Macroeconomic Factors Impacting Bank Risk in the U.S.

An econometric analysis

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Abstract

As an economic agent, the core function of a bank is to mobilize funds from various sources, in the form of equity, market borrowings and deposits, disburse the same in loans and advances, and, make investments in productive segments of the economy. Through this process, the bank undertakes enormous risk on its book and charges interest to compensate it. During the loan appraisal process, it is vital to assess the underlying risk of the assets so as to price it correctly.

In this paper, we have presented our views on assessment of such risks with a focus on factoring the risks arising out of the macroeconomic factors. Specifically, we have modelled the impending state / province level risks.

Acknowledgements

1. INTRODUCTION

The core activities of a bank are to raise funds through deposits and market borrowings, and deploy the same through loans and advances and various investments. Through this process, the bank undertakes enormous risk on its book and charges interest to compensate it. During the loan appraisal process, it is vital to assess the underlying risk of the assets correctly. One of the underlying risk factor is the macroeconomic conditions.

Macroeconomic dynamics of different states or provinces of a country are different, although, those are largely driven by the federal or central level economic policies and conditions. Hence, it is important to capture impending macroeconomic risk of a state. In this paper, we have provided a generic model to assess such risk and taken the example of the United States of America and some of its states to demonstrate the model. We have also provided the framework through which such a model can be developed which, obviously, should vary based on nature of the bank and its portfolio characteristics.

1.1 Problem statement

For the purpose of objectivize the problem, we have worked with a specific problem statement, which is, as follows:

"How could we anticipate economic slowdown in an USA state?"

The model would take macroeconomic data as predictors of credit risk sentiments of a state. Such model should be flexible enough to complement credit strategy of a bank with the addendum of state specific idiosyncratic factor. More specifically, our model can be used to capture this idiosyncrasy.

1.2 Approach

To develop the model, broadly, we have adopted an approach where we have executed the following steps, in sequence.

- **Network analysis**: Studying the macroeconomic factors and how they interact with each other, leading to provide understanding of the important factors

- **Factor selection**: The network analysis provides a set of important factors, such as, income, purchasing powers, ease / affordability of accessing capital, productivity and policy prudence by the local government. Based on availability and relevance, a set of variables have been selected within these factors.

- **Factor scoring**: We have created a set of derived variables to capture the risk level and direction stemming of the variable. A three-point scoring, called Red-Amber-Green (RAG) has been used. Further, based on our experience of working with financial institutions of similar nature, we have given weights to the variables as per their importance.

- **Score aggregation**: Weighted average of scores will contribute to final risk level / direction of a state.

2. MODEL BUILDING

This section contains the steps of developing the model under discussion. The steps, those we have followed, are network analysis, factor selection, factor scoring and score aggregation. Details of those are given below.

2.1 Network analysis

We studied the important economic factors and their relationships with the credit worthiness of borrowers. We covered the factors which impact directly as well as indirectly (up to 5th degree). The relationship is depicted in Exhibit 1.

