Opioid Prescription Rates and Asset Prices — Assessment of Causal Effects

Introduction

Overdosing on opioids, a class of substances that acts upon opioid receptors to produce morphine-like effects, has become a serious social problem in recent years. We explore the link between county-level opioid prescription rates and asset prices, specifically, stock returns of firms headquartered in that county, as well as real estate prices. In order to establish the causal effects of opioid prescription rates on firm stock returns, we first apply an instrumental variable (IV) regression approach and use the number of clandestine drug laboratories in a county to be the instrumental variable. The results provide robust evidence that county-level opioid prescription rates have a negative causal effect on the equity returns of firms headquartered in that county. Furthermore, we analyze the effect of Medical Board of California’s 2014 regulatory revision aimed at reducing controlled substance overdose due to prescriptions and implement a difference-in-differences (DiD) estimation. The DiD estimation results show that this policy change has a positive dynamic effect on Californian firms’ equity returns. We also find that the opioid prescription restriction assistance program provided by California Health Care Foundation (CHCF) to certain counties in California helps to raise the median prices of existing single-family homes in those counties by $28,078 on average.

Portfolio Analysis

We construct long-short portfolios that long firms’ stocks in the bottom decile of the opioid prescription level while we short firms in the top decile of opioid prescription level. Since we focus on subsequent returns, the ranking of opioid prescription levels should be constructed based on data from previous years. Furthermore, the trend of opioid prescription rates conveys more information than the rates for each year as we can smooth out idiosyncrasies. Therefore, we calculate 3-year backward-moving moving average of opioid rates for the purpose of smoothing time series and reducing noise. The 3-year moving average of opioid prescription rates of county i in year t is constructed as: $$M_{Oi} = \frac{1}{3} \sum_{\tau=t-2}^{t} O_{i,\tau}$$, wherein O represents the opioid prescription rate of a particular county in a given year and MO is the moving average of opioid rates. Each firm is assigned to a ranked decile portfolio, from 1 to 10, which corresponds to its MO in its headquarter location as of last year. Rank 1 corresponds to the opioid prescription level in the lowest decile; whereas Rank 10 corresponds to the highest decile. Figure 1a shows that, the cumulative return of the constructed long-short portfolio is around 96%, from January 2009 to December 2018. The t-statistic of the monthly return difference between the highest ranked portfolio and the lowest ranked portfolio is 2.03, which is statistically significant at 5% level. Figure 1b depicts the cumulative returns on the low-rate portfolio (blue) and high-rate portfolio (red) separately.

IV Regression & DID Estimation

To address any potential endogeneity concern and to rigorously analyze whether opioid prescription rates have causal effects on future returns, we employ IV (of clandestine drug labs in a county) regressions on our sample. Specifically, we run the following two-stage least squares (2SLS) regression:

$$y_{it} = \alpha + \beta_1 O_{i,t} + \beta_2 X_{i,t} + \epsilon_{it}$$

where

$$\tilde{O}_{it} = \delta_0 + \delta_1 t + \delta_2 X_{it} + \nu_{it}$$

Then using the first stage estimates $\hat{\delta}$’s, we run OLS regressions on our sample.

DID for Assistance Program

Using county-level data, we investigate whether county-level opioid prescription rates are linked with the subsequent equity returns of firms headquartered in that county, as well as the real estate price of the county. First, we construct a long-short portfolio that longs firms’ stocks with bottom-decile-level opioid prescription rates and shorts firms’ stocks with top-decile-level opioid prescription rates (based on the previous year’s backward-looking moving average of opioid prescription rates within that county). We find that the difference in returns between the long portfolio and short portfolio is statistically significant. Second, we run the panel regression and Fama-MacBeth regression (results presented in our full paper) of stock returns on opioid rates with additional financial control variables. The results suggest that there is a negative relationship between firms’ returns and opioid prescription rates. Additionally, in order to determine if there is a causal relationship, we apply IV and DID estimation to test whether the causal evidence that opioid prescription rates in a firm’s headquarter county have negative causal effect on firms’ subsequent returns. We also find that opioid prescription reduction assistance provided by California Health Care Foundation (CHCF) to certain counties in California raises the median prices of existing single-family homes in those counties by $28,078 on average.