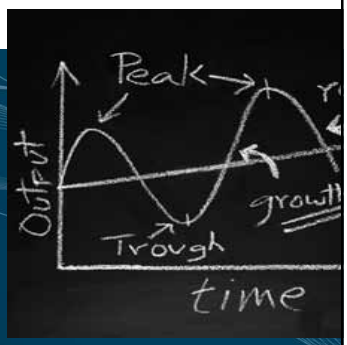
Economic impact Grade Migration modelling

– to address pro-cyclicality in current risk management practice



David Molyneaux
Edinburgh - August 2011

The Procyclicality Problem

FSB FINANCIAL STABILITY BOARD

BANK FOR INTERNATIONAL SETTLEMENTS

14TH FEBRUARY UPDATE TO THE G20 FINANCE MINISTERS AND CENTRAL BANK GOVERNERS:

"..The key issue …..is to mitigate or dampen financial system *procyclicality*, i.e., how financial system-wide risk can be amplified by interactions within the financial system and between the financial system and the real economy, sometimes leading to financial crises. In economic upswings, the financial system creates and tends to become overexposed to aggregate risk, via ample credit availability, rapid increases in asset prices, leverage and maturity mismatches. If the system has not built sufficient buffers in good times, when the financial cycle turns, the downturn can induce widespread financial distress and be amplified by substantial deleveraging, reducing the provision of credit and key financial services to the economy. **A specific focus here is how to put in place various forms of buffers that act countercyclically, thereby also possibly restraining the build-up of systemic risk…"**

Calculation of a Long Run PD

Example: Using economic modeling to create a *forward looking* PD

» Risk grades can be represented by an average "score"

» Using the average score for each risk grade, one can estimate the PD for each grade under the expected economic conditions for each quarter

	Average Score	Q1 2003	Q2 2003	Q3 2003	…	*Q3 2010*	*Q4 2010*
Grade 1	271	0.2%	0.1%	0.2%	…	*0.3%*	*0.2%*
Grade 2	247	0.5%	0.4%	0.6%	…	*0.7%*	*0.5%*
Grade 3	216	2.2%	1.8%	2.3%	…	*2.8%*	*2.8%*
Grade 4	189	7.0%	6.1%	7.2%	…	*7.9%*	*7.8%*
Grade 5	172	13.9%	12.4%	14.0%	…	*15.2%*	*14.6%*

$$\ln(odds) = m(\vec{e}) \cdot score + k(\vec{e})$$

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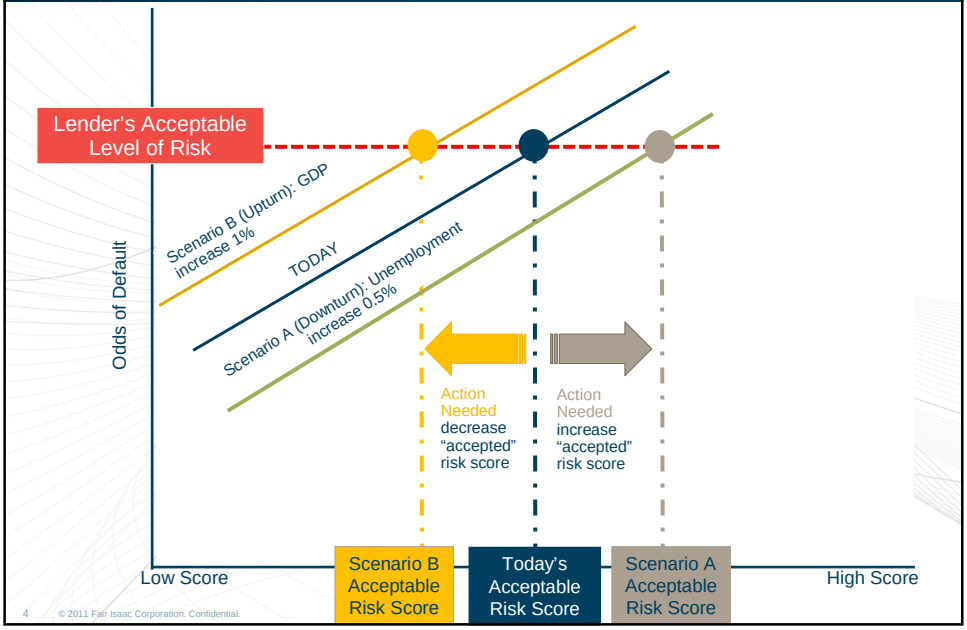
"Next Generation" Bank: FICO Economic Impact Solutions



