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Karen Maguire
Oklahoma State University

Arthur Santos Miranda
Oklahoma State University

John V. Winters
Iowa State University

Department of Economics
Oklahoma State University
Stillwater, Oklahoma

339 BUS, Stillwater, OK 74078, Ph 405-744-5110, Fax 405-744-5180

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Karen Maguire
Assistant Professor
Department of Economics and Legal Studies in Business
Spears School of Business
Oklahoma State University
352 Business Building, Stillwater, Oklahoma 74078
karen.maguire@okstate.edu
(Corresponding Author)

Arthur Santos Miranda
Department of Accounting
Spears School of Business
Oklahoma State University
Stillwater, Oklahoma 74078
arthuhs@okstate.edu

John V. Winters
Associate Professor
Department of Economics
Iowa State University
460B Heady Hall, Ames, Iowa 50011
and
IZA, Bonn, Germany
winters1@iastate.edu

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Abstract

The effects of the American opioid crisis have been widespread, leading to increases in addictions, poor health outcomes, and death. We expect that these effects may vary across the workforce, in particular that blue-collar employment, which generally requires more physically demanding labor, may be associated with a higher use of pain medication including opioids. This paper analyzes the relationship between the share of blue-collar employment and the number of opioid prescriptions from 2014 to 2016 for the Appalachian region as compared to the contiguous U.S. We find that there is a positive and statistically significant relationship in the Appalachian region.

Introduction

The opioid epidemic in the United States began in the late 1990s, accelerated in 2012, and was declared a national public health emergency in October 2017.[1] Between 1991 and 2011, the number of opioid prescriptions and deaths related to opioids tripled. Deaths from opioid overdose were five times greater in 2016 than in 2009; and in 2016, forty percent of opioid deaths were from prescription opioids rather than heroin (CDC 2017a).[2] As of 2016, according to the American Society of Addiction Medicine (ASAM), drug overdose was the leading cause of accidental death in America, with 52,404 such deaths. Prescription medication led to 20,101 of those deaths (ASAM 2016).

The media coverage of the opioid crisis often focuses on Appalachia, where drug related deaths are generally higher than in other parts of the country. The four states with the highest overdose rates in 2015 were, in order, West Virginia, New Hampshire, Kentucky, and Ohio (Hedegaard, Warner, and Miniño 2017). Three of these four states are in the Appalachian region. The Economist (2017) presents data from the Center for Disease Control (CDC) for 2015 showing that the predominantly white and rural Appalachian region is hard hit with fatalities from this crisis (Economist, 2017). According to the CDC, between 2014 and 2016, West Virginia had the highest drug overdose death rate (CDC NCHS 2018).[3] It is a relatively white, rural, and poor state, and the crisis affects those demographics in particular.

Abuse of prescription pain medication has the potential to affect the economy through the labor market. Harris et. al. (2017) show that from 2013 - 2015, a 10 percent increase in opioid

[1] There was an upward trend in overdose deaths from opioid prescriptions beginning in the 1990s and a second surge beginning in 2012 (CDC 2017a, CDC 2017b).
[2] ASAM lists types of opioid prescriptions as oxycodone, hydrocodone, codeine, morphine, and fentanyl (ASAM 2016).
[3] Death rate is measured as the number of deaths per 100,000 by state adjusted for differences in age-distribution and population size (CDC NCHS 2018).

prescriptions per capita leads the employment-to-population ratio to fall by 0.61 percent, the labor force participation rate (LFPR) to fall by 0.56 percent, and the unemployment rate to go up by 0.1 percent. Krueger (2017) estimates that 20 percent of the decline in the LFPR rate for men from 1999 - 2015 is due to the increase in opioid prescriptions. His data further show that the Southeast region, covering much of the Appalachian region, had both a high rate of opioid prescriptions and a large drop in the LFPR from 1999-2015 (Fleming and Leatherby 2017). In our paper, we look at the composition of the existing labor force, rather than the effects on the LFPR. In particular, we hypothesize that increases in blue-collar, physically demanding, employment will lead to an increase in prescriptions for pain medication, specifically opioids.

