Does Local Oil and Gas Development Affect College Enrollment?:
Evidence from Pennsylvania and New York

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Summary

- I exploit spatial and time variations of oil and gas wells and use the instrumental variable approach to estimate the causal effects of local oil and gas development on college attendance in Pennsylvania and New York from 2003 to 2017.

- I find that local oil and gas development has negative effects on enrollment in nearby two-year colleges.

  - The effect is likely driven by college dropouts rather than incoming students.
  - The effect is similar across male and female students.

Literature Review

Human capital as a channel of resource curse

- Resource booms restructure local labor markets and bring more low-skilled jobs

  - Oil boom and coal boom in the 1970s increased local employment and income (Black et al. 2005)
  - Added jobs are primarily low-skilled (Black et al. 2005; Weinstein 2014)
  - The shale revolution has similar effects (Komarek 2016; Paredes et al. 2015)
  - Decreasing earnings differentials between college- and HS-educated workers (Upton and Yu 2017)

- Increasing demand for low-skilled labor can affect schooling decisions

  - Unconventional oil and gas development has decreased enrollment in Grade 11 and 12 (Zuo, Schieffer and Buck 2019)
  - Larger gender gap in high school dropout rates (Cascio and Narayan 2017)
  - Lower educational attainment associated with slower long-term growth in coal-mining counties (Douglas and Walker 2017)

Literature Review

Shortcomings of the current literature

- Student outcomes
  - The focus of literature is on high school dropouts, presumably the low-skilled workforce.
  - Recent studies on the shale boom followed this strategy (Zuo et al. 2019; Cascio and Narayan 2017)
    - However, construction and extraction occupations only consist of 15% of employment in the OG industry.
  - More importantly, a college degree in today's labor market is not the same as it was in the 1980s.
    - National high school completion rate among all persons aged 25 and over has increased from 62.5% in 1975 to 88.4% in 2015 (NCES).
    - Only one case study on college enrollment in Kent Co., California (Michieka and Gearhart 2018)

- Measuring oil and gas development
  - Previous studies on fracking used wells count as a proxy
  - Conventional oil and gas has been assumed away (or as implicitly controlled by fixed effects)
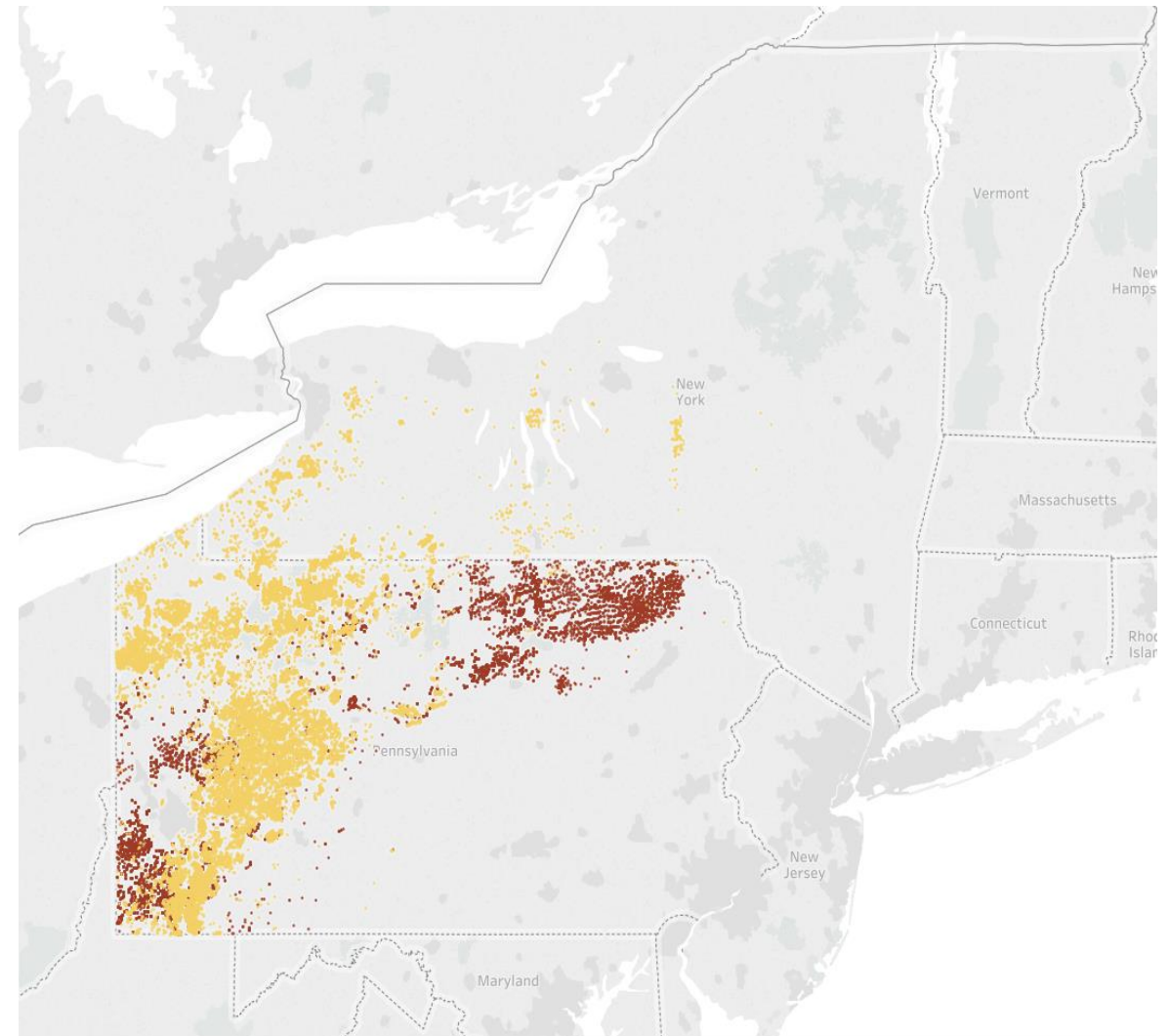
Research Questions

