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The Local Economic Impacts of Natural Resource Extraction: A Survey of Economic Literature

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INTRODUCTION

The past decade has been a dynamic one for the energy industry. During the early and mid-2000s, a combination of rising prices and technological advancements (*i.e.*, the combined use of horizontal drilling and hydraulic fracturing, or "fracking") led to the extraction of previously unrecoverable shale reserves. The shale boom saw the expansion of extraction activity in new geographic areas within the United States, including North Dakota and Pennsylvania.[1] Since late 2014, however, oil prices have fallen due to a combination of global supply and demand factors.[2] As these resource-rich areas undergo major economic changes, it is increasingly critical to understand the local economic implications of natural resource extraction.

This article presents a review of the economics literature that explores the relationship between resource extraction and local labor market and economic conditions. Economic theory predicts a positive relationship between resource booms and busts, earnings and employment at the local level. Employment and earnings will experience growth during a boom and decline during a bust. The theory is supported by empirical and anecdotal evidence, which suggests that resource booms and busts can lead to large increases and reductions in earnings and employment. These salient labor market impacts have important secondary effects that include educational attainment, migration decisions, and social insurance participation.

Part I of this article summarizes and explains the economic mechanisms using a basic labor market supply and demand model. Part II describes the earnings and employment effects of a natural resource boom and bust. Part III outlines the secondary effects that arise from changes in

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1. U.S. ENERGY INFO. ADMIN., *Drilling Productivity Report* (Feb. 13, 2017), eia.gov/petroleum/drilling/#tabs-summary-2 [https://perma.cc/4FXB-BUKM].

2. U.S. ENERGY INFO. ADMIN., *Petroleum & Other Liquids: Spot Prices* (Feb. 23, 2017), eia.gov/dnav/pet/pet_pri_spt_s1_a.htm [https://perma.cc/66A3-A84F].

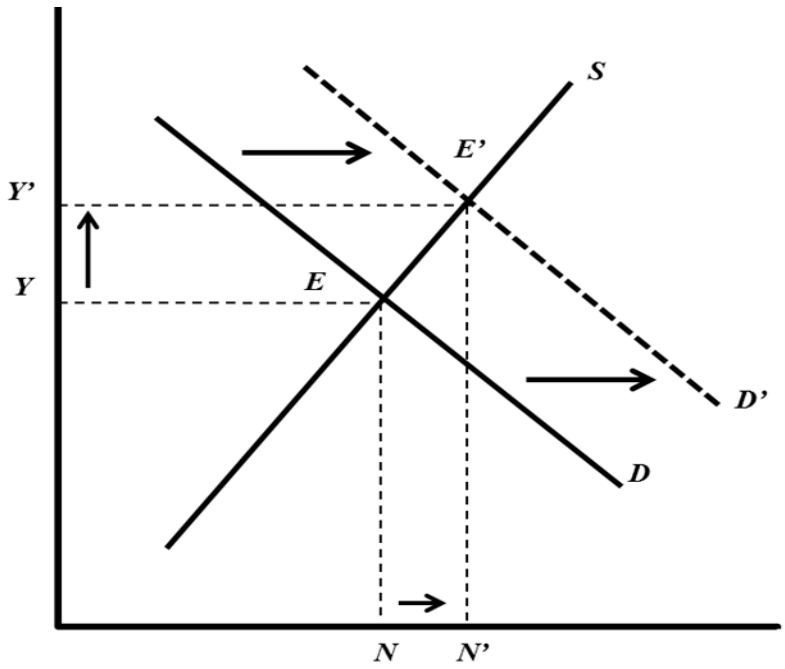
earnings and employment. The final section presents concluding remarks on the relationship between resource extraction and local economic activity.

I. BASIC ECONOMIC MODEL

Exhibit 1 illustrates the predictions of a basic model of labor supply and demand. In particular, the model examines the impact of a labor demand shock on earnings and employment. The upward-sloping labor supply curve and downward-sloping labor demand curve reflect basic economic principles. The labor supply curve traces out the relationship between wages and labor force participation, with the practical implication that there is a positive relationship between wages and labor force participation. Similarly, the labor demand curve traces out the relationship between wages and the labor demanded by firms. The negative relationship here suggests that firms demand less labor as wages increase.

