Preliminary and Incomplete

Impact of Oil Boom and Bust on Human Capital Investment in the U.S.

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Abstract

This paper uses Census IPUMS data from 1970 to 2010 to estimate the impact of the oil boom and bust on wages and human capital formation in the US. The paper finds that the oil boom between 1970 and 1980 was associated with a slower growth in the relative demand for skills in the oil and gas sector and regions where the sector had a large presence. Overall, the oil boom led to a sharp rise in real wages in oil areas relative to non-oil parts of the nation, raising the opportunity cost of additional schooling. Real wage premium for a college degree declined during the oil boom in oil-rich regions such as Texas, compared with non-oil areas. The oil boom of the 1970's potentially had an impact on human capital investment through two channels—by raising the opportunity cost of additional schooling as well as by lowering the returns from going to college. Using a synthetic cohort approach the paper finds that relative to cohorts who went to high school in the pre-boom period, the cohort reaching high school age during the oil boom was about 2 percentage points less likely to have a college degree by the time they turned 34 to 37 years of age in 2000.

1. Introduction

Booms and busts in natural resources can have ripple effects through a region's economy with long-term implications for the local labor markets. While the multiplier effects of resource booms receive much of the attention in the media and popular press, swings in resource activity can also have unexpected consequences that can stunt human capital formation and impede long-term growth (Gylfason, 2001), (Gylfason, Herbertsson, & Zoega, 1999). Existing empirical evidence, however, remains mixed. Since coal mining employed a larger percentage of low-skilled workers relative to non-coal sectors, the coal boom of the 1970s increased the relative demand for low-skilled workers and contributed to narrower skill premium in coal-rich pockets of Kentucky and Pennsylvania, with adverse effects on school enrolment (Black, McKinnish, & Sanders, 2005).

The skill distribution in the oil and gas industry, on the other hand, does not differ so significantly from non-oil sectors. Indeed, prolonged periods of high oil prices that led to a rapid growth in wages and employment in Alberta, Canada had a small positive impact on long run educational attainment (Emery, Ferrer, & Green, 2012). Using US data, (Keane & Prasad, 1996) found that oil price shocks resulted in lower aggregate wages and short run employment but wider skill premium, with considerable variation in the impact across industries and skill groups. While previous research on the impact of oil shocks has focused primarily on the different sectors and the overall economy, it is well-known that oil prices can have heterogeneous impacts across different regions in the US.

The energy sector has historically played a central role in oil-rich states such as Texas, a state that 22 percent of total oil production in the nation. While oil price shocks have a countercyclical effect on the nation as a whole, the oil rich regions tend to thrive, on net, in episodes of sharp spikes; oil booms played a pivotal role in shielding the Texas economy from multiple national recessions (Brown & Yucel, 2005) (Yucel, 2005). Elevated oil prices are frequently cited as reasons why Texas enjoys a long-term growth lead over the nation and had stronger recovery after the Great Recession. Just as positive oil price shocks tend to benefit Texas, its economy tanks when prices plunge. Like the rest of the world, the US witnessed

wild swings in oil prices due to OPEC induced supply restrictions in the 1970's. The WTI crude oil prices (real 2000 dollars) increased more than five-fold from about $15 in 1970 to about $80 in 1980 (Figure 1). The spike was followed by an equally sharp drop during the 80's with oil prices declining to a low of just over $20 in the later part of 1980's. What role did the oil boom and bust play in shaping local labor markets in Texas and other oil-abundant areas?

Using the standard human capital investment model from (Becker, 2002) and (Mincer, 1958), (Black et al., 2005) showed that improvement in economic conditions can affect educational attainment through two channels: (1) by changing the skill premium due to changes in relative demand for skilled workers and (2) by increasing the opportunity cost of additional schooling. The impact of oil boom on human capital investment though the second channel is clear. Oil boom of the 70's led to stronger growth in oil-producing states like Texas and therefore raised the opportunity of schooling through its pro-cyclical effect on wages. Previous research has found negative effects of higher minimum wage on school enrolment (Neumark & Wascher, 1995). But the impact of the oil boom on college enrolment through increases in skill premium is less obvious than found in (Black et al., 2005) for the coal boom. In contrast with the coal industry, the oil sector does not disproportionately employ low-skilled workers. Before the boom started, in 1970, 35 percent of workers in the oil and gas sector lacked a high-school degree, a smaller percentage than 38 percent for all industries (Table 1). The percentage of workers with a college degree in oil and gas was higher than in other industries from 1970 to 1990, although since 1990 the skill distribution has shifted in favor of the more educated at a slower pace in the oil sector than all industries combined.