Exhibit 1: Factors impacting the credit risk of borrowers
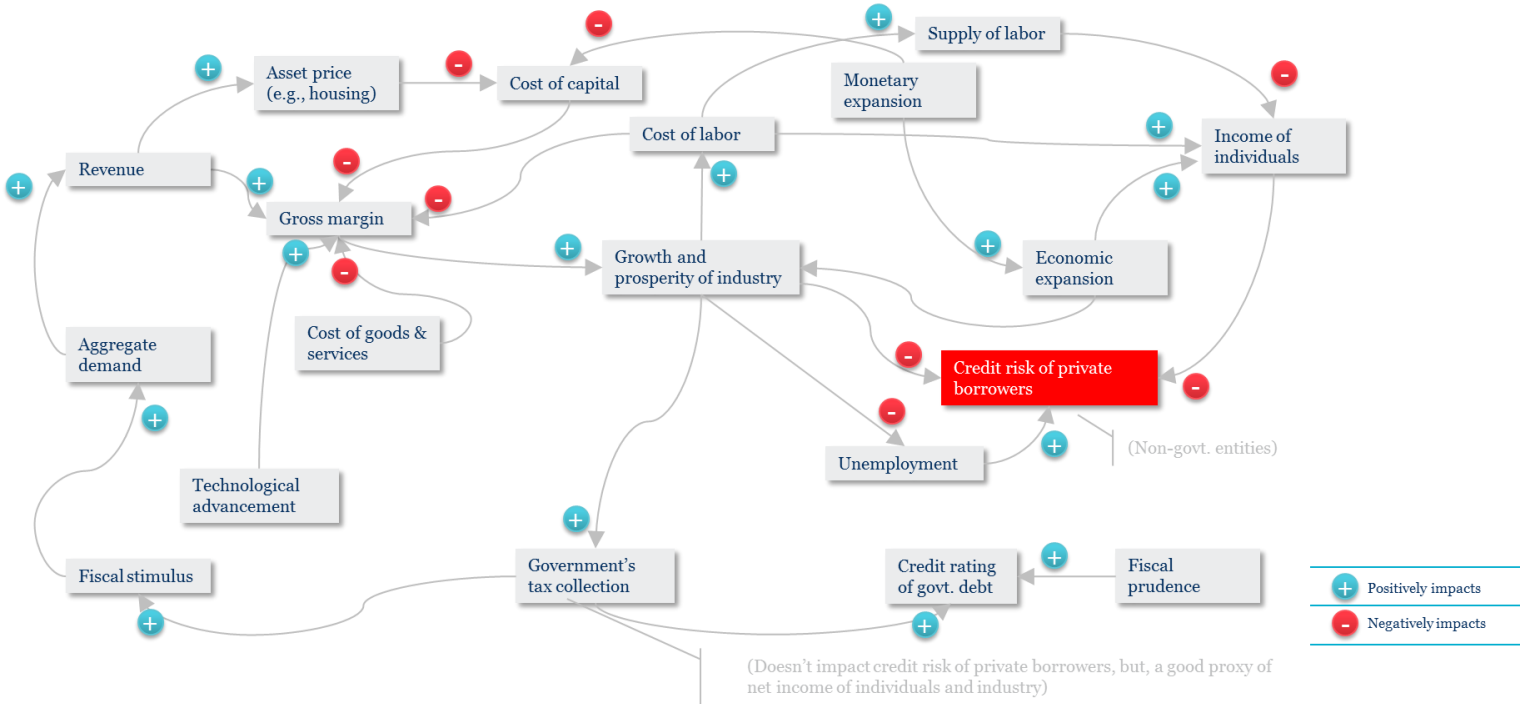

2.2 Factor selection

Based on the causality analysis and our experience of developing these models using statistical tools, we have shortlisted five broad categories to be involved in the subsequent step of the model

building. These categories are income of private entities, their purchasing power, cost of capital, productivity, and, governance and policy prudence.

Based on their importance and sensitivity to the standard credit risk indicators, we have weighed them. In this analysis, we have decided the variables keeping a retail and small business loan portfolios in mind. Hence, income of individuals / entities become prime risk factor, and hence, deserves highest weights. Similarly, the S&P rating of muni bonds, have historically been proven as less significant, although important, for these kind of portfolios. Accordingly, we have weighted it less in this balance scorecard approach. The details have been described in Exhibit 2.

Exhibit 2: Economic parameters and their weights

Category	Economic factor	
Income of private entities	Real per capita personal income	1
	Unemployment Rate	2
	Tax Collection, which is a good proxy for income	3
Purchasing Power	Consumer Price Index (CPI)	4
	Wholesale Price Index (WPI), which is less relevant than CPI in this context	5
Cost of capital	Cost of equity	6
	Cost of debt (long term and short term interest rates) – measured through asset price	7
Productivity	GDP and GDP growth rate	8
	Industry performance	9
Governance and Policy Prudence	Credit rating of Govt. debt (Muni)	10
	Fiscal prudence	11
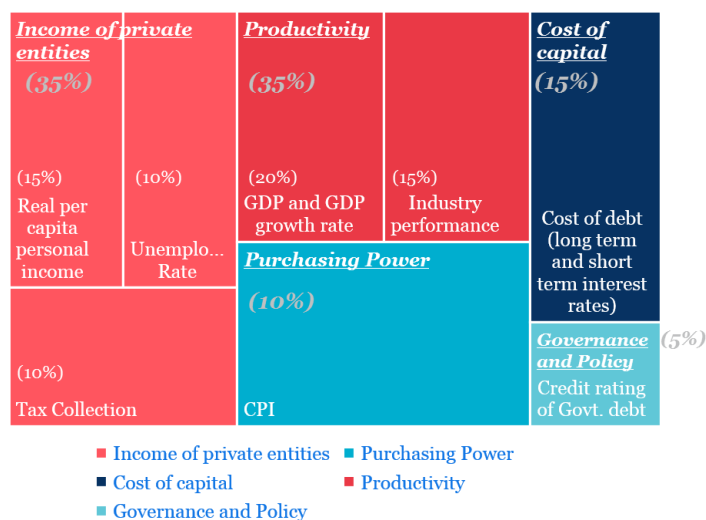
Note: the variables, those are highlighted in red, variable number 5, 6 and 11, have been excluded from the model as those are relatively less relevant than others