In equilibrium (E), labor supply (S) is equal to labor demand (D), earnings are Y, and labor force participation is N. Now, if there is a positive shock to labor demand, such as an oil or natural gas production boom, then the labor demand curve (D) shifts outward from D to D'.

Exhibit 1–Labor Supply and Demand



The new labor market equilibrium is E', while earnings and labor force participation increase to Y' and N', respectively. A positive shock to labor demand will increase earnings and labor force participation. In practice, the size of these effects depends on the slopes of the labor supply and demand curves. For example, the steeper the labor supply curve (S) for a given shock to labor demand, there will be a smaller increase in labor force participation and a larger increase in wages. Thus, a larger shift in the labor demand curve is required to induce the same increase in labor force participation.

II. EARNINGS AND EMPLOYMENT EFFECTS

A growing literature in labor economics examines the impact of labor demand shocks on local economic conditions. Many of these studies focus on the impact of labor demand shocks that result from resource booms and busts on earnings and employment outcomes.[3] As predicted by the economic theory, there were large increases in earnings and employment in resource-rich areas.

One such paper by Joseph Marchand examined the earnings and employment growth differentials between areas with and without resource production (coal, natural gas, and oil) in the provinces of Alberta, British Columbia, Manitoba, and Saskatchewan in Western Canada.[4] The author focused on the resource booms and busts from the 1970s through the mid-2000s, and generally found large earnings and employment increases for workers in the energy industry as well as those in other industries.[5] For the 1996 through 2006 boom period, Marchand found a 68.3% increase in total earnings, a 21.5% increase in earnings per worker, and a 46.7% in

3. *See* Mallory Vachon, *Local Labor Market Conditions and the Federal Disability Insurance Program: New Evidence from the Bakken Oil Boom* (May 13, 2015), ssrn.com/abstract=2727381 [https://perma.cc/4JDR-M48Z] (examining earnings) [hereinafter Vachon: Federal Disability]; Mallory Vachon, *The Impact of Local Labor Market Conditions on Migration: Evidence from the Bakken Oil Boom* (Sept. 25, 2015), ssrn.com/abstract=2727380 [https://perma.cc/9UQJ-WE87] (examining earnings) [hereinafter Vachon: Migration]; Jeremy Weber, *The Effects of a Natural Gas Boom on Employment and Income in Colorado, Texas, and Wyoming*, 34 Energy Econ. 1580-–88 (Sept. 2012) (examining earnings); Dan Black, Terra McKinnish & Seth Sanders, *The Economic Impact of the Coal Boom and Bust*, 115 ECON. J. 449–76 (Apr. 2005) (examining employment); James Feyrer, Erin T. Mansur & Bruce Sacerdote, *Geographic Dispersion of Economic Shocks: Evidence from the Fracking Revolution*. dartmouth.edu/~mansur/papers/feyrer_mansur_sacerdote_frackingjobs.pdf [https://perma.cc/JW48-CTLX] (2016) (examining employment); Joseph Marchand, *Local Labor Market Impacts on Energy Boom-Bust-Boom in Western Canada*, 71 J. URB. ECON. 165–74 (2012) (examining both earnings and employment).

4. Marchand, supra note 4, at 167.

5. *See id.* at 166–68.

employment for the energy industry.[6] In addition to finding large effects for the energy industry, Marchand was able to disentangle the spillover effects of the boom on earnings and employment outside the energy industry.[7] He found that the 1996 through 2006 boom led to a 39% increase in total earnings, a 22.6% increase in earnings per worker, and a 16.3% increase in employment growth for other industries.[8] Further, Marchand found slightly larger effects for the 1971 through 1981 boom, while finding relatively little impact during the bust from 1981 through 1991.[9]

