowers or by a small number of large borrowers. The extent to which the latter can be taken into account in an aggregate-level stress test is debatable. The issue is discussed further in Misina, Tessier, and Dey (2006).

bankrupt companies to the total number of companies in that sector.[3]

Macroeconomic environment

The evolution of defaults will depend on the dynamics of the macroeconomic variables. We model these using a vector autoregression (VAR) system. Exogenous variables considered include U.S. GDP, U.S. interest rate, and commodity prices. Changes in these variables will affect the endogenous variables (Canadian GDP, Canadian interest rate) that enter the equation[s] for the sectoral default rate.

Portfolio loss distribution

The expected loss on a portfolio with exposures to *s* industries is

$$El_t^s = \sum_{s=1}^{S} \pi_t^s \times ex_t^s \times l_t^s,$$

where

π_t^s is the default rate in industry *s* at time *t*,

ex_t^s is the exposure to industry *s* at time *t*, and

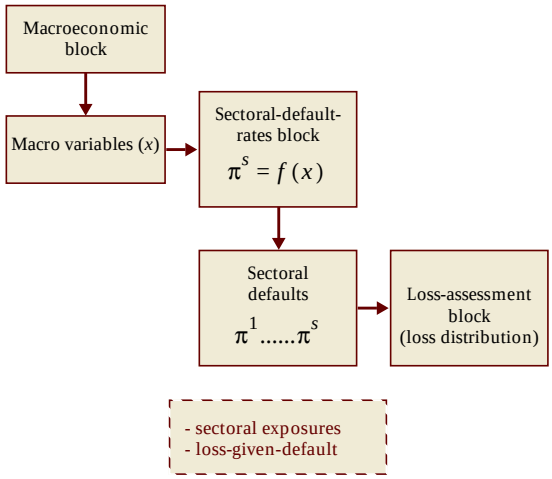
l_t^s is loss-given-default (LGD) in industry *s* at time *t*.

To arrive at a loss distribution of the loans portfolio, one has to specify exposures and LGD for each industry.

For an individual obligor, LGD at time *t* is defined as

$$l_t = 1 - rr_t,$$

Figure 1 Components of the Stress-Testing Model



3. An alternative option is to use historical default rates. Defaults, as defined by rating agencies, are broader events than bankruptcies and, in addition to actual bankruptcies, include events such as missed interest payments and "distressed exchanges" (a type of financial restructuring whose purpose is to help the borrower avoid default). Given that all these events affect banks' economic capital, one could argue that the use of default rates in the context of our exercise is preferable. Unfortunately, the data on defaults of Canadian companies prior to the mid-1990s are based on very limited company coverage.

where rr_t is the recovery rate: the amount of money that can be recovered on defaulted loans. For a given industry, the recovery rate is the average recovery rate on loans to that industry. The recovery rate for a credit portfolio is defined in a similar manner.[4]

Scenarios and Results

The key part of the stress-testing exercise is scenario selection. By "scenario" we mean a particular event (e.g., an increase in interest rates), and possibly its broader implications, that could result in significant losses to financial institutions. Scenarios can be based on historical experience or they can be hypothetical. In either case, the objective is to select as scenarios those rare, but plausible, events that have led to problems in the past or could do so in the future.

We perform a series of stress tests under different scenarios, including an increase in the U.S. interest rate, a U.S. recession, a commodity price increase, and a combination scenario (U.S. recession and a commodity price increase). The implications of each scenario for the banking sector are inferred by computing the corresponding loss distribution for the portfolio, the expected loss, as well as the 99 and 99.9 per cent value at risk.

To assess the impact of these losses, it is necessary to consider them in relation to banks' ability to absorb them. We arrive at a rough assessment by comparing the losses under different scenarios to the average historical loan-loss provisions. This exercise answers the following question: had the worst-case scenario materialized at time *t*, would the banks' provisions at that time have been sufficient to cover the losses arising from that scenario?

Overall, we find that the average historical provisions would have been sufficient to cover losses, although more work is needed to improve our understanding of both the behaviour of provisions and model results before firm conclusions can be drawn from this exercise.

Summary and Further Work

In this work, we sought to accomplish two objectives: (i) to describe an approach to aggregate stress testing that is flexible and easy to implement; and (ii) to perform aggregate stress tests to assess credit risk in the loans portfolio of the Canadian banking sector.

While we believe that we have gone some way towards fulfilling the first objective, improvements are needed both in the data and in the methods used, to make this analysis useful for regular assessments.

With regard to the data, we believe that the use of bankruptcy data as a proxy for default rates is not fully satisfactory. Bankruptcy rates will, in general, underestimate default rates, because default events (such as missed interest payments) are more frequent than bankruptcies. In addition, one would expect defaults to be more sensitive to current business conditions than bankruptcies. In the absence of reliable data on defaults, adjustments to bankruptcy rates are needed. Use of the adjusted data will affect the results obtained.

With respect to the methods, we see two major avenues for improvement: changes in the macroeconomic block and the introduction of non-linearities.

In the paper, the interrelationships among the macro variables were summarized using a reduced-form statistical model. Ideally, one would like to have a structural model that would be flexible enough to incorporate all variables of interest.

In addition, linear specification, both in the macroeconomic and the default rate blocks, is quite restrictive, since it implies that responses to shocks will exhibit, among other properties, symmetry (the impact of positive and negative shocks of the same magnitude is the same in absolute value) and history independence (the impact does not depend on the starting point). Our current work suggests that non-linearities in both modules are important and that they deliver more plausible responses.

4. In practice, recovery rates are either assumed to be constant, or are assumed to be stochastic and drawn from a particular distribution. In both cases, recovery rates are assumed to be independent of default rates. The evidence, however, seems to suggest that the recovery rates are not constant and, more importantly, that there is a link between default rates and recovery rates. There seems to have been little work on this issue to date, particularly for Canadian companies.

Improvements along these lines are currently under way in preparation for the forthcoming financial sector assessment (FSAP) exercise.[5]

References

Misina, M., D. Tessier, and S. Dey. 2006. "Stress Testing the Corporate Loans Portfolio of the Canadian Banking Sector." Bank of Canada Working Paper No. 2006-47.

Virolainen, K. 2004. "Macro Stress Testing with a Macroeconomic Credit Risk Model for Finland." Bank of Finland Discussion Paper No. 18/2004.

5. Work on non-linearities is described in the report on p. 49.