Identification

Toni M. Whited

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Empirical corporate finance has come a long way in a short amount of time!

- Gone are the days of

  Endogenous variable $Y = (\text{Vector of endogenous variables } X)\,\beta + u$

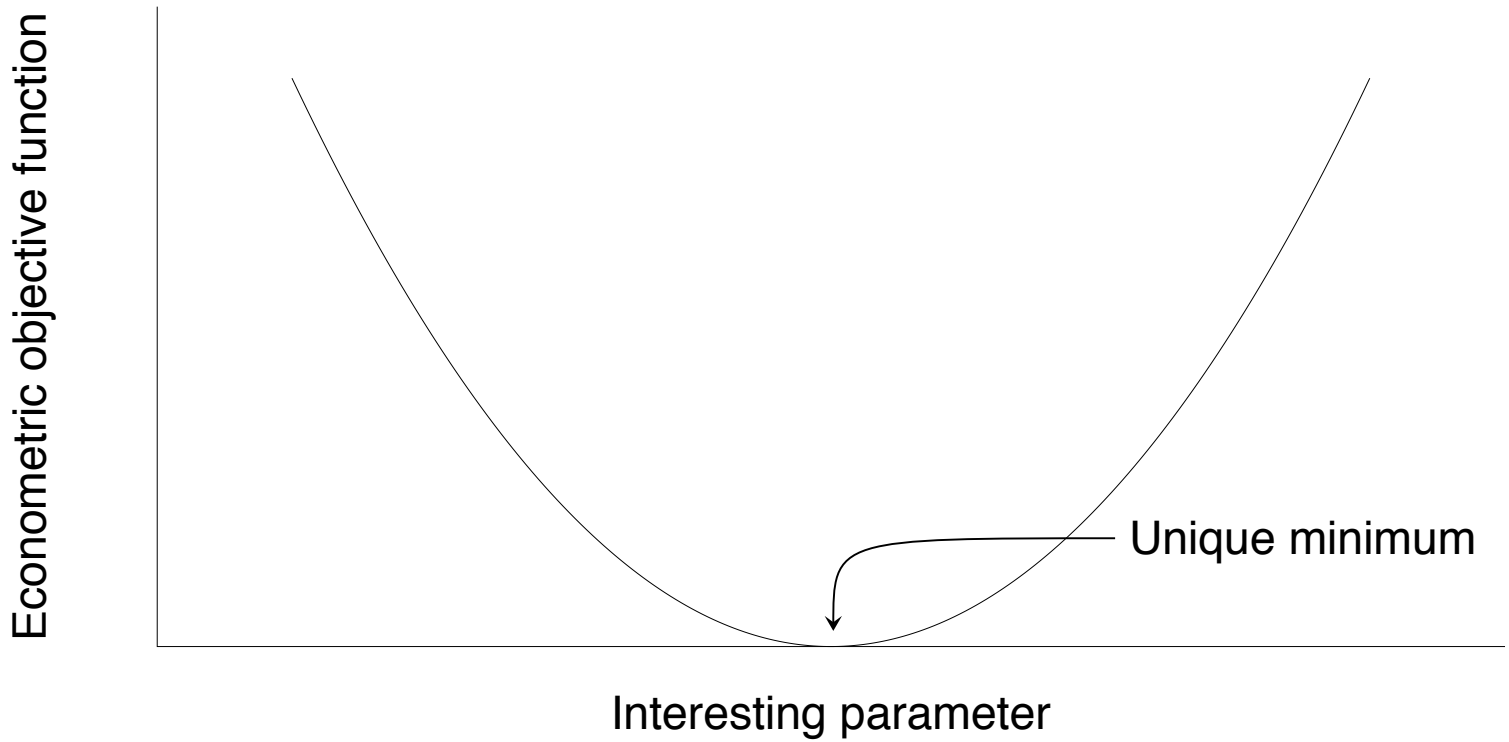
- Accompanied by statements that

- X **determines** Y.

We understand that exogenous variation can establish causation!

- But we need to go further.
- And we also need to go back.

Econometrically, identification is having a unique minimum for the objective function.



Exogenous events or data variation are neither necessary nor sufficient for identification.

Good identification

is always made relative to a

verbal or mathematical theory.