Although, the skill distribution in the oil sector during the pre-boom years was not much different from non-oil, prolonged periods of oil boom can boost oil extraction, mining, and support services, likely leading to differential changes in skill distribution between oil and non-oil sectors. Therefore, the impact of oil boom on human capital investment is expected to operate through both channels—decline in skill premium and increase in opportunity cost of schooling.

This paper uses Census IPUMS data from 1970 to 2010 and employs a synthetic cohort approach to estimate the impact of oil boom on human capital investment in the US. There are three primary findings. Frist, the share of college graduates in the oil and gas sector rose less rapidly than non-oil/gas during the oil boom. On the other hand, the share of relatively unskilled workers—those without a high school degree—saw a somewhat smaller decline. The change in the share of workers with a high school diploma did not differ significantly in oil-gas sector from the rest of the economy. During the oil bust, the employment share of college graduates increased more rapidly in oil-gas compared with other sectors while the decline in unskilled-workers was roughly the same. Thus the oil boom was associated with a slower growth in the relative demand for skills.

Second, the slower growth in relative demand for skills during periods of oil boom suggests that oil prices might have had a negative impact on skill premium. Previous research has shown that real wage growth of college graduates was significantly slower than that of high school graduates and the college wage premium shrank during the 1970's (Katz & Murphy, 1992). The decline in the skill premium during the oil boom, however, was 5 percentage points larger in oil regions that are more sensitive to sharp swings in oil prices, suggesting that oil prices could have dented incentives to go to college in areas with high concentration of oil and gas activity.

On the other hand, during the oil bust in 1980's college wage premium rose dramatically, nationwide. But the growth in college premium was 3 percent larger in oil regions compared with non-oil areas. Overall, data from 1970 to 1990 show that growth in skill premium in oil intensive regions is negatively related to swings in oil prices. In addition to relatively larger declines in skill premium during the oil boom, real wage growth, on average for all workers,

from 1970 to 1980 was also 30 percent higher in oil areas; from 1980 to 1990 after the oil bust it was 2 percent lower.

And finally, The paper finds that relative to cohorts who went to high school in the pre-boom period, cohorts who were born in oil-rich states such as Texas and were 17 years old in the boom period were 2 percentage points more likely to get a high school degree by year 2000 but about 2 percentage points less likely to have a college degree by the time they turned 34 to 37 years of age in 2000. The rest of the paper proceeds as follows. Section 2 describes the data. Sections 3 through 6 discuss the results. Finally, there is a brief conclusion.

2. Data

All estimates in this paper are based on 1% Census IPUMS obtained from Minnesota Population Center for the years 1970, 1980, 1990, 2000, and 2010. The sample was restricted to workers who are employed with positive wages and hours. Estimates are weighted by person weight. Wages obtained by dividing annual wage and salary income by annual hours worked. Annual hours worked were calculated as the product of weeks worked last year times hours worked per week. For 1970 only interval data on weeks worked and hours per week are available, hence they were calculated by setting the intervals to the median within the intervals where the median was obtained from 1980 data. Similar procedure was followed for weeks worked in 2010 with median from 2000. Oil Area is defined as county groups available in various years with >2% employment in oil and gas sector, and non-oil area with <0.5%.

3. Changes in Employment Share

In 1970, before the oil boom started, share of workers without a high school diploma in the oil and gas sector was 35 percent, 3 percentage points lower than 38 percent overall across all sectors (Table 1). On the other hand 17 percent of workers in the oil and gas sector had a college degree compared with 13 percent across all sectors. Clearly, the oil and gas sector employed more skilled workers relative to the rest of the economy. Table 1 demonstrates a secular upward trend in relative demand for skills across all sectors, as the skill distribution shifted in favor of the highly educated in four decades since 1970. The share of college graduates increased over time across both oil/gas and non-oil/gas sectors while the share of high school graduates remained largely stable and the share workers without a high school diploma fell.

