Ratio of Changes:

How Real Estate Shocks Did Not Affect Corporate Investment

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Simplified Chaney, Sraer, Thesmar (AER 2012)

➔ Does an increase in collateral induce more investment?

➔ Common corporate-finance specification:

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = \beta \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

➔ capex (capital expenditures),

➔ real-estate (dollar value, mostly headquarter),

➔ ppe (property plant and equipment)

- ➔ really just a scale adjustment
- ➔ (titled) interest is about real-estate and capex

➔ CST add fixed effects (FE) for time and other controls.

! Positive Coefficient Interpretation !

! More Real-Estate Collateral $\Rightarrow$ More Corporate Investment !

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.07 \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

➔ CST emphasize coefficient magnitude

➔ too much? a one-time shock on real-estate value stock will have a permanent effect on capex flow. Is the payoff on capex immediate?

➔ Somewhat generous on simul-timing.

➔ T around 20 (3,000 firms, 15 years)

Time Falsification?

➔ Opinion: Time falsification should be standard in all event papers

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.07 \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.08 \times \frac{\text{realestate}(i,t+4)}{\text{ppe}(i,t+3)} + \text{FE}(i) + \ldots + e$$

➔ Shock (in title) is not empirical.

➔ Presumably, managers did not invest in anticipation of real-estate gains four years into the future.

➔ Shock (in title) is only theoretical.

? Positive Coefficient Interpretation ?

? More Real-Estate Collateral $\Rightarrow$ More Investment ?

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.07 \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

➔ Or could it be merely variation in ppe ?

➔ Here, 100% correlation. But similar with correlation adjustments, as, say, when ppe is used for Y and assets for X.

➔ Similar (here the same) variables (1/ppe) multiply both the dependent and independent variables.

➔ Not shown: lots of variation in 1/ppe, relative to numerators.

➔ Q: Does coefficient reflect primarily numerator associations?

What About The Constant 1.0?

More Real-Estate Collateral $\Rightarrow$ More Investment ?

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.07 \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

More 1.0 $\Rightarrow$ More Investment ?

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.13 \times \frac{1.0}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

More Real-Estate Collateral $\Rightarrow$ More 1.0 ?

$$\frac{1.0}{\text{ppe}(i,t-1)} = 0.20 \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

➔ Somehow real-estate and capex each increased (heterogeneously) in non-(FE)-controlled way.

➔ PS: Coefs reflect T-stats and magnitudes fairly.

Chaney, Sraer, Thesmar (2020) Response

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.07 \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.13 \times \frac{1.0}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

➔ Let's "split" the difference?

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.05 \times \frac{\text{realestate}}{\text{ppe}(i,t-1)} + 0.12 \times \frac{1.0}{\text{ppe}(i,t-1)} + \ldots$$

➔ CST: Problem is now under control: 0.05 coef is still positive.

➔ Me: Specification is still bad ("trended"): see 0.12 coef on constant.

Is Specification Under Control Now?

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = 0.05 \times \frac{\text{realestate}}{\text{ppe}(i,t-1)} + 0.12 \times \frac{1.0}{\text{ppe}(i,t-1)} + \dots$$

➔ 1. In Paper: Reasonable specifications under the null (of no association) still estimate similar coefficients in Monte-Carlo.

➔ 2. Regression still contains uncontrolled denominator effects:

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = -0.05 \times \frac{\text{realestate}}{\text{ppe}(i,t-1)} + 0.05 \times \frac{1.0}{\text{ppe}(i,t-1)}$$
$$+0.15 \times \log\left[\frac{1.0}{\text{ppe}(i,t-1)}\right] + \dots$$

Specification

➔ The specification wrestles (badly) with shared variation in 1/ppe on both X and Y.

➔ The specification is a bad crutch for the problem at hand.

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What if there is a Better Alternative?

➔ A specification that removes time-variation in denominator;

➔ and thus removes the problem, once and for all.

Translate Fixed Effects to Changes

From

$$\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)} = \beta \times \frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)} + \text{FE}(i) + \ldots + e$$

To

$$\Delta_t\left[\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)}\right] = \beta \times \Delta_t\left[\frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)}\right] + \ldots + e$$

➔ Familiar.

➔ Identical in two periods.

➔ Similar in more periods.

Care About Numerator?

