# SOVEREIGN AND MUNICIPAL DEFAULT PROBABILITY RESEARCH

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May 2013

# History of U.S. Municipal Ratings

# Pre-1940

- 1918: Moody's begins publishing annual Municipal and Government Manual. The manuals include bond ratings and are purchased mostly by investors.
- 1929: 55% of US munis are rated Aaa and another 23% are rated Aa.
- 1933: Peak of muni default wave. Most defaults caused by over-bonding, poor revenue source diversification, property tax delinquencies and bank closures/bank holidays
  - Over 4700 muni defaults during the 1930s.
  - 10-Year default rate for 1929 Aaa rated munis is 10%.
  - 10-Year default rate for 1929 Aa rated munis is 25%.
  - Overall, munis *underperform* corporates in each rating category.
- 1939: 1% of US munis are rated Aaa and 14% Aa.

“ ”
...

*This shortcoming of inadequate analysis is natural, indeed, in view of the size of the task. For instance, the 1937 industrial manual of Moody lists 5,032 companies on which statistical information has been gathered and prepared; 691 bond issues of these companies have been rated. The utility staff of the same agency covered 1,986 companies "fully" and added short paragraphs on a further 347 units; 1,547 public utility bonds were selected for rating. As to railways, 1,597 roads are listed with 1,668 issues rated.* ***The municipal manual discussed 14,711 taxing bodies and rated 4,816 securities of 3,704 issuing units. One cannot escape being impressed by the volume of expensive work involved - and by the conclusion that a uniform pattern of rating, making all these different issues comparable with one another in terms of some nine grades, handled by a large staff of moderately paid analysts with necessarily divergent experiences, biases, and opinions, can only be applied if based on none but obviously visible and easily comparable features.*** *The staggering cost of detailed study of some 23,000 issuing units, or even of the almost 9,000 rated issues, is prohibitive. Accordingly, the responsible agencies advise the customer not to rely upon the ratings alone but to use them together with the text of the manual and even to buy special investment advisory services which they are ready to supply. The candid observer cannot help wondering whether it would not be a still more responsible attitude to stop the publication of ratings altogether in the best interest of all concerned.*

- ***Melchior Palyi, Journal of Business of the University of Chicago, January 1938***

# Mid 20th Century

- 1949: S&P starts issuing muni ratings. Small issuers given the option to pay for a rating.
- 1963: Moody's and S&P rating levels remain near post-Depression lows despite two decades of minimal defaults.
- 1965: Moody's downgrades New York City from A to Baa; S&P follows in 1966. Resulting controversy triggers Congressional hearings, a book-length study by the 20th Century Fund and other investigations.
- 1968: S&P migrates to the issuer-pays model for all munis. Moody's follows shortly thereafter.
- 1971: Ambac pioneers the monoline insurance industry. MBIA formed in 1974.

**“…”**

*[N]o one, including some of the analysts involved, with whom we have spoken, with whom others that we know have spoken at very great length indeed, are quite sure what a rating is based upon. The criteria are foggy. The rating services maintain a sort of an aloofness and are not too willing to discuss with the representatives in municipal offices of cities what it is about the city that occasions the upward or downward move in a rating.*

- ***Roy Goodman, Director of Finance, New York City, In Congressional Testimony, Dec. 5, 1967***

# Recent History

- 1999: Fitch study finds that post-1979 default rates in most muni sectors were very low, suggesting that municipal ratings and corporate ratings are not comparable. Moody's reports similar results in 2002.
- 2002: Hedge fund manager Bill Ackman issues a research report on MBIA revealing that it is 139 times leveraged and thus not deserving of its AAA/Aaa rating
- 2008: California Treasurer Bill Lockyer reports that California paid $102 million for "unnecessary" municipal bond insurance; Moody's Laura Levenstein claims that the dual muni/global ratings scale dates from 1920; Connecticut Attorney General Richard Blumenthal sues rating agencies over inconsistencies between muni and corporate rating scales

“ ...”

*All three credit rating agencies systematically and intentionally gave lower credit ratings to bonds issued by states, municipalities and other public entities as compared to corporate and other forms of debt with similar or even worse rates of default, Blumenthal alleges.*

*As a result of these deceptive and unfairly low ratings, Connecticut's cities, towns, school districts, and sewer and water districts have been forced to spend millions of taxpayer dollars to purchase bond insurance to improve their credit rating, or pay higher interest costs on their lower rated bonds.*

*"We are holding the credit rating agencies accountable for a secret Wall Street tax on Main Street -- millions of dollars illegally exacted from Connecticut taxpayers," Blumenthal said. "Connecticut's cities and school districts have been forced to spend millions of dollars, unconscionably and unnecessarily, on bond insurance premiums and higher interest rates as a result of deceptive and deflated credit ratings. Their debt was rated much lower than corporate debt despite their much lower risk of default and higher credit worthiness.*

-***Connecticut Attorney General’s Office Press Release, July 30, 2008***

# The Financial Crisis to Today

- Most monoline insurers go bankrupt or suffer multiple-notch downgrades (due to insuring toxic MBS and CDOs)
- Auction rate market freezes
- In April 2009, Moody's places the entire muni sector – i.e., all issuers – on negative outlook
- In December 2010, Meredith Whitney panics the muni market by incorrectly forecasting 50-100 or more sizeable defaults in 2011
- Connecticut lawsuit is settled for $900k of credits for future ratings services and no admission of guilt
- Annual muni bond default rates remain low. Default rates on rated munis and General Obligations remain even lower

# Takeaways

- Municipal bond ratings performed poorly during the Depression.
- Rating agencies (over)-reacted by severely grading municipalities for the next 70 years, creating the so-called dual ratings scale.
- Severe municipal ratings gave rise to the monoline bond insurance industry, which received billions of taxpayer dollars and then blew itself up by using proceeds to insure toxic structured finance assets.
- Problems occurred under both the issuer-pays and investor-pays models. Issues with municipal bond rating quality are only partially explained by incentives; the real problem has been insufficient rigor.

# What the Market Needs

Municipal bond assessments that:

- Are based on thorough research of historic credit performance and issuer-specific financial conditions rather than conjectures and generalizations
- Rely primarily on quantitative approaches (given the large number of issuers together with the expense and subjectivity of analytical talent)
- Are transparent and thus clearly understood by participants on both the buy and sell sides

These comments apply to sovereign ratings as well.

# Depression Era Default Research & Modeling

# Municipal Credit Scoring

## Goal:

- Use empirical methodology to calculate credit scores for California (and potentially other US cities)

## Approach:

- Use a composite of financial statistics published in each city's Comprehensive Annual Financial Report
- Fully transparent methodology
- Score should take the form of a default probability

## Benefits

- Easy to keep current
- Can be applied to *all* issuers – even those that don't purchase bond ratings

# Why a Default Probability?

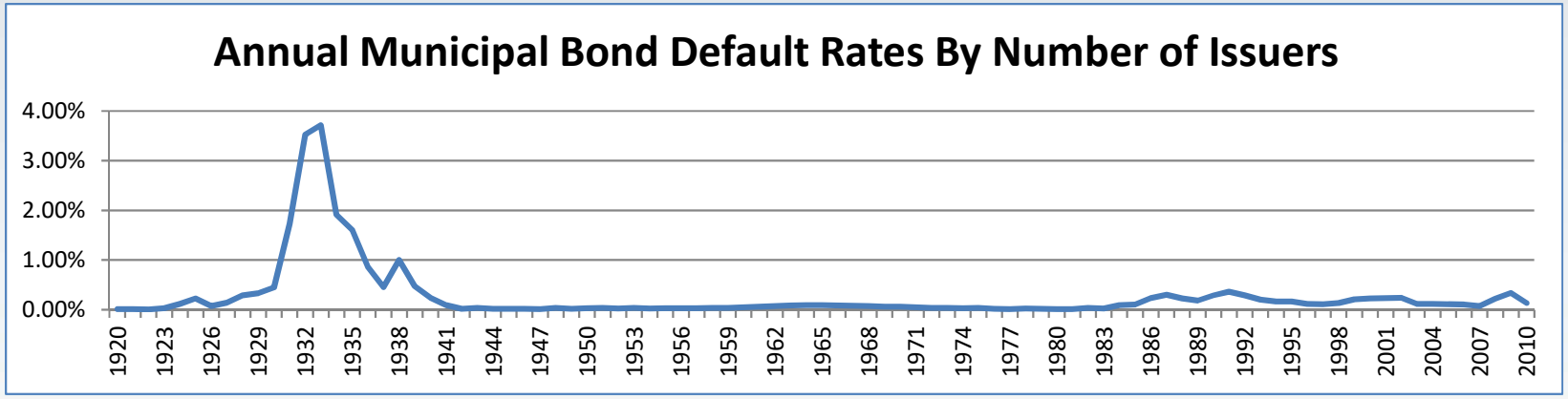
- Default probability scores would allow us to estimate “fair value” yields for municipal bonds
- Other components of fair value include:
  - Recovery rate
  - Risk premium
  - Tax treatment adjustments
- Fair value (aka intrinsic value) calculations are common for corporate and structured bonds – we could improve transparency and liquidity by applying this technique to munis
- A widely accepted system that translates fiscal changes to updated default probabilities and fair bond yields would assist issuers in analyzing the debt service impact of their policy choices

# Estimating Default Probabilities

- Different types of models have been developed for different asset classes.
- The most relevant asset class for our purpose is debt issued by private (i.e., unlisted) firms such as Moody's Riskcalc.
- The dominant methodology for estimating private firm default probability involves the following:
  - Gather data points for a large set of firms that have defaulted and for comparable firms that have not defaulted
  - Use theory and statistical analysis to determine a subset of variables that distinguish between defaulting and non-defaulting firms
  - Use statistical software to fit a model on the selected variables. Data for current issuers can then be entered into the model to calculate their default probabilities
- George Hempel applied a similar approach to municipal bonds in a 1973 study, but only had access to a small data sample.