2.3 Factor scoring

The above-mentioned economic factors are to be measured through economic variables. Each factor can be measured through one or more variables. In our model, most of the variables are numeric in nature. The variable values are converted to three points risk factors, called, Red, Amber and Green. Further, the Red, that signifies high risk, has been assigned a numeric value of 1, the Amber, medium risk, bear value 2, and, the Green, low risk, have value 3.

Real per capita income serves as a measurement of the stability and wealth of individual, as well as, assesses an area's affordability. Investments in areas with higher per capita income is expected to yield a higher return. A few variables which we have used are ratio of annual per

capita income for the state to that of the USA for the latest year and year-over-year growth rate of annual per capital income of the state.

Unemployment rate: Rising unemployment is seen as a sign of a weak economy, with slow growth and little spending. Unemployment causes a loss in disposable income which becomes a ripple effect. And, companies face less demand for their products as people have less income. This necessarily results in low credit worthiness of borrowers, and, hence, more defaults are observed. A few variables which we have used are slope of linear trend of unemployment rates in last eight quarters and the quarterly average of the ratio of quarter-over-quarter growth in the state to the national average.

State tax collection: Greater tax collection indicate higher taxable income of the people i.e. higher wages. This will create an increasing consumer spending and also enhancing the ability to repay debts. Again, increase in tax collection will indicate more investment in technology, education, etc. which in turn will create more jobs, and hence more income for the people. Thus, increased amount of tax collected is an indicator of more jobs, more income, improved standard of living and hence a healthy and growing economy. A few variables which we have used are year-over-year percentage growth for respective states and percentage contribution to total US tax collection.

Consumer price index (CPI) measures changes in the price level of basket of consumer goods and services purchased. Inflation is a function of the supply and demand for money, it helps increase production. More dollars translate to more spending, which equates to more aggregated demand which results in more production. Increasing CPI also makes it easier on debtors, who repay their loans with money that is less valuable than the money they borrowed. This encourages borrowing and lending. An important variable which we have used are inflation of the state.

Housing price index (HPI) measures average price changes in repeat sales or refinancing on the same properties. House being the best long term asset, a rise in house prices increases the wealth of householders. Increasing HPI indicate more demand and less supply in economy. Banks can lend more on the basis of the increased price of the house and households could use this bigger loan to spend on other items. Also, householders can take equity withdrawal from the increased value of their house. This can create a significant increase in consumer spending and also increasing ability of consumers to repay. Increasing house price is a good indicator of benign long term interest rate regime which is good for general business activities. An important variable which we have used is a ratio of quarter-over-quarter percentage growth for respective states to that at the national level.

Gross domestic product (GDP) is an estimate of the total value of goods and services produced in a country, which in turn implies more jobs and decreasing unemployment, hence, more income.

As income of the people increases, standard of living and ability to repay debts increases. Thus, an increasing GDP indicates an overall growth of the economy. A few notable variables are standing (percentile) of a state's GDP growth amongst its peers and ratio of that of a state to the national average.

Industry performance: Economic growth is an increase in the capacity of an economy to produce goods and services, compared from one period of time to another. Industrial growth and better performance of industries indicate production of more goods & services and hence more jobs and less unemployment, more tax collection which in turn will aid economic growth and increasing ability of consumers to repay. We have compared the performing / non-performing industries at the national level with those at the state level. We have also measured the importance of specific industries in overall economies of a state and assessed their performance and outlook to decide the risk factors.