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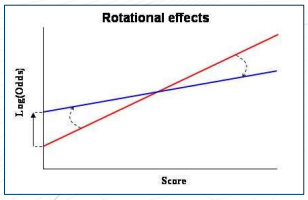
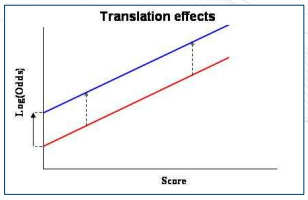
Some Challenges to Consider…

- A score's log-odds is impacted by many factors. The true impact of macro-economic needs to be isolated
  - Macro-economic conditions
  - Changes in underlying population (e.g. origination strategies)
- Slope and Intercept are correlated
  - One must distinguish between
    - a change in slope
    - a change in intercept unconnected with a change in slope

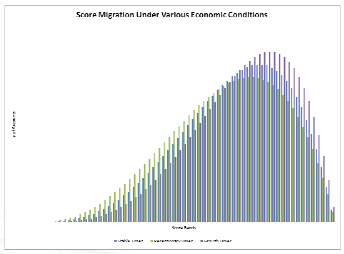




- FICO has created algorithms to handle these 2 challenges

What is Grade Migration?
Panel Regression Model to Predict Score Distribution

- Economic impact GM model – to **predict score distribution** over time
- FICO research recommends using **Panel Regression** – public available



- The economic model to predict score distribution is

$$p_j(t) = \beta_j^{(0)} + \beta_j^{(1)} \cdot p_j(t-1) + \beta_j^{(2)} \cdot UR(t-2) + \beta_j^{(3)} \cdot \Delta HPI(t-3)$$

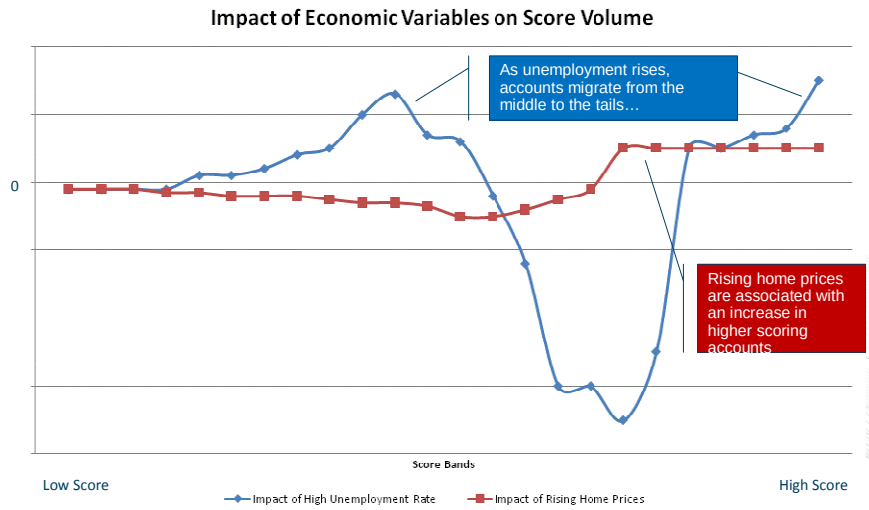
where $p_j^{(t)}$ is the % of scoreable accounts in score bin *j* for quarter *t*

UR is the unemployment rate,

ΔHPI is the quarterly difference in home price index.