1. Does local oil and gas development affect college attendance?

2. Does local oil and gas development affect female students differently than male students regarding their postsecondary schooling decisions?
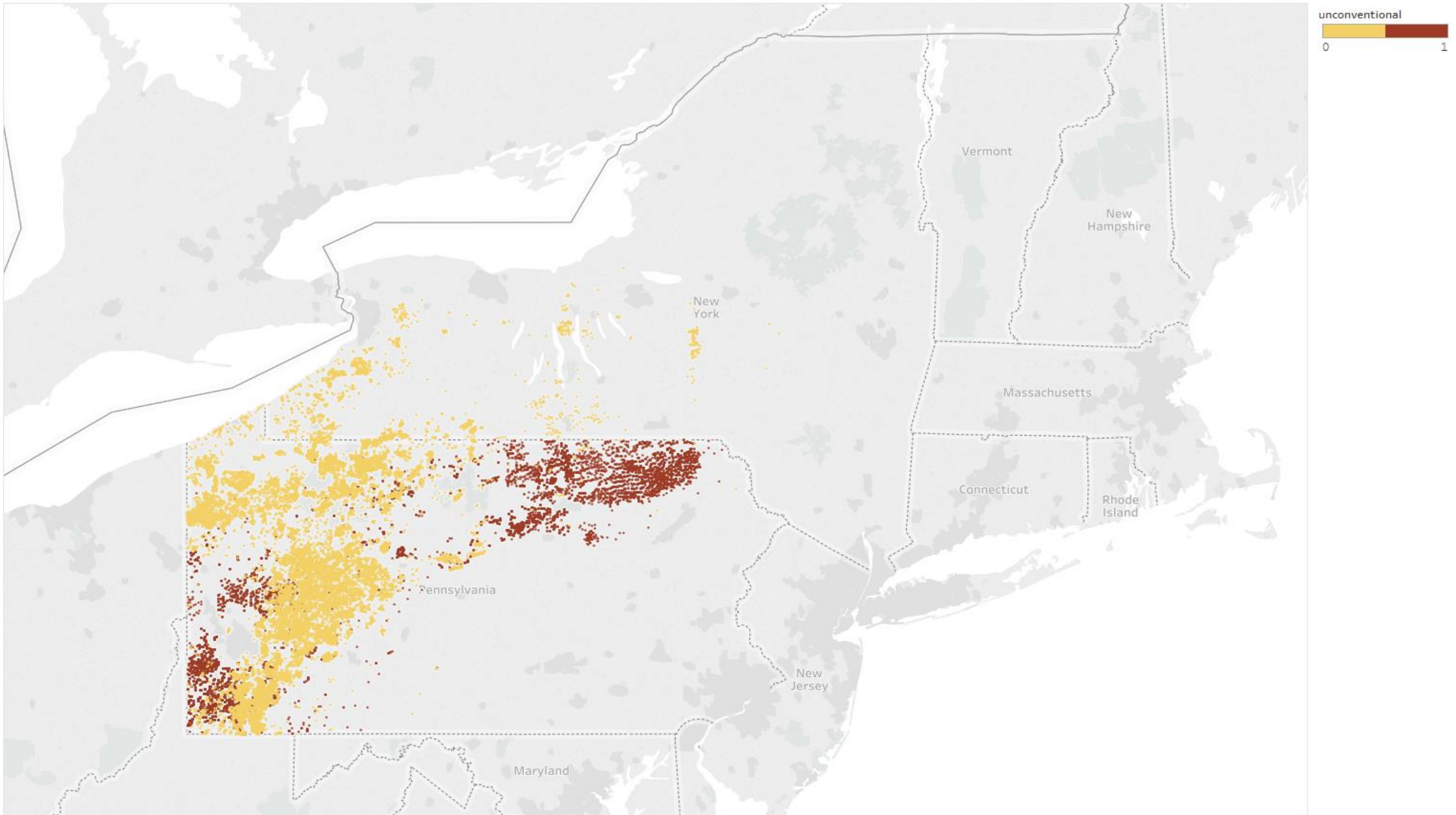
Data