But the pattern of change in skill composition of the workforce was different in the oil/gas sectors compared with non-oil/gas. The share of college graduates in the non-oil-gas sector rose 5 percentage points (43 percent) from 1970 to 1980, during the oil- boom while it rose just 3 percentage points (19 percent) in the oil-gas industry. On the other hand, the share of relatively unskilled workers—those without a high school degree—declined 15 percentage points (38 percent) in industries other than oil and gas while the oil\gas sector saw smaller 11 percentage points (31 percent) decline. The change in the share of workers with a high school diploma did not differ significantly in oil-gas sector from the rest of the economy. During the oil bust, the employment share of college graduates increased more rapidly in oil-gas compared with other sectors while the decline in unskilled-workers was roughly the same. Thus the oil boom was associated with a slower growth in the relative demand for skills. This suggests that skill premium could be negatively related to changes in oil prices in regions that have a heavier concentration of oil and gas industry.

Table 2 presents difference-in-differences estimates of the impact of oil price shocks on employment shares of various skill groups in the oil and gas sector by estimating the following specification:

$$Educ_{it}^{j} = \alpha + \beta After\ Oil\ Shock_t + \gamma Oil\ \&\ Gas\ Sector + \delta Oil\ \&\ Gas * After\ Oil\ Shock + X_{it} + u_{it}$$

A linear probability model is estimated by restricting the sample to just workers with positive hours and wages with $Educ_{it}^{j}$ an indicator variable taking a value of 1 or zero to indicate j^{th} of the four categories of educational attainment: no high school, high school diploma, some college, and college. The vector of variables X_{it} contains demographic controls such as age, sex, and race. Columns 1, 3, 5, and 6 show results for the entire U.S. For comparison, the table also presents estimates for an oil-intensive state such as Texas.

In panel A, the coefficients on the interaction term between indicators for oil and gas sector and year 1980 suggest that employment share with no high school diploma increased significantly relative to non-oil industries both in the US (column 1) and Texas (column 2). The employment share of college graduates increased 2 percentage points less (Panel A: column 7), overall, in the oil and gas sector during the boom while it rose 2 percentage points more during the bust (Panel B: column 7). Impact of the oil boom and bust on college graduates' employment shares in the oil/gas sector was of similar magnitude in Texas but the differences are not statistically significant. The slower growth in relative demand for skills during periods of oil boom suggests that oil boom-bust cycles have a countercyclical impact on the skill premium in oil-producing regions.

4. Impact on Skill Premium

Given the increased relative demand for low-skilled in the oil and gas sector during the oil boom, the skill premium should decline in oil areas relative to non-oil areas. Table 3 presents difference in differences estimates of the impact of the oil boom in oil producing regions relative to non-oil regions. The following specification with log of real wage is estimated:

$$Log\ RWage_{it} = \alpha + \alpha_j \sum \alpha_j Educ_{it}^{j} + \beta AfteOilShock_t + \sum \beta_j AfterOilShock_t * Educ_{it}^{j}$$
$$+ \gamma Oil\ \&\ Gas\ Sector + \sum \gamma_j Oil\ \&\ Gas\ Sector * Educ_{it}^{j} + \delta Oil\ \&\ Gas_i$$
$$* AfterOilShock_t + \sum \delta_j Oil\ \&\ Gas * AfterOilShock_t * Educ_{it}^{j} + X_{it} + u_{it}$$

Columns 1 and 2 show that the real wage premium, for a college degree, did in fact decline in oil areas, compared with non-oil, during the oil boom in 1980 with a larger decline in Texas. Once again, the impact of the 1980's oil bust measured in 1990 was symmetrically opposite (columns 3 and 4).

Table 3 confirms oil price's likely negative impact on the college premium. Columns 1 of Table 3 shows that, nationally, college graduates' real wages rose 8 percent less during the oil boom relative to growth in real wages of high school graduates. This decline in the real wage premium for college graduates during the oil boom in the 70's was 5 percentage points larger in oil regions that are more sensitive to sharp swings in oil prices, suggesting that oil prices could have significantly dented incentives to go to college in areas with high energy industry concentration. Column 2 of Table 3 suggests that the relative decline in the college wage premium during the oil boom is even stronger in Texas.