# Applying this Approach

- Problem: Lack of recent defaults.
  - Income Securities Advisors' database contains fewer than 40 general obligation bond defaults between 1980 and mid-2011.

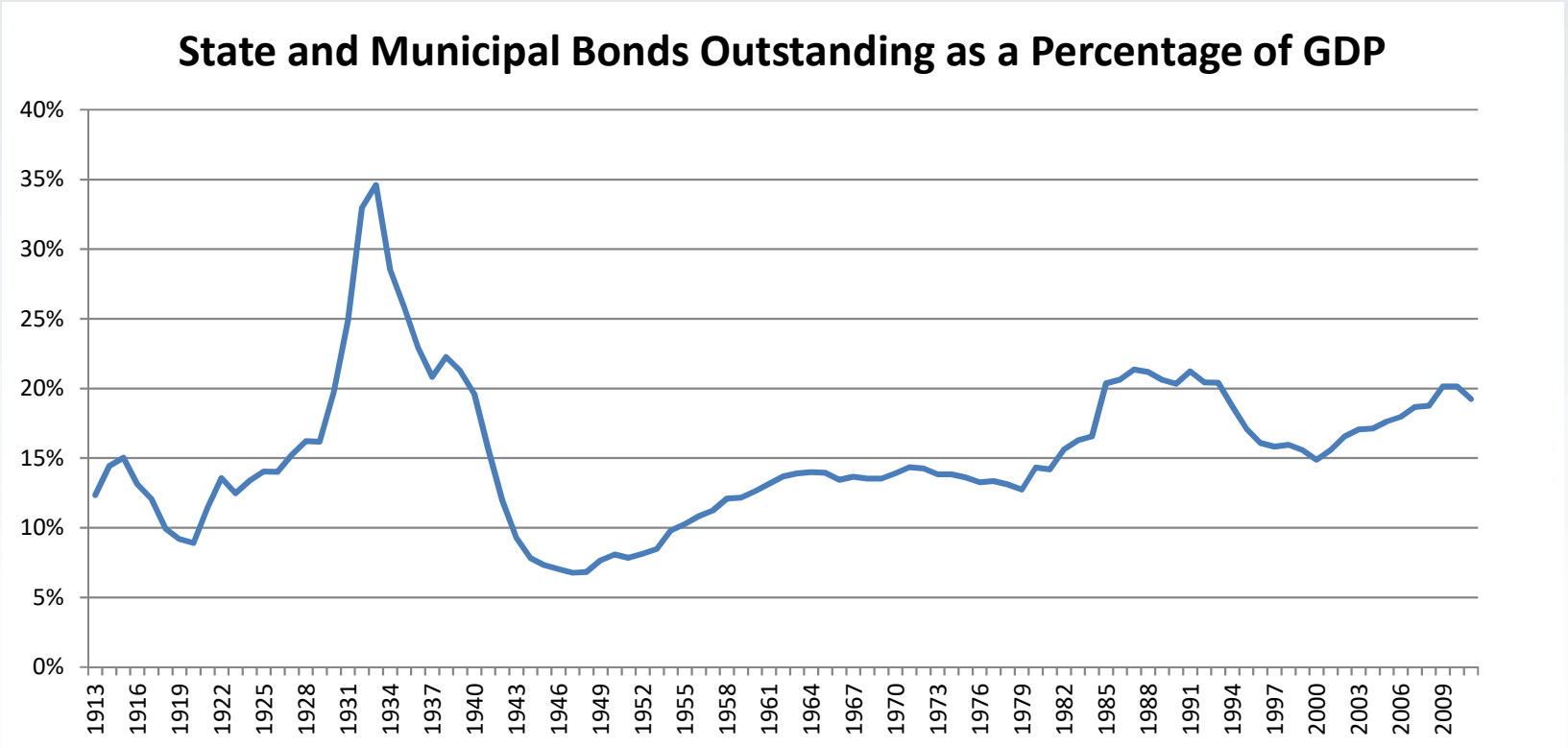



*Source: Kroll Bond Rating Municipal Bond Study (2011). Public domain data collected by and in possession of PSCS.*

- Solution: Follow the example of Reinhart & Rogoff (2009) by looking at older defaults.

# Will the Depression Muni Experience Repeat?

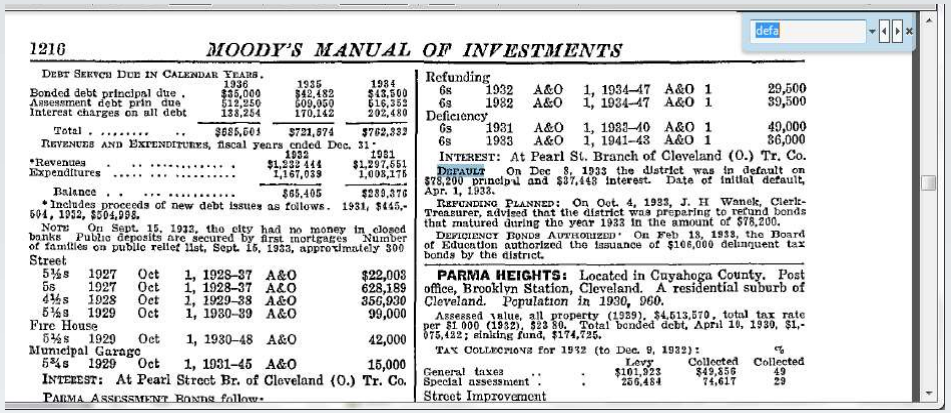
Unlikely: We have not seen a buildup of municipal bond debt relative to GDP similar to the one that preceded the Depression. Municipal issuance surged after WW I as investors demanded tax free bonds and governments needed to build roads to accommodate newly popular automobiles.




*Source: Kroll Bond Rating Agency Municipal Default Study, 2011. Public domain data collected and in possession of PSCS.*

# Gathering Depression-era Default Data

- Sources
  - Old Moody's bond manuals
  - Old Census reports
  - Newspaper accounts
  - Records at state archives
- Technologies
  - Some resources on Google books
  - Library material needs to be photographed with proper lighting and a good camera
  - Photographs can be processed by Abbyy FineReader, which perfoms Optical Character Recognition and can convert inputs to PDFs or spreadsheets
  - Older material is usually too difficult to process automatically so offshore data entry personnel were used



1216 MOODY'S MANUAL OF INVESTMENTS

DEBT SERVICE DUE IN CALENDAR YEARS.

| | 1936 | 1935 | 1934 |
|---|---|---|---|
| Bonded debt principal due | $35,000 | $42,482 | $43,500 |
| Assessment debt prin due | 512,250 | 509,950 | 516,352 |
| Interest charges on all debt | 138,254 | 170,142 | 202,480 |
| Total | $685,504 | $721,574 | $762,332 |

REVENUES AND EXPENDITURES, fiscal years ended Dec. 31:

| | 1932 | 1931 |
|---|---|---|
| *Revenues | $1,223,444 | $1,297,551 |
| Expenditures | 1,167,039 | 1,093,175 |
| Balance | $65,405 | $203,376 |

*Includes proceeds of new debt issues as follows. 1931, $445,504, 1932, $504,938.

NOTE. On Sept. 15, 1933, the city had no money in closed banks. Public deposits are secured by first mortgages. Number of families on public relief list, Sept. 15, 1933, approximately 300.

| | | | | | |
|---|---|---|---|---|---|
| Street | | | | | |
| 5½s | 1927 | Oct | 1, 1928–37 | A&O | $22,008 |
| 5s | 1927 | Oct | 1, 1928–37 | A&O | 628,189 |
| 4½s | 1928 | Oct | 1, 1929–38 | A&O | 356,930 |
| 5½s | 1929 | Oct | 1, 1930–39 | A&O | 99,000 |
| Fire House | | | | | |
| 5½s | 1929 | Oct | 1, 1930–48 | A&O | 42,000 |
| Municipal Garage | | | | | |
| 5¾s | 1929 | Oct | 1, 1931–45 | A&O | 15,000 |

INTEREST: At Pearl Street Br. of Cleveland (O.) Tr. Co.

PARMA ASSESSMENT BONDS follow:

| | | | | | |
|---|---|---|---|---|---|
| Refunding | | | | | |
| 6s | 1932 | A&O | 1, 1934–47 | A&O 1 | 29,500 |
| 6s | 1932 | A&O | 1, 1934–47 | A&O 1 | 39,500 |
| Deficiency | | | | | |
| 6s | 1931 | A&O | 1, 1932–40 | A&O 1 | 49,000 |
| 6s | 1933 | A&O | 1, 1941–43 | A&O 1 | 86,000 |

INTEREST: At Pearl St. Branch of Cleveland (O.) Tr. Co.

DEFAULT. On Dec 8, 1933 the district was in default on $78,200 principal and $37,448 interest. Date of initial default, Apr. 1, 1933.

REFUNDING PLANNED: On Oct. 4, 1933, J. H. Wanek, Clerk-Treasurer, advised that the district was preparing to refund bonds that matured during the year 1933 in the amount of $78,200.

