A DIFFERENT PERSPECTIVE ON DRUG OVERDOSES

The COVID-19 epidemic has diverted public attention from another on-going, world-wide health crisis --- the scourge of drug overdoses. The "Big Three" drugs that most often abused ---opioids, methamphetamines and cocaine --- caused an estimated 95,000 deaths in the United States in 2018 (Cunningham, 2020). Between 2010 and 2018, deaths attributed to drug overdoses surged by 151% in the United States (Merelli, 2020) and opioid abuse by itself accounted for an estimated 67,000 of those deaths (Cunningham, 2020). Preliminary reports also that a surge in opioid overdoses deaths has occurred after the onset of the Coronavirus pandemic (CDC, 2020).

The most popular interpretation of the surge in drug overdose deaths due asserts that they constitute an understandable reaction to economic misery. In this context, stagnant incomes and unemployment often are cited as primary causes of opioid abuse. The *New York Times* (2019) gave voice to this view of the world when it headlined, "Opioid deaths rise when auto plants close."

Case and Deaton (2015, 2017, 2020) were among the first to argue that a large proportion of opioid deaths represent "deaths of despair." They assert that the despair that is generated in individuals when they experience deteriorating economic conditions drives those individuals to abuse drugs. Case and Deaton (2020) go beyond this to issue an indictment of capitalism and American society is both sweeping overall and specific in parts. For example:

> Our story of deaths of despair; of pain; of addiction, alcoholism and suicide; of worse jobs with lower wages; of declining marriage, and of of declining religion is mostly a story of non-Hispanic white Americans without a four-year degree (Case and Deaton, 2020).

These assertions represent testable propositions and in this paper, we present and interpret important new evidence that subjects these and other hypotheses to scrutiny.

AN OVERVIEW OF PREVIOUS WORK

The economic misery/deaths of despair view of the world is intuitively appealing because it is consistent with anecdotal reports and personal observations. It is true that many opioid overdose deaths occur in locales characterized by high unemployment and minimal or negative

real income growth. This invites one to conclude that unemployment and lagging income growth are the major causes of opioid abuse. The deaths of despair explanation passes the informal eyeball test applied by time-constrained reporters and has led many individuals to conclude that the economic misery/deaths of despair hypothesis represents *the* explanation for lofty opioid death rates.

However, as we show in a section below, economic misery is but one of a half-dozen or more identifiable determinants of opioid death rates and may not be the most important one. The evidence in favor of the economic misery hypothesis is mixed (Childhuri and Li, 2017; Ruhm, 2018; Aliprantis and Schweitzer, 2018; Currie et al, 2019; Metcalf and Wang, 2019; Blake-Gonzalez et al., 2020). Ruhm (2018), for example, concluded that changes in economic conditions account for less than one-tenth of the recent rise in drug and opioid mortality.

One particularly useful contribution in this area is Nosrati et al. (2019), who utilized an annual county-level panel dataset to estimate how mortality rates were influenced by crime and imprisonment, ethnicity, household income, and opioid prescription rates. Their use of county-level data is particularly appropriate because county jurisdictions in the United States are first responders to episodes of opioid abuse. It is they, along with health providers, who bear most of the immediate public costs of drug abuse. Hence, focusing on their circumstances is valuable if one seeks to understand the practicalities of drug abuse.

It is fair to observe that the use of city- and county-level data has been more common in medical studies investigating opioid use than it has been in economic studies. The work we present below builds upon Nosrati et. al. (2019) but explores a half-dozen additional hypotheses of importance concerning the determinants of drug overdose death rates. Hence, we present a hybrid health/economics approach to the examination of opioid death rates.

Blake-Gonzalez et al. (2020), using city- and county-level data, found only moderate connections between the rate of unemployment in local jurisdictions and their opioid death rates. As did Childhuri and Li (2017), Blake-Gonzalez et al. (2020) found supply-side factors to be important; easy accessibility of opioid prescriptions resulted in rising opioid death rates. But Blake-Gonzalez et al. (2020) also discovered that factors including market concentration, travel time to work, the riskiness associated with a job, population density, and the availability of health insurance to pay for prescriptions were statistically significant contributing factors to

rising opioid death rates. Further, like Metcalf and Wang (2019), they found higher levels of physical risk in jobs contributed to increases in opioid overdose death rates. In contrast to Case and Deaton (2020), after controlling for a dozen or more factors, no statistical link was found between an individual educational attainment and opioid death rates.