Table 3 further shows that, in contrast to the oil boom, during the oil bust when oil prices crashed between 1980 and 1990, the real wage growth of college graduates was 14 percent (0.153-0.013) higher than those with just a high school diploma. It is well-documented that the skill premium rose rapidly in the U.S. during this period. But the growth in college premium was 3 percent (0.072-0.036) larger in oil regions compared with non-oil areas. Oil producing areas in Texas saw an even larger growth in college wage premium relative to non-oil producing areas of the state. In sum, Table 3 shows that skill premium in oil intensive regions are negatively related to swings in oil prices.

5. Overall Impact on Wages

Table 4 presents means of real wage for the period spanning the oil boom in the 70's and the oil bust in the 80's. Average real wage in regions which had negligible oil and gas employment declined 4.2 percent from 1970 to 1980. On the other hand, in regions with significant oil and gas employment, average real wage rose 26 percent during the oil boom. Means of real hourly wage in Table 4 provide tentative evidence that the oil boom raised the opportunity cost of additional schooling. Table 5 presents difference-in-differences estimates of the oil boom's impact on real wage, overall, in oil areas relative to non-oil areas by estimating the following

specification:

$$Log\ RWage_{it} = \alpha + \beta AfterOilShock_t + \gamma OilArea_i + \delta OilArea_i * AfterOilShock_t + X_{it} + u_{it}$$

Table 5 shows that real wage in regions with significant oil employment was 18 percent lower than non-oil regions in 1970 but wage growth from 1970 to 1980 was 30 percent higher in oil areas and the difference is statistically significant; from 1980 to 1990 after the oil bust it was 2 percent lower in oil-intensive regions. Tables 4 and 5 show that the oil boom of the 1970's could potentially impact human capital investment through both channels—by raising the opportunity to cost to additional schooling as well as by lowering the returns from going to college.

6. Impact of the Oil Boom on Human Capital Investment

Since expected rate of return to college is a significant determinant of the decision to enroll in college, prolonged periods of oil boom could have important effects on human capital

investment. Did the decline in the skill premium and the overall increase in real wage due to the oil boom adversely affect human capital investment? To test this hypothesis, the paper adopts the approach in (Emery et al., 2012)and compares the education attainment of cohorts who turned 17 years of age during the pre-boom period (1970 to 1973) with those who turned 17 during the boom period (1978 to 1981). Highest grade attained of both these groups is compared in 1990 when they were 20 to 23 years old and in 2000 when they were 34 to 37 years of age. But this inter-cohort difference in final education attainment may also partly reflect cohort effects which had nothing to do with the oil boom. The impact of the oil boom can be disentangled by comparing this inter-cohort difference for workers who went to school in an oil-producing state such as Texas with that in other non-oil rich states, by estimating the following difference-in-differences specification:

$$HIGRADE_{it}^{j} = \alpha + \beta BoomCohort_{it} + \gamma BornInTexas_{it} + \delta BoomCohort_{it} * BornInTexas_{it} + X_{it} + u_{it}$$

$HIGRADE_{it}$ is an indicator for highest grade j completed. The Census IPUMS data does not have information on state the workers whet to school in. To proxy for the state of schooling, comparison is made for those who were born in Texas vs. outside Texas. Table 6 examines the evidence by estimating the impact of the oil boom and bust on a cohort that turned 17 in an oil intensive region like Texas relative to other states. By 1990, this cohort born in Texas during the boom was 2 percentage points less likely to have a college degree than the cohort turning 17 during the pre-boom years from 1970-1973. Even by the year 2000, the boom cohort was 2 percentage points less likely to have a college degree than the pre-boom cohort.