Identification means

the quantity you estimate

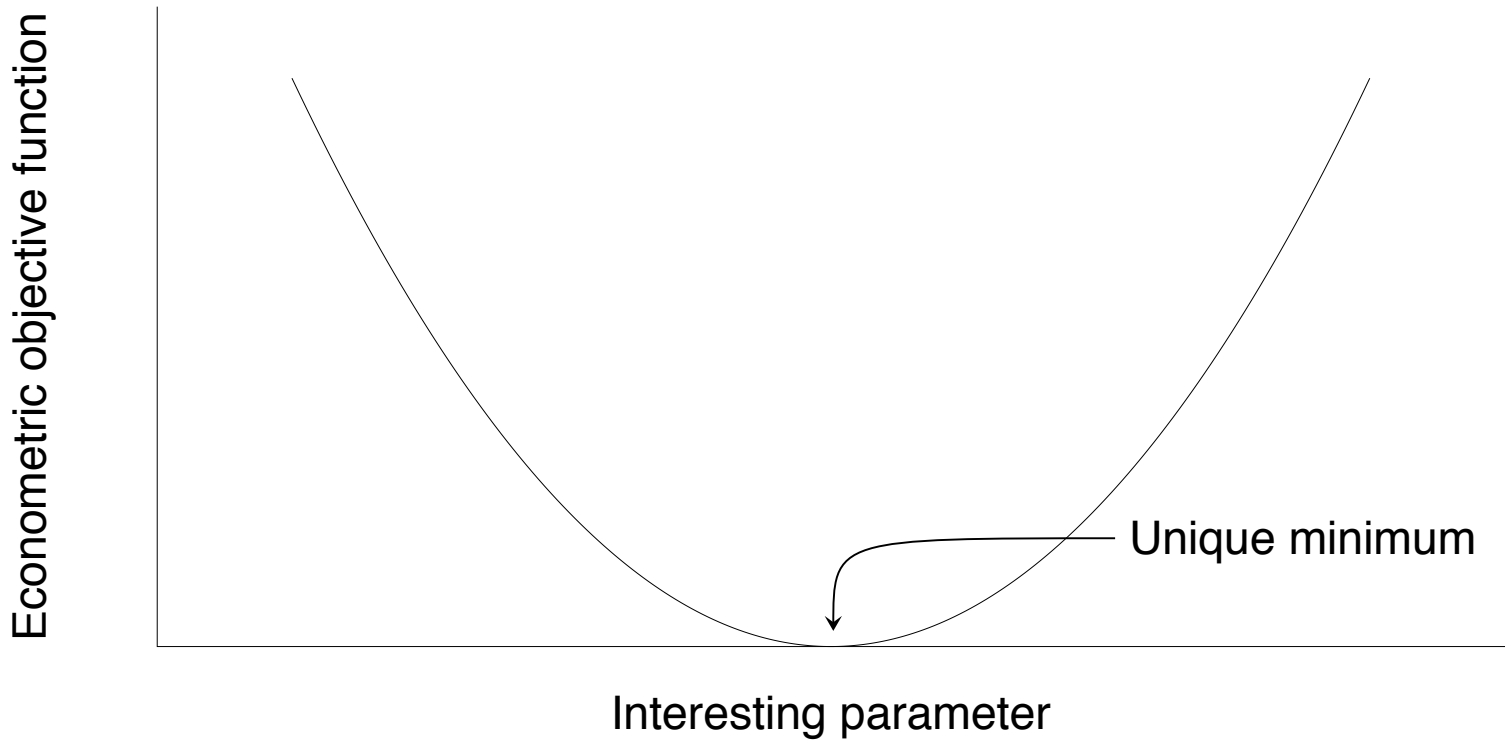
answers an interesting question.

Illustrate these points with several examples.

The first example shows that exogenous variation is not sufficient for identification.

- Bennedsen, Nielsen, Pérez-González, and Wolfenzon (2007) (EXCELLENT PAPER!!!)
- Does in-family CEO succession affect firm performance?
- OLS will not work because it will not identify the direction of causation.
- But how does this relate to . . .

Econometrically, identification is having a unique minimum for the objective function.