$p_j^{(t-1)}$ is an auto-regressive term (the score distribution in a previous qtr

How economic variables impact the migration of scores across bands…



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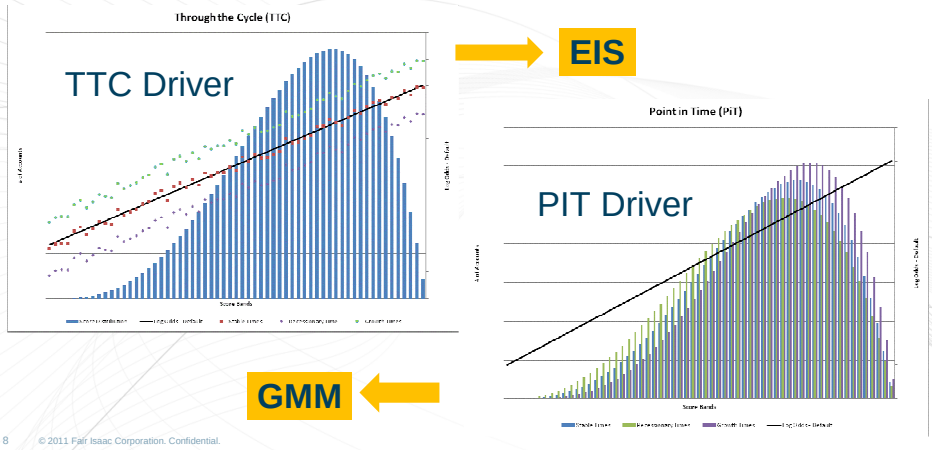
Integration in Basel III Solution

In Basel III, we need to account for two effects:

1) Fluctuation of PD w/in score bands (Driver #1) &
2) Migration of accounts across score bands (Driver #2)



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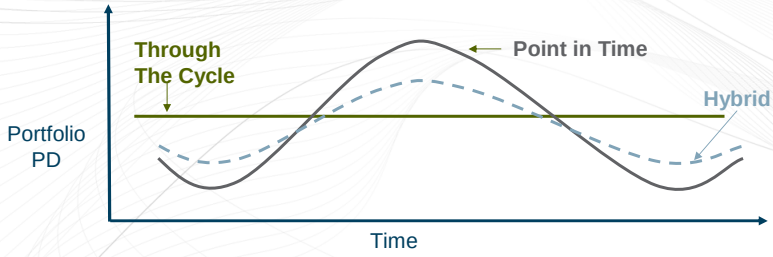
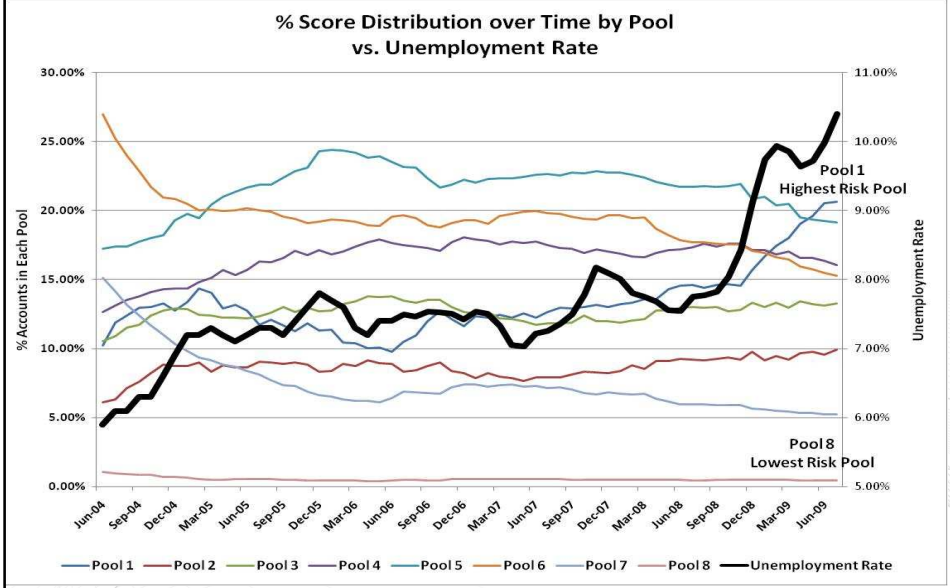
PIT vs. TTC: Clients' rating philosophy will determine how economic factors influence these drivers

