Reconciling Estimates of the Speed of Adjustment of Leverage Ratios

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Speed of Adjustment

- Firms have leverage targets.
- The denominator of a leverage ratio can change for a variety of reasons.
  - Investment (market and book leverage)
  - Investor Sentiment (market leverage)
  - Capital Depreciation (book leverage)
- How long does it take for firms to get back to their targets?

Measuring SOA

- First-order panel autorgression

$$
\begin{aligned}
L_{i,t} - L_{i,t-1} &= \lambda(T_i - L_{i,t-1}) + u_{i,t} \\
L_{i,t} &= (1-\lambda)L_{i,t-1} + \lambda T_i + u_{i,t} \\
L_{i,t} &= \rho L_{i,t-1} + (1-\rho)T_i + u_{i,t} \\
\lambda &= SOA \\
\rho &= 1 - SOA
\end{aligned}
$$

The Problem and the Goal

- Five Estimators: OLS, Fixed Effects, Long Difference, Arellano Bond, and Welch.
- Different methods for estimating the autoregression give one very different answers.
- So $AR(1)$ process must be misspecified.
- In this case how do we measure SOA??

The Solution: Reconciliation Estimator

- Data Step:
  - Estimate ρ on **real** data using each estimator considered:
- Simulation Step:
  - Simulate an $AR(1)$ with a certain ρ.
  - Estimate ρ with each estimator on the **simulated** data.
  - Take the difference between each of these estimates and the actual data estimates.
  - Save the sum of squared differences.

The Solution: Reconciliation Estimator

- Pick the ρ that minimizes the sum of squared differences.
- The normalized sum of squared differences is a “t-statistic” that can be used as a specification test.
- This is really just a combination of minimum distance estimation and SMM.
- Lose the term “reconciliation estimator.”
- Correct the standard errors for simulation error.

But But But . . .

- Leverage cannot follow an $AR(1)$ because it is bounded between zero and one.
- Placebo Process
  - Start each firm out with its own leverage.
  - Increment its leverage with some other random firm's **change** in leverage.
  - Obtain a placebo process.

Bootstrapped Leverage

- Make simulated leverage that adjusts to a target.

$$\text{Simulated Leverage} = \rho\text{Placebo Leverage} + (1-\rho)\text{Target}$$

- The target is a function of the firm's starting leverage.
- Run the SMM/MinDist estimator.

Results

- The Welch estimator does the best job of estimating a ρ.
- OLS is dismal.
- The rest do well for $\rho < 1$ but stink for $\rho > 1$.
- The reconciliation estimator gives an estimate of SOA that is slightly negative.
- The specification test statistic is “large” for the SMM estimation and “small” for the SMM/Bootstrap hybrid.

No Need to Do SMM

- You have closed form solutions for your estimators.
- Just do minimum distance.
- The bootstrapped version of SMM is consistent via the exact same mechanism, so it cannot be correcting for bias.

COVARIANCES COVARIANCES COVARIANCES

- The Hausman test is beautiful.
- **Ferrari estimator** (efficient, only consistent under the null) versus
  Honda Accord estimator (inefficient, always consistent)
- To test for the differences between estimates, you do not have to calculate their covariance.
- None of Welch's estimators are arguably efficient and all break down under the alternative.

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- Yugo estimators?

So? The Idea is Intuitive

- The “Welch/Hausman” test statistics are probably much too large.
- The estimator puts too much weight on OLS.
- OLS is the worst estimator.
- What is the distribution of the Welch statistic?