Data

In order to examine the relationship between blue-collar employment and opioid prescriptions, we collected data on the number of opioid prescriptions made per 100 people (OP) in each of the contiguous 48 states from 2014-2016 from the CDC (CDC 2017b).[4] We also collected data on the number of persons employed by industry category (BEA 2017). We then categorized the industries into blue-collar and white-collar industries; see Table 1.[5] Finally, we calculated the share of total employment that was blue-collar for each state and year (BCE).

Due to the large impact that the opioid epidemic is having in the Appalachian region, we analyze these states separately. Eleven states are in the Appalachian region: Alabama, Georgia, Kentucky, Mississippi, North Carolina, Ohio, Pennsylvania, South Carolina, Tennessee, Virginia, and West Virginia. Though most of these states are not entirely in the Appalachian

[4] The data on opioid prescriptions also include the number of prescriptions for four additional categories, long-acting (LAER), low (< 50), medium (50-90), and high (> 90) daily dosages.
[5] It was not possible to determine whether workers were in physically demanding labor or not using the NAICS employment categories, so industries with a large number of physically demanding jobs were categorized as blue-collar. (See Table 1).

region, non-trivial areas of these states are included.[6] In addition, this follows the Appalachian Regional Commission's categorization of states in the Appalachian region.[7] Table 2 reports BCE and OP for each state in the Appalachian region for 2016. Only two states in the Appalachian region, Virginia and Georgia, are below the U.S. average in BCE and only Virginia is below average in OP.

To examine the unconditional relationship between BCE and OP, we constructed a scatter plot of the variables for the contiguous United States and for the Appalachian region in Figure 1. Figure 1 shows that there is a positive relationship in both samples and that there is stronger relationship between BCE and OP in the Appalachian region.

In order to control for other factors associated with higher rates of opioid use, we constructed state-year variables for the percentage of individuals that are white (non-Hispanic), male, uninsured, and the median real household income using the American Community Survey data (ACS 2014-2016). These were all important factors to consider in the analysis because the opioid crisis is often described as a predominantly a crisis for those who are white, rural, poor, and male.

Results

We used the following state and year fixed effects regression in which i=state and t=year from 2014 to 2016.[8]

$$\begin{aligned}\text{AllOpioids}_{it} = {} & \beta_0 + \beta_1 \text{ShareBlueCollar}_{it} + \beta_2\ \text{PercentWhite}_{it} + \beta_3\ \text{PercentMale}_{it} + \\ & \beta_4\ \text{MedianEarnings}_{it} + \beta_5\ \text{PercentUninsured}_{it} + \delta_t\ \text{year}_t + \gamma_i\ \text{state}_i + \varepsilon_{it}\end{aligned}$$

[6] Only West Virginia is entirely within the Appalachian region.
[7] The Commission also includes Maryland and New York, but only a small part of each state is included so we excluded them.
[8] The data on the share of rural individuals did not change over time and was excluded.

The results in Table 3, column 1 show that for all states, there is a positive relationship between BCE and OP, but it is not statistically significant.[9] For the Appalachian region, Table 3, column 2, there is a positive and statistically significant relationship between BCE and OP.[10] The findings indicates that a one standard deviation increase in BCE is associated with a 34.06 increase in OP on average. Given that the mean OP in the Appalachian region is 96.09, this is an economically significant effect. (See Table 4 for Summary Statistics.) In addition to the coefficient on BCE, the coefficient on the percentage of white, male, and uninsured individuals is also statistically significant in the Appalachian region. The coefficients indicate that a one standard deviation increase in the percentage of white, male, and uninsured individuals leads to a decrease of 26.12, a decrease of 2.95, and an increase of 9.44 OP on average, respectively. This is counter to the argument that opioids are predominantly an issue for white males. These results are likely driven by collinearity in the small Appalachian sample, all three variable are insignificant if BCE is excluded, while the results for BCE were robust to the exclusion of these variables.[11]

