Instrumental Variable: Examples

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Questions about questions

Research FAQs:

Before running a regression, ask the following four questions (see J. D. Angrist & Pischke, 2009, Ch. 1)

1. What is the causal relationship of interest?
2. What is the experiment that could ideally be used to capture the causal effect of interest?
3. What is your identification strategy?
4. What is your mode of statistical inference?

FAQ 1. What is the causal relationship of interest?

FAQ 2. What is the experiment…?

- Describe an ideal experiment.
- Highlight the forces you'd like to manipulate and the factors you'd like to hold constant.
- FUQs: fundamentally unidentified questions
  - Causal effect of race or gender;
    - However, we can experiment with how **believes** about a person's gender of race affect decisions (Bertrand & Mullainathan, 2004).
  - Do children that start school 1 year later learn more in the primary school?
    - Because older kinds are in general better learners there is not counter factual.
    - However, it is possible to establish this school starting effect on adults (Black, Devereux, & Salvanes, 2008).

FAQ 3. What is your identification strategy?

Identification strategy

is the manner in which a researcher uses observational data (i.e., data not generated by a randomized trial) to approximate a real experiment (J. D. Angrist & Krueger, 1991)

1. Use theory!
2. Analyze, what were/are the policies/environments that could mimic the experimental setting?

FAQ 4. What is your mode of statistical inference?

- describes the population to be studied,
- the sample to be used,
- and the assumptions made when constructing standard errors.
- choose appropriate statistical methods
- apply them diligently.

Examples

Example 1. wage, education and random nature of the date of birth

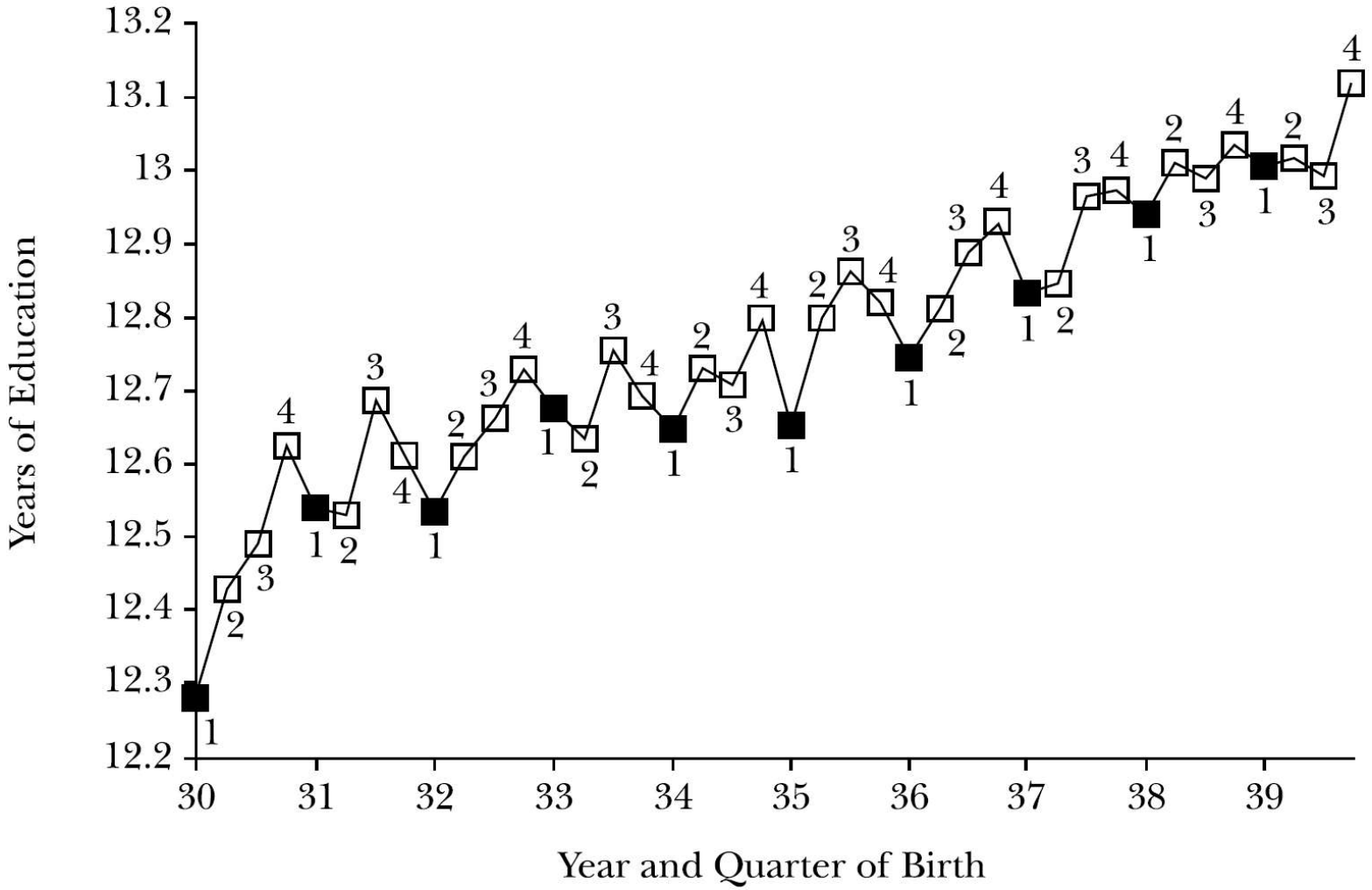
Angrist, J. D., & Krueger, A. B. (1991). Does Compulsory School Attendance Affect Schooling and Earnings? The Quarterly Journal of Economics, 106, 979–1014. https://doi.org/10.2307/2937954