S&P Ratings: It reflect a state's ability to pay debts and the general health of the state's economy. A higher credit rating indicates lower interest costs. If a state receives a lower ranking, or its credit rating is downgraded, the cost of borrowing goes up, which can negatively affect a state's budget and growth expenditures. We have studied the long term rating grades for last three years and their directions in those three years.

2.4 Score aggregation

Using the variable scores, as described in section 2.3, and their weights, as described in section 2.2, we calculated the aggregate risk score of a state. The results, back-testing and interpretations will be described in section 3.

3. RESULTS

In this paper, we have shown results for 15 states of the USA. The calculated scores are given in Exhibit 3: Risk score of 15 states.

Exhibit 3: Risk score of 15 states

States		Income of Private Parties (35%)				Purchasing Power (10%)	Interest Rate (15%)	Productivity (35%)				Governance & Policy (5%)	Final Ranking
		Real per capita Personal Income (15%)	Unemployment Rate (10%)	Tax Collection (10%)	Combined1	CPI (Region wise Rating) (10%)	HPI (15%)	GDP (20%)	Industry Performance (15%)	Combined 2		S&P (5%)	Score
Alaska	AK	1	1	2	1.3	2	1	1	1	1.0		2	1.3
California	CA	2	2	3	2.3	2	3	3	2	2.6		2	2.5
Colorado	CO	3	3	2	2.7	2	3	2	2	2.0		2	2.4
Florida	FL	2	2	2	2.0	3	3	3	3	3.0		3	2.7
Georgia	GA	2	2	3	2.3	3	2	3	3	3.0		3	2.6
Iowa	IA	3	3	2	2.7	3	1	1	2	1.4		3	2.1
Mississippi	MS	2	2	2	2.0	3	1	1	2	1.4		2	1.8
New Jersey	NJ	3	2	2	2.4	3	1	1	3	1.9		1	2.0
New York	NY	3	2	2	2.4	3	1	1	2	1.4		3	2.0
North Carolina	NC	1	2	2	1.6	3	2	2	3	2.4		3	2.2
Oregon	OR	2	2	3	2.3	2	3	3	3	3.0		3	2.7
Utah	UT	2	3	2	2.3	2	3	3	2	2.6		3	2.5
Washington	WA	3	2	3	2.7	2	3	3	2	2.6		3	2.7
West Virginia	WV	2	2	2	2.0	3	1	1	1	1.0		2	1.6
Wyoming	WY	3	2	2	2.4	2	1	1	1	1.0		3	1.7

We have defined risk score [1.0, 2.0] for low risk category (marked with green color), risk score (2.0, 2.3] for medium risk category (marked with amber color), and, risk score (2.3, 3.0] for high risk category (marked with red color). For the sake of conservatism, and various other reasons, we are biased towards high risk scoring.

When the above-mentioned scores are plotted in a map, the complete information is revealed in intuitive manner.

**Exhibit 4: Plot of risk scores**
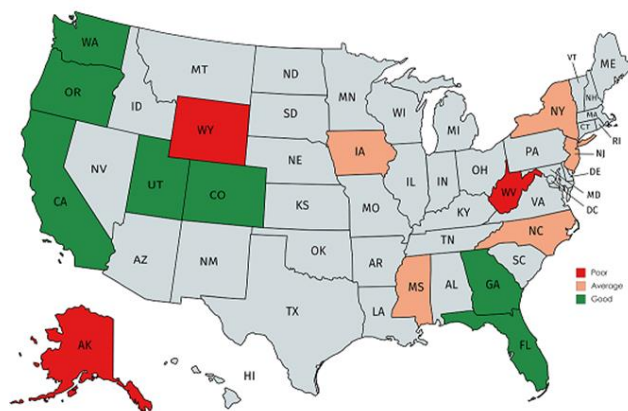
For this specific analysis, we have tested out results against the state-wise economic conditions and their rankings. This exercise was carried out by the McKinsey & Company and published at https://www.usnews.com/news/best-states. The framework has also been used to assess the stability of the variable definitions by way of assessing the risk-level directions across business cycles, including, but not limited to, the recession of 2008-09.