7. Summary and Conclusion

The paper shows that the share of college graduates increased over time across both oil/gas and non-oil/gas sectors while the share of high school graduates remained largely stable and the share

of workers without a high school diploma fell. But the pattern of change in skill composition of the workforce was different in the oil/gas sectors compared with non-oil/gas. The share of college graduates in the oil-gas sector increased less compared with non-oil/gas sectors during the oil-boom. On the other hand, the share of relatively unskilled workers saw a smaller decline oil and gas sector. The employment share of college graduates, during the oil bust, increased more rapidly in the oil/gas sector compared with the rest of the economy while the decline in unskilled-workers was roughly the same. Slower growth in the relative demand for skills during the oil boom and stronger growth in the bust suggests that oil boom-bust cycles have a countercyclical impact on the skill premium in regions that have a higher concentration of oil and gas industry.

Relative to the rest of the economy the oil-producing regions saw a sharper decline in the college wage premium during the boom, suggesting that oil prices could have significantly dented incentives to go to college in areas with high energy industry concentration. During the oil bust in the 1980's, college wage premium rose across the nation, but growth was larger in oil regions. Overall wage growth could also have affected schooling choices. Real wage growth in oil-producing regions was 30 percent higher during the oil boom while it was 2 percent lower during the oil bust. Prolonged periods of oil boom in the 1970's could potentially have affected human capital investment through both channels—by raising the opportunity cost of additional schooling as well as by lowering the college wage premium. The paper uses a synthetic cohort approach to examine the evidence on oil boom's impact on human capital investment by comparing final education attainment of cohorts that turned 17 during the oil boom (the boom cohort) with that of the pre-boom cohort turning 17 before the boom started (pre-boom cohort). The difference in final educational attainment between the two cohorts in an oil intensive region

like Texas relative to other states provides an estimate of the impact of oil boom on human capital investment. The paper finds that the boom cohort in Texas was 2 percentage points less likely to have a college degree than an otherwise identical cohort turning 17 during the pre-oil boom years.

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Figure 1: Oil Price Booms and Bust from 1970-2010

