Score Plus
→ data → information → profit

A. BACKGROUND AND GOAL

A.1. Stability and Covid-19

Stable income - current and future - has become more important as a determinant of personal customer risk during the Covid-19 crisis. Customers who have fluctuating incomes are much more likely to run into financial problems.

A.2. Building stability into decision making

Many lenders have introduced policy rules (outside scorecards) or made *ad hoc* changes to scorecard weights during the Covid-19 crisis. It is impossible to calibrate these correctly until sufficient evidence accumulates. But evaluating multiple changes with lots of assumptions requires very large samples. Therefore, it takes a long time.

So there is a premium on simplicity: simpler changes can be evaluated and calibrated more quickly. Simple does not mean simplistic. It is important to combine different sources to get insight into likely customer behavior. But the information should be used in a straightforward way so that future evaluation and modification are quicker and more transparent.

The Stable Income Index is designed to facilitate this task. It synthesizes relevant data into a single number which meets two needs:

- Immediately modify scorecards and underwriting rules to reflect a new understanding of customer risk.
- Facilitate early and accurate analysis and correction as empirical evidence emerges.

A.3. Stable Income Index (SII)

Insight into income stability comes from two principal sources:

- Employment information
- Financial information

The Stable Income Index (SII) creates two sub-indices from these sources. These are added together to give an overview measure, the SII, ranking borrowers' vulnerability to shocks to income. The SII can be used as a scorecard characteristic or implemented as a policy outside scorecards.

Different lenders will have access to different information. So it may not be possible to implement both components of the index. Each component can be used independently.

A.4. Health warning

The structure and weights of this index are based on expertise and credit experience, but not on data analysis. So it is likely to be directionally correct. But the calibration is certainly wrong. Only analysis can correct the calibration and structure of the index. Analysis needs data. How to do this analysis is discussed at the end of this paper.

B. INDEX DEFINITION

B.1. Overall Structure

The SII is the sum of two sub-indices: Employment and Financials.

B.2. Employment Dimension

B.2.1. Ideas

- People working in the public sector or retired have generally not suffered any loss of income and are protected from loss of income in the foreseeable future.
- However, people who have recently retired may have experienced a significant reduction in income and still be adjusting lifestyles.
- Some public sector workers may be on temporary contracts or otherwise lack the employment security associated with the sector. Generally, these will have short time on job.
- Some employment sectors, notably health, are protected from economic shocks.
- Others are particularly exposed. Previous recessions have shown that the construction and transport sectors (including delivery) always suffer. In addition, many people working in these areas lack job security.

- There has been an upsurge of unemployment for people working on short term and insecure work contracts.

B.2.2. Values - Employment Stability

Item	Condition 1	AND Condition 2	Source	Points
1	Retired	Retired ≥ 3 years	Occupation/Employment Status Time based on age & std retirement age	+2
2	Retired	Retired < 3 years		+1
3	Public Sector	Time on Job ≥ 3 years	Employment Status, Time on job	+2
4	Public Sector	Time on Job < 3 years		+1
5	Health Sector		Occupation or employer	+1
6	Self-employed		Employment Status	-2
7	Unemployed/Not employed		Employment status	-2
8	Private Sector	Interim OR Zero Hours OR Fixed Term Contract	Employment Status, Employment Contract	-2
9	Hotel/Restaurant etc.		Occupation or employer	-2
10	Transport/Construction		Occupation or employer	-1
11	Private Sector	Time on Job < 5 years	Employment Status, Time on Job	-1
12	Private Sector	Time on Job ≥ 5 years		0
13	All other			0

B.2.3. Notes

- This list is intended to be fairly robust across different countries and credit products. But it should be carefully reviewed to make sure that it can be applied and makes sense on any given credit portfolio. Terminology should be adapted to national usage.
- These criteria assume that information about occupation and employer is available for all individuals. In many cases, sector of work (transport, health etc.) is derived from employer. This may require a list of employers in each sector.
- Individuals are classified according to the first item for which they meet the conditions. So a self-employed nurse is "Health Sector" (line 5), but a nurse in a public hospital is "Public Sector" (lines 3-4). Likewise, a bus driver for a publicly operated utility is "Public Sector" (lines 3-4), while a self-employed bus driver will be "Self Employed" (line 6), but a bus driver for a private company is in Transport Sector (line 7).
- For retired people, it is usually not possible to know directly how long the person has been retired. The best surrogate is to look at age compared to the "normal" retirement age in the given market. For instance, a retired person, aged 66, in a country where most people retire at age 65 is considered to be retired for one year (line 2).
- There should be no one in the "All Other" group (line 13). This simply serves as a check on programming.
- What happens when there are two applicants/customers? In most cases, loss of employment for either of the people will cause a payment problem. So the worst status should be analyzed. EXCEPT if one person is "Unemployed/Not employed" (line 7), the status for the other person should be chosen.