Conclusion

The effects of the opioid crisis have been widespread, leading to increases in addictions, poor health outcomes, and death. We find that higher blue-collar employment (BCE) is positively and statistically significantly associated with increased opioid rates (OP) in the Appalachian region. However, we are unable to determine why this relationship exists only in

[9] These results were largely consistent across all categories of opioid prescriptions including long acting, high, medium, and low daily dosages. BCE was positive and statistically significant for the medium daily dose only. In that case, a one standard deviation increase in BCE led to a 1.35 increase in OP, which is not economically significant.
[10] The results were positive and statistically significant across all categories of OP.
[11] Results are available upon request.

this region. We have controlled for many of the factors that are commonly associated with higher rates of opioid prescriptions, including race, gender, household income, and access to health insurance; however, our findings for these variables over the period 2014-2016 were generally not significant. Future research over longer periods or specifications that control for other dynamic changes in regional factors, such as access to opioid medications, may provide insights into the reasons for the significant relationship between BCE and OP in the Appalachian region.

It is worth noting that the rate of opioid prescriptions decreased significantly in 2017. There was a nine percent decline on average across states, which included a decrease of over 10 percent in two Appalachian states, West Virginia and Pennsylvania. The news is not all good however, as deaths from overdoses continued to increase (Woolston 2018). Clearly more research is needed to understand the factors, such as employment composition that may lead to increases in opioid prescriptions.

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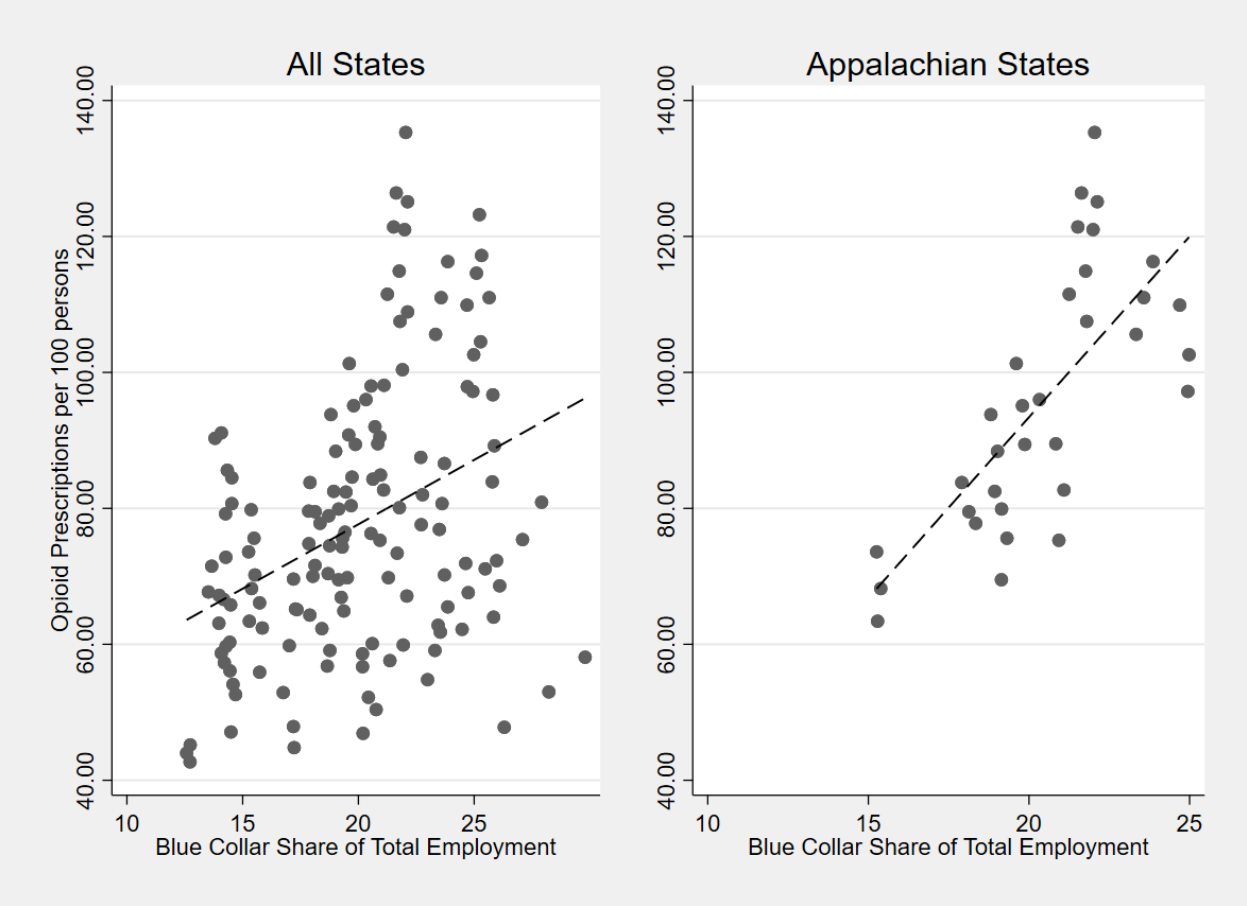
Figure 1: Blue-Collar Employment and Opioid Rates, 2014-2016