Sample selection

- Pennsylvania (excluding Philadelphia and Pittsburgh)

- New York (excluding NYC)

Oil and gas wells in Pennsylvania and New York

unconventional
0   1

Map based on longitude and Latitude. Color shows details about unconventional. The data is filtered on minimum of Plug Year and minimum of Spud Year. The minimum of Plug Year filter includes on or after 1/1/2003 and keeps Null values. The minimum of Spud Year filter includes dates on or after 1/1/2003.

Is there a resource curse?

Empirical strategy

- College enrollment at the county-level

- Fixed effects model

$$Enrol_{cst} = \delta OG_{cst} + X_{cst}\beta + \alpha_c + \gamma_{st} + \epsilon_{cst}$$

  - College enrollment outcomes
  - Oil and gas measured by number of active wells within the county
  - Control variables: population density, wages, labor participation, unemployment rate
  - County and state-by-year fixed effects

- Instrumental variable

  - OG_{cst} may be endogenous
  - Instrument OG_{ct} with $Resource_c \times PPI_t$ (Zuo et al. 2019; Weber 2014)
    - Resource: share of county area that overlaps the oil/gas play
    - PPI: national producer's price index of crude oil/natural gas

Data

College enrollment

- Integrated Postsecondary Education Data System (IPEDS)

- Types of institutions:
  - Four-year: Bachelor's or more advanced degrees
  - Two-year: Associate's degree; most students are local
  - Non-degree granting

- Institution-level enrollment outcomes
  - Total enrollment
  - Enrollment by gender