How should one account for the discordant conclusions of researchers concerning the economic misery/deaths of despair hypothesis? We observe that studies that control for more explanatory factors and studies that utilize more micro-level data (such as cities and counties) typically find looser relationships between opioid death rates and economic factors. It is not that the relationships disappear, but rather that they assume quantitatively less important roles as explanatory factors.

In this paper, we delve more deeply into the work of Blake-Gonzalez et. al. (2020) and briefly probe the developing relationship between opioid abuse, alcohol abuse, and COVID-19.

THE MODEL THAT GENERATES OUR RESULTS

The dependent variable in our analysis is the logarithm of the age-adjusted drug overdose death rate (*DEATHRATE*) in every year of a 2008-2017 study period for 84 Virginia cities and counties.[1] Age-adjusted death rates recognize that varying age distributions of populations in jurisdiction could drive differences in behavior. Small population size is the reason that a specific city or county was not included in the sample; drug overdose data are not published for the smallest cities and counties.

Our basic estimating equation is:

DEATH RATE = f(PRESCRIBE, MRKTCONC, MEDHHINC, UNEMPL, MINING, (1)
DISABIILTIY, PCTHLTHIN, POPDENSITY, HSCOMPLUS, TRAVELTIME, JAIL, WHITE)

where:

PRESCRIBE = Annual opioid prescribing rate per 100 individuals

[1] In the Commonwealth of Virginia, "independent cities" exist that exercise governmental duties virtually identical to those of counties. They are independent in that even though in some cases they are physically surrounded by a county. They tax and spend on their own. More than 30 such cities are part of our sample and this group largely consists of the most populous cities in Virginia.

MRKTCONC = Share of opioid pills supplied by the five largest pharmacy suppliers

MEDHHINC = Annual median household income

UNEMPL = Annual unemployment rate

MINING = percent of employment in mining

DISABILITY = percent of population aged 18-64 that receive some form of disability payment under Social Security

PCTHLTHIN = percent of population under age 65 with health insurance

POPDENSITY = Population per square mile

HSCOMPLUS = percent of population aged 25 or older with a high school diploma or more

TRAVELTIME = Average travel time to work

JAIL = percent of residents aged 15-64 in prisons or jails per 100,000 people

WHITE = Dummy variable, where self-identified white = 1, 0 otherwise

Detail concerning these variables and their sources is supplied in Blake-Gonzalez et al. (2020).

EMPIRICAL RESULTS

Table 1 presents our semi-logarithmic regression estimates. Note that all the independent variables have been lagged by one year and are labeled *t-1*. The lags reflect the likelihood that delays exist in individuals adjusting to new economic and social realities and our own desire to avoid possible econometric endogeneity problems.

Table 1. Regression Results: The Logarithm of Opioid Death Rates as a Function of Various Socioeconomic Variables

Variable	Coefficient	Standard Error	t-Statistic	Probability
CONSTANT	**0.825001**	**.208973**	**3.95**	**.0001*** **
PCTHLTHIN$_{t-1}$	**0.019012**	**0.00619**	**3.11**	**.0000*** **
MEDHHINC$_{t-1}$	**-.000014**	**.00000152**	**-9.17**	**.0000*** **
UNEMPL$_{t-1}$	**.032349**	**.009319**	**3.47**	**.0006*** **
DISABILITY$_{t-1}$	**.009948**	**.007745**	**1.28**	**.1996**
PRESCRIBE$_{t-1}$	**.002059**	**.0000812**	**25.35**	**.0000*** **
MRKTCONC$_{t-1}$	**-.006087**	**.000981**	**-6.20**	**.0000*** **
HSCOMPPLUS$_{t-1}$	**-.001510**	**.005375**	**-0.28**	**.7789**
MINING$_{t-1}$	**.018085**	**.002653**	**6.82**	**.0000*** **
TRAVELTIME$_{t-1}$	**.043966**	**.004603**	**9.55**	**.0000*** **
JAIL$_{t-1}$	**.014324**	**.003088**	**4.64**	**.0000*** **
WHITE$_{t-1}$	**.001322**	**.000822**	**1.61**	**.1082**
POPDENSITY$_{t-1}$	**-.0000228**	**.00000991**	**-2.30**	**.0218** **