DEFICIENCY BONDS AUTHORIZED: On Feb 13, 1933, the Board of Education authorized the issuance of $166,000 delinquent tax bonds by the district.

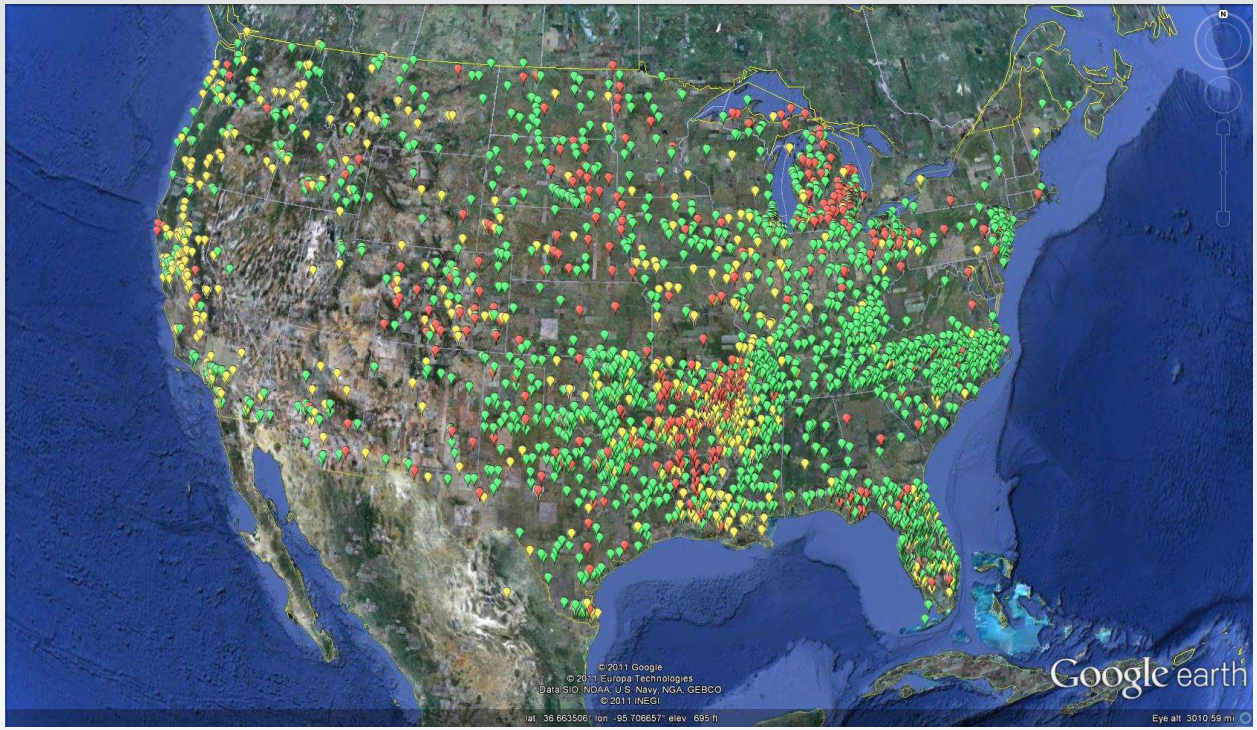
**PARMA HEIGHTS:** Located in Cuyahoga County. Post office, Brooklyn Station, Cleveland. A residential suburb of Cleveland. Population in 1930, 960.

Assessed value, all property (1933), $4,513,570; total tax rate per $1,000 (1932), $23.30. Total bonded debt, April 10, 1930, $1,075,422; sinking fund, $174,725.

TAX COLLECTIONS for 1932 (to Dec. 9, 1932):

| | Levy | Collected | % Collected |
|---|---|---|---|
| General taxes | $181,923 | $49,356 | 49 |
| Special assessment | 256,484 | 74,617 | 29 |
| Street Improvement | | | |

# US Municipal Bond Defaults: 1920 to 1939




Yellow = Special Districts

Red = School districts

Green = Cities, States and Counties

Source: Public Sector Credit Solutions Default Database

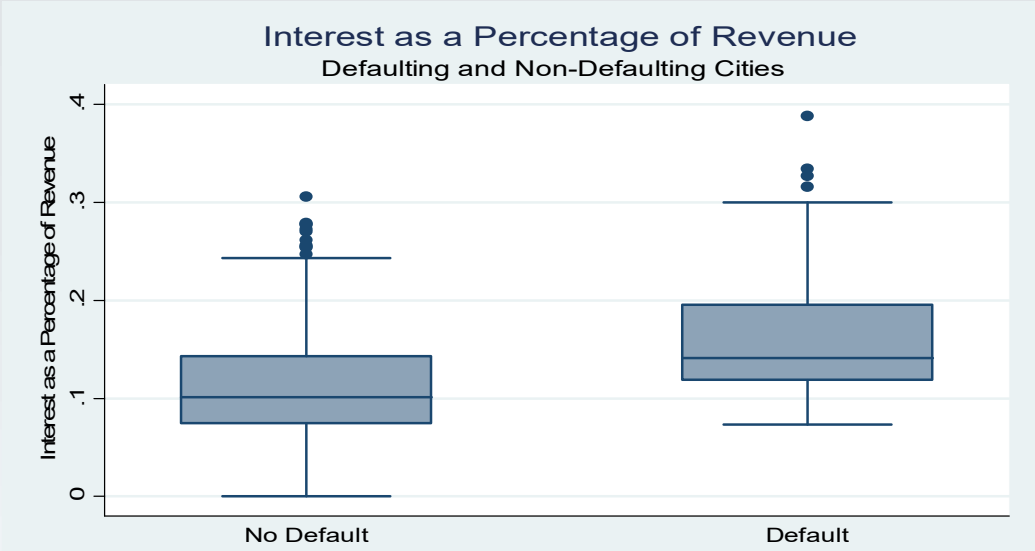
- Over 5000 defaults in all
- Defaults heavily concentrated in specific states, esp. Florida, the Carolinas, Arkansas, Louisiana, Texas, New Jersey, Michigan, Ohio and California
- No defaults reported in Maryland, Delaware, Connecticut, Vermont and Rhode Island

# Drivers of Depression-Era Defaults

- Poor control of municipal bond issuance in certain states such as Florida (which had outlawed state debt), Michigan, New Jersey and North Carolina.
- Many defaults stemmed from bank failures and bank holidays. When banks holding sinking funds and other municipal deposits were not open, issuers could not access cash needed to perform on their obligations.
- Prohibition had eliminated alcohol taxes as a revenue source; local income and sales taxes had yet to become common. Cities were thus heavily reliant on real estate taxes. When real estate values fell and property tax delinquencies spiked, many issuers became unable to perform.
- Many defaults occurred in drainage, irrigation and levee districts. Bonds funding these agricultural infrastructure projects were serviced by taxes paid by a small number of farmers or farming companies. A single delinquency could thus trigger a default.

# Analysis and Modeling of Large City Defaults

- Strongest predictor was ratio of **Interest to Total Revenue**.
- Mean ratio for defaulting cities was 16.1% versus 11.0% for non-defaulters.
- High ratio non-default observations were concentrated in **Virginia** – which has a unique law requiring the State to cover municipal bond defaults. A dummy was added to address this state-specific attribute
- **Change in Annual Revenue** was also significant
- Population changes and cash balances were not significant




| Variable | Coefficient | Standard Error | p |
|---|---|---|---|
| Interest/Revenue | 17.41951 | 1.99172 | 0.000 |
| Virginia Dummy | -3.695301 | 1.471739 | 0.012 |
| Δ Revenue | -1.964635 | -1.964635 | 0.042 |
| Constant | -4.13551 | 0.3037248 | 0.000 |

$$\mathbf{dp} = \exp(-4.14 + 17.42\mathrm{IR} - 3.70\mathrm{VA} - 1.96\Delta\mathrm{R}) \\ /(1 + (-4.14 + 17.42IR - 3.70VA - 1.96\Delta\mathrm{R}))$$

# Some Other Observations

- Pensions and Other Post Employment Benefits (OPEB) are a threat to certain issuers, but we should consider the following:
  - Underfunded pensions are nothing new
  - Discussion around the issue is often distorted by political considerations. In particular, comparisons between a government's annual budget (a flow) and its unfunded liabilities (a stock reported in present value terms) are not meaningful
  - Future pension and OPEB expenditures should be estimated and compared to projected revenues
- Recoveries on municipal bond defaults have been quite high both during the Depression and more recently. New York City (1975) and Orange County (1994) both had full recoveries. Jefferson County, Stockton and San Bernardino creditors may not be as fortunate, however.

# Public Sector Credit Framework

# Two Quantitative Methodologies

PSCS is developing two methodologies for estimating government bond default probabilities.

- Simple logistic regression model for cities and other smaller issuers
- Multi-Year budget simulation tool for states, countries and other large issuers. Could also be applied to larger cities and counties. This open source tool is called the “Public Sector Credit Framework” - PSCF

# PSCF Principles

Public Sector Credit Framework is:

- Quantitative – To decrease the likelihood that unconscious biases will affect the analysis and to take advantage of the computer's ability to rapidly perform large numbers of calculations.
- Transparent – So that other analysts can examine and update assumptions.
- Open Source – In the hope that a community of developers will form to enhance the tool.

The open source release is only a framework. Users or vendors would have to build their own issuer-specific models.