- Point in Time (PiT): Risk grades defined by characteristics influenced by the economy (typically behaviour scorecards using characteristics such as %dlqL3M, CT/DT Ratio)
- Through the Cycle (TTC): Risk grades defined by non-cyclical variables (typically origination scorecards using characteristics such as age, marital status)
- Most rating philosophies take a hybrid approach



Loan Portfolio Score Migration



Loan Portfolio
PD Pool Migration Model

The following table summarises the % PD Pool Migration Model developed for a Loan portfolio

- Household Savings Yearly Change (9 months lag)
- GDP Yearly Change (3 months lag)
- GFCF Yearly Change (6 months lag)

Overall Panel Regression
R-squared = 0.72

Model Coefficients

Panel	GDP	GFCF	HsldSav	Intercept
Pool 1	-0.090	-0.055	-0.650	0.225
Pool 2	-0.003**	-0.032	-0.150	0.102
Pool 3	-0.001**	-0.025	-0.055	0.135
Pool 4	-0.150	-0.135	0.220	0.143
Pool 5	-0.301	-0.081	0.554	0.141
Pool 6	0.351	0.155	0.001**	0.182
Pool 7	0.222	0.185	0.077	0.064
Pool 8	0.008	0.012	0.000**	0.005

** Note: GDP Coefficients for Pools 2 & 3 were constrained to be negative
Household Savings Coefficients for Pools 6 & 8 were constrained to be positive

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Personal Loan Portfolio
PD Pool Migration Model

The following table summarises the % PD Pool Migration Model developed for a Loan portfolio

- Pool level summary stats

BASE MODEL RESULTS BY PANEL

Panel	#_valid_obs	avg_perf	avg_resid	RMSE	R-squared
Pool 1	62	0.133	0.000	0.007	0.934
Pool 2	62	0.086	0.000	0.006	0.247
Pool 3	62	0.126	0.000	0.006	0.081
Pool 4	62	0.165	0.000	0.007	0.708
Pool 5	62	0.215	0.000	0.009	0.712
Pool 6	62	0.193	0.000	0.011	0.667
Pool 7	62	0.074	0.000	0.014	0.561
Pool 8	62	0.005	0.000	0.001	0.354

- RMSE is the square root of the variance of the residuals.
- Whereas R-squared is a relative measure of fit, RMSE is an absolute measure of fit (how close the observed data points are to the model's predicted values).
- RMSE can be interpreted as the standard deviation of the unexplained variance, and has the useful property of being in the same units as the response variable (%accounts). Lower values of RMSE indicate better fit.
- Actual vs. predicted graphs demonstrate fit over time

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Loan Portfolio
PD Pool Migration Model Results

» The following table demonstrates the reduction in model R-squared by removing in-model chars

REDUCED MODEL RESULTS

Dropped Variable	R-squared	R-Squared Reduction
GDP	0.645	0.075
Household Savings	0.590	0.131
GFCF	0.565	0.156

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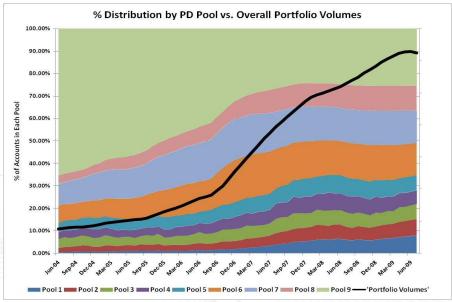
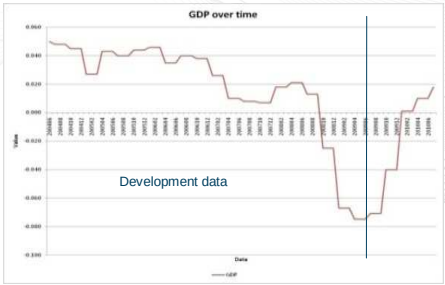
Grade Migration
Some Challenges