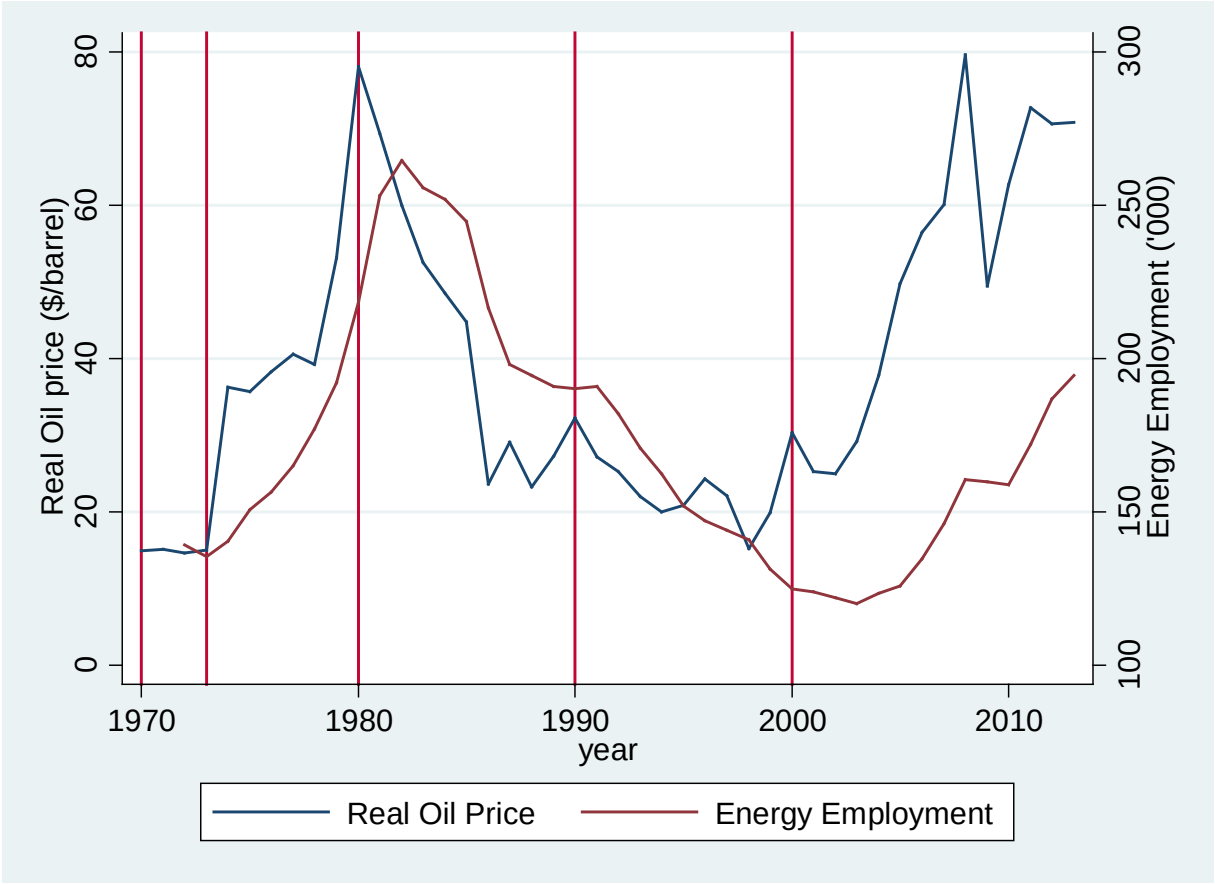

Table 1: Employment Shares by Educational Attainment in Oil and Gas Vs. Other Industries (USA)

	1970	1980	1990	2000	2010
Non-Oil/Gas					
HS Dropout	37.72	23.05	13.02	10.47	8.60
HS	35.70	38.77	32.91	37.70	33.35
Some College	13.55	19.52	30.49	24.12	26.28
College+	13.02	18.66	23.57	27.71	31.77
Oil/Gas					
HS Dropout	34.53	23.55	13.32	11.63	11.23
HS	34.03	37.29	32.29	41.84	42.44
Some College	14.18	18.59	26.41	20.30	22.42
College+	17.26	20.57	27.99	26.23	23.91
All Sectors					
HS Dropout	37.71	23.05	13.02	10.47	8.61
HS	35.70	38.76	32.91	37.71	33.38
Some College	13.56	19.52	30.47	24.12	26.27
College+	13.04	18.67	23.59	27.71	31.75
N	714564	899783	1053413	1173951	1289412

This table is based on 1% Census IPUMS obtained from Minnesota Population Center for the years 1970, 1980, 1990, 2000, and 2010. The sample was restricted to workers who are employed with positive wages and hours. Estimates are weighted by person weight (perwt).

Table 2: Difference-in-difference Estimates of Impact of Oil boom and bust on Employment Share of Education
(Dependent Variable: Categories of Education Attainment)
(Treatment: Cohort with Birth Year 19xx-19xx turning 17 during Oil Boom)

	(1) USA: No High School	(2) Texas: No High School	(3) USA: High School	(4) Texas: High School	(5) USA: Some College	(6) Texas: Some College	(7) USA: College+ 1970-1980	(8) Texas: College+ 1970-1980
Panel A: 1970-1980								
Oil/Gas Sector	-0.038**	-0.109**	-0.001	0.016	0.009	0.016	0.029**	0.078**
	(0.009)	(0.017)	(0.009)	(0.017)	(0.007)	(0.014)	(0.007)	(0.014)
After Oil Boom	-0.137**	-0.139**	0.023**	0.039**	0.055**	0.055**	0.060**	0.046**
	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.003)
Oil & Gas*After Oil Boom	0.045**	0.062**	-0.002	-0.021	-0.021**	-0.020	-0.022**	-0.020
	(0.011)	(0.020)	(0.012)	(0.020)	(0.009)	(0.017)	(0.009)	(0.016)
Panel B: 1980-1990								
Oil/Gas Sector	0.004	-0.047**	-0.006	-0.009	-0.007	-0.001	0.009	0.056**
	(0.005)	(0.009)	(0.007)	(0.011)	(0.006)	(0.010)	(0.006)	(0.009)
After Oil Bust	-0.105**	-0.128**	-0.058**	-0.052**	0.112**	0.120**	0.052**	0.060**
	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)	(0.001)	(0.002)
Oil & Gas*After Oil Bust	-0.005	0.018	0.009	-0.014	-0.027**	-0.025	0.023**	0.020
	(0.008)	(0.014)	(0.010)	(0.016)	(0.009)	(0.015)	(0.009)	(0.014)

