Revisiting the Economic Impacts of Fracking in the Pennsylvania

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Overview

This study employs annual and monthly panel data and quarterly time series to estimate how development of the Marcellus, Utica, and Upper Devonian shale formations affects employment, income, and output in Pennsylvania. The economic shock from shale energy development is measured as the value of shale investment and new production. This effort is motivated by a series of recent papers on the economic impacts of shale energy development, see Freyrer et al. (2017), Komarek (2016), Lee (2015), and Weber (2012).

These papers share a common thread in which economic outcomes are compared with econometric techniques either before or after shale development or between regions with and without unconventional oil and gas production. These differences-in-differences studies employ either cross sectional data or panel data across counties and years. Selection of control groups varies by study as with the selection of various proxies for shale industry activity, such as number of wells drilled, producing wells, and production from existing or new wells. While the results vary significantly among studies, the general consensus is that the economic impacts of shale energy development are modest with some studies finding neglible impacts. In particular, many econometric studies conclude that ex ante input-output (IO) studies over-estimate the economic impacts of shale energy development. The findings presented in this study cast doubt on this view.

Methods

To provide a benchmark of comparison for the econometric analysis an input-output (IO) model is simulated for a $1 million shock in shale energy investment and production, showing that employment increases by 7.2 jobs and value added rises $1.07 million.

During the early stages of shale gas field development as companies drill to secure leases they develop an inventory of drilled but uncompleted wells. Eventually these wells are brought into production as gathering systems and processing plants are built and as connections with high compression interstate pipelines connections are made. Measuring shale activity by new production misses investment in well construction that in many cases may occur months or years before. Likewise, estimating activity by well numbers misses the royalties and taxes generated once production commences. This study solves this problem by combining these two measures into the value of investment and production.

Our measure of shale industry activity estimates the combined value of shale investment and new production that constitutes an economic shock to local economies. Pennsylvania provides an ideal case study because a new unconventional oil and gas industry was built over the past decade, involving an investment of more than $75 billion.

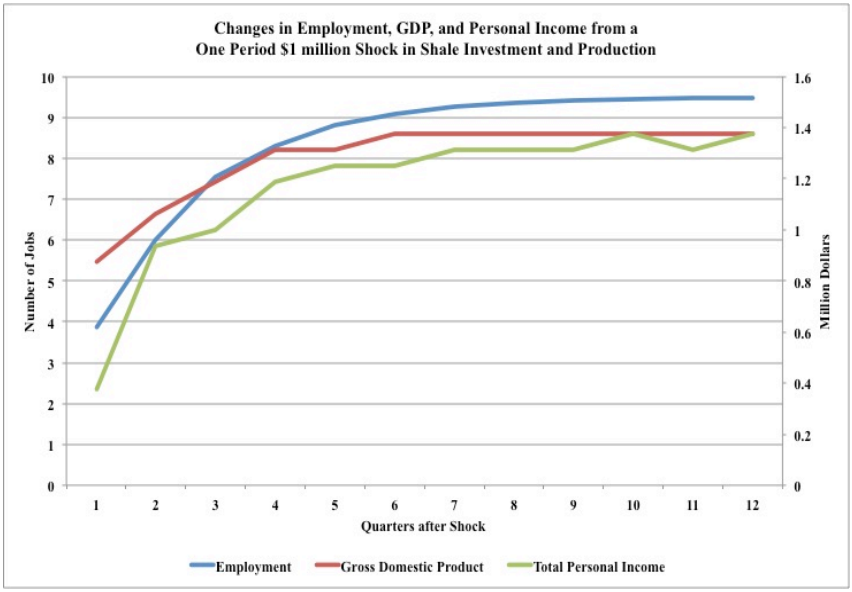
The econometric analysis entails regressions using annual, quarterly, and monthly data for Pennsylvania are performed at the county, regional, and state levels. Three classes of economic outcomes are modeled: total employment, gross domestic product or value added, and personal income. Employment is available at all three frequencies at the county and state level while the later two are only available at annual and quarterly periodicity at the state level. The annual and quarterly time series are from January 2005 through December 2016. First differences in these economic outcomes are regressed on the value of new investment and new production and seasonal dummy variables.

Results

Using the methods developed by Andrews (1993) we test for structural change and find clear evidence for such a break in July 2007 coinciding with the widespread adoption of horizontal drilling. The estimated short-run employment multiplier before the break is 3.3 and 7.8 after the break, which is close to the static IO multiplier.

The next finding is that the measure of shale activity developed in this study is compared with five other approaches in the literature and is found to be preferred with the lowest Schwarz Bayesian information criterion. Third, the employment multipliers are estimated at various levels of aggregation and imply that a $1 million shock to shale investment and production creates 0.6 jobs at the county level, up to 3.1 jobs at the regional level, and at least 7.8 jobs at the state level.

Quarterly models are used to estimate shale multipliers for state value added and income, which also are close to those from input-output models. Finally, to capture dynamic effects, a vector autoregressive (VAR) model of output, income, and employment is developed, The dynamic VAR simulation finds that a $1 million shock in shale investment and production generates 9.5 jobs and $1.4 million in additional income and output after 18 months.



Conclusions

This study conducts an econometric analysis estimating employment, output, and income multipliers associated with shale energy industry investment and new production. The analysis uncovers a structural break in the multipliers in mid 2007 that coincides with the adoption of hydraulic fracturing. Multipliers estimated over the entire sample are roughly half the size of multipliers estimated with samples after the structural break. A dynamic vector autoregressive model of gross domestic product, income, and employment is estimated using quarterly data and the impacts of shocks in shale investment and production are simulated. The VAR simulation indicates that a $1 million shale shock adds 3.9 jobs, $0.87 in gross domestic product, and $0.38 in personal income after one quarter. The impacts of the shock level out after 5 quarters so that the long-run employment multiplier is 9.5 and the multipliers for gross domestic product and personal income are both slightly less than 1.4. Overall, the findings suggest that the economic impacts of fracking may be larger than the consensus view.

References

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