The model is a verbal model

- Agency problem

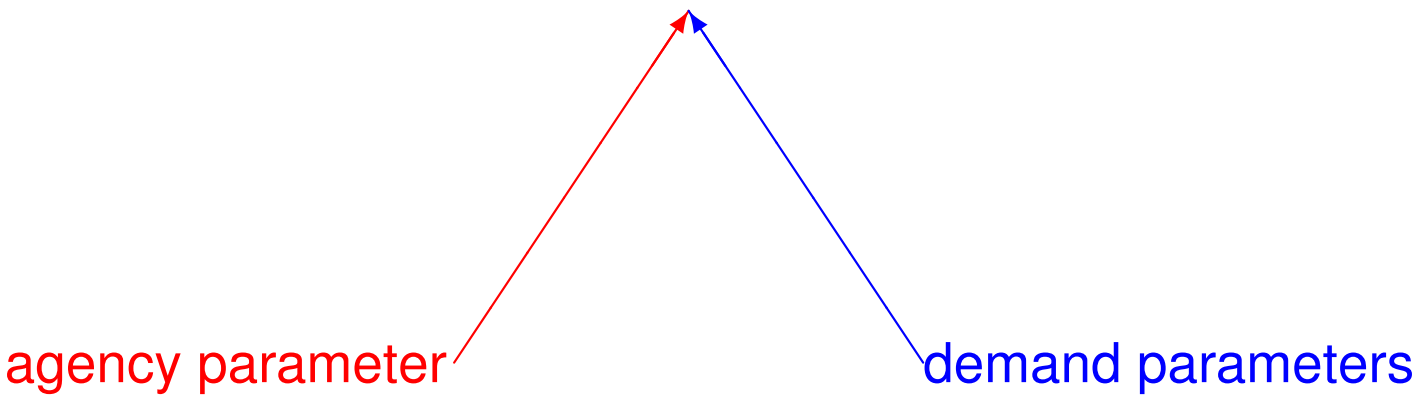
  $\longrightarrow$ bad choice from a limited family pool
  $\longrightarrow$ poor performance

- An estimated parameter needs to measure this interesting mechanism

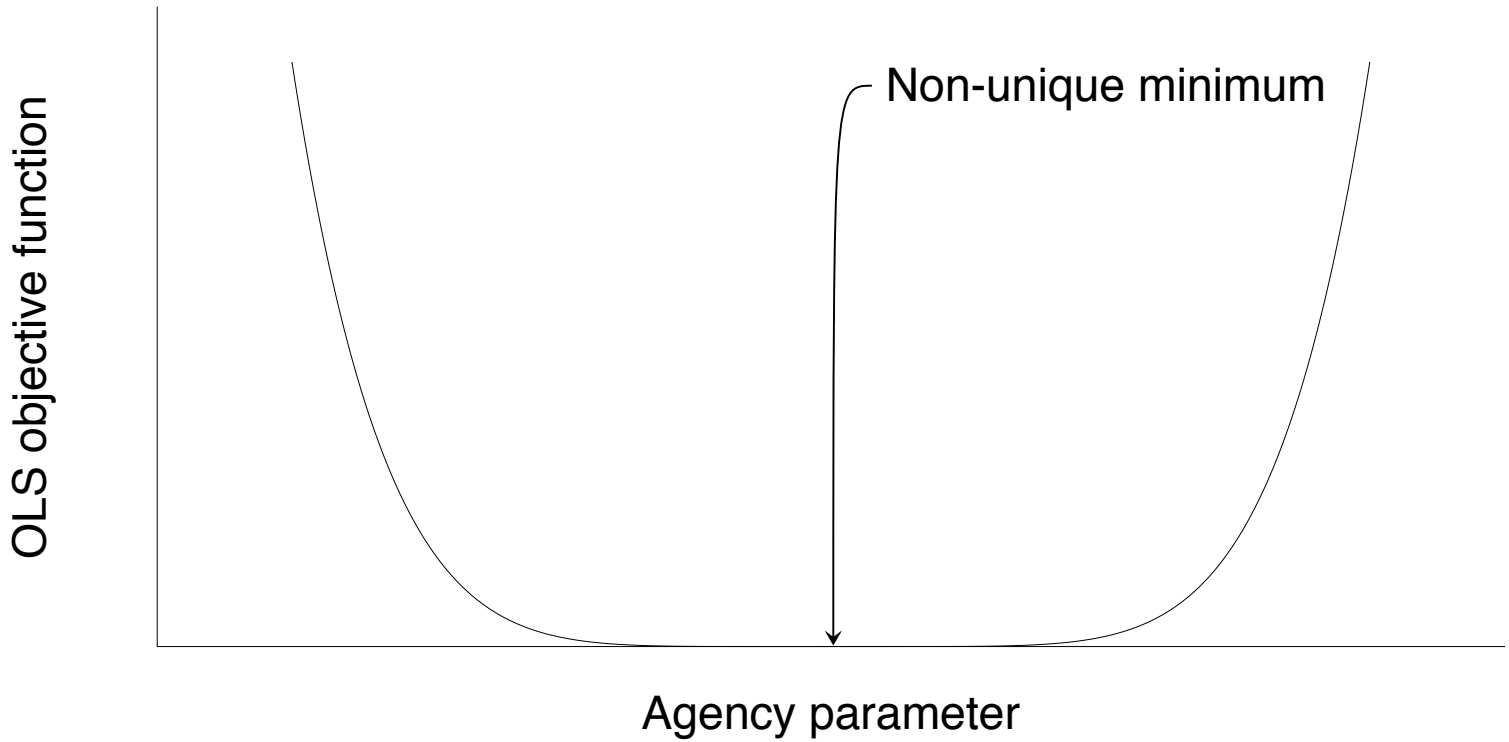
- But **unobservable** economic conditions also affect the demand for an inside CEO

The OLS slope is a function of more than one interesting parameter

$$\text{performance} = \alpha + \beta\,(\text{In-family succession}) + u$$



In terms of the agency parameter, the OLS objective function has a non-unique minimum.



