# The Impact of Unconventional Oil and Gas Developments on Population Dynamics: A County-Level Analysis of Migration Inflow and Outflow

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**Introduction:** This paper uses a difference in difference methodology to determine whether producing oil and gas via shale has an economically significant effect on migration dynamics and on the job market in terms of the number of employed individuals, the number of establishments, total wages and average annual pay per person in twenty-six counties in Ohio and Pennsylvania. The employment, population and wage trends of a control group of thirteen counties with similar employment by industry that did not begin producing shale gas around 2011 is compared to thirteen counties in a treatment group that did begin oil and gas production at that time. The analysis incorporates migration inflow and outflow between counties in the control and treatment groups.

**Table 1: Migration Dynamics in Boom and Non-Boom Counties**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| *DV: Net Migration* | | | | | (Only Ohio) |
| Fracking boom | -37** | -37** | -34.09** | -34.09** | -55.51*** |
| | (17.64) | (17.96) | (17.44) | (17.44) | (17.95) |

**Table 2: The effect of the fracking boom and migration dynamics on employment, payrolls, establishments**

| | Model 1 | Model 2 | Model 3 | Model 4 | Model 5 |
|---|---|---|---|---|---|
| *DV: Number of Employed* | | | | | |
| Fracking boom | 708*** | 712*** | 722*** | 556** | 555** |
| | (292) | (225) | (221) | (234) | (230) |
| *DV: # of Establishments* | | | | | |
| Fracking boom | 29.5** | 35*** | 35*** | 31.7*** | 31.8*** |
| | (12.8) | (9.9) | (9.8) | (9.43) | (9.47) |
| *DV: Average Annual Pay* | | | | | |
| Fracking boom | 2431.3*** | 2442.5*** | 2443.1*** | 2281.2*** | 2285.8*** |
| | (559) | (561.4) | (560.7) | (440.8) | (440.9) |
| *DV: Total Wages (in thousands)* | | | | | |
| Fracking boom | 117408*** | 103651*** | 103570*** | 84602*** | 84915*** |
| | (33823) | (32330) | (32259) | (32356) | (32374) |

**Result:** As shown in Table 1, the fracking boom had a negative impact on net migration, as about thirty-seven more people moved out of the fracking counties compared to the non-producing counties. The migration trend in boom and non-boom counties differed, significant at the 1% level. Furthermore, the negative impact on net migration was greater in Ohio (-55 at the 1% significance level) than it was in Pennsylvania (-19 at the 5% significance level). Even though this result is statistically significant, such a small number compared to these counties' populations cannot be considered to have an economically significant impact on the socio-demographics of these counties. This result suggests that the shale boom did not create permanent labor migration and was responsible for only a small migration outflow. Results in Table 2 suggest that the number of jobs in producing counties was 2.4 percent higher than it was in non-producing counties, the number of establishments was 1.1 percent higher, total wages were 3 higher, and the average annual pay was 1.5 percent higher.

**Methodology:** The first analysis addresses the impact of the shale boom on net migration (defined as population inflow less population outflow. Equation (1) states:

$$NetMigration_{it} = \beta_0 + \beta_1 dummy1_{it} + \beta_2 dummy2_{it} + \beta_3 interaction_{it} + \varepsilon_{it}$$

The second analysis estimates the effect of shale production on job market variables

$$JobMarket_{it} = \beta_0 + \beta_1 dummy1_{it} + \beta_2 dummy2_{it} + \beta_3 dummy3_{it} + \beta_4 \text{inflow}_{it} + \beta_5 \text{outflow}_{it} + \varepsilon_{it}$$

Dummy 1=0 if from a non-producing county
Dummy 2=0 Before shale production started

**Notes**: Tables are cropped to save space. The models were estimated with several variations, including county fixed effects and time fixed effects. Models gradually include State Dummy, Population, Migration Inflow, Migration Outflow, County FE and Time FE. I used the models to obtain the marginal effect of shale production on employment, payrolls, and the number of establishments by taking migration dynamics into account. Population and migration differences play a role in determining labor market outcomes.

**Conclusion**: Based on this analysis, counties that adopt these shale production methods experienced a statistically and economically significant positive marginal effect on labor market outcomes, significant at the 1% level, that is robust across various specifications. The analysis reveals a small but statistically significant negative impact on migration, as shale regions have experienced some migration outflows, as discussed in some sociology literature. The labor market results are significantly larger than the negative net migration effect