FamaMacbeth regression vs. Fixed effect

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Intro

- Two general forms of dependence
  - Firm Effect
    - The residuals of a regression can be cross sectionally correlated (e.g. the observations of a firm in different years are correlated)
  - Time Effect
    - The residuals of a given year may be correlated across firms. (e.g. the observations of a year in different firms are correlated)
- An important statistical issue is that firm returns are cross-sectionall correlated: $\mathrm{Cov}(r_{it}, r_{jt})$ is far from zero.

Fama Macbeth (1973)

- Two Step Regression
  - First Step

$$Y_{i1} = \delta_{0,1} + \delta^1_{1,1} X^1_{i,1} + \cdots + \delta^k_{k,1} X^k_{i,1} + \varepsilon_{i,1}$$
$$\vdots$$
$$Y_{iT} = \delta_{0,1} + \delta^1_{1,T} X^1_{i,T} + \cdots + \delta^k_{k,T} X^k_{i,T} + \varepsilon_{i,T}$$

  - Second Step

$$\begin{bmatrix} \bar{Y}_1 \\ \vdots \\ \bar{Y}_T \end{bmatrix}_{T\times 1} = \begin{bmatrix} 1 & \delta^0_1 & \delta^1_1 & \dots & \delta^k_1 \\ \vdots & \vdots & \vdots & \dots & \vdots \\ 1 & \delta^0_T & \delta^1_T & \dots & \delta^k_T \end{bmatrix}_{T\times(k+2)} \times \begin{bmatrix} \lambda \\ \lambda_0 \\ \lambda_1 \\ \vdots \\ \lambda_k \end{bmatrix}_{(k+2)\times 1}$$

- Fama-MacBeth technique was developed to account for correlation between observations on different firms in the same year

Fama Macbeth (1973)

- Fama-MacBeth approach was designed to deal with time effects in a panel data set, not firm effects.
- The firm effect may be less important in regressions where the dependent variable is returns (and excess returns are serially uncorrelated) than in corporate finance applications where unobserved firm effects can be very important
- FM method is used for the estimation of factor risk premia in the analysis of linear factor models

Newey and West (1987)

- Newey and West (1987) adjustment to the results of the regression, however, produces a new standard error for the estimated mean that is adjusted for autocorrelation and heteroscedasticity.
  - Only input is the number of lags to use when performing the adjustment

$$Lag = 4(T/100)^{\frac{2}{9}}$$

  where T is the number of periods in the time series

Fixed Effect

$$y_{i,t} = \alpha + \beta x_{it} + \varepsilon_{it} \rightarrow \begin{cases} y_{i,t} = \alpha + \beta x_{it} + (a_i + u_{it}) & \text{Firm Fixed effect} \\ y_{i,t} = \alpha + \beta x_{it} + (a_t + \nu_{it}) & \text{Time Fixed effect} \end{cases}$$

- Assumptions about unobserved terms: **strict exogeneity**
    1. Firm Fixed effect: $E(x_{it} u_{is}) = 0$ for $s = 1, 2, \ldots, T$
    2. Time Fixed effect: $E(x_{it} \nu_{st}) = 0$ for $s = 1, 2, \ldots, n$

Conclusion

- Both methods rely on zero correlation between the error terms of non-contemporaneous periods. A difference is weighting:
  - The Fama-Macbeth procedure weights each time period equally.
  - A panel regression will effectively give greater weight to periods with more observations or greater variation in right hand side variables
- The econometric analysis of panel data depends in a crucial way on the cross-sectional and timeseries correlation of the regression residuals

Estimation Results

By different methods

	(1) Lag(5)	(2) Lag(4)	(3) TimeFE	(4) PairFE	(5) Time Cluster
FCA*	0.00296***	0.00296***	0.00351***	-0.00330**	0.00347***
	(6.35)	(6.48)	(8.93)	(-2.71)	(7.42)
FCA*2	0.00480***	0.00480***	0.00542***	0.000901	0.00538***
	(11.15)	(10.64)	(12.49)	(0.93)	(10.27)
ρ_t	0.303***	0.303***	0.275***	0.253***	0.275***
	(18.05)	(16.20)	(337.99)	(306.57)	(10.95)
ActiveHolder	0.00356***	0.00356***	0.00438***	0.00724*	0.00466***
	(3.81)	(3.76)	(4.56)	(2.40)	(3.99)
SameHolderType	-0.00569	-0.00569	-0.00227	0	-0.00170
	(-0.94)	(-0.93)	(-0.42)	(.)	(-0.31)
SameGroup	0.0167***	0.0167***	0.0171***	0	0.0173***
	(7.24)	(7.32)	(14.41)	(.)	(8.45)
Constant	0.0372**	0.0372**	0.0306***	0.0197*	0.0297***
	(3.06)	(3.18)	(5.05)	(2.56)	(4.03)
Observations	1381437	1381437	1381437	1381437	1381437

t statistics in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$