Dependent variable is categories of education attainment as indicated in the column heading. Estimates obtained from Linear Probability Model. Standard errors are in parenthesis. Other controls include age, sex, and a dummy for white. Sample restricted to Pre-Boom and Boom cohorts in years 1990 or 2000 as indiacetd in the column heading. This table is based on 1% Census IPUMS obtained from Minnesota Population Center for the years 1970, 1980, 1990, 2000, and 2010. The sample was restricted to workers who are employed with positive wages and hours. Estimates are weighted by person weight (perwt). Wages obtained by dividing annual wage and salary income by annual hours worked. Annual hours worked were calculated as the product of weeks worked last year times hours worked per week. For 1970 only interval data on weeks worked and hours per week are available, hence they were calculated by setting. Both were obtained by setting the intervals to median within the intervals where the median was obtained from 1980 data. Similar procedure was followed for weeks worked in 2010 with median from 2000. Oil Area is defined as county groups available in various years with >2% employment in oil and gas sector, and non-oil area with <0.5%.

Table 3: Difference-in-difference Estimates of Impact of Oil boom and Bust on Skill Premium
(Dependent Variable: Log of Real Wage)
(Treated Group: Oil Area)
(Omitted Category: High School Dropout)

	(1) USA 1970-1980 (Oil Boom)	(2) Texas 1970-1980 (Oil Boom)	(3) USA 1980-1990 (Oil Bust)	(4) Texas 1980-1990 (Oil Bust)
Oil Area*After	0.302**	0.150**	-0.085**	-0.067**
	(0.014)	(0.024)	(0.020)	(0.026)
Oil Area*HS Grad	0.023**	0.057**	-0.005	-0.004
	(0.009)	(0.026)	(0.015)	(0.021)
Oil Area*Some Col	0.029**	0.038	0.012	-0.020
	(0.012)	(0.032)	(0.017)	(0.023)
Oil Area*College+	0.057**	0.099**	0.005	-0.033
	(0.012)	(0.033)	(0.016)	(0.023)
After* HS Grad	-0.028**	0.020	0.013**	0.011
	(0.003)	(0.024)	(0.003)	(0.016)
After* Some Col	-0.021**	-0.007	0.061**	0.056**
	(0.004)	(0.030)	(0.004)	(0.017)
After* College+	-0.106**	-0.045	0.153**	0.160**
	(0.004)	(0.031)	(0.004)	(0.018)
Oil Area*After* HS Grad	-0.023	-0.057*	0.036	-0.012
	(0.018)	(0.034)	(0.024)	(0.033)
Oil Area*After* Some Col	-0.013	-0.054	0.054**	0.050
	(0.021)	(0.041)	(0.025)	(0.034)
Oil Area*After* College+	-0.053**	-0.137**	0.072**	0.072**
	(0.021)	(0.041)	(0.025)	(0.034)
Observations	1217526	57555	1417785	79982
R-Sq	0.19	0.20	0.20	0.22

Dependent variable is logarithm of real wage. Standard errors are in parenthesis. This table is based on 1% Census IPUMS obtained from Minnesota Population Center for the years 1970, 1980, 1990, 2000, and 2010. The sample was restricted to workers who are employed with positive wages and hours. Estimates are weighted by person weight (perwt). Wages obtained by dividing annual wage and salary income by annual hours worked. Annual hours worked were calculated as the product of weeks worked last year times hours worked per week. For 1970 only interval data on weeks worked and hours per week are available, hence they were calculated by setting. Both were obtained by setting the intervals to median within the intervals where the median was obtained from 1980 data. Similar procedure was followed for weeks worked in 2010 with median from 2000. Oil Area is defined as county groups available in various years with >2% employment in oil and gas sector, and non-oil area with <0.5%.