Postsecondary educational institutions, 2010

State

NY

<2YR 79
2YR 89
4YR 79

PA

<2YR 79
2YR 121
4YR 73
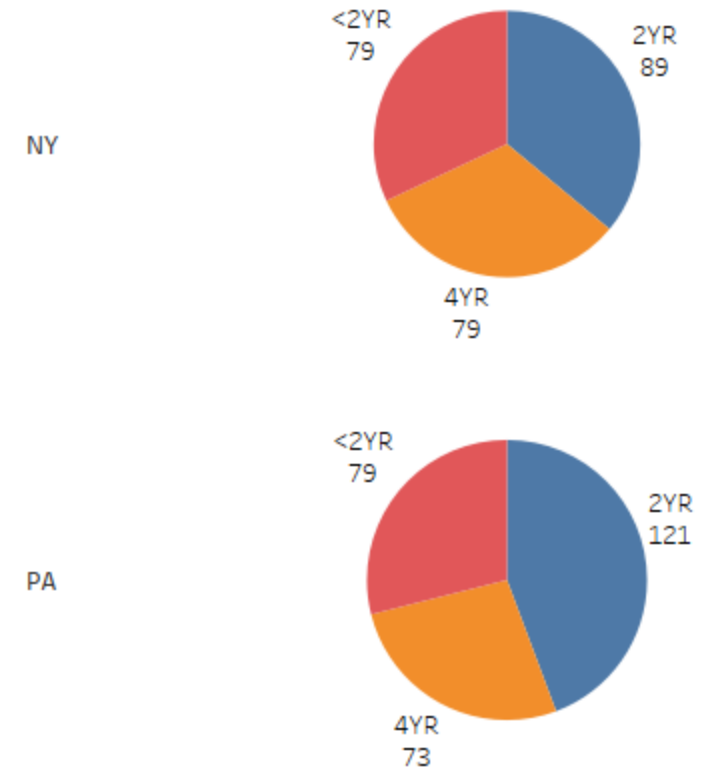
Data

Summary of sources

1. Oil and gas wells from state agencies

2. College characteristics and enrollment from IPEDS

3. HS post-graduation outcomes from state agencies (currently only PA)

4. Local economic conditions from BEA and BLS

Results

Full sample

	2YR Total (1)	2YR Male (2)	2YR Female (3)	4YR Total (4)	4YR Male (5)	4YR Female (6)
OG	-0.454	-0.400*	-0.434	0.070	0.244	0.025
	(0.283)	(0.243)	(0.278)	(0.046)	(0.156)	(0.044)
Controls	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Time FE	State-Year	State-Year	State-Year	State-Year	State-Year	State-Year
Counties	119	119	119	119	119	119
N	1785	1785	1785	1785	1785	1785

Results

Restricted sample excluding counties without colleges

	2YR Total (1)	2YR Male (2)	2YR Female (3)	4YR Total (4)	4YR Male (5)	4YR Female (6)
OG	-1.099*	-0.978*	-1.034	0.070	0.244	0.025
	(0.661)	(0.569)	(0.644)	(0.046)	(0.156)	(0.044)
Controls	Y	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y	Y
Time FE	State-Year	State-Year	State-Year	State-Year	State-Year	State-Year
Counties	80	80	80	67	67	67
N	1200	1200	1200	1005	1005	1005

Results

PA only

	HS Grads (1)	Degree-Bound (2)	2YR Total (3)	2YR Male (4)	2YR Female (5)
OG	0.025	0.047	-0.257	-0.204	-0.225
	(0.033)	(0.030)	(0.188)	(0.149)	(0.175)
Controls	Y	Y	Y	Y	Y
County FE	Y	Y	Y	Y	Y
Time FE	Year	Year	Year	Year	Year
Counties	64	64	64	64	64
N	832	832	960	960	960

Conclusions

- Local oil and gas development has decreased college enrollment in Pennsylvania and New York

  - One percent increase in active wells leads to one percent decrease in enrollment in two-year colleges
  - No effects on enrollment in four-year colleges

- This effect is likely driven by enrolled students dropping out of college rather than graduating high school students entering college

- No strong evidence of heterogeneous effects based on gender

Extensions

- Interacting OG with state dummies

  - Effects on 2-year colleges not significantly different between NY and PA
  - There is a small positive effect on four-year colleges in PA (.26)
  - Further research needed to confirm this

- Event study shows effects moderately diminished over time

- Institution-level analysis suggests negative effects are driven by enrollment in smaller colleges that eventually closed down.

- Spatial autoregressive models suggest no significant spillover effects on two-year colleges, but spillovers and direct impacts are in opposite direction for four-year colleges (possibly the reverse causal story)

  - Unfortunately, econometricians have not yet developed an estimator that combines spatial weighting, IV and panel data.

Thank you!