Identification strategy:

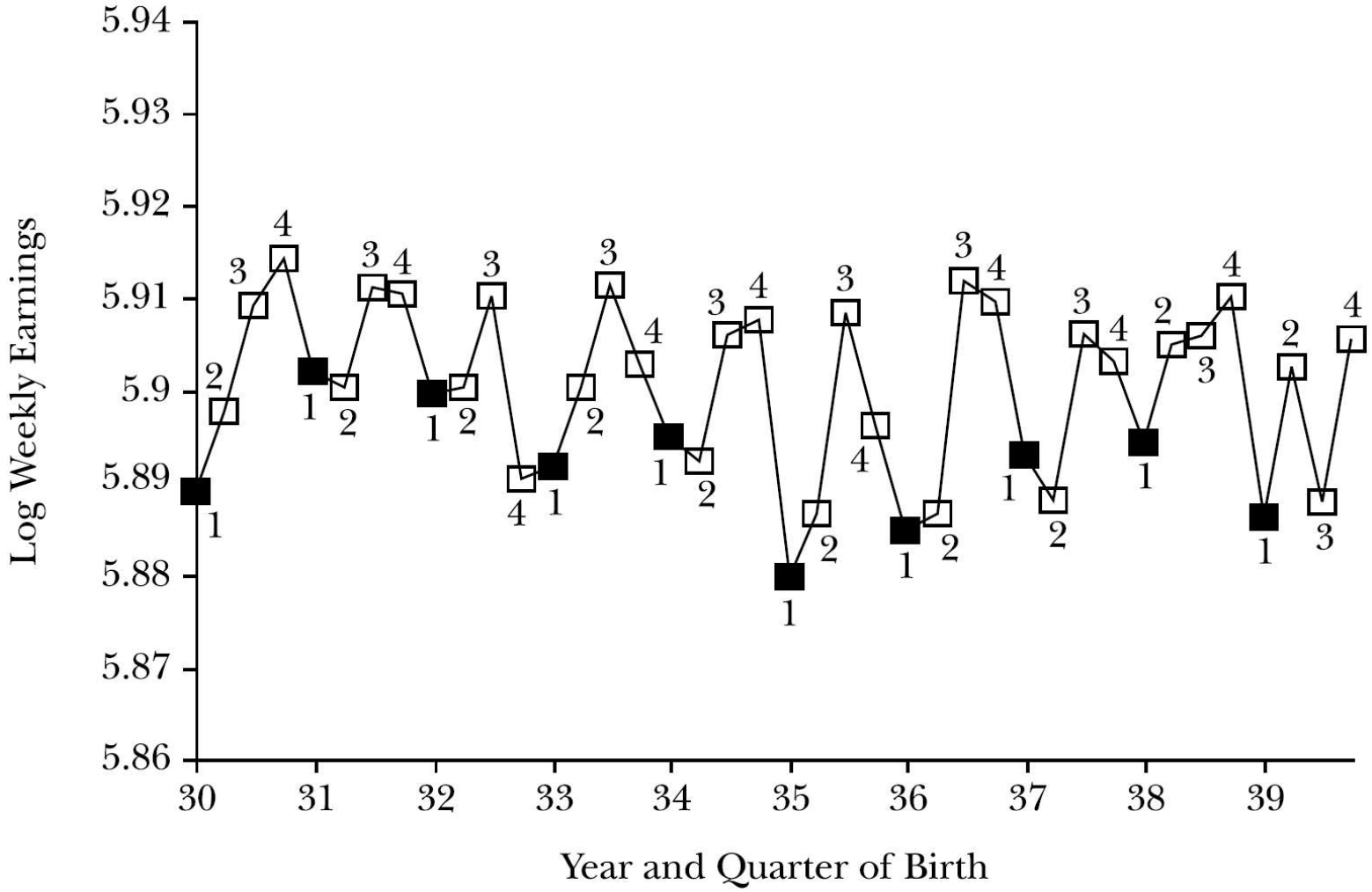
- Policy required students to enter school in the calendar year in which they turned six years old;
- Children born in the fourth quarter enter school at age 5 and ¾ , while those born in the first quarter enter school at age 6 ¾;
- Compulsory schooling laws require students to remain in school until their 16th birthdays;