Table 4: Real Wage in Oil Area Vs. Non-Oil Area (USA)
(Mean in Parenthesis, Median in Square Brackets)

	1970	1980	1990
Non-Oil/Gas Area	16.22	15.54	16.67
	[13.73]	[12.02]	[12.67]
Oil/Gas Area	13.83	17.43	18.34
	[11.47]	[13.40]	[14.26]
All Areas	16.09	15.59	16.70
	[13.53]	[12.04]	[12.67]

This table is based on 1% Census IPUMS obtained from Minnesota Population Center for the years 1970, 1980, 1990, 2000, and 2010. The sample was restricted to workers who are employed with positive wages and hours. Estimates are weighted by person weight (perwt). Wages obtained by dividing annual wage and salary income by annual hours worked. Annual hours worked were calculated as the product of weeks worked last year times hours worked per week. For 1970 only interval data on weeks worked and hours per week are available, hence they were calculated by settin . Both were obtained by setting the intervals to median within the intervals where the median was obtained from 1980 data. Similar procedure was followed for weeks worked in 2010 with median from 2000. Oil Area is defined as county groups available in various years with >2% employment in oil and gas sector, and non-oil area with <0.5%.

Table 5: Difference-in-difference Estimates of Oil boom and Bust on Real Wage
(Dependent Variable: Log of Real Wage)
(Treated Group: Oil Area)

	(1) 1970-1980 (Oil Boom)	(2) 1980-1990 (Oil Bust)
Oil Area	-0.183**	0.121**
	(0.004)	(0.006)
After Oil Shock	-0.072**	0.067**
	(0.001)	(0.001)
Oil Area*After Oil Shock	0.305**	-0.020**
	(0.008)	(0.009)
Observations	1217526	1417785
R-Sq	0.00	0.00

Dependent variable is logarithm of real wage. Estimates obtained from Linear Probability Model. Standard errors are in parenthesis. This table is based on 1% Census IPUMS obtained from Minnesota Population Center for the years 1970, 1980, 1990, 2000, and 2010. The sample was restricted to workers who are employed with positive wages and hours. Estimates are weighted by person weight (perwt). Wages obtained by dividing annual wage and salary income by annual hours worked. Annual hours worked were calculated as the product of weeks worked last year times hours worked per week. For 1970 on ly interval data on weeks worked and hours per week are available, hence they were calculated by setting . Both were obtained by setting the intervals to median within the intervals where the median was obtained from 1980 data. Similar procedure was followed for weeks worked in 2010 with median from 2000. Oil Area is defined as county groups available in various years with >2% employment in oil and gas sector, and non-oil area with <0.5%

Table 6: Difference-in-difference Estimates of Oil boom on Educational Attainment
(Dependent Variable: Categories of Education Attainment)
(Treatment: Cohort with Birth Year 19xx-19xx turning 17 during Oil Boom)

	(1) HS Drop 1990	(2) HS Drop 2000	(3) HS Grad 1990	(4) HS Grad 2000	(5) Some Coll 1990	(6) Some Coll 2000	(7) College+ 1990	(8) College+ 2000
Texas Born	0.004	0.005	0.004	0.013**	0.015**	0.013**	-0.023**	-0.031**
	(0.004)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
Boom Cohort	0.005**	0.011**	0.024**	0.008**	-0.005**	-0.001	-0.023**	-0.017**
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Texas Born* Boom Cohort	0.008	-0.002	0.011	0.021**	-0.001	0.002	-0.018**	-0.021**
	(0.005)	(0.005)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)
Observations	237671	245709	237671	245709	237671	245709	237671	245709
R-Sq	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Dependent variable is categories of education attainment as indicated in the column heading. Estimates obtained from Linear Probability Model. Standard errors are in parenthesis. Other controls include age, sex, and a dummy for white. Sample restricted to Pre-Boom and Boom cohorts in years 1990 or 2000 as indiacetd in the column heading. This table is based on 1% Census IPUMS obtained from Minnesota Population Center for the years 1970, 1980, 1990, 2000, and 2010. The sample was restricted to workers who are employed with positive wages and hours. Estimates are weighted by person weight (perwt). Wages obtained by dividing annual wage and salary income by annual hours worked. Annual hours worked were calculated as the product of weeks worked last year times hours worked per week. For 1970 only interval data on weeks worked and hours per week are available, hence they were calculated by setting. Both were obtained by setting the intervals to median within the intervals where the median was obtained from 1980 data. Similar procedure was followed for weeks worked in 2010 with median from 2000. Oil Area is defined as county groups available in various years with >2% employment in oil and gas sector, and non-oil area with <0.5%.