Source: ASAM 2016; BEA 2017.

Table 1: Industry Categories

Blue-Collar Industries	White-Collar Industries
70-Farm	600-Wholesale trade
100-Forestry	700-Retail trade
200-Mining	900-Information
300-Utilities	1300-Management
400-Construction	1400-Administrative and waste management
500-Manufacturing	1500-Education
800-Transportation and warehousing	1600-Health care
	1700-Arts
	1800-Accommodation and food services
	1900-Other services
	2000-Government

Table 2: Appalachian State Data - 2016

State	BCE Share	Opioid Rate
Alabama	22.00	121.0
Georgia	18.34	77.8
Kentucky	24.95	97.2
Mississippi	23.34	105.6
North Carolina	18.94	82.5
Ohio	20.94	75.3
Pennsylvania	19.14	69.5
South Carolina	19.87	89.4
Tennessee	21.78	107.5
Virginia	15.29	63.4
West Virginia	20.33	96.0
United States	18.56	66.5

Table 3: Regression Results

Dependent Variable: Opioid Rate	**All States**	**Appalachian States**
Blue-Collar Share	1.383	**13.42*** **
	(0.985)	(7.171)
Percent White	-0.0552	**-2.402** **
	(-0.0782)	(-2.444)
Percent Male	3.965	**-9.823***
	(0.867)	(-1.916)
Real Median HH Income	-3.79e-05	-0.00131
	(-0.116)	(-1.497)
Percent Uninsured	0.572	**3.212***
	(1.050)	(1.896)
Year FE	Yes	Yes
State FE	Yes	Yes
R-squared	0.805	0.972
Observations	144	33
Number of States	48	11

Note: Robust t-statistics in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Summary Statistics

All States (N=144)	**Mean**	**Median**	**Std. Dev.**	**Minimum**	**Maximum**
All Opioid Prescriptions	77.54	74.65	19.96	42.70	135.30
Blue-Collar Employment	19.94	20.03	3.96	12.58	29.80
Percent White	78.29	78.75	10.33	56.47	94.75
Percent Male	49.32	49.19	0.66	48.21	51.48
Real Median HH Income	55259.85	53558.50	8805.85	39680.00	78945.00
Percent Uninsured	9.17	8.75	3.261	2.50	19.10
Appalachian States (N=33)					
All Opioid Prescriptions	96.09	95.10	19.13	63.40	135.30
Blue-Collar Employment	20.51	20.84	2.58	15.23	24.98
Percent White	73.87	69.05	10.87	58.51	93.58
Percent Male	48.84	48.75	0.30	48.21	49.43
Real Median HH Income	48977.76	47275.00	7089.27	39680.00	68114.00
Percent Uninsured	9.78	10.00	2.94	5.10	15.80