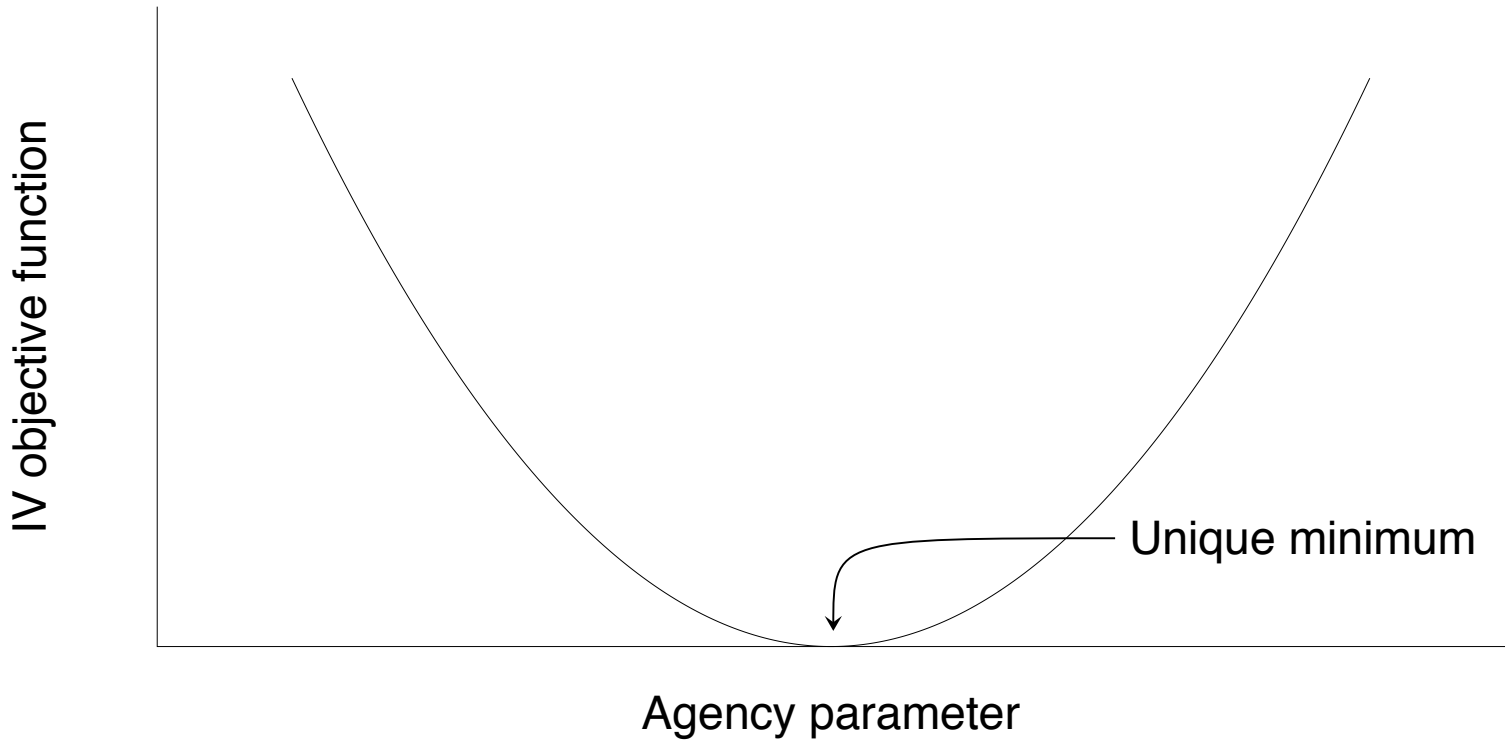
Isolate the agency parameter with an instrument

- Gender of the first born child!
- Clearly random!
- Not **exogenous** without further assumptions.

Using instruments or natural experiments is not an assumption-free exercise!

- Random events are only useful for observational studies if people react to them.
- This instrument only works because of the existence of sexism.
- It's the sexism that isolates the underlying agency parameter, not the biology.
- Assume sexism affects performance only via the the choice of a family CEO.