» Portfolio grew significantly during development period



» Full economic cycle not part of development period

» Economic drivers smoothness, quarterly jumps



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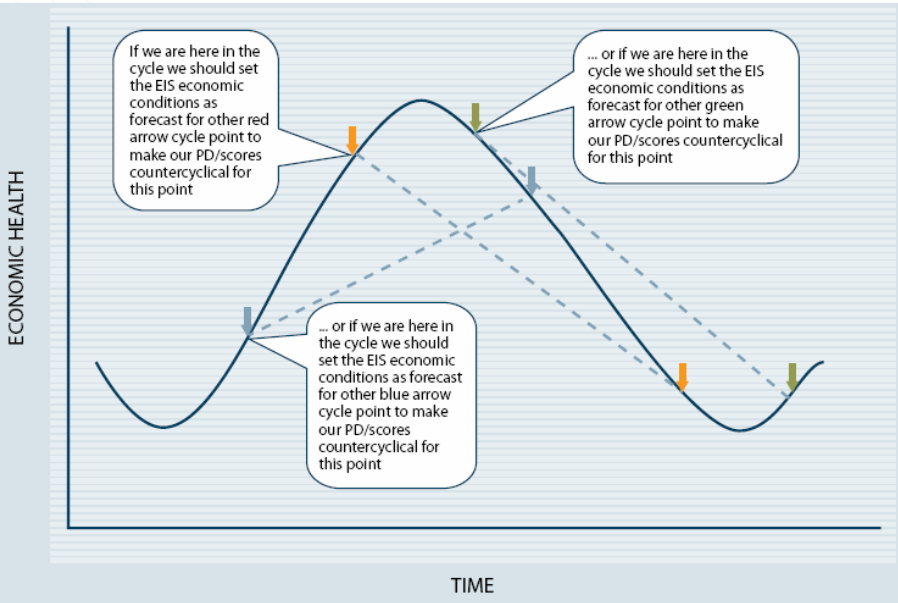
Adjusting for Economic Effects



Example

A two grade rating system covering the portfolio with observed exposure volumes

Now we apply the economic models using the target condition variable values

Then we apply a scalar to the Target Economic PD's to reflect the target exposure distribution

	Current Estimates & Observations			Target Economic Condition	
	PD%	Asset Volume (EAD)		PD%	Asset Volume (EAD)
Grade A	0.5	60		0.4 (EIS)	70 (Migration)
Grade B	2.5	40		2.0 (EIS)	30 (Migration)
Total Portfolio	1.3	100		0.88	100

	Target Condition PD %	Observed EAD	Scalar	'Scaled' Grade PD %
Grade A	0.4	60		0.34
Grade B	2	40		1.69
Total Portfolio	1.04	100	0.846*	0.88

•The ratio of the portfolio level PD with and without the impact of account migration (0.88/1.04)

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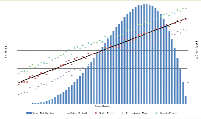
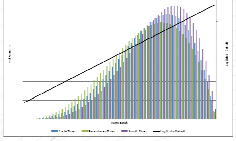
FICO EIS Framework for Capital Stability

- The FICO approach for capital stability makes use of two model methodologies on the portfolio default rate
- The migration and grade rate changes caused by economic condition change are separately investigated

What is the score to odds relationship during economic change? → **EIS Models** → **Show the effect of the economy on the default rate at each PD pool**



How does the account distribution across PD pool / score ranges during economic change? → **Grade Migration Models** → **Predict % accounts / exposure within each PD pool during economic change**



EIS and GMM work together
to describe the full impact of economic conditions (e.g. downturn, stress scenario, normal)
on the portfolio default rate

Thank You – Any questions?