Combination of school start age policies and compulsory schooling laws creates a natural experiment in which children are compelled to attend school for different lengths of time depending on their birthdays.

Average schooling by quarter of birth



Average wage by quarter of birth



Fantastic instrumental variable:

- Quarter of birth;
- The intuition is:
  - Only a small part of variance in education (the one linked to the quarter of birth) is used to identify the return to education.
  - This small part of variance occurs due to random natural experiment, thus the ceteris paribus holds here.

Estimates

TABLE 6.5
Returns to schooling using alternative quarter of birth instruments

	OLS (1)	2SLS (2)	OLS (3)	2SLS (4)	2SLS (5)
Years of education	.071 (.0004)	.074 (.028)	.071 (.0004)	.075 (.028)	.105 (.020)
First-stage F-statistic		48		47	33
Instruments	None	Quarter 4	None	Quarter 4	3 quarter dummies
Year of birth controls	No	No	Yes	Yes	Yes

Notes: This table reports OLS and 2SLS estimates of the returns to schooling using quarter of birth instruments. The estimates in columns (3)–(5) are from models controlling for year of birth. Columns (1) and (3) show OLS estimates. Columns (2), (4), and (5) show 2SLS estimates using the instruments indicated in the third row of the table. F-tests for the joint significance of the instruments in the corresponding first-stage regression are reported in the second row. Sample size is 329,509. Standard errors are reported in parentheses.

Conclusions

- IV estimates are very close to the OLS;
- What does it mean?
  - Ability bias was small in the OLS!

Example 2. Children and their parents' labor supply: Evidence from exogenous variation in family size

(J. Angrist & Evans, 1998) Angrist, J., & Evans, W. N. (1996). Children and their parents' labor supply: Evidence from exogenous variation in family size.

Research question and the problem

- **What is the effect of additional child on women labor market participation?**
- Conventional wisdom:
  - More children require more time therefore, women used to sacrifice own employment opportunities.

Endogeneity problem

What would the ideal experiment here?

- Families without children are inappropriate counter factual
- Rich families can afford more children: inappropriate counter factual
- Family usually plan for having an additional children
  - thus, a families with 1 children are also inappropriate counter factual
- we need a **source of exogenous variation in children**

Identification strategy

People may plan for a second child, but they cannot plan for having twins!!!

- We can use dummy variable for a twin birth as instrument for the number of children.

Results

Dependent Variable	Mean (1)	OLS (2)	IV Estimates Using: Twins First Stage (3)	Twins Wald Estimates (4)	Sex Composition First Stage (5)	Sex Composition Wald Estimates (6)
Employment	.528	−.167	.625	−.083	.067	−.135
		(.002)	(.011)	(.017)	(.002)	(.029)
Weeks worked	19.0	−8.05		−3.83		−6.23
		(.09)		(.76)		(1.29)
Hours/week	16.7	−6.02		−3.39		−5.54
		(.08)		(.64)		(1.08)

Note: The table reports OLS and Wald estimates of the effects of a third birth on labor supply using twins and sex composition instruments. Data are from the Angrist and Evans (1998) extract including married women aged 21–35 with at least two children in the 1980 census. OLS models include controls for mother's age, age at first birth, dummies for the sex of first and second births, and dummies for race. The first stage is the same for all dependent variables.

References

Angrist, J. D., & Krueger, A. B. (1991). Does Compulsory School Attendance Affect Schooling and Earnings? *The Quarterly Journal of Economics*, *106*(4), 979–1014. http://doi.org/10.2307/2937954

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