

## **“The Economics Behind the Epidemic: Afghan Opium Price and Prescription Opioids in the US”**

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The United States are in the middle of the most devastating overdose epidemic since the highest peak of the HIV/AIDS pandemic in 1995. According to the US Centers for Disease Control and Prevention, in 2016 nearly 64,000 people across the country died of drug overdose and at least two-thirds of those deaths were linked to opioids. The current epidemic is particularly striking because most drug abusers, even if they later progress to illicit or illegal opioid use, start taking opioids that are prescribed by their physicians. Since health care professionals have started to treat pain as a serious medical issue a few decades ago, pharmaceutical companies took advantage of this concern. Through extensive marketing campaigns, they persuaded doctors to generously prescribe opioid-based products like OxyContin and Percocet. The marketing campaign of OxyContin, introduced by Purdue Pharma in 1996, has been among the most incisive promotion strategies related to painkillers. Between 1996 and 2002, Purdue Pharma funded more than 20,000 pain-related educational programmes through direct sponsorship or financial grants and launched a multifaceted campaign to encourage long-term use of opioid analgesics for chronic non-cancer pain. As a consequence, the rate at which these drugs were prescribed to patients increased rapidly, despite the strong evidence on the risks of addiction and abuse associated to a prolonged use of opioids.

In previous studies, researchers have found significant evidence for the market-expanding or spillover effects of Direct-to-Consumer advertising (DTCA) on various outcomes such as doctors visits, drug sales, and drug adherence in relation to the medical sector. Here, we investigate the economic incentives behind this unprecedented crisis that has hit the US in the last decades. This paper assesses the extent to which the recent increase of POs in the US follows an economic mechanism rather than a purely medical rationale. We concentrate on different opium-based substances within Schedule II or Schedule III drugs, which are associated to high and moderate risks of abuse, as defined by the US Controlled Substances Act of 1970. We consider hydromorphone, methadone, meperidine, oxycodone, hydrocodone, fentanyl and morphine. We standardise the relative potency of these opiates taking into account the fact that, for instance, fentanyl is seventy five times more dangerous than morphine.

Differently from other studies, we construct a measure of opioids exposure that consists of the interaction between the quarterly price of opium in Afghanistan and the US county-level number of mining sites per capita in 1983. The geographical variability comes from the number of mining sites per capita, which depend on the geo-morphological features of a given county. At the same time, this measure is a good predictor for the demand of analgesics during the period 2000-2016. Most manual occupations in the mining and construction industries, in fact, because of their physical nature, are at risk of chronic pain conditions and are often associated to higher rates of consumption of opioid prescriptions painkillers, which allow a quicker return to the job to patients.

The economic incentive to prescribe opium painkillers derives from the quarterly price of opium in Afghanistan. Opium price appears to be highly volatile and a substantial part of this variation is caused by the occurrence of violent conflicts in Afghanistan. Yet, the fluctuations in the price of opium should, in principle, be completely unrelated to the amount of opioid-based drugs prescribed in the US. A statistically relevant association between the price of opium in Afghanistan and the quantity of POs sold in the US would, instead, uncover the existence of an economic rationale behind the rapid surge in the prescription rates which lies outside of medical necessities.

We explore the motives behind the economic driving forces of the opioid epidemic in the US. We test whether increases in the price of opium predict lower prescription rates of opioid-based drugs in counties with higher exposure to POs. We corroborate our argument by distinguishing the effects of the variation in the price of the raw materials on natural, semi-synthetic (resulting from chemical modifications to natural opiates) and synthetic (chemically manufactured) opioids.

Our results demonstrate a strong and significant negative effect of Afghan opium price on prescription rates with an elasticity equal to 0.6%. Additionally, we provide a number of robustness checks and placebo exercises that supports our main results. Finally, we look at the differential effects across different types of opioids, i.e. natural, semi-synthetic and synthetic. The empirical evidence shows that most of the negative effect is due to the prescription of natural opioids and marginally due to semi-synthetic drugs. When we focus on the synthetic components (methadone excluded), we detect a positive correlation with the price of opium. These additional results clearly support the existence of a substitution effect between natural and synthetic drugs based on the fluctuations in the price of raw opium. Our results underline a precise economic mechanism, according to which the higher the price of the raw material the lower (higher) the amount of natural (synthetic) opioids sold.