# PSCF Solution Overview

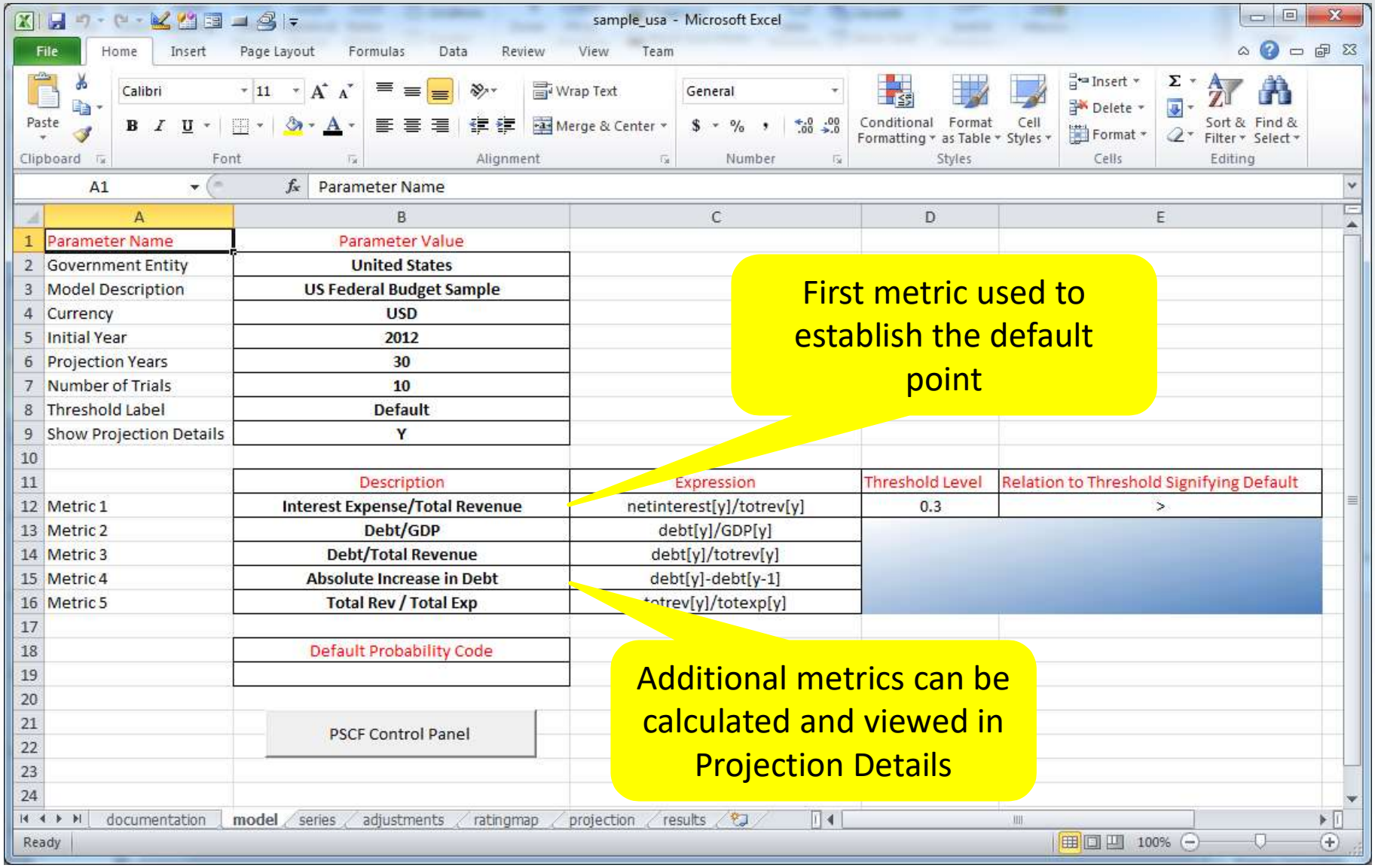
Quantitative methodology based on:

- Multi-Year Budget Projections for Each Public Sector Issuer
  - Can rely in part on estimates published by the government itself
- Monte Carlo Simulation of economic variables such as GDP growth, inflation and interest rates
  - Forecasts and historical data are available from a number of vendors including IHS Global Research
- Default point stated in terms of a fiscal ratio
  - Debt to GDP
  - Interest Expense to Revenue
  - Debt to Assessed Valuation
  - Others?
- Annual default probabilities calculated as the percentage of simulation trials resulting in ratios surpassing the default point; DPs can be mapped to ratings within the framework

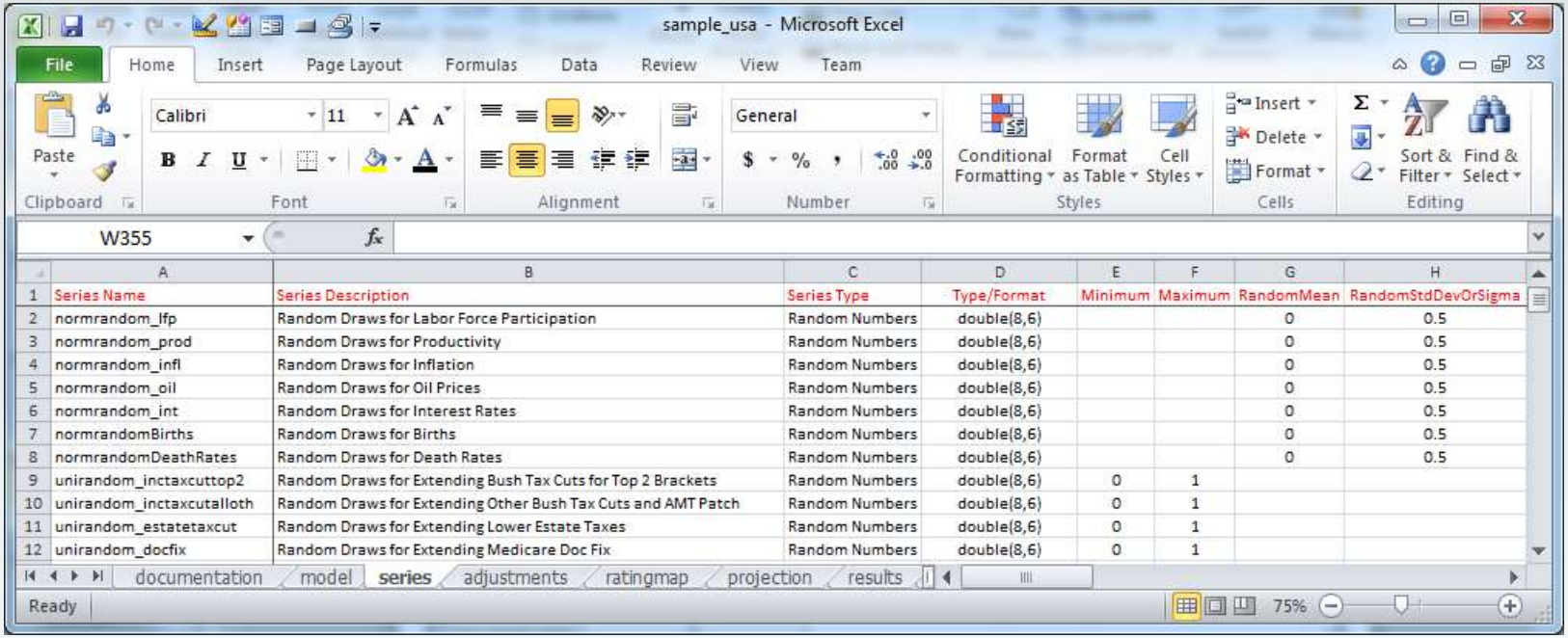
# Technology Overview

- User interface implemented as an Excel add-in
- User enters simulation data in two tabs of the spreadsheet and then runs the simulation from a control panel
- Excel inputs are converted to a C program, the program is compiled and then executed. Results are written to text file(s) and loaded into Excel tab(s)
- C program is compiled with the GNU C++ compiler and is thus compatible with Linux and other operating systems. GNU compiler is installed with the framework
- We also install the Boost C++ library which we use for random number generation
- C language and compiling are used in order to maximize speed enabling the user to run complex simulations and large numbers of trials
- We hope that programmers participating in the open source community will port the capabilities to other environments