4. IMPLEMENTATION AND USAGES

There are three steps for implementing this framework, namely, data collection, calculations and decision of risk level and directions. Data needs to be collected from various sources, some are public and some may be subscribed by the bank. All data need to be validated and the collection process need to be audited periodically. We have observed that macroeconomic data vary from source to source primarily because of variation in data definitions and collection methodologies. Calculations are straight forward and not resource intensive. Hence the same can be implemented in spreadsheet or existing risk management platform. However, if the data quality methods are to be included, specialized software may be required. The calculation step should include risk outlook in addition to the risk levels. The forward looking risk outlook, which is an important decision making parameter, can be calculated in many ways, simplest of which is percentage difference from previous time period. If the risk score has increased by a threshold, say, 10%, the risk outlook can be "increasing", if decreased by 10%, the risk outlook can be "decreasing" and "stable" otherwise. A few other simple approaches can be to fit a trend line and moving average.

Exhibit 5: Implementation and usage mechanism
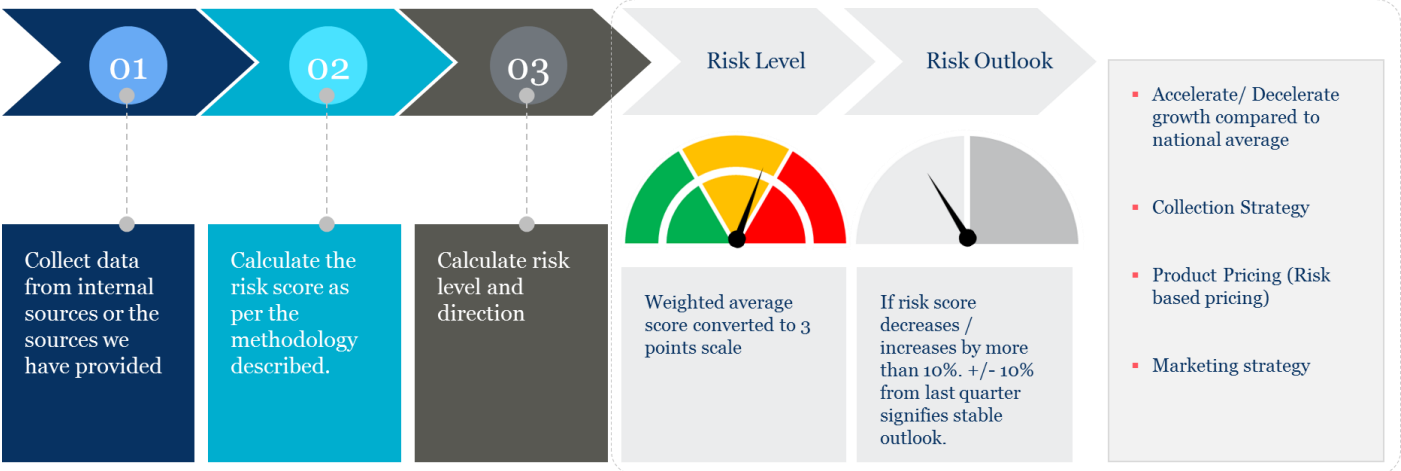
These kind of frameworks usually considers data of recent past, such as, latest three years, as too much old data may not be relevant for the existing business cycle. Hence, these do not require to store too much old data which eases the implementation processes. However, during the framework development phase, old data should be considered for ensuring stability of the framework.

In this analysis, we have used quarterly data for latest three years. However, more or less frequent data can be used as well. A bank should assess the relevant variables, based on its portfolio risk characteristics, and frequency of data, based on its internal policy, to customize the framework best suitable for them.

5. CONCLUDING REMARKS AND RECOMMENDATIONS

As we have worked with various financial institutions of varying sizes and kinds, and, participated in many other discussions, we have felt that a scientific and well governed framework is necessary in taking state specific business decisions related to advances portfolios. Such decisions could involve loan growth strategy, collection strategy, product pricing (risk based pricing) and marketing strategy. This framework is designed in such a way that it complements a country-level strategy and not to be used as a standalone decision making framework. This framework can also be extended for other portfolios, such as, investment, deposits and liabilities, after identifying the right variables through network analysis.

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