Notes: Dependent variable is the drug overdose death rate per 100,000 population (DEATHRATE) in the jurisdictions. White's (1980) cross section heteroscedasticity correction has been applied. Total observations (n) = 533 from 84 cities and counties. R^2 adj. = .443; F = 22.17 (.0000). ***, **, and * indicate statistical significance at the .01, .05, and .10 levels, respectively, in two-tailed tests.

We discuss the estimates in Table 1 in detail in Blake-Gonzalez et al. (2020). We now undertake a different task --- demonstrating empirically the extent to which these variables influence opioid death rates. In the process, we will see that while the economic misery/deaths of despair hypothesis has some empirical validity, it is far from a complete description of the complexity of the opioid death phenomenon.

Supply-Side Considerations

We begin by exploring the notion that easy access to opioid prescriptions causes higher opioid death rates (as suggested by Nosrati et al. (2019) and Monat et al. (2019)). Table 1 provides firm evidence of this. The average number of opioid prescriptions written per 100 individuals is strongly and positively associated with opioid death rates. As Table 2 reveals, every five additional prescriptions per 100 individuals pushes up the opioid death rate by 1.03 % (*ceteris paribus*).

Some Virginia cities and counties have many physicians and pharmacies within their borders. In such situations, lack of familiarity of physicians and pharmacists with those requesting prescriptions may led to multiple prescriptions being written to the same individual

and abuse. Our regression results suggest this may be true. Markets where a small number of pharmacies fill most of the prescriptions appear to be better able to keep track of opioid users. Table 2 estimates that a 5.0% absolute increase in the market share of the five largest pharmacies in a jurisdiction leads to a 3.05% decrease in the opioid death rate. This is another indication that local conditions matter where opioid abuse is concerned. One size does not fit all.

Demand –Side Considerations

--Economic Despair

We utilize two explanatory variables that address economic distress: median household income and the unemployment rate in each jurisdiction. Lower median household incomes are associated with higher opioid overdose death rates (holding other things constant). Table 2 tells us that a $10,000 increase in median household income will reduce the opioid death rate by 1.40 %. This is evidence in favor of the economic misery/deaths of despair hypothesis, but the impact is quite modest. A $10,000 increase in median household income in Dickenson County in Southwest Virginia's coal country would have translated to a 33.8% increase in that county's median household income in 2017 --- a huge increase. Yet even this substantial injection of income would reduce Dickenson's opioid death rate only from 57.7 to 56.9. This tepid support at best for the narrative being offered by proponents of the economic misery/deaths of despair hypothesis.

The other economic distress variable we examine is the unemployment rate in each jurisdiction. The effect is larger here, but still only of moderate size. A 2.0% absolute increase in the unemployment rate stimulates a 6.47% increase in the opioid overdose death rate (see Table 2). Using Dickenson County once again as our example, in 2017, its average rate of unemployment was 6.7%. Hence, reducing this rate to 4.7% would cause Dickenson's opioid death rate to fall from 57.7 to 54.0.

We summarize our results by observing that the economic misery/deaths of despair hypothesis is valid but perhaps surprisingly unimportant in a quantitative sense as a determinant of opioid overdose death rates are concerned. Other factors must be taken into consideration.

