The Missing Intercept Problem when going from Micro to Macro

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The Missing Intercept Problem

- Example: Autor-Dorn-Hanson (2013) "import competition explains one-quarter of the contemporaneous aggregate decline in US manufacturing employment"
- Arrive at this number by scaling regression coefficient estimated from regional data by total Chinese import penetration
- Important: can only do this under very strong assumptions
- True much more generally, whenever you want to learn about aggregates from cross-sectional variation (RCTs, DiD, etc etc)
- Intuitively: cross-sectional variation only identifies relative effects
- ... but we do not care about these, instead care about absolute effects
- Papers making this point and strategies for recovering missing intercept http://benjaminmoll.com/micro_to_macro/

The Missing Intercept Problem

- Explain issue in context of “fiscal stimulus $\Rightarrow$ output, consumption, etc?”
  - Examples: Nakamura-Steinsson (2014), Wolf (2021),...
  - (To be clear: these papers explicitly note problem, propose solutions)
- Notation
  - x_{it}: government spending (G) in region i in year t
  - y_{it}: GDP in region i in year t
  - $X_t = \frac{1}{N}\sum_{i=1}^{N} x_{it}$: aggregate government spending
  - $Y_t = \frac{1}{N}\sum_{i=1}^{N} y_{it}$: aggregate GDP
- **Question we want to answer: what’s the effect of X_t on Y_t?**
- In principle, could just regress Y_t on X_t (VAR etc). But often don’t want to do that because don’t believe identification off time-series.
- $\Rightarrow$ use x-sectional variation instead, but missing intercept problem

Other examples of missing intercept problem

1. China shock: x =import competition, y =employment (e.g. Autor-Dorn-Hanson)
2. Household balance sheets in Great Recession: x=housing net worth, y=consumption, employment (e.g. Mian-Sufi)
3. Bank lending cuts to firms: x=bank lending, y=firm production (e.g. ChodorowReich, Herreño)
4. Unemployment benefits: x= unemployment benefits, y=unemployment (e.g. ChodorowReich-Coglianese-Karabarbounis)
5. Stock market consumption wealth effect: x= stock market wealth, y=employment, consumption (e.g. ChodorowReich-Nenov-Simsek)
6. Monetary policy and mortgage refinancing: x=housing equity, y=refinancing/consumption (e.g. Beraja-Fuster-Hurst-Vavra)
7. Consumer bankruptcy: x=debt forgiveness, y=employment (e.g. Auclert-Dobbie-GoldsmithPinkham)
8. ... and many more ...

The Missing Intercept Problem

- Problem: regression coefficient estimated with x-sectional variation only tells you what happens in some regions relative to others...
    - what happens in regions with large G relative to those with small G
- ... but not the aggregate effect of government spending
- Extreme case (just to make the point):
    - GDP in high-G regions unaffected
    - GDP in low-G regions actually decreases
    - $\Rightarrow$ in x-section, observe positive correlation between G & GDP
- Can also imagine opposite: G increases GDP a lot in both low- and high-G regions, just more so in the latter
- Naively scaling up coefficient estimated with x-sectional variation gives completely wrong result – "Missing Intercept Problem"

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  - ε_{it}: other determinants of y_{it}, $\frac{1}{N}\sum_{i=1}^{N} \varepsilon_{it} = 0$
- Assume GDP in region i satisfies

$$y_{it} = \alpha + \beta x_{it} + \gamma X_t + \varepsilon_{it} \tag{$*$}$$

(Other specifications similar, e.g. $y_{it} = \alpha + \tilde{\beta} x_{it} + \tilde{\gamma} X_{-it} + \varepsilon_{it}$, $X_{-it} := \sum_{j \neq i} x_{jt}$)
  - $\gamma > 0$ e.g. due to tradables $\Rightarrow$ demand from j "spills over" to i
  - $\gamma < 0$ e.g. due to factor mobility $\Rightarrow$ boom in region j hurts i
- True aggregate relation

$$Y_t = \alpha + (\beta + \gamma) X_t \quad \text{or} \quad \Delta Y_t = (\beta + \gamma) \times \Delta X_t$$

- Aggregate elasticity $\beta + \gamma$ may be $\gtrless 0$ depending on β, γ

The Missing Intercept Problem

- Now suppose that estimate ($*$) using cross-sectional variation
  - typical strategy: estimate ($*$) with time fixed-effects
- No x-sectional variation in aggregate $X_t \Rightarrow$ soaked into intercept

$$y_{it} = \tilde{\alpha}_t + \beta x_{it} + \varepsilon_{it}, \qquad \tilde{\alpha}_t := \alpha + \gamma X_t$$

- Naive exercise concludes that aggregate relationship is

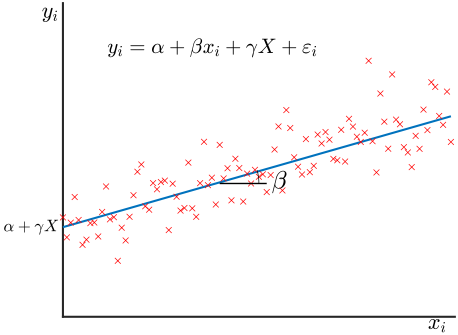
$$\Delta Y_t = \beta \times \Delta X_t$$

  i.e. aggregate elasticity is β which is wrong!

