Vintage Effects in Loan Default Models

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Vintage Effects: Etymology

- Why is vintage a sufficient statistic for wine?
- Idea is that only conditions at bottling matter
- Thereafter, all vintages face same controlled environment
- No interaction between cellar conditions and vintage
- Some usefulness, but analogy breaks down
- Origination regimes drift but...
- Credit markets are not wine cellars
- Clearest example: interaction between equity and house price declines → “cohort” effects
Student Loan Vintage Effects

Five Year Cumulative Default Rates by year borrower entered repayment

Source: Looney & Yannelis
Lending Club Vintage Effects

Standard Program Credit Performance – 36 Month

Prime 36M Cumulative Net Charge-off Rate

- 2009
- 2010
- 2011
- 2012
- 2013
- 2014
- 1Q2015
- 2Q2015

Month on Book
Subprime Mortgage Vintages

Figure 14: Recent Subprime Vintages Have Performed Poorly
Percent of Loans 60+ Days Delinquent by Year of Origination

Source: Moody’s Investors Service
Relevance for Stress Testing

• Want to kick the tires on a portfolio of loans

\[ \text{Loss}_t = PD_t \times LGD_t \times EAD_t + \xi_t \]

• How can we model changing environment if there are vintage effects?

• Usual strategy: use whatever data we have to estimate fixed vintage effects

• But that doesn’t allow for dynamics, making out-of-sample predictions (i.e. stress testing!) tenuous

• Fundamental problem with RF out-of-sample
This paper

• Estimate mixture model with vintage-specific weights in loan hazards
• There are $J$ types of mortgages
• Estimated, but we know there is type heterogeneity
  • Woodheads (Campbell et al., 2016)
  • Fastidious (Aiello, 2016)
  • Liars (Haughwout et al., 2011)
• Mass point levels common across vintages but
• Different origination years have different type mix
• Allow default/prepayment types to be correlated
Wine intuition

- Suppose 1979 vintage had 2 (unobservable) types
  1. “juvenile delinquents” that burst bottles by 1983
  2. perfect wine

- Conventional model would predict in 1983 that 1979 was a uniformly terrible year

- Authors’ mixture model would recognize that residual bottles are a great bet
Mortgage Intuition

• Can’t judge a portfolio to be particularly exposed if it’s already “burned out” of all the risky types
  • And vice-versa via prepayment
• Data allows us to estimate share of good and bad types in each vintage with the data we do have
• Allows us to postulate residual distribution of types
• Should improve out-of-sample prediction under alternative scenarios
1. Does risk dependence matter?

- Given that “estimate of covariate coefficients similar” between independent/dependent risks specs...

1. Should we care about accounting for dependence?
   - Stress testing: care about exposure to covariates, mass points less relevant

2. Why difference in effect of stress?
   - Is there?
   - Baseline model accuracy is empirical question.
Is difference significant?

Old = conventional model
New = unobserved-heterogeneity model

Cumulative Default Rates

Cumulative Prepayment Rates
2. Alternative goal: drive $\delta_{\tau_k} \rightarrow 0$

- Why not find a spec that **fully** explains vintages?
- If key problems of FEs are dynamic selection, out-of-sample prediction, marginal vs. average, why not use rich enough covariates that explain away entirety of vintage effects?
- Ideal for stress testing!
- Authors cite Demyanyk and van Hemert (2011) as evidence that residual vintage effects cannot be explained with covariates.
Subprime Vintage Effects

Source: Palmer (2015)
3. Simulate out of sample

- Table 5 full of NAs
- Virtue of this method is allows simulation of those
- Could back-test by estimating in 2012 and simulate using 2014 realized covariates
- Compare to 2014 actual realizations key test

Average Marginal Vintage Effects on Default \[^{1}\]

\[
\sum_{k=1}^{K} \text{Pr}(v = \mu^k | T^1 > \text{dur}, T^2 > \text{dur}) e^{v_1}
\]

<table>
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<tr>
<th>Vintage</th>
<th>Duration (quarters)</th>
<th>1</th>
<th>9</th>
<th>17</th>
<th>25</th>
<th>33</th>
<th>41</th>
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<td>8.54</td>
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<td>6.34</td>
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<tr>
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<td>10.65</td>
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</tbody>
</table>

Notes: Average marginal vintage effects computed for loans still ongoing and current at each duration. Based on estimated dependent competing risks model with unobserved heterogeneity, presented in Table 4.

Source: LPS
Little things

• Notation confusing: $j$ sometimes indexes unobserved heterogeneity types and an exit type in the same equation.
• Still requires extrapolating out-of-sample (baseline hazard, for example—virtue of parametric $\lambda_0$)
• At what level is unemployment measured?
• What level of HPI used to impute time-varying LTV?
• More flexible LTV function? Spline?
• Include other controls like $\Delta$HPI
Conclusion

• Authors develop a very intuitive mixture model
• Captures vintage heterogeneity in a way that captures dynamics while still doubling down on vintage concept
• Could be especially important when evaluating legacy pools
• Why not capture vintage effects fully with Xs?
• Need more evidence that this matters: back-testing simulations