# Walkthrough Part 1: Model Sheet



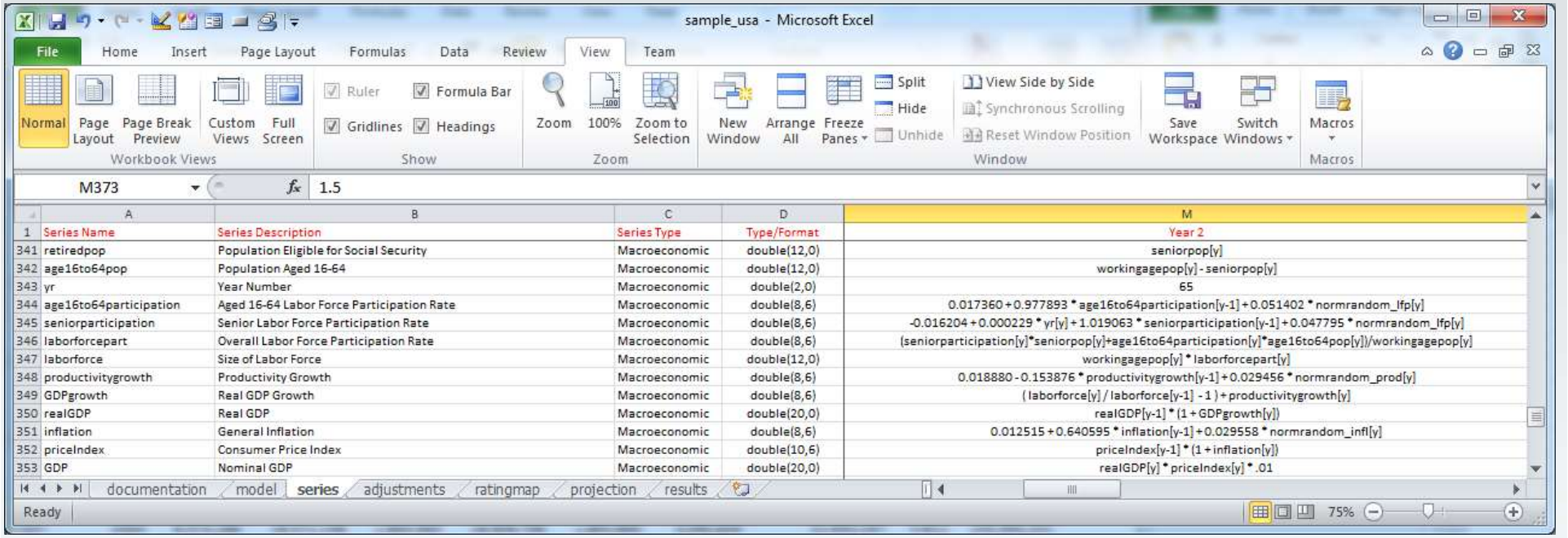
# Part 2: Series Sheet / Random Numbers




| | A | B | C | D | E | F | G | H |
|---|---|---|---|---|---|---|---|---|
| 1 | Series Name | Series Description | Series Type | Type/Format | Minimum | Maximum | RandomMean | RandomStdDevOrSigma |
| 2 | normrandom_lfp | Random Draws for Labor Force Participation | Random Numbers | double(8,6) | | | 0 | 0.5 |
| 3 | normrandom_prod | Random Draws for Productivity | Random Numbers | double(8,6) | | | 0 | 0.5 |
| 4 | normrandom_infl | Random Draws for Inflation | Random Numbers | double(8,6) | | | 0 | 0.5 |
| 5 | normrandom_oil | Random Draws for Oil Prices | Random Numbers | double(8,6) | | | 0 | 0.5 |
| 6 | normrandom_int | Random Draws for Interest Rates | Random Numbers | double(8,6) | | | 0 | 0.5 |
| 7 | normrandomBirths | Random Draws for Births | Random Numbers | double(8,6) | | | 0 | 0.5 |
| 8 | normrandomDeathRates | Random Draws for Death Rates | Random Numbers | double(8,6) | | | 0 | 0.5 |
| 9 | unirandom_inctaxcuttop2 | Random Draws for Extending Bush Tax Cuts for Top 2 Brackets | Random Numbers | double(8,6) | 0 | 1 | | |
| 10 | unirandom_inctaxcutalloth | Random Draws for Extending Other Bush Tax Cuts and AMT Patch | Random Numbers | double(8,6) | 0 | 1 | | |
| 11 | unirandom_estatetaxcut | Random Draws for Extending Lower Estate Taxes | Random Numbers | double(8,6) | 0 | 1 | | |
| 12 | unirandom_docfix | Random Draws for Extending Medicare Doc Fix | Random Numbers | double(8,6) | 0 | 1 | | |

- Create any number of random series.
- One random number generated per series per trial.
- Three random number distributions supported:
- Uniform / Normal / Cauchy-Lorenz (allowing fat tails)
- User can impose maxima and minima on generated numbers

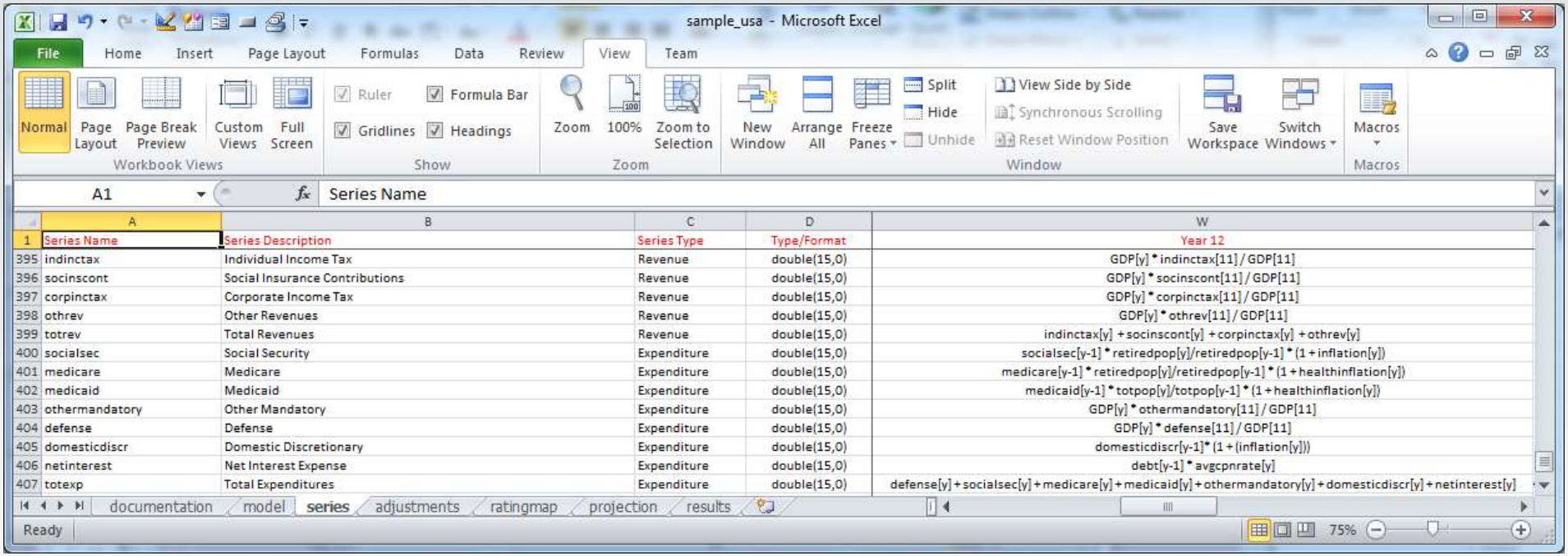
# Part 3: Series Sheet / Macro Variables




| | A | B | C | D | M |
|---|---|---|---|---|---|
| 1 | Series Name | Series Description | Series Type | Type/Format | Year 2 |
| 341 | retiredpop | Population Eligible for Social Security | Macroeconomic | double(12,0) | seniorpop[y] |
| 342 | age16to64pop | Population Aged 16-64 | Macroeconomic | double(12,0) | workingagepop[y] - seniorpop[y] |
| 343 | yr | Year Number | Macroeconomic | double(2,0) | 65 |
| 344 | age16to64participation | Aged 16-64 Labor Force Participation Rate | Macroeconomic | double(8,6) | 0.017360 + 0.977893 * age16to64participation[y-1] + 0.051402 * normrandom_lfp[y] |
| 345 | seniorparticipation | Senior Labor Force Participation Rate | Macroeconomic | double(8,6) | -0.016204 + 0.000229 * yr[y] + 1.019063 * seniorparticipation[y-1] + 0.047795 * normrandom_lfp[y] |
| 346 | laborforcepart | Overall Labor Force Participation Rate | Macroeconomic | double(8,6) | (seniorparticipation[y]*seniorpop[y]+age16to64participation[y]*age16to64pop[y])/workingagepop[y] |
| 347 | laborforce | Size of Labor Force | Macroeconomic | double(12,0) | workingagepop[y] * laborforcepart[y] |
| 348 | productivitygrowth | Productivity Growth | Macroeconomic | double(8,6) | 0.018880 - 0.153876 * productivitygrowth[y-1] + 0.029456 * normrandom_prod[y] |
| 349 | GDPgrowth | Real GDP Growth | Macroeconomic | double(8,6) | ( laborforce[y] / laborforce[y-1] - 1 ) + productivitygrowth[y] |
| 350 | realGDP | Real GDP | Macroeconomic | double(20,0) | realGDP[y-1] * (1 + GDPgrowth[y]) |
| 351 | inflation | General Inflation | Macroeconomic | double(8,6) | 0.012515 + 0.640595 * inflation[y-1] + 0.029558 * normrandom_infl[y] |
| 352 | priceIndex | Consumer Price Index | Macroeconomic | double(10,6) | priceIndex[y-1] * (1 + inflation[y]) |
| 353 | GDP | Nominal GDP | Macroeconomic | double(20,0) | realGDP[y] * priceIndex[y] * .01 |

- Inflation, GDP and interest rates can be modeled using any combination of constants, functions of random numbers and functions of other variables or prior year values
- Any C-compliant expression may be used
- Minima and maxima also supported
- Can use different formulae for different years