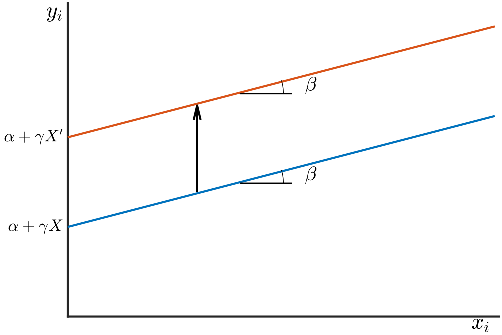
- Logic: cross-sectional variation identifies the slope but not the intercept. But intercept is what we really care about!

Graphical Version

Cross-sectional variation identifies slope but not intercept



Shifts in aggregate X shift entire regression line



The Missing Intercept Problem

- More general version of same logic

$$y_{it} = \alpha + \beta x_{it} + \gamma Z_t + \varepsilon_{it}, \quad Cov(Z_t, X_t) \neq 0$$

where Z_t = other aggregate factors driving employment

- Naive exercise again gets it wrong: true aggregate elasticity $\neq \beta$
- Also many other possible specifications with same logic

Other examples of missing intercept problem

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Strategies for recovering the missing intercept

- In short: need more structure...
- ... i.e. a “model” (in general sense of word)
- Won’t do justice here but see many of the papers on this list
  http://benjaminmoll.com/micro_to_macro/
- Good starting points: ChodorowReich lecture notes
  https://scholar.harvard.edu/chodorow-reich/classes/economics-2410hfc-advanced-topics-applied-macroeconomics
- My guess: no general solution, expect solution to depend on particular application
- Still: good methodological question to think about. High return from any progress.

Candidate strategies for recovering MI (non-exhaustive list)

1. Using full-blown models to convert regional estimates into partial and general equilibrium effects
    - Nakamura-Steinsson, Guren-McKay-Nakamura-Steinsson, ChodorowReich-Nenov-Simsek, Auclert-Dobbie-GoldsmithPinkham, ...
2. Using a bit of structure + VAR estimates
    - Wolf, Beraja-Hurst-Ospina

Some other papers sound like they help with MI problem but I don't think they do, for example:

1. Egger, Haushofer, Miguel, Niehaus, Walker (Econometrica, 2022) "General equilibrium effects of cash transfers: experimental evidence from Kenya"
    - RCT provides $\approx$ \$1000 to households across 653 randomized villages $=>$ 15% of local GDP
    - identifies very local GE effects via spatial variation in share of neighboring villages that are treated (GE effects within 2km radius)
    - similar to local spillovers in Miguel-Kremer 2004 worms paper
    - but this is different from macro GE effects
    - another way to see this: local GE effects identified off cross-sectional variation $\Rightarrow$ silent on part of missing intercept by design

2. Huber (RFS, 2022) "Estimating GE Spillovers of Large-Scale Shocks"
    - my understanding: know aggregate effect and then decompose it PE and GE effects

Link to Reflection Problem? Not really

- Assume employment in region i satisfies

$$y_i = \alpha + \beta Y + \gamma X + \eta x_i + \varepsilon_i \qquad (*)$$

- Same as (1) in Manski (1993) except that he uses z in place of x
- True aggregate relation is – same as Manski's (3) and (4)

$$Y = \alpha + \beta Y + (\gamma + \eta) X \quad \Rightarrow \quad Y = \frac{\alpha}{1-\beta} + \frac{\gamma+\eta}{1-\beta} X$$

- Substitute into $(*)$ – same as Manski's (5)

$$y_i = \frac{\alpha}{1-\beta} + \frac{\gamma+\beta\eta}{1-\beta} X + \eta x_i + \varepsilon_i$$

- **Reflection problem:**

$$\text{only} \quad \frac{\alpha}{1-\beta}, \quad \frac{\gamma+\beta\eta}{1-\beta}, \quad \eta \quad \text{identified}$$

$\Rightarrow$ **can't separate** β, γ

Link to Reflection Problem? Not really

Differences betw reflection problem (RP), missing intercept (MI)

1. RP about separating β, γ. MI: learning about $\frac{\gamma+\eta}{1-\beta}$ from η.
2. MI because don't want to use variation in X. RP even if use X
3. RP only an issue if $\beta \neq 0$ but MI an issue even with $\beta = 0$

Bottom line:

- RP and MI are related but different
- Both about SUTVA violations `https://en.wikipedia.org/wiki/Rubin_causal_model#Stable_unit_treatment_value_assumption_(SUTVA)`
- ... but that seems to be only commonality

Conclusion

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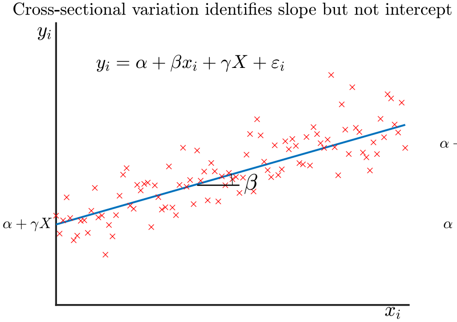

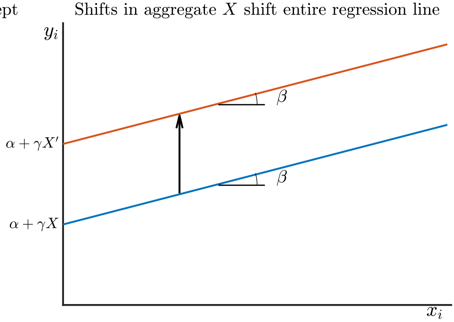

- Whatever you do, please don't just scale up micro regression coefficients!