In another paper, authors Dan Black, Terra McKinnish, and Seth Sanders examined the coal boom and bust of the 1970s and 1980s on labor market outcomes in the Appalachian states of Kentucky, Ohio, Pennsylvania, and West Virginia.[10] This examination found a positive relationship between coal production and earnings and employment growth.[11] Overall, they found that total earnings grew 5% faster, earnings per worker grew 3% faster, and employment grew 2% faster each year for coal counties as compared to those without coal.[12] However, in comparison to Marchand, they discovered large, negative effects on labor market outcomes during the bust. Between 1983 and 1989, total earnings grew 5.5% slower, earnings per worker grew 2.8% slower, and employment grew 2.7% slower each year for coal counties compared to those without coal.[13]

In line with the results of Black, McKinnish, and Sanders, this author found an approximately 3% annual earnings growth for oil counties compared to counties without oil in Montana, North Dakota, and South Dakota from 2005 through 2009.[14] Yet, a study by James Feyrer, Erin Mansur, and Bruce Sacerdote took a different approach.[15] Rather than examining earnings and employment growth rates in response to resource extraction, they examined the number of jobs associated with earnings increases in resource-rich areas.[16] They found that every million dollars in new earnings is associated with an additional 0.85 jobs within a county.[17]

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6. *Id.* at 169.
7. *See id.* at 165.
8. *Id.* at 170 (as shown by Table 2a).
9. *Id.*
10. *See* Black, McKinnish & Sanders, *supra* note 4, at 449.
11. *See id.* at 450.
12. *Id.* at 458.
13. *Id.*
14. *See* Vachon: Federal Disability, *supra* note 4, at 29 (calculating from data contained in Table 1).
15. *See* Feyrer, Mansur & Sacerdote, *supra* note 4, at 2.
16. *See id.*
17. *Id.* at 16.

III. SECONDARY EFFECTS

While these earnings and employment effects are significant and garner considerable media attention, there are many secondary effects that may have more far-reaching impacts. One of the important questions in labor economics has been the response of individuals to changes in earnings. How does a change in earnings or employment prospects alter individual behavior? As earnings increase, the value of employment increases relative to the value of outside options. It is this substitutability between labor force participation and outside options that underlies the secondary effects of resource booms. The high degree of substitutability, suggests that workers are more sensitive to wage changes. The shale boom provides a natural experiment through which we can examine the impact of a change in earnings on various outcomes.

Research by Elizabeth Cascio and Ayushi Narayan examined the relationship between earnings and educational attainment in areas impacted by the recent shale boom.[18] Since lower-skilled male workers generally fill many oil and gas jobs, people often substitute away from education and into the labor market during a boom.[19] In 2000, the male high school dropout rate was 10% in states with shale reserves.[20] The shale boom increased the dropout rate by 3 to 3.5 percentage points.[21]

The results in Cascio and Narayan show that educational attainment of working-age men decreased during the boom. Such estimates suggest potentially suboptimal investments in education in response to an increase in earnings. These changes may lead to future shortages of skilled labor, making it difficult for workers to transition during a bust.

In addition to education, other outside options to employment include participation in social insurance programs such as Social Security Disability Insurance (DI). The DI program is the largest income replacement program in the U.S. for non-elderly adults.[22] Growth in the DI program since the 1970s has coincided with a well-documented decline in wages and labor force participation of low-skilled workers.[23] Since the DI program is more attractive as outside options decline, a key question in labor economics is to what extent changes in the labor economic

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18. *See* Elizabeth U. Cascio & Ayushi Narayan, *Who Needs a Fracking Education? The Educational Response to Low-Skill Biased Technological Change* (Nat'l Bureau of Econ. Research, Working Paper No. 21359, 2015).
19. *Id.* at 4.
20. *Id.*
21. *Id.*
22. *See* Dan Black, Kermit Daniel & Seth Sanders, *The Impact of Economic Conditions on Participation in Disability Programs: Evidence from the Coal Boom and Bust*, 92 AM. ECON. REV. 27–50, 27 (2002).
23. *Id.* at 28.