In terms of the agency parameter, the IV objective function has a unique minimum.



This is a great paper because it identifies an interesting economic effect!

- It doesn't just find exogenous variation.
- It uses that exogenous variation to answer a specific, interesting, well-defined question.

The next example shows that exogenous variation is not even necessary for identification!

- Davis, Fisher, and Whited (2014)
- Do agglomeration externalities affect aggregate consumption growth?
- How big are these effects

We also have to make a lot of assumptions

$$\max_{\substack{\{C_t,K_{bt+1},K_{ht+1},y(z^t),l_b(z^t),l_h(z^t),n(z^t),\\ k_b(z^t),k_h(z^t),k_{ft+1}(z^t),h(z^t)\}_{t=0}^{\infty}}} \sum_{t=0}^{\infty}\beta^t \ln C_t + \psi \sum_{t=0}^{\infty}\beta^t \sum_{z^t}\mu_t(z^t)n(z^t)\ln\frac{h(z^t)}{n(z^t)}$$

subject to

$$\begin{aligned}
C_t + \Gamma_{bt}\left[K_{bt+1} - (1-\kappa_b)K_{bt}\right] + \Gamma_{ht}\left[K_{ht+1} - (1-\kappa_h)K_{ht}\right] \\
+ \Gamma_{ft}\sum_{z^t}\mu_t(z^t)\left[k_{ft+1}(z^t) - (1-\kappa_f)k_{ft}(z^{t-1})\right] \\
\leq \left[\sum_{z^t}\mu_t(z^t)y(z^t)^{\eta}\right]^{1/\eta} \\
y(z^t) \leq [\Upsilon_t z_t]^{(1-\alpha)\phi}\, x(z^t)^{\frac{\lambda-1}{\lambda}}\, l_b(z^t)^{1-\phi}\, k_b(z^t)^{\alpha\phi}\, n(z^t)^{(1-\alpha)\phi},\ \forall z^t \\
h(z^t) \leq l_h(z^t)^{1-\omega}\, k_h(z^t)^{\omega},\ \forall z^t \\
l_h(z^t) + l_b(z^t) \leq k_{ft}(z^{t-1})^{\zeta},\ \forall z^t \\
\sum_{z^t}\mu_t(z^t)k_b(z^t) \leq K_{bt} \\
\sum_{z^t}\mu_t(z^t)k_h(z^t) \leq K_{ht} \\
\sum_{z^t}\mu_t(z^t)n(z^t) \leq N_t
\end{aligned}$$

with $K_{b0}, K_{h0}, k_f(z_0), \left\{\Upsilon_t, \Gamma_{bt}, \Gamma_{ht}, \Gamma_{ft}, N_t, z^t\right\}_{t=0}^{\infty}$ and $x(z^t)$ given.

. . . and more assumptions

$$\Gamma_{jt} = \gamma_j^{-t}, \ j = b, f, h;$$
$$\Upsilon_t = \gamma_a^t;$$
$$N_t = \gamma_n^t.$$

$$g_c = \gamma_j^{-1} g_{k_j}, \ \ j = b, f, h$$

$$g_l = \gamma_n^{\zeta - 1} g_{k_f}^{\zeta}$$

$$g_c = \gamma_a^{(1-\alpha)\boldsymbol{\delta}} {g_l}^{1-\boldsymbol{\delta}} {g_{k_b}}^{\alpha\boldsymbol{\delta}}$$