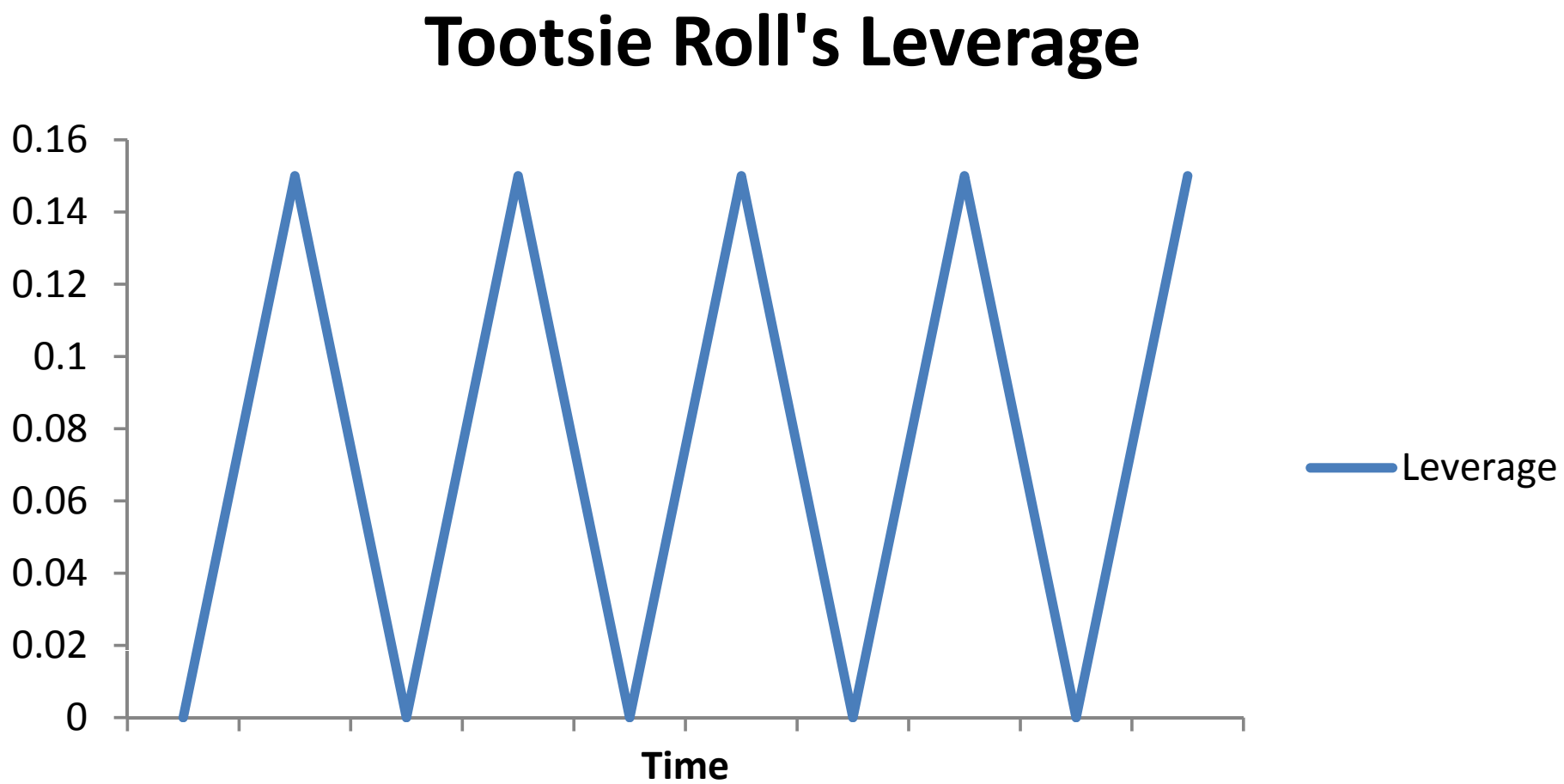
Mispecification

- What if leverage follows a truncated $ARMA(1,1)$, say?
- All of the estimators are going to return biased estimates.
- Decay for an $ARMA$ process can be much slower than the decay for and AR process with the same ρ.
- Estimate of ρ too high.
- Estimate of SOA too low, and maybe negative.

The Meaning of SOA

- An $AR(1)$ implies adjusting a constant fraction of leverage every period.
- No model of optimal leverage implies this kind of behavior
- Contingent claims (Fischer, Heinkel, Zechner) models: (S, s) behavior.
  - issuance costs, bankruptcy costs, drift, etc.
- Neoclassical investment/leverage (Hennessy, Whited) models: many adjustments.
  - investment adjustment costs, productivity shock persistence, production technology, etc.

Tootsie Roll Leverage



Tootsie Roll Leverage

- $\rho = -1$
- Tootsie roll fills up 200% of the gap between actual and target leverage every period.
- Target is not the mean.

Infrequent Adjustment

- Leary and Roberts: firms adjust leverage somewhat infrequently.
- The changes in leverage will for the most part be uncorrelated.
- $\rho = 1$
- Yet speed of adjustment should be related to the average time it takes to adjust.

What I Like

- Compare Estimators!!!
- Invent Estimators!!!!

Work to be Done

- Make an estimator that works under general processes and prove that it works. (Edgeworth expansions.)
- Do traditional Monte Carlos—not hybrid bootstrap Monte Carlos, unless you can prove that they work. (Edgeworth expansions.)
- Think about what SOA means in terms of theory.