B.3. Financial Stability Dimension

B.3.1. Ideas

- This dimension identifies people who have recently had a shock to their income or who are at high risk of doing so in the future, based on unstable recent income.
- This requires access to customer financial information, either because the lender holds the customer's

principal current account, or has access through open banking. Some of the data may also be obtained through credit bureau.

- The dimension also looks at precautionary savings. These help a borrower to deal with such a shock. Customers with less than half of a month's income available for emergencies are vulnerable.
- Finally, customers with no or low housing expense are more resilient in case of shock. Therefore, homeowners without mortgages are considered to have better financial stability.

B.3.2. Values - Financial Stability

Item	Variable	Source	Threshold	Points
1	Total CTO (credit turnover) last 3 mos / Typical income	Monthly current account summary	< 70%	-1
			< 90%	-0.5
			≥ 90%	0
2	% Months in last 12 m. with CTO < 85% of Typical (pre-crisis) income	Monthly current account summary (if less than 12 m. history, calculate on available months)	≤ 10%	+0.5
			10 - ≤ 20%	0
			> 20%	-0.5
3	Total accessible savings/ Typical income	Current account and savings accounts; most recent full month data	< 50%	-0.5
			50 - < 200%	0
			200% +	+0.5
4	Home owner without mortgage?	Credit bureau for mortgage Application/Credit bureau for home ownership	No	0
			Yes	+0.5

B.3.3. Notes

- In this case, the person receives points in each category for which they are available. The values are summed over each of the four components. So the worst index would now be -2 and the best +1.5
- Typical Income is the median monthly Credit Turnover on the principal current account from March 2019 to February 2020. So it is pre-crisis income. Most borrowers adjust their expenses to that habitual level of income.
- People who have fluctuating incomes in the past are more likely to have income from sources which will not be stable in the future - self-employed, dependent on overtime earnings or paid on commission.
- Accessible savings are all on-demand savings accounts balances and minimum balance on all current accounts over the past month. It does not include savings such as pension plans or savings blocked for more than 3 months.

C. HOW TO USE THE SII

C.1. Separately or together?

The SII has been conceived as whole. But often, a lender will only have the information to populate one of the two components - Employment or Financial. Each component can be used independently of the other.

If both components are available, it is possible to use them - and evaluate them - separately. But the SII is designed to be used as single number if possible.

C.2. Building SII into a score model

Simplicity is key in defining an effective lending policy because it facilitates the evaluation and adaptation of the policy as conditions change. The simplest way to use the SII is as a scorecard element. But that poses the question of its weight relative to the rest of the scorecard. The best structure is:

Final Score = Existing Score + λ x SII

C.3. Scaling λ

The value of λ will depend on the (judgmental) importance of income stability relative to the existing model. Note that most existing scorecards will already be largely be driven by stability - it is the key dimension in score models for personal lending.

There are three methods, ranging from the most satisfactory (and complex) to the simplest (and least satisfactory):

- Run a logistic regression on recent data to determine the correct empirical weight for λ based on performance during the Covid-19 crisis. For this, a very short outcome and broad bad definition is appropriate (e.g. 1 missed payment in 3 months). The SII can be tested on the applicants or customers scored in March 2020 with an outcome in June 2020.
- Calculate the spread of scores between expected goods (population weighted by 1-PD) and expected bads (population weighted by PD); then scale the SII so that the spread between expected goods and expected bads is around 10-15% of that on the total scorecard.
- Calculate the standard deviation of the score on the total population; scale the SII so that the standard deviation of the scaled SII is 10-15% of the total score.

C.4. SII as a policy rule

If it is not practical to build SII into a score model, it is possible to apply it as a policy filter outside the scorecard - e.g. decline applications with an SII $\leq$ -1. This is straightforward to implement but more complicated to evaluate afterwards - and misses out on potential borrowers who have stability problems which are compensated by a strong profile on other factors.

This approach will work for application decision making but is less satisfactory for assigning PDs used in IFRS9 and IRB models, as well as for behavioral scores in general.

C.5. When to use it?

Ideally, the SII or something similar should have been incorporated into decision making from March 2020. However, it is possible to introduce it in addition to or (preferably) to replace existing fixes applied to the structure of scores and policies. The history accumulated in the past three months can be used to better calibrate the index.