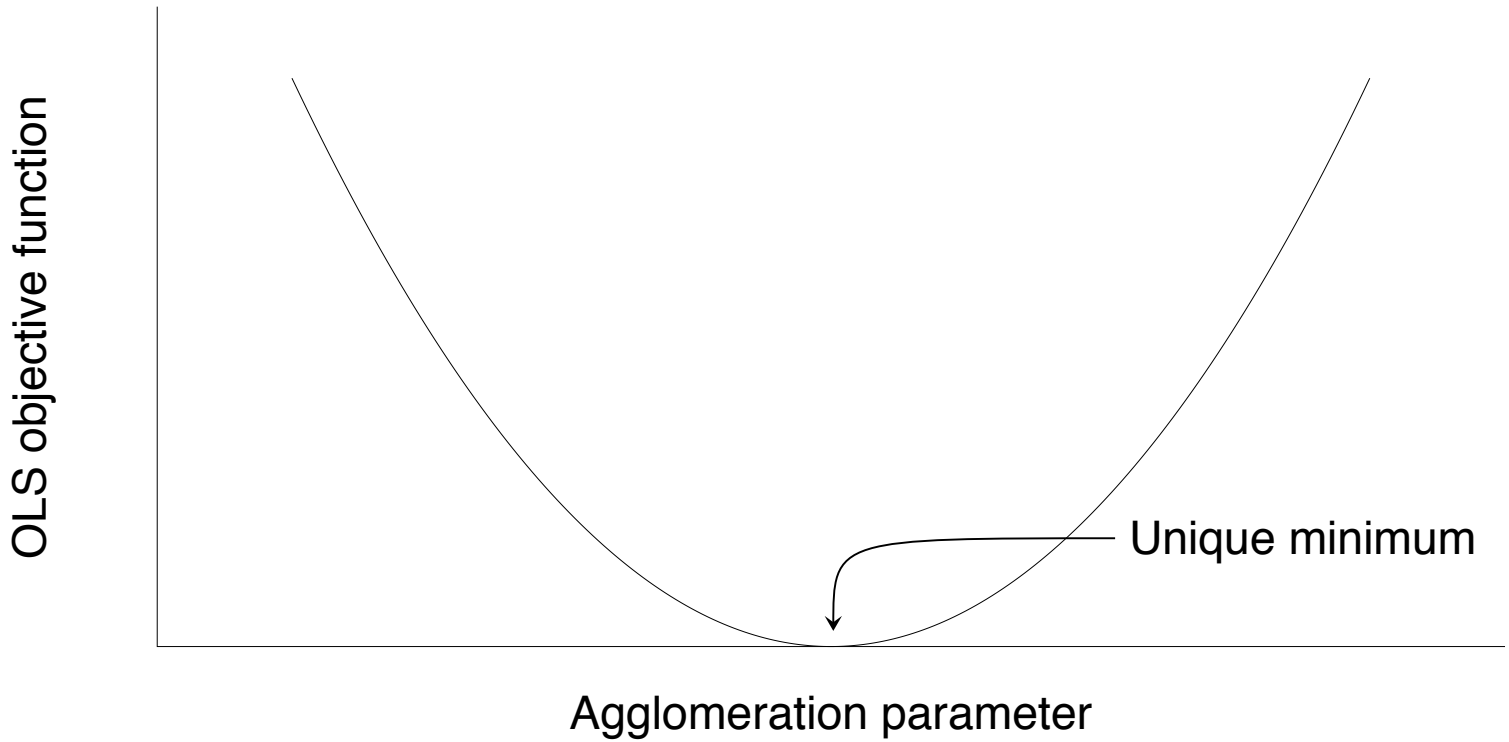
$$\boldsymbol{\delta} \equiv \phi\boldsymbol{\lambda}$$

$$g_c = \gamma_a^{\frac{(1-\alpha)\boldsymbol{\delta}}{1-\boldsymbol{\delta}\alpha+(\boldsymbol{\delta}-1)\zeta}} \gamma_b^{\frac{\alpha\boldsymbol{\delta}}{1-\boldsymbol{\delta}\alpha+(\boldsymbol{\delta}-1)\zeta}} \gamma_f^{\frac{\zeta(1-\boldsymbol{\delta})}{1-\boldsymbol{\delta}\alpha+(\boldsymbol{\delta}-1)\zeta}} \gamma_n^{\frac{(1-\zeta)(\boldsymbol{\delta}-1)}{1-\boldsymbol{\delta}\alpha+(\boldsymbol{\delta}-1)\zeta}}$$

Under these assumptions, identification is given by a correlation

- If the agglomeration externality is present
- the correlation between a forecast of land rents and TFP growth is a function of the externality and some other easily-estimated parameters.
- Otherwise the correlation is zero.

In terms of the agglomeration parameter, the OLS objective function has a unique minimum.



This type of exercise does not constitute an assumption of identification

- Assumptions about the structure of the model $\longrightarrow$ identification.
- Just as assumptions about sexism $\longrightarrow$ identification.

In the third example, exogenous variation is neither necessary nor sufficient for identification

- Li, Whited, and Wu (2014)
- What matters more for leverage: taxes or agency?
- We estimate a dynamic agency model.
- Endogenous collateral contraints.
- Contains a natural experiment concerning collateral.

We establish external model validity using a natural experiment on the value of collateral

- Secured lending through a special purpose vehicle—SPV.
- The firm sells the collateral to the SPV.
- SPV is exempt from the automatic stay in bankruptcy.
- Easier for the lender to seize the collateral.
- Unless, . . .

Recharacterization

- The judge sees fit to recharacterize the sale as a loan.
- Then in bankruptcy the collateral goes back to the firm and is subject to the automatic stay.
- More uncertainty about the value of the eventual seizure.