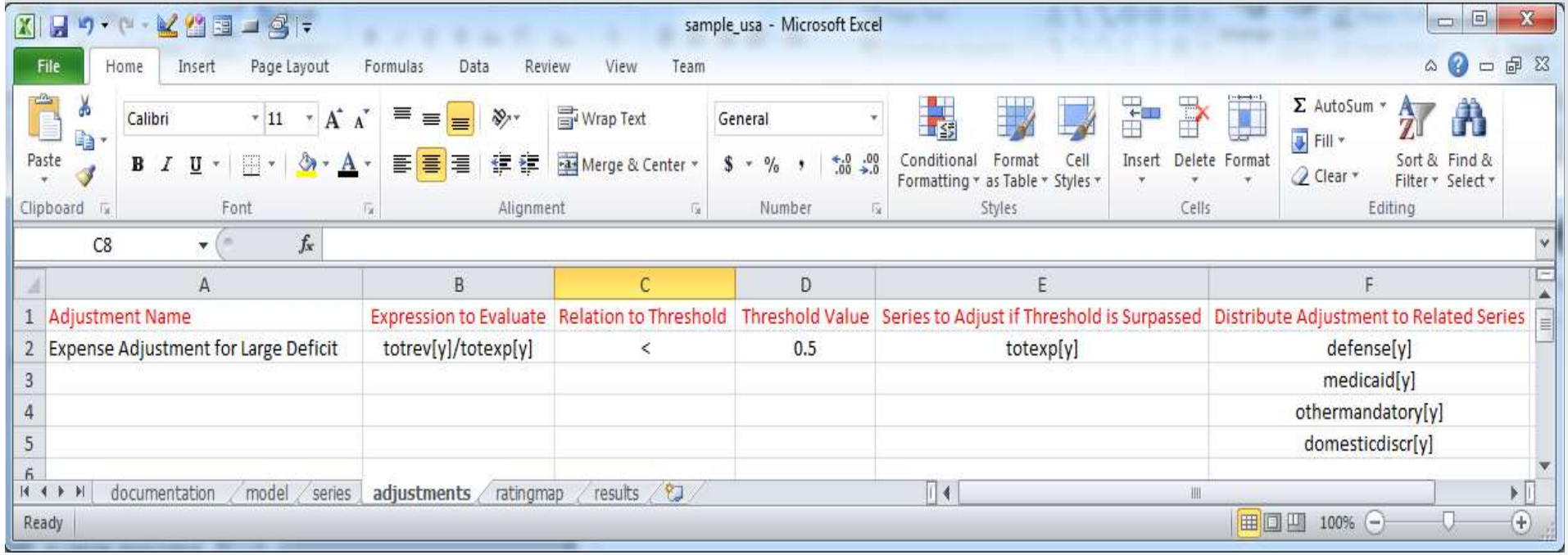
# Part 4: Series Sheet / Revs & Exps.




| | A | B | C | D | W |
|---|---|---|---|---|---|
| 1 | Series Name | Series Description | Series Type | Type/Format | Year 12 |
| 395 | indinctax | Individual Income Tax | Revenue | double(15,0) | GDP[y] * indinctax[11] / GDP[11] |
| 396 | socinscont | Social Insurance Contributions | Revenue | double(15,0) | GDP[y] * socinscont[11] / GDP[11] |
| 397 | corpinctax | Corporate Income Tax | Revenue | double(15,0) | GDP[y] * corpinctax[11] / GDP[11] |
| 398 | othrev | Other Revenues | Revenue | double(15,0) | GDP[y] * othrev[11] / GDP[11] |
| 399 | totrev | Total Revenues | Revenue | double(15,0) | indinctax[y] + socinscont[y] + corpinctax[y] + othrev[y] |
| 400 | socialsec | Social Security | Expenditure | double(15,0) | socialsec[y-1] * retiredpop[y]/retiredpop[y-1] * (1 + inflation[y]) |
| 401 | medicare | Medicare | Expenditure | double(15,0) | medicare[y-1] * retiredpop[y]/retiredpop[y-1] * (1 + healthinflation[y]) |
| 402 | medicaid | Medicaid | Expenditure | double(15,0) | medicaid[y-1] * totpop[y]/totpop[y-1] * (1 + healthinflation[y]) |
| 403 | othermandatory | Other Mandatory | Expenditure | double(15,0) | GDP[y] * othermandatory[11] / GDP[11] |
| 404 | defense | Defense | Expenditure | double(15,0) | GDP[y] * defense[11] / GDP[11] |
| 405 | domesticdiscr | Domestic Discretionary | Expenditure | double(15,0) | domesticdiscr[y-1]* (1 + (inflation[y])) |
| 406 | netinterest | Net Interest Expense | Expenditure | double(15,0) | debt[y-1] * avgcpnrate[y] |
| 407 | totexp | Total Expenditures | Expenditure | double(15,0) | defense[y] + socialsec[y] + medicare[y] + medicaid[y] + othermandatory[y] + domesticdiscr[y] + netinterest[y] |

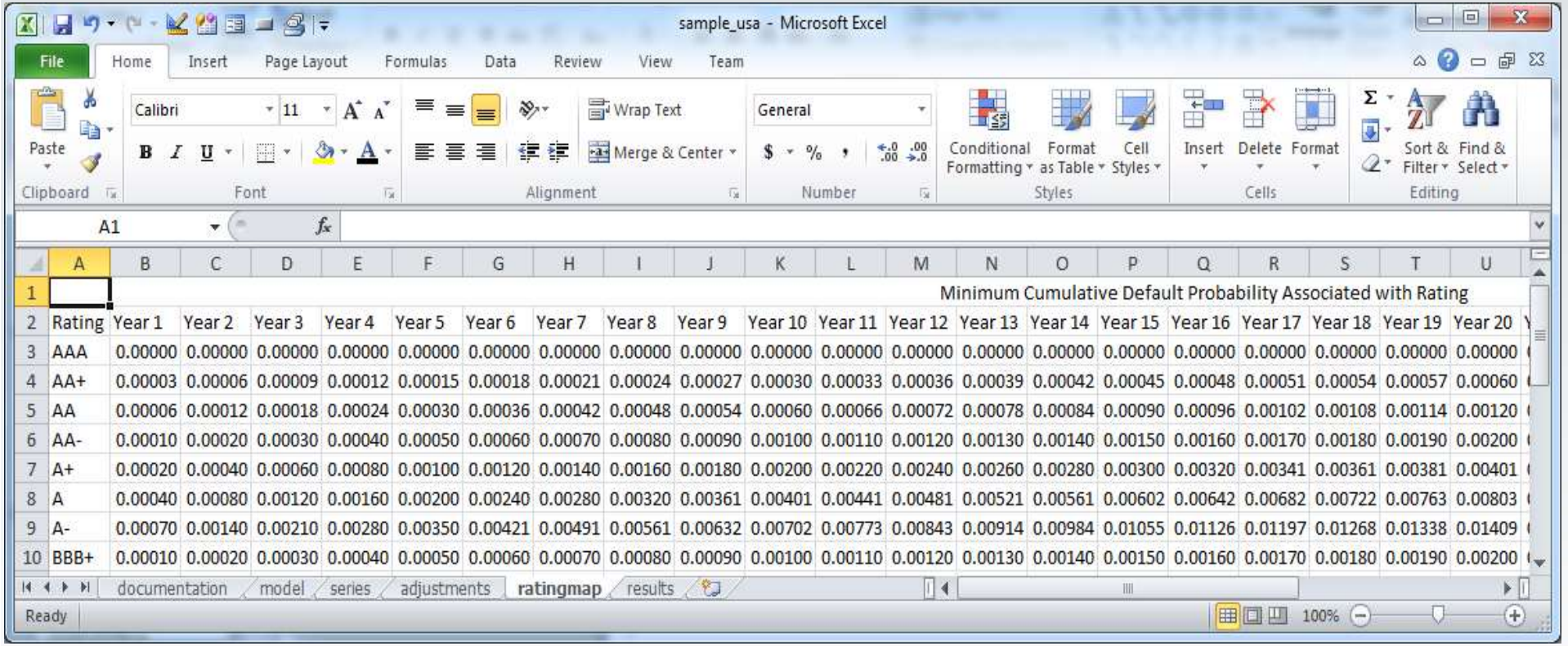
- Revenue and expenditure items can also use any valid C expression
- Items may be linked to macroeconomic variables such as inflation or GDP.
- Annual surpluses or deficits can be computed from the revenue and expenditure series and then added to the previous year's debt.

# Walkthrough Part 5: Adjustments Sheet




- Legislative/executive decisions to reduce deficits (or spend large surpluses) can be simulated in the adjustments sheet.
- Revenue/Expenditure ratios can be bounded and changes to either revenues or expenditures can be distributed pro rata back to select budget lines.
- Would like to support more constraints in future releases.