Table 2. How Drug Overdose Death Rates Respond to Change in Selected Variables in 84 Virginia Cities and Counties, 2008-2017

Variable	Magnitude of Change from Median Value	% Change in Drug Overdose Death Rate
$MEDHHINC_{t-1}$	$10,000 Increase in Annual Median Household Income	1.40% decrease
$UNEMPL_{t-1}$	2.0% absolute increase in median unemployment rate	6.47% increase
$PRESCRIBE_{t-1}$	5 additional prescriptions annually above the median	1.03% increase
$MRKTCONC_{t-1}$	5% absolute increase in median market concentration	3.05% decrease
$PCTHLTHIN_{t-1}$	5% absolute increase in adults with health insurance	9.5% increase
$MINING_{t-1}$	5% absolute increase in median workers in mining	9.05% increase
$TRAVELTIME_{t-1}$	5-minute increase in median commuting time	21.95% increase
$JAIL_{t-1}$	5% absolute increase in jail population	7.11% increase
$POPDENSITY_{t-1}$	5% absolute increase in population density	0.66% decrease

--Workplace Risk

Rigorous analyses of the impacts of workplace risk are difficult to undertake because of worker self-selection, inadequate reporting of accidents, and the infrequency of incidents in many occupations. Coal mining, however, is an industry that long has kept track of injuries and deaths that occur because of workplace accidents. Virginia ranks among the top fifteen coal mining states in the country (National Mining Association, 2020) and this is an important reason why coal mining accident data are available for Virginia cities and counties. We estimate that a 5.0% absolute increase in the median number of workers involved in mining in a jurisdiction is associated with a 9.05% increase in opioid death rates (Table 2). In Dickenson County, this implies an increase in the opioid overdose death rate from 57.7 to 66.6 (again, holding other things constant). Mining is dangerous work and results in injuries which in turn may stimulate opioid use and abuse. However, this evidence does not fit into the economic misery/deaths of despair framework unless one takes an additional step and labels involvement in coal mining per se as an indication of despair.

--Transfer Payments and Disability Status

The President's Council of Economic Advisors (2019) concluded that government transfer payments, especially those that support disability status, and insurance coverage for adults provide potential and actual opioid abusers with the funds to develop and support their drug habits. These are controversial claims, and we did not find statistically significant evidence in favor of the hypothesis that disability status stimulates opioid abuse leading to deaths.

However, the Table 1 regression does reveal a statistically significant relationship between the percent of adults under age 65 with health insurance and opioid death rates. The effect, however, is modest. A 5.0% absolute increase in adult health insurance coverage spurs a 9.5 % increase in the opioid death rate (Table 2). In 2018 in Dickenson County, this suggests that an increase in adult health insurance coverage from 89.4% to 94.4% spurs an increase in that county's opioid overdose death rate from 57.7 to 63.2.

--Rural vs. Urban

Rural locations such as Dickenson County often exhibit higher rates of drug abuse (Oppel, 2019). To capture the possible impact of rural vs. urban locations, we employ a population density metric to see if the degree of "rural-ness" remains an important determinant of drug overdose death rates when examined within the context of a multivariate model. Our measure of population density is Population Per Square Mile (POPDENSITY) --- the number of residents per square mile in each jurisdiction and Table 1 reveals that increasing population density has a negative impact upon opioid overdose death rates. A 5.0% increase in population density in Dickenson County, for example, is associated with a 0.66% decline in that county's opioid overdose death rate (Table 2). Practically speaking, this means that approximately an 1,100 person increase in Dickenson County's 2017 population of 14,721 would be required to reduce Dickenson's opioid overdose death rate from 57.7 to 56.7. This suggests that while the rural vs. urban distinction is real, it is not as large in magnitude as some believe.

--The Role of Education

Case and Deaton (2015, 2017, 2020) argue that the lack of formal education leads to drug abuse. Their formal education metric was whether an individual has earned a bachelor's degree or more. Our view is that a more useful measure of formal education (and one more closely linked to the realities of labor markets in non-urban areas) is whether an individual has earned a high school diploma. In many Virginia locales, a college degree is not essential to employment but a high school diploma is because it symbolizes a variety of desired employee characteristics that include the ability to read, perform at least elementary computations, follow directions, and persist. As Table 1 indicates, we do not find a statistically significant relationship between this measure of educational attainment and opioid overdose death rates. Nor, we should add, did we

in separate analyses detect any statistically significant relationship between college degrees and opioid overdose death rates.