Anti-recharacterization laws were passed at the state level

- Texas and Louisiana in 1997 and Alabama in 2001
- Plausibly exogenous

And then an important court case nullified them

- 2003: *Reaves Brokerage Company, Inc. v. Sunbelt Fruit & Vegetable Company, Inc.*

- The judge ignored the Texas statute, applied federal law, and recharacterized the collateral.

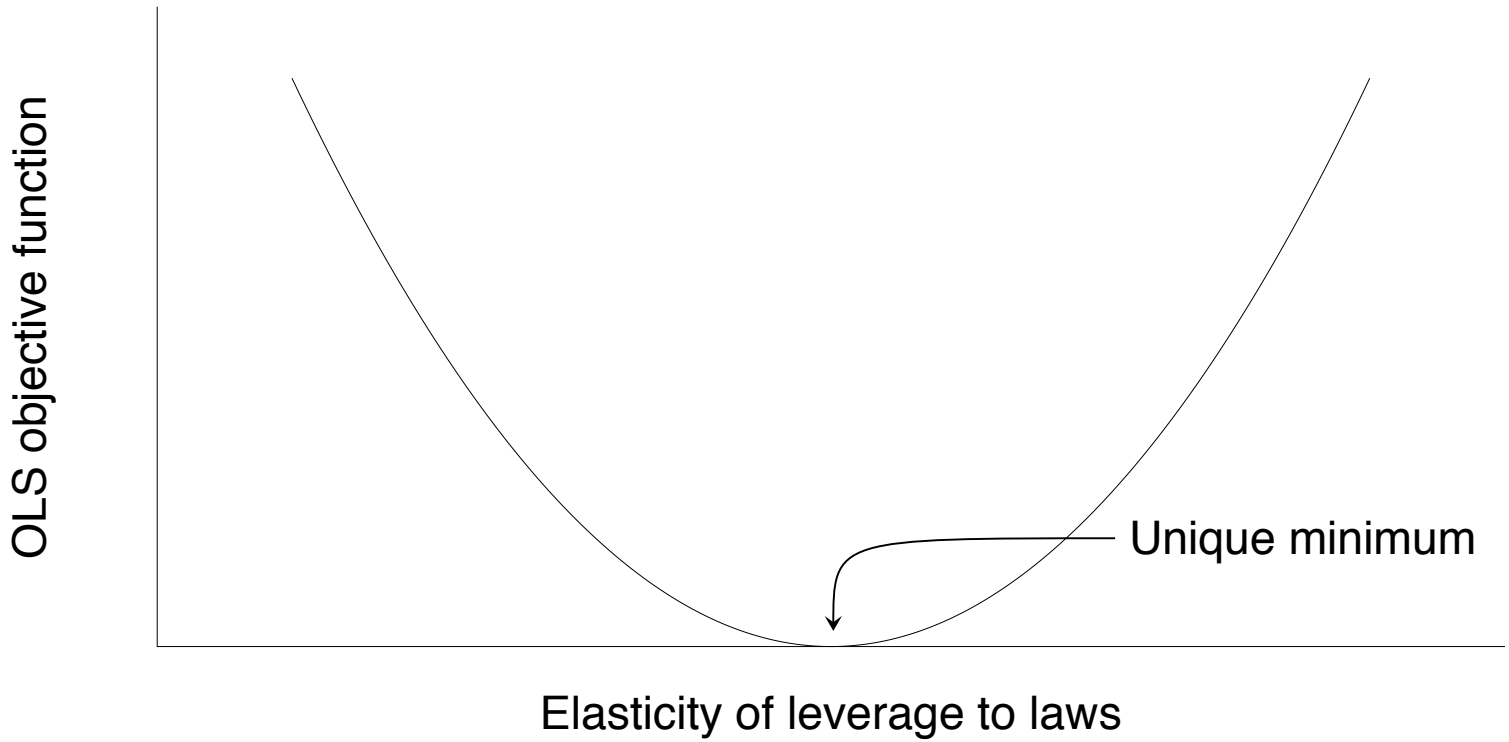
This setting lends itself to a diff-in-diff

- "After" is after the year the law was passed but before 2004.
- "Treated" is incorporation in TX, LA, or AL.
- Diff-in-diff effect is 0.04 with a clustered *t*-stat of 2.5.
- With firm and year fixed effects and many controls, the diff-in-diff effect is 0.04 with a clustered *t*-stat of 2.0.