Please send additional questions and/or comments to zchen64@syr.edu

Institution-level analysis

Empirical strategy

- IPEDS sample of postsecondary educational institutions in NY

- Fixed effects model

$$Enrol_{icst} = \delta_1 Conv_{ict} + \delta_2 Unconv_{ict} + X_{ct}\beta + \alpha_i + \gamma_t + \epsilon_{ict}$$

  - College enrollment outcomes
  - Spatial count of conventional and unconventional oil and gas wells
  - Control variables: population density, wages, labor participation, unemployment
  - Institution- and year-fixed effects

- Instrumental variable

  - $Conv_{ict}$ is instrumented while $Unconv_{ict}$ treated as exogenous for the NY sample

Institution-level analysis

NY only

	Total FE	Male FE	Female FE	Total IV-FE	Male IV-FE	Female IV-FE
l_conv_near50	0.096	0.006	0.124	0.145	0.357	0.152
	(0.120)	(0.167)	(0.122)	(0.227)	(0.304)	(0.229)
assoc_conv_near50	-0.125	-0.035	-0.133	-0.311*	-0.304	-0.327**
	(0.145)	(0.196)	(0.142)	(0.179)	(0.231)	(0.163)
bacc_conv_near50	-0.126	-0.105	-0.152	-0.094	-0.262	-0.095
	(0.123)	(0.187)	(0.125)	(0.234)	(0.364)	(0.236)
<2YR # l_d_unc_ne~50	0.066	0.011	0.075*	0.069*	0.023	0.078*
	(0.040)	(0.040)	(0.042)	(0.041)	(0.042)	(0.043)
2YR # l_d_unc_near50	-0.016	-0.026**	-0.014	-0.011	-0.025**	-0.008
	(0.011)	(0.010)	(0.012)	(0.013)	(0.012)	(0.014)
4YR # l_d_unc_near50	-0.009	-0.034	-0.008	-0.008	-0.032	-0.007
	(0.014)	(0.024)	(0.012)	(0.016)	(0.026)	(0.013)
l_popdensity	0.269	0.344*	0.255	0.280	0.418**	0.264
	(0.203)	(0.194)	(0.202)	(0.209)	(0.188)	(0.208)
lWages2	0.248	0.629	0.211	0.177	0.346	0.147
	(0.338)	(0.541)	(0.335)	(0.335)	(0.588)	(0.328)
lforce	-0.222	0.416	-0.481	-0.406	0.342	-0.691
	(1.046)	(1.503)	(1.061)	(1.088)	(1.517)	(1.108)
Unempl_rate	-0.028	0.010	-0.034	-0.030	0.034	-0.038
	(0.026)	(0.037)	(0.028)	(0.030)	(0.042)	(0.033)
r2	0.091	0.085	0.080			
N	3289	3289	3289	3289	3289	3289
N_g	248	248	248	248	248	248

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Data

Variable	Obs	Mean	Std. Dev.	Min	Max
bacc_enrolt	960	3536.607	4751.987	0	20126
assoc_enrolt	960	2553.403	4595.513	0	25259
Unempl_rate	960	6.472708	1.784531	3.1	17.1
force	960	.4941326	.0388588	.2510621	.5670892
popdensity2	960	281.4768	449.4052	11.58923	3071.671
l_unc_d	960	.7577526	1.429341	0	5.963579
l_conv_a	960	2.548129	3.224358	0	8.884194
iv3	960	122.394	95.61168	0	274.7167
iv3c	960	170.8196	73.54181	0	274.7167

Variable	Obs	Mean	Std. Dev.	Min	Max
bacc_enrolt	825	5622.725	10083.01	0	58434
assoc_enrolt	825	3696.247	4629.242	0	21266
Unempl_rate	825	6.296848	1.690088	3.4	11
force	825	.4868813	.0338941	.3895853	.6456028
popdensity2	825	258.3664	408.4698	2.611551	2276.99
l_unc_d	825	0	0	0	0
l_conv_a	825	1.304758	2.00108	0	7.248504
iv3	825	52.25076	80.5851	0	274.7167
iv3c	825	137.3814	91.23879	0	274.7167

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Evidence for the reverse story

Does oil and gas concentrate in areas where residents are less educated?