--Travel Time to Work

Whether a worker lives in a rural area or an urban center, commuting time to work is a consideration. Long commuting times to places of employment impose financial, temporal, and emotional costs on individuals that discourage labor force participation and reduce the rate of employment. We find support for this supposition in Table 1. In Dickenson County, for example, a 5.0-minute increase in the average commuting time of its workers would result in an increase in its opioid overdose death rate from 57.7 to 70.4 (*ceteris paribus*, as are all the estimates reported here). This is an interesting finding not only because travel time to work has largely been ignored in discussions of drug abuse, but also because it applies both to rural and urban situations.

--Jail and Incarceration

"Lock'em up" is a solution to criminal and social problems that long has been popular in the United States, which has one of the highest incarceration rates in the world. In Virginia, entire political campaigns have focused on candidates' promises to lengthen sentences and eliminate parole. Yet it is not clear that jailing actual or potential drug abusers is an effective social strategy (Nosrati et al, 2019). The regression evidence in Table 1 supports this view. Once again using Dickenson County as our example, we see in Table 2 that a 5.0% absolute increase in that county's jail population generates a 7.11 % increase in its opioid overdose death rate (holding other things constant). By nearly any standard, this is a substantial negative outcome, and one that hinges the adverse effects the jailing of one individual has both upon that individuals and that individual's family and friends. Our findings are consistent with those of other major studies, for example, the Pew Trusts (2018).

--A White Problem?

The assertion of Case and Deaton (2020) that drug abuse in the United States is predominantly a non-Hispanic white phenomenon has been echoed by others (Hansen and Netherland, 2016; Meunnig et al., 2018). Dickenson County, which was 97.9% white in 2017, would seem to provide support for this proposition because its elevated 57.7 per 100,000 people

opioid overdose death rate in 2017 was more than double the Virginia city/county average of only 27.5. On the other hand, the simple correlation coefficient between the opioid overdose death rates of the cities and counties in our sample and the percent of individuals in the same jurisdictions who self-identify white is only .051. We tested a version of this racial proposition by including in our estimating equation an independent variable that is the percent of people 15 years or older in a jurisdiction that self-identifies as a non-Hispanic white. Table 1 reveals that while the sign on the estimated race coefficient was positive, it failed to achieve statistical significance at the .05 level and was not significant at the .10 level either. Thus, when multiple possible explanatory influences are accounted for, there is only modest evidence in favor of the "this is a white problem" hypothesis.

COVID-19, ALCOHOL ABUSE, AND OPIOID OVERDOSE DEATH RATES

How do phenomena such as COVID-19 and alcoholism affect opioid overdose death rates? The answer is, we do not yet know. The data we have used in this study consist of annual observations of cities and counties in Virginia. Fortuitously, the Overdose Detection Mapping Application Program (ODMAP) has been collecting real time opioid incident data from participating law enforcement and health organizations in the District of Columbia, Maryland, Virginia and West Virginia. These data, when made public, will provide an important means for researchers to see if connections exist between opioid overdose death rates and COVID-19.

Meanwhile, alcohol consumption up 14% during a period beginning in late May 2020 and extending into June 2020 (JAMA Network, 2020). Does this mean that alcohol abusers are more likely to become drug abusers? Perhaps, but this connection has yet to be established. However, the National Institute on Alcohol Abuse and Alcoholism (2020) opines that "alcohol has the potential to further complicate the COVID-19 pandemic in multiple ways." Extensive use of alcohol weakens the immune systems of individuals and therefore make it more likely that someone will contract COVID-19 (Livingston, 2020). Will these circumstances translate to opioid abuse? The jury is out.

Simultaneously, COVID-19 also has caused the economy to contract and unemployment rates have spiked upward. Will these adverse circumstances give new life to the economic misery/deaths of despair narrative? Once again, we must wait and see.

It should be possible by Spring 2021 for researchers to see if there are connections between phenomena such as COVID-19, alcoholism, and opioid overdose death rates. It will suffice for us to observe that seldom in American history has it been so essential for reputable researchers to undertake immediate, rigorous, and objective analysis of relevant data.

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