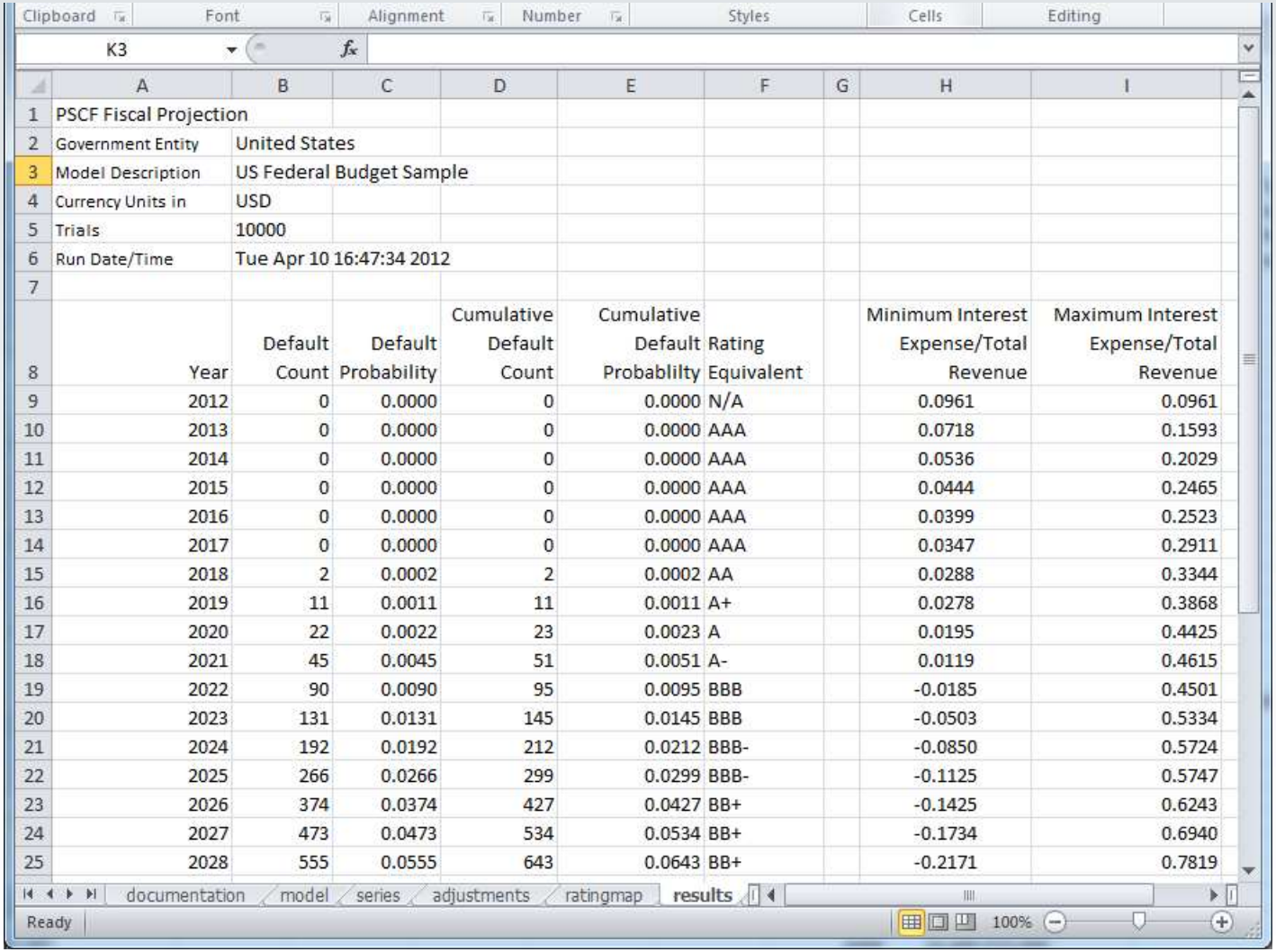
# Walkthrough Part 6: Ratingmap Sheet




| Rating | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | Year 6 | Year 7 | Year 8 | Year 9 | Year 10 | Year 11 | Year 12 | Year 13 | Year 14 | Year 15 | Year 16 | Year 17 | Year 18 | Year 19 | Year 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| AAA | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 | 0.00000 |
| AA+ | 0.00003 | 0.00006 | 0.00009 | 0.00012 | 0.00015 | 0.00018 | 0.00021 | 0.00024 | 0.00027 | 0.00030 | 0.00033 | 0.00036 | 0.00039 | 0.00042 | 0.00045 | 0.00048 | 0.00051 | 0.00054 | 0.00057 | 0.00060 |
| AA | 0.00006 | 0.00012 | 0.00018 | 0.00024 | 0.00030 | 0.00036 | 0.00042 | 0.00048 | 0.00054 | 0.00060 | 0.00066 | 0.00072 | 0.00078 | 0.00084 | 0.00090 | 0.00096 | 0.00102 | 0.00108 | 0.00114 | 0.00120 |
| AA- | 0.00010 | 0.00020 | 0.00030 | 0.00040 | 0.00050 | 0.00060 | 0.00070 | 0.00080 | 0.00090 | 0.00100 | 0.00110 | 0.00120 | 0.00130 | 0.00140 | 0.00150 | 0.00160 | 0.00170 | 0.00180 | 0.00190 | 0.00200 |
| A+ | 0.00020 | 0.00040 | 0.00060 | 0.00080 | 0.00100 | 0.00120 | 0.00140 | 0.00160 | 0.00180 | 0.00200 | 0.00220 | 0.00240 | 0.00260 | 0.00280 | 0.00300 | 0.00320 | 0.00341 | 0.00361 | 0.00381 | 0.00401 |
| A | 0.00040 | 0.00080 | 0.00120 | 0.00160 | 0.00200 | 0.00240 | 0.00280 | 0.00320 | 0.00361 | 0.00401 | 0.00441 | 0.00481 | 0.00521 | 0.00561 | 0.00602 | 0.00642 | 0.00682 | 0.00722 | 0.00763 | 0.00803 |
| A- | 0.00070 | 0.00140 | 0.00210 | 0.00280 | 0.00350 | 0.00421 | 0.00491 | 0.00561 | 0.00632 | 0.00702 | 0.00773 | 0.00843 | 0.00914 | 0.00984 | 0.01055 | 0.01126 | 0.01197 | 0.01268 | 0.01338 | 0.01409 |
| BBB+ | 0.00010 | 0.00020 | 0.00030 | 0.00040 | 0.00050 | 0.00060 | 0.00070 | 0.00080 | 0.00090 | 0.00100 | 0.00110 | 0.00120 | 0.00130 | 0.00140 | 0.00150 | 0.00160 | 0.00170 | 0.00180 | 0.00190 | 0.00200 |

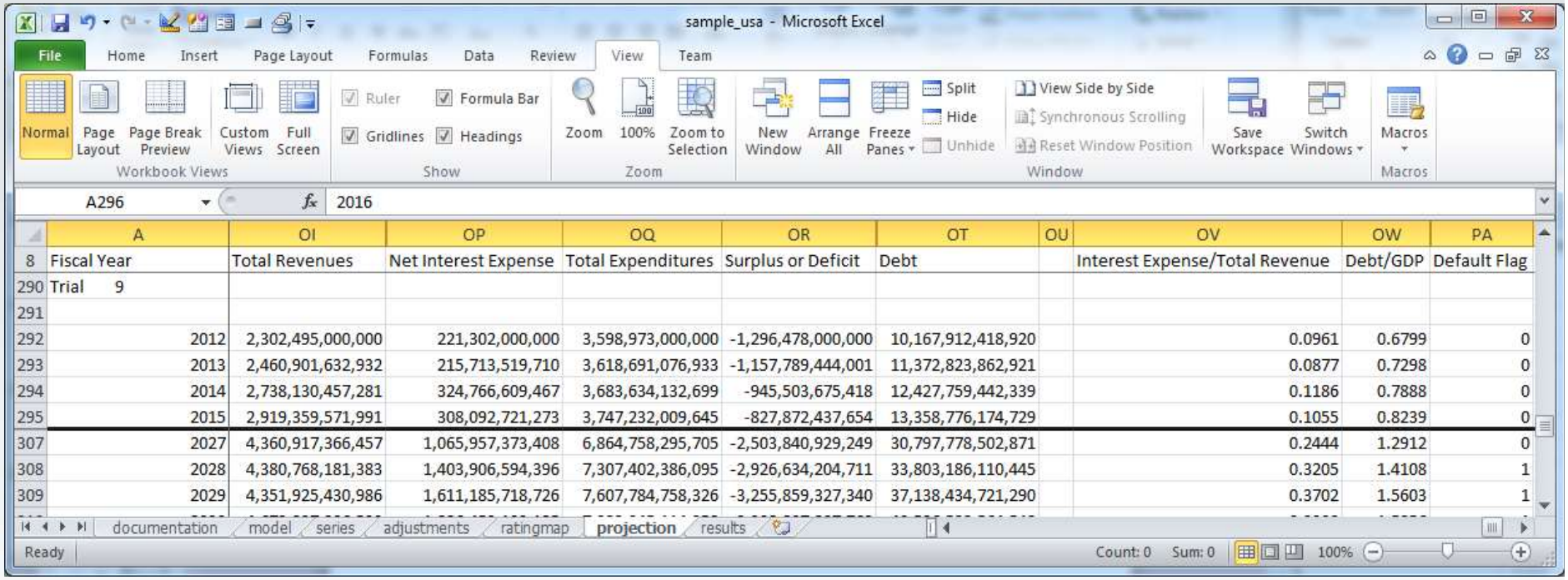
- Associate cumulative default probabilities with rating grades.
- Any rating system can be used.
- System returns a vector of annual ratings in recognition of the fact that bonds with different terms have different levels of risk.