➔ Changes of Ratios (CoR, d(v/z)):

$$\left[\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)}\right] - \left[\frac{\text{capex}(i,t-1)}{\text{ppe}(i,t-2)}\right]$$

$$= \beta \times \left\{\left[\frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)}\right] - \left[\frac{\text{realestate}(i,t-1)}{\text{ppe}(i,t-2)}\right]\right\} + \ldots + e$$

➔ vs. Ratios of Changes (RoC, (dv)/z):

$$\left[\frac{\text{capex}(i,t)}{\text{ppe}(i,t-1)}\right] - \left[\frac{\text{capex}(i,t-1)}{\text{ppe}(i,t-1)}\right]$$

$$= \beta \times \left\{\left[\frac{\text{realestate}(i,t)}{\text{ppe}(i,t-1)}\right] - \left[\frac{\text{realestate}(i,t-1)}{\text{ppe}(i,t-1)}\right]\right\} + \ldots + e$$

➔ What theory would not allow this?

Ratios of Changes

$$\left[\frac{\Delta_t \text{capex}(i,t)}{\text{ppe}(i,t-1)}\right] = \beta \times \left[\frac{\Delta_t \text{realestate}(i,t)}{\text{ppe}(i,t-1)}\right] + \ldots + e$$

➔ Denominator now does only what you need it for:

- ➔ scale control across different firms.

➔ Time-variation in ppe is removed by specification.

- ➔ similar to rescaling the lagged variable by $\text{ppe}(i,t-2)/\text{ppe}(i,t-1)$.
- ➔ Not revolutionary: Variables are now akin to "rate of returns."

Ratios of Changes (RoC) Regression

- RoC and Cor variables can be very different:
  - ...obviously when the denominator changes greatly.
  - Example: num=(19.9,20.0); denom=(100,200).
  - RoC: 0.2 – 0.1 = +0.1; vs. CoR = –0.1/100 = –0.001

  - in CST, the sign of d(Y/X) vs (dY)/X changes often.
  - especially for growing, volatile (small, non-RE).

Back to CST 2012

➔ Good RoC Regression:

$$\left[\frac{\Delta_t \text{capex}(i,t)}{\text{ppe}(i,t-1)}\right] = -0.02 \times \left[\frac{\Delta_t \text{realestate}(i,t)}{\text{ppe}(i,t-1)}\right] + \ldots + e$$

➔ Not shown: bad CoR regression has positive coefficient, just like CST

➔ One regression specification in which the independent variable (dREisPos $\times$ repi) is not the ppe CoR;

➔ but with CoR continuing as the dependent variable, the coefficient still turns negative:

➔ spurious time correlation problem is not mechanical, but empirical.

➔ Why? The reason are differential trends of small vs large firms.

➔ Same results when Great (Real-Estate) Recession data is added.

Specifications

➔ If you care about the numerator in a ratio, and

➔ you use the denominator primarily as a scale adjustment, and

➔ firms are different enough to require mean adjustments;

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➔ If you care about the numerator in a ratio, and

➔ you use the denominator primarily as a scale adjustment, and

➔ firms are different enough to require mean adjustments;

➔ then do not use a fixed-effects level regression!

➔ Use an RoC specification instead!

So What Went Wrong?

➔ Usually, I do not speculate on motives of authors,

... but

➔ CST are top-notch empiricists,

➔ ... and I believe the answer is quite innocuous.

My Guess

➔ CST merely used the most common “standard” specification in the literature, without giving it a second thought.

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➔ CST merely used the most common "standard" specification in the literature, without giving it a second thought.

➔ PS: I would guess that CST would no longer run and present the same regressions as sufficient evidence,

- ➔ Even if they still believe that RE $\rightarrow$ Capex, they would now show you more and/or different evidence.
- ➔ ... but you would have to ask them.

- ➔ We improve over time by learning from critics, not from friends,
- ➔ just as my paper improved from their response to my first draft.
- ➔ Unfortunately, unlike software, our journals are not good at iterating towards better versions of our shared standard knowledge.

Memes in Publications?

➔ CoR + FE specifications have infiltrated finance/economics.

➔ They are standard in many contexts.

➔ They often deliver desired (possibly spurious) results.

- ➔ Whether inference remains or changes requires reexamination.

➔ Their use may have expanded due to (evolutionary) publication pressures.

- ➔ Like cross-country regression methodology (Holderness (CFR 2016)).

➔ I am a little unfair to CST; they are not alone in using CoR w/ FE.

Stopping Memes

➔ Critical (Finance) Review is essential to our profession.

- ➔ I apologize to my colleagues (and to CST), but
- ➔ I believe that reexamination (and iteration) of every paper by independent critical minds is most essential to our profession as of 2021.
- ➔ Most papers have not yet been reexamined.

- ➔ There will be a painful transition period, as our profession gets used to less spectacular results, more caveats, and less holier-than-thou.

- ➔ I believe this is more important than novel "constructive" findings.

- ➔ CST just happened to be one important paper I stumbled on.
- ➔ Even if you still believe their RE $\rightarrow$ Capex inference, I hope my paper and its evidence has improved your understanding.