conditions led to changes in DI program participation.[24] For instances the coal boom of the 1970s reduced DI payments by 1.26% for coal counties relative to non-coal counties in Appalachia.[25] The shale boom reduced DI payments by 2.5% for oil counties relative to no-oil counties in Montana, North Dakota, and South Dakota.[26] The shale boom reduced DI participation by 1.6% for oil counties relative to no-oil counties in Montana, North Dakota, and South Dakota.[27]

Within economics, migration decisions are often viewed as utility maximization problems in which individuals choose the location that provides the highest utility. Utility is determined by analyzing earnings, amenities and the costs of moving between locations. From the basic model of labor supply and demand, an increase in labor demand will increase earnings and labor force participation. In reality, labor markets are often regional. Expanding the model of labor supply outlined in Exhibit 1 to two regions, one can imagine that increased labor demand, earnings, and employment in one region, such as an oil- or gas-producing region, will likely induce economic migrants from another region.

Empirical estimates are in line with these theoretical predictions. This author found that earnings growth in resource-rich counties significantly increased net migration in oil counties in North Dakota during the shale boom.[28] Overall, the net migration rate in North Dakota oil counties increased by 2.6 percentage points.[29] The pre-boom net migration rate was -1.5%, or out-migration.[30] More people were leaving these counties than coming in prior to the boom. Therefore, the estimates suggest that the post-boom net migration rate is 1.1%, or in-migration. The boom transformed these counties from population-losers to population-gainers, making them among the fastest growing counties in the country.

CONCLUSION

This article provides a review of the economic literature that examines the impact of natural resource shocks on labor market conditions. Booms and busts in resource production create unexpected labor demand shocks that either increase or decrease earnings and employment, particularly for resource-rich areas. In addition, the primary earnings and employment

24. *See id.* at 28–29 (describing DI participation and enrollment requirements).
25. *Id.* at 38.
26. Vachon: Federal Disability, *supra* note 4, at 17.
27. *Id.*
28. Vachon: Migration, *supra* note 4, at 16–17.
29. *Id.* at 16.
30. *Id.* at 33.

effects lead to important secondary effects on other labor market outcomes that include education, social insurance program participation, and migration. Specifically, the various studies examined in this article find reductions in educational attainment during resource booms,[31] reductions in social insurance participation,[32] and increases in net-migration.[33]

However, the shale boom came to a halt with the precipitous decline in oil prices that began at the end of 2014. Between June 2014 and February 2016, oil prices fell by approximately 75%, from $108 to $26.21 per barrel;[34] as of April 2017, prices have rebounded to around $50 per barrel.[35] This decrease in prices is due to a combination of supply and demand factors. In terms of supply, the U.S. shale boom increased global supplies. At the same time, the Organization of Petroleum Exporting Countries (OPEC) decided not to decrease production during the boom in the U.S. As for demand, there has been lower than expected growth in Europe and China.

Overall, the decrease in prices represents a negative shock to local economic conditions that will reduce earnings and employment in resource-rich areas. These academic implications are in line with the job losses that have been observed in the industry. With regard to the secondary effects discussed in this article, falling incomes and employment opportunities should reverse the observed trends in dropout rates, reduce and nearly eliminate migration effects, and increase DI payments and participation.

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31. *See* Cascio & Narayan, *supra* note 19.

32. *See* Black, Daniel & Sanders *supra* note 24; *see also* Vachon: Federal Disability, *supra* note 4.

33. *See* Vachon: Migration, *supra* note 4.

34. CHARLES RILEY, OIL CRASH TAKING STOCKS DOWN . . . AGAIN, (2016), http://money.cnn.com/2016/02/11/investing/oil-price-crash/ [https://perma.cc/E7MF-9XTD].

35. U.S. ENERGY INFO. ADMIN, *Daily Prices*, EIA (April 20, 2017), https://www.eia.gov/todayinenergy/prices.php [https://perma.cc/WFB6-LDQV] (using the West Texas Intermediate benchmark).