# Walkthrough Part 7: Results Sheet



| | A | B | C | D | E | F | G | H | I |
|---|---|---|---|---|---|---|---|---|---|
| 1 | PSCF Fiscal Projection | | | | | | | | |
| 2 | Government Entity | United States | | | | | | | |
| 3 | Model Description | US Federal Budget Sample | | | | | | | |
| 4 | Currency Units in | USD | | | | | | | |
| 5 | Trials | 10000 | | | | | | | |
| 6 | Run Date/Time | Tue Apr 10 16:47:34 2012 | | | | | | | |
| 7 | | | | | | | | | |
| 8 | Year | Default Count | Default Probability | Cumulative Default Count | Cumulative Default Probablilty | Rating Equivalent | | Minimum Interest Expense/Total Revenue | Maximum Interest Expense/Total Revenue |
| 9 | 2012 | 0 | 0.0000 | 0 | 0.0000 | N/A | | 0.0961 | 0.0961 |
| 10 | 2013 | 0 | 0.0000 | 0 | 0.0000 | AAA | | 0.0718 | 0.1593 |
| 11 | 2014 | 0 | 0.0000 | 0 | 0.0000 | AAA | | 0.0536 | 0.2029 |
| 12 | 2015 | 0 | 0.0000 | 0 | 0.0000 | AAA | | 0.0444 | 0.2465 |
| 13 | 2016 | 0 | 0.0000 | 0 | 0.0000 | AAA | | 0.0399 | 0.2523 |
| 14 | 2017 | 0 | 0.0000 | 0 | 0.0000 | AAA | | 0.0347 | 0.2911 |
| 15 | 2018 | 2 | 0.0002 | 2 | 0.0002 | AA | | 0.0288 | 0.3344 |
| 16 | 2019 | 11 | 0.0011 | 11 | 0.0011 | A+ | | 0.0278 | 0.3868 |
| 17 | 2020 | 22 | 0.0022 | 23 | 0.0023 | A | | 0.0195 | 0.4425 |
| 18 | 2021 | 45 | 0.0045 | 51 | 0.0051 | A- | | 0.0119 | 0.4615 |
| 19 | 2022 | 90 | 0.0090 | 95 | 0.0095 | BBB | | -0.0185 | 0.4501 |
| 20 | 2023 | 131 | 0.0131 | 145 | 0.0145 | BBB | | -0.0503 | 0.5334 |
| 21 | 2024 | 192 | 0.0192 | 212 | 0.0212 | BBB- | | -0.0850 | 0.5724 |
| 22 | 2025 | 266 | 0.0266 | 299 | 0.0299 | BBB- | | -0.1125 | 0.5747 |
| 23 | 2026 | 374 | 0.0374 | 427 | 0.0427 | BB+ | | -0.1425 | 0.6243 |
| 24 | 2027 | 473 | 0.0473 | 534 | 0.0534 | BB+ | | -0.1734 | 0.6940 |
| 25 | 2028 | 555 | 0.0555 | 643 | 0.0643 | BB+ | | -0.2171 | 0.7819 |

# Walkthrough Part 8: Projection Sheet




| | A | OI | OP | OQ | OR | OT | OU | OV | OW | PA |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Fiscal Year | Total Revenues | Net Interest Expense | Total Expenditures | Surplus or Deficit | Debt | | Interest Expense/Total Revenue | Debt/GDP | Default Flag |
| 290 | Trial 9 | | | | | | | | | |
| 291 | | | | | | | | | | |
| 292 | 2012 | 2,302,495,000,000 | 221,302,000,000 | 3,598,973,000,000 | -1,296,478,000,000 | 10,167,912,418,920 | | 0.0961 | 0.6799 | 0 |
| 293 | 2013 | 2,460,901,632,932 | 215,713,519,710 | 3,618,691,076,933 | -1,157,789,444,001 | 11,372,823,862,921 | | 0.0877 | 0.7298 | 0 |
| 294 | 2014 | 2,738,130,457,281 | 324,766,609,467 | 3,683,634,132,699 | -945,503,675,418 | 12,427,759,442,339 | | 0.1186 | 0.7888 | 0 |
| 295 | 2015 | 2,919,359,571,991 | 308,092,721,273 | 3,747,232,009,645 | -827,872,437,654 | 13,358,776,174,729 | | 0.1055 | 0.8239 | 0 |
| 307 | 2027 | 4,360,917,366,457 | 1,065,957,373,408 | 6,864,758,295,705 | -2,503,840,929,249 | 30,797,778,502,871 | | 0.2444 | 1.2912 | 0 |
| 308 | 2028 | 4,380,768,181,383 | 1,403,906,594,396 | 7,307,402,386,095 | -2,926,634,204,711 | 33,803,186,110,445 | | 0.3205 | 1.4108 | 1 |
| 309 | 2029 | 4,351,925,430,986 | 1,611,185,718,726 | 7,607,784,758,326 | -3,255,859,327,340 | 37,138,434,721,290 | | 0.3702 | 1.5603 | 1 |

- Optional projection tab shows trial-by-trial, year-by-year results for each variable you want to see.
- Default flag is set whenever the first metric specified in the models sheet surpasses the default threshold.

# Selected Media Coverage

FT Alphaville – Monte Carlo Simulated Credit Risk - http://ftalphaville.ft.com/2012/05/02/983041/monte-carlo-simulated-sovereign-credit/

Canadian Broadcasting Company – Rating Agency Rebellion - http://www.cbc.ca/player/News/Business/ID/2258963934/

Concord Coalition – Do Bond Markets Underestimate the True Riskiness of U.S. Treasuries? - http://www.concordcoalition.org/tabulation/do-bond-markets-underestimate-true-riskiness-us-treasuries

Global Treasury News – An Alternative to Sovereign Credit Ratings: PSCF http://www.gtnews.com/Articles/2013/An_Alternative_to_Sovereign_Credit_Ratings__PSCF.html (Gated)

Government Finance News, February 2013 (Hard Copy)

# Applications of PSCF

Provincial Solvency and Federal Obligations, Macdonald-Laurier Institute. http://www.macdonaldlaurier.ca/files/pdf/Provincial-Solvency-October-2012.pdf

Italy Model – Covered in MF (Milano) – 26 July 2013 →

Modeling Illinois Credit, Mercatus Center. Forthcoming.

ettori: n.d. MF 26-LUG-20

iffusione: n.d. Dir. Resp.: Osvaldo De Paolini da pag. 4

LE PROBABILITÀ DI FALLIMENTO SECONDO UN'INDAGINE PSCS

## *Italia, rischio default al 2,6%*

DI ESTER CORVI

Moody's ha abbassato il rating dell'Italia fino a Baa2, a un passo dal temuto livello junk bond, ma c'è chi, numeri alla mano, con questo giudizio non è d'accordo. Perché ritiene che sia del tutto ingiustificato per un Paese che non solo ha dimostrato in passato di saper convivere con ratio elevati debito-pil, ma che nei mesi scorsi ha anche imboccato con coraggio la via del risanamento. Lo sostengono gli esperti della società statunitense Public Sector Credit Solutions (Pscs) (fondata da Marc Joffe, ex direttore di Moody's Analytics), che hanno elaborato diverse proiezioni sull'evoluzione futura delle finanze pubbliche italiane, utilizzando un modello econometrico. E sono arrivati alla conclusione che le probabilità di default dei titoli di Stato italiani sono solo il 2,6%.Una percentuale risibile, che stride con la recente impennata del differenziale Btp-Bund oltre quota 500. Le ragioni principali sono quelle ricordate in precedenza: in primo luogo, l'Italia ha sostenuto nella metà degli anni Novanta spese per interessi maggiori di quelle attuali in percentuale sul debito senza fallire e, anche se il tasso di interesse medio sul debito pubblico raggiungesse il 7% (un processo che richiederebbe alcuni anni in funzione della struttura del nostro debito), il rapporto interessi/pil salirebbe, ma resterebbe comunque inferiore al livello sperimentato a metà degli anni Novanta. Il secondo aspetto che sostiene la valutazione degli analisti di Pscs è che l'Italia con la riforma pensionistica ha affrontato il problema dell'invecchiamento della popolazione, mentre il calo del tasso di fertilità si è stabilizzato negli ultimi anni.

Osservando l'esperienza del passato, si può notare che l'Italia dal momento della sua costituzione, nel 1861, non è mai fallita fino al 1932, a causa delle spese legate Prima guerra mondiale, è più tardi nel 1940, in conseguenza della dichiarazione di guerra alla Francia e alla Gran Bretagna. Un debito che non fu completamente onorato fino al 1952. Da allora l'Italia non è mai più stata insolvente, diversamente dalla Grecia ha registrato cinque default tra il 1862 e il 1964.

Se si guarda alle prospettive future, gli esperti fanno notare che il deficit dell'Italia (3,2% del pil nel 2011) è relativamente modesto e in decisa riduzione, visto che le stime del Fondo monetario internazionale lo indicano nel 2012 intorno al 2,6%, nonostante un calo del pil dell'1,9%, in un trend di graduale ma deciso miglioramento. In conclusione, in uno scenario a dieci anni, applicando il modello di Pscs e considerando le molte variabili in gioco, le probabilità di un default dell'Italia sono inferiori al 3%.

Un'elaborazione molto ardita, quella realizzata dalla Public Sector Credit Solutions, che ha pubblicato nel maggio scorso un'analisi per il calcolo delle probabilità annuali di default da parte dei governi. Il modello è stato elaborato al fine di effettuare una simulazione fiscale pluriennale, basata su numerosi scenari relativi al pil, all'inflazione e ai tassi di interesse. La relazione comprendeva anche un'analisi dettagliata dei conti pubblici italiani, che è stata in seguito aggiornata.

Joffe ha fondato la Pscs e divulgato il Public Sector Credit Framework open source allo scopo di elevare il livello di analisi del credito sovrano e sub-sovrano. «A causa dei disordini sociali che comportano, le crisi del credito sovrano possono trasformarsi in questioni di vita o di morte. Saperle prevedere con precisione è quindi una priorità sociale importante». La Pscs ha l'obiettivo, a detta dei fondatori, di produrre «ricerca destinata a tutti i principali emittenti sovrani e sub-sovrani, applicando tecniche trasparenti e quantitative e spera che la ricerca contribuisca alla creazione di un'agenzia di rating no-profit come quelle suggerite da Bertelsmann e Roland Berger». (riproduzione riservata)

# US Fiscal Crisis Probability