FICO® Scores Through the Economic Cycle
Understanding Consumer Sensitivities to Economic Fluctuations

Dr. Gerald Fahner
Senior Principal Scientist, FICO
Worries About the Next Recession

Economics

Markets Warning From doom loops

By Mark Gongloff
January 2, 2019

Goldman Sachs: Recession Fears Overblown

Yahoo Finance Video • Jan 10, 2019, 11:54 AM

Yahoo Finance’s Adam Shapiro, Julie Hyman, and Dan Roberts join Medley Global Advisors’ Managing Director of Global Macro Strategy Ben Emons to discuss Goldman Sachs’ report that recession fears are overblown.

Market turbulence: is US recession risk rising?

Stocktake: Investors shouldn't confuse a slowdown with a recession, ‘that’s just wrong’

© Tue, Jan 29, 2019, 05:00
FICO® Score – A Data Science Success Story

- World’s #1 credit bureau score, available in 25+ countries
- Used by 70,000+ businesses, rating agencies and secondary market to improve risk assessment, transparency, decisions
- 10 billion+ decisions/year
  - Originations
  - Underwriting
  - Account management
  - Collections
What’s in a FICO® Score Number?

• A FICO® Score is:
  • A number from 300-850
  • Based on information in consumers’ credit files
  • Designed to *rank-order* consumer risk (Odds)
What Happens in a Recession?

• Don’t assume that a given score will always reflect the same Odds
  • Rank-ordering of Odds is stable
  • Odds-to-score relation is variable

• Must monitor Odds-to-score relation and recalibrate when necessary
Variability of Odds to Score Relation Through Great Recession

FICO® Score

Log(Repayment Odds)
“Of all my FICO 680’s tell me who will go bad in the next recession.”

Senior Executive of Large US Bank
Economic Cycle Impact on Odds to Score Relation

Do all 680’s drop by the same amount?
Hypothesis: Not Everyone (Even at the Same FICO Score) is Equally Impacted by a Recession

Economic Sensitivity Index (ESI) rank-orders consumers with respect to their sensitivity to the economic cycle.

ESI measures “Cycle Risk”, not “Credit Risk”.
Segmenting Consumers According to ESI

ESI Distribution of US Scoreable Population

- 20% most robust ones
- 20% most sensitive ones
Deterioration of Repayment Odds During Great Recession, by ESI Segment

US Scoreable Population (Total)

US Scoreable Population (by ESI Segment)
### 90+ DPD Rates for FICO® Score 680 Consumers

**Worst Performance on Any Trade Line**

<table>
<thead>
<tr>
<th></th>
<th>All Consumers @ FICO® Score ~680</th>
<th>20% Most Sensitive @ FICO® Score ~680</th>
<th>20% Most Robust @ FICO® Score ~680</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>90+ DPD Rate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal Economy</td>
<td>12.5%</td>
<td>14.0%</td>
<td>11.8%</td>
</tr>
<tr>
<td>Great Recession</td>
<td>20.7%</td>
<td>29.3%</td>
<td>13.7%</td>
</tr>
</tbody>
</table>
### Profiling Sensitive Versus Robust Consumers at FICO® Score 680

<table>
<thead>
<tr>
<th>Most Sensitive Consumers…</th>
</tr>
</thead>
<tbody>
<tr>
<td>…more actively search for credit</td>
</tr>
<tr>
<td>…have higher total balances</td>
</tr>
<tr>
<td>…more recently opened a new trade line</td>
</tr>
<tr>
<td>…have experienced fewer delinquencies(!)</td>
</tr>
</tbody>
</table>
Collider Bias and Spurious Correlations

- Rain
- Sprinkler
- Wet
Conceptual Definition of Economic Sensitivity as a Causal Effect

Potential future scenarios

If normal economy: \( pD = 13\% \)

If recessionary economy: \( pD = 22\% \)

\( 9\% \) increase in \( pD \) caused by recession

Joe’s economic sensitivity

• We solved the counterfactual problem
Counterfactual Analysis Approach

- Leverage natural experiments over the economic cycle, captured by credit bureau data
- Challenge: Distributional differences between “Stressed” and “Control” groups
- Approach: Matched sampling finds baseline-comparable “twins”


Matt  Default  Mike  Good
FICO 671  TOB 264 months 39% Utilization
FICO 668  TOB 257 months 43% Utilization
Matched Sampling Based on Machine-Learned Propensity Score

1. Train Stochastic Gradient Boosting to learn likelihood of stress exposure

Increasing likelihood of stress exposure

- Stressed cases
- Control cases
Matched Sampling Based on Machine-Learned Propensity Score

2. Find matched pairs with similar exposure likelihood, but where one partner is exposed to stress and the other is a control.

Increasing likelihood of stress exposure

Method
“Caliper matching on the propensity score”
Example of Matching Success

• Prior to matching

• Post matching
Machine Learning of ESI Model from Matched Sample

Matched Sample

Stochastic Gradient Boosting

Prediction

Consumer attributes, Flag for economic condition

- Normal
- Great Recession

Joe

Consumer attributes only
Turning Machine Learned Black Box Into Explainable Scorecard

Scorecardizer Approach to xAI: Train Scorecard to approximate ESI generated by ML model
Add domain expertise to warrant explainability and palatability

Counterfactual analysis using machine learning

Stochastic Gradient Boosting

Data

Domain expertise

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Attributes</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of months since the most recent serious delinquency</td>
<td>No serious delinquency</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>0 — 5</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>6 — 11</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>12 — 23</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>24+</td>
<td>55</td>
</tr>
<tr>
<td>Overall utilization on revolving trades</td>
<td>No revolving trades</td>
<td>30</td>
</tr>
<tr>
<td></td>
<td>Under 6%</td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>7 — 19%</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>20 — 49%</td>
<td>45</td>
</tr>
<tr>
<td></td>
<td>50 — 89%</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>90% or more</td>
<td>15</td>
</tr>
</tbody>
</table>

*Purely illustrative, not part of actual model
At similar credit risk scores:
• Increase exposure to robust consumers
• Deal more conservatively with sensitive consumers

New swap sets!
ESI Applications for Provisioning

Scenario-Adjusted FICO® Score

FICO® Score → pD component of Expected Credit Loss model → Point estimate of Odds

Other attributes

FICO® Score → Scenario-adjusted FICO® Score → Unchanged model → Scenario-adjusted Odds

Other attributes

Discussion

- Created Economic Sensitivity Index to tell apart recession-sensitive from robust consumers
  - New insights who the sensitives are
  - Valuable for decisioning and provisioning

- Success “secrets”
  1. Start with great questions
  2. Proper problem formulation is half the solution
  3. Reason about causality/distinguish from correlation—Seek explanation not just prediction
  4. Machine Learning provides data mining efficiencies, but doesn’t help with 1.-3.
  5. Combine data-driven learning with domain expertise
Thank You!

Dr. Gerald Fahner
geralfahner@fico.com