D. EVALUATION AND MODIFICATION

D.1. Why evaluate?

The proposed index is wrong - is based on expertise and experience but not on data analysis. It is closer to reality than not doing anything at all, and easier to manage than multiple changes to existing rules and scorecard characteristics. But it will need to be adjusted in the light of evidence (data) and changes in perspective (economic outlook). Evidence-driven modifications are based on evaluating the performance of the SII on short term outcomes.

D.2. Limits on Evaluation

In the current highly uncertain economic environment, the past is a very uncertain guide to the future. So it is necessary to overlay the results of analysis of past behavior with management judgment on how the economic situation is likely to vary in the next 12 months.

If unemployment is likely to get worse, then it is reasonable to give a greater weight to SII than is justified by the historical data. On the other hand, if management judges that unemployment is unlikely to deteriorate further, then the weight assigned to the SII should be less than what the historical data suggests.

D.3. What to evaluate

The evaluation has two stages:

- Firstly, to validate the calibration: is an index of +2 better than an index of +1 and how should the overall index be used with other scoring characteristics (value of λ)?
- Secondly, validate the structure of the index - are the individual criteria in line with future observed customer behavior, is the balance correct between the employment and financial components?

In both cases, "validate" means to check the predictive power of the index and to modify either its calibration or structure. So the result will be a modification of the index - either its weighting in the overall score model or the relative weights of the Employment and Financial sub-indices, or the individual criteria within each sub-index.

The first stage should be done as soon as around 100 "bads" are available, based on a broad definition (1 payment missed in 3 months since score, for instance). The second stage requires more data - say 200 "bads" on the same definition.

D.4. Evaluating Calibration

D.4.1. Front end

Once the SII has been applied, a first evaluation should be performed to examine:

- The distribution across the various attributes of the two components of the SII (% of population).
- The average PD on the people in each attribute. The PD is calculated according to the standard score-odds line from the existing score model.

This can be done based on as little as a one week's processing of scores. But it should be repeated once a full month's data is available.

D.4.2. Early outcomes

The earliest usable outcome to test actual performance is 3 months after the score date. The calibration definition of "bad" should be any arrears at this point (whether this is an acceptance or an ongoing score). Arrears less than some minimal level (e.g. 50 € or $50) may be ignored. For the evaluation to make sense, it is reasonable to look for at least 100 "bads". If these are not available at 3 months, the evaluation must be postponed.

For secured lending, delinquency rates are lower and delinquency emerges more slowly. For this kind of lending, an outcome of 6 months is more reasonable.

The calibration is done by running a logistic regression for:

$$\textbf{log-odds} = \alpha + \beta \times \textbf{score} + \gamma \times \textbf{SII}$$

The ratio γ/β can then be compared via a hypothesis test to the λ assigned in Section C.

Note that the early evaluation should be treated with caution. There is lots of operational noise in a 1-down bad definition, and certain types of payment behavior may not be seen until later in the customers' life-cycle.

D.4.3. Full outcomes

Because of the limitations of the early evaluation, it is important to follow up with a full evaluation at the normal point for measuring the score outcomes. The conventional performance definition is applied.

D.4.4. Payment holidays

Payment holidays or deferrals complicate the evaluation of customers' credit quality. Accounts subject to payment holidays at the evaluation date should be excluded from the analysis.

D.5. Evaluating Structure

D.5.1. Employment and Financial Sub-Indices

Once about 150 bads are available, the weights assigned to the Employment and Financial components can be evaluated. Are the relative weightings of the two components correct? This is done by estimating a logistic regression:

$$\textbf{log-odds} = \alpha + \beta \times \textbf{score} + \gamma \times \textbf{Employment SII} + \zeta \times \textbf{Financial SII}$$

If the SII sub-indices are correctly weighted, the values of γ and ζ should be close. So the hypothesis $\gamma/\zeta = 1$ is tested.

This process can be accelerated by using the Marginal Kolmogorov-Smirnov approach.

D.5.2. Structure of Employment Sub-Index

The score-odds relationship estimated in the previous paragraph is used to assign PDs to each person in the sample. With these PDs, it is possible to calculate expected goods and bads for each line 1-12 of the Employment Dimension. Delta scores will indicate whether the weights are reasonable.

D.5.3. Structure of the Financial Sub-Index

Similarly, the Financial Sub-Index should be analyzed. But each of the four items in the index is a different characteristic, so they should each be analyzed separately.

Helen McNab
helen.mcnab@scoreplus.com
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Gerard Scallan
gerard.scallan@scoreplus.com