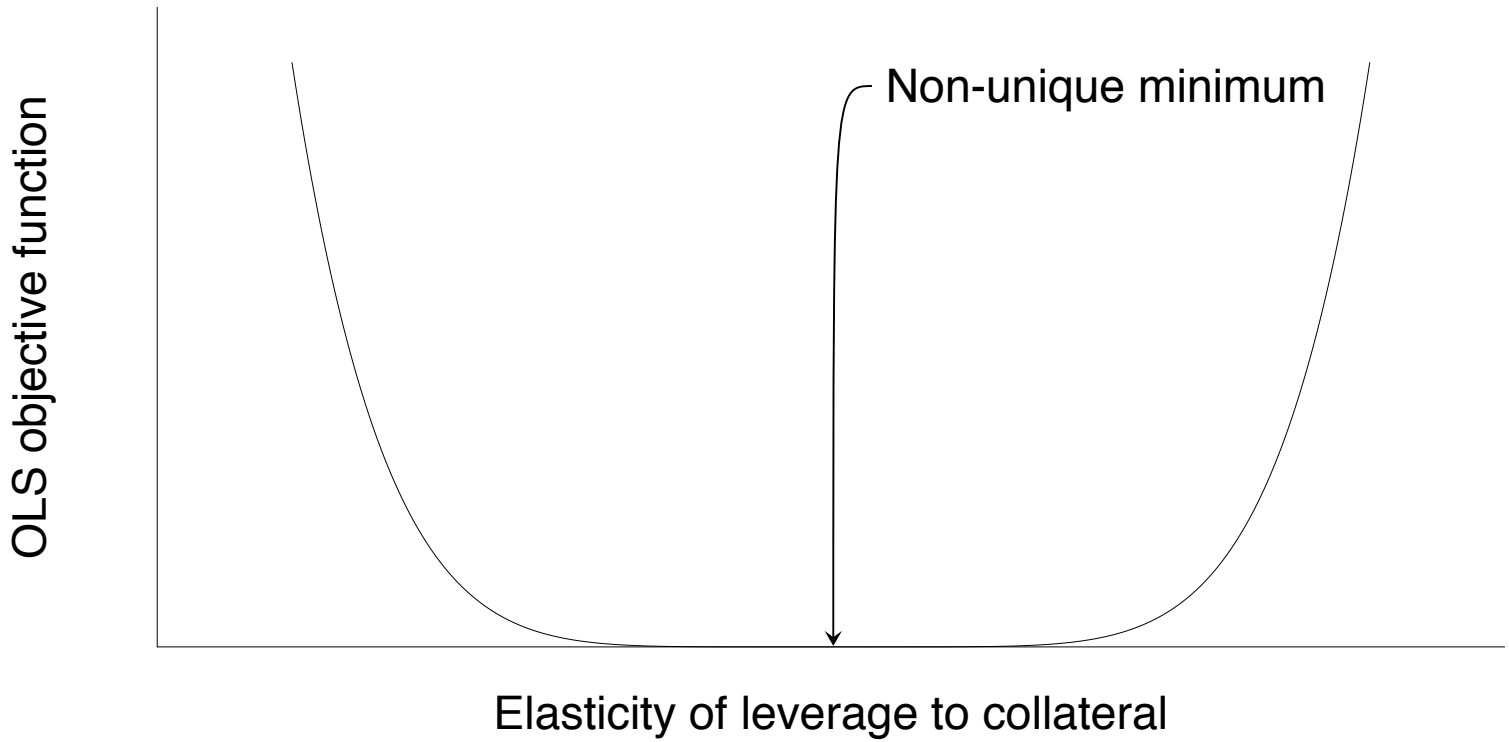
The laws are plausibly exogenous, but the diff-in-diff does not give us identification!

- So we have estimated the causal effect of antirecharacterization laws on leverage.
- But we have not estimated the effect of the change in the value of collateral on leverage.

In terms of the sensitivity of leverage to laws, the OLS objective function has a unique minimum.



In terms of the sensitivity of leverage to collateral, the OLS objective function does not have a unique minimum.



Combining the diff-in-diff with the model gives us identification!

- The value of collateral is a model parameter.
- Estimate the model before/control, before/treated, after/control, after/treated.
- The effect is 0.07!
- The model tells us that the control group leverage is not constant.

We need to go beyond finding exogenous variation

- Sometimes elasticities are interesting.
- Often they do not identify interesting economic effects.
- What are the assumptions you need to identify an interesting economic effect?

We need to go beyond finding exogenous variation

- Even random variation is not exogenous.
- What assumptions do you need to get exogeneity?

Exogenous variation is not necessary for a good reduced form paper.

Studies with no traditional identification can be useful

- Papers that use endogenous correlations to test certain theories against others.

  Danis, Rettl, and Whited (2014)

- Papers that describe interesting new facts.

  Duchin, Gilbert, Harford, Hrdlicka (2014)

The End