

The Role of Opioid Prices in the Evolving Opioid Crisis

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Executive Summary

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The Council of Economic Advisers (CEA) has previously estimated that the annual economic cost of the opioid crisis is substantially higher than previously thought, at over half a trillion dollars in 2015. In order to better understand the spread of the crisis and mitigate its large costs, it is crucial to understand all the factors underlying it. In this report, the CEA describes and analyzes two separate waves of the crisis—the first wave, from 2001 to 2010, which was characterized by growing overdose deaths involving the misuse of prescription opioids; and the second wave, from 2010 to 2016, which was characterized by growing overdose deaths involving illicitly manufactured opioids (heroin and fentanyl). We find that in the first wave, prescription opioid prices fell in conjunction with expanded government health care coverage and a rising market share of generic opioids. In the second wave, supply expansions of illicit opioids reduced their prices.

This report also attempts to quantify the effect of prescription opioid price changes on the number of overdose deaths in the first wave and finds that falling prices may have been an important factor. In the second wave, medical and public health steps implemented to reduce prescription opioid use disorder may have led to increased demand for illicitly manufactured opioids, with supply expansions in the market for illicit opioids potentially exacerbating the rise of overdose deaths involving those opioids.

The first wave of the opioid crisis has previously been attributed to the pharmaceutical industry's marketing efforts, which downplayed the risks of opioid use disorder, and to changes in physicians' prescribing norms, which encouraged the prescription of opioids for pain management. Both of these factors were likely important, although their roles have yet to be quantified. In this analysis, the CEA examines an additional factor that, in the setting of manufacturer overpromotion and changing prescribing norms, may also have played a role: falling out-of-pocket prices for prescription opioids. Out-of-pocket prices for prescription opioids declined by an estimated 81 percent between 2001 and 2010. The falling prices were a consequence of the expansion of government health care coverage, which increased access to all prescription drugs—including opioids. We argue that these falling out-of-pocket prices effectively reduced the price of opioid use not only in the primary market but also in the secondary (black) market for diverted opioids, from which most people who misuse prescription opioids obtain their drugs.

As a calibration exercise, we assume that secondary market prices are proportional to out-of-pocket prices in the primary market, and we apply estimates from the academic literature of how drug use responds to changing prices. Under the proportional price assumption and given the elasticities from the academic literature, the decline in observed out-of-pocket prices is

capable of explaining between 31 and 83 percent of the growth from 2001 to 2010 in the death rate involving prescription opioids. However, falling out-of-pocket prices could not have led to a major rise in opioid misuse and overdose deaths without the increased availability of prescription opioids resulting from changes in pain-management practice guidelines that encouraged liberalized dispensing practices by doctors, illicit “pill mills,” increased marketing and promotion efforts from industry, and inadequate monitoring or control against drug diversion. We note that the decline in out-of-pocket prices for prescription opioids was associated with generic market entry and rising government subsidization, especially as rolls in the Social Security Disability Insurance program grew starting in the 1990s, and Medicare Part D prescription drug coverage was implemented in 2006. This analysis does not attempt to identify any causation, but it is notable that the share of prescription opioids provided for beneficiaries in government programs grew from 17 percent to 60 percent of all opioid prescriptions and accounted for three-fourths of the growth in prescribed opioids between 2001 and 2010. During the height of the prescription opioid overdose epidemic, we find that without health insurance, the out-of-pocket cost of maintaining an addiction to a commonly misused brand-name opioid—OxyContin—could have been prohibitively expensive for the average American. These findings associating increased opioid misuse with the growth of public programs do not imply that these programs lack social value but rather the importance of safeguards to ensure appropriate prescribing, opioid use, and measures to reduce any impact on opioid use disorders. The majority of patients prescribed opioids use them appropriately and do not contribute to opioid misuse directly or indirectly. One of the challenges of addressing the opioid crisis is balancing the goal of subsidizing opioids when they are prescribed for appropriate use with the need to discourage overprescription and misuse.

The CEA finds that the second wave of the opioid crisis starting in 2010—characterized by rising illicit opioid overdose deaths from heroin and fentanyl—was likely a result of efforts to limit the supply of prescription opioids. The efforts increased demand for illicit opioids, and perhaps more importantly, led to an expanded supply of illicit opioids. Initially, efforts aimed at reducing prescription opioid misuse, including reformulation of extended-release OxyContin to make it more difficult to abuse, successfully reduced prescription opioid-involved overdose deaths. But the reduction in prescription opioid misuse had the unintended consequence of raising demand for cheaper, more readily available substitutes in the illicit market and thus opened a market opportunity for illicit drug suppliers to fill. Efforts to stem the first wave of the crisis led the now-enlarged pool of people with opioid misuse disorder to shift from prescription to illicitly produced opioids. An expansion in foreign-sourced supply was also important for the growth of illicitly manufactured opioids, as evidenced by falling quality-adjusted prices, largely due to expanded heroin trafficking from Mexico and relatively inexpensive synthetic opioids from both Mexico and China (i.e., fentanyl) that are many times more potent than heroin.

While government programs increased access to all prescription drugs, greater emphasis on pain management—resulting in changes to prescribing guidelines, aggressive marketing by

opioid manufacturers, poor controls against diversion from legitimate uses, and the expansion of “pill mills”—was also instrumental in increasing opioid utilization. Indeed, absent these factors, consumers could not have responded to lower out-of-pocket prices by increasing their own nonmedical use or by expanding supply to the secondary market. In this sense, a laxer environment for obtaining prescription opioids was a necessary precondition for falling prices to play a significant role in the opioid crisis. In addition, it is important to emphasize that the falling price of the medical use of prescription opioids benefited patients as they could access needed drugs at lower out-of-pocket cost. By contrast, the falling price of the nonmedical use of prescription opioids, enabled by a lax prescribing environment in conjunction with lower out-of-pocket prices, may have played an important role in fueling the opioid crisis.

The Trump Administration has taken swift action to address the opioid crisis. It has limited high-dose opioid prescriptions, promoted better information about the risks of opioid misuse, undertaken measures to cut the supply of illicit drugs including fentanyl, and invested in treatment and life-saving drugs for those currently suffering from substance use disorder. There are signs that these measures may be paying off. After an increasing trend in the number of opioid overdose deaths, preliminary estimates show the growth in deaths involving opioids stopped rising in 2017.

Introduction

America is in the middle of an opioid crisis that is dramatic in its proportions compared with other health crises. In 2017, the number of people who died of an opioid-involved drug overdose (47,600) exceeded the number of deaths from the HIV pandemic at its peak in 1995 (CDC 2019).¹ Since 2000, the United States has lost as much of its population to the opioid crisis as it lost to World War II—both costing just over 400,000 fatalities (DeBruyne 2017). The staggering opioid overdose death toll has pushed drug overdoses to the top of the list of leading causes of death for Americans under the age of 50 years, and has cut 2.5 months from U.S. life expectancy (Dowell et al. 2017).

As a measure of this crisis, the CEA has previously assessed its full economic cost. In 2015 alone, the CEA estimated that the total cost of the opioid epidemic was \$504 billion, several times larger than previous cost estimates (CEA 2017). The CEA’s approach constituted a more complete assessment of the costs because it incorporated the full cost of increased morbidity and mortality from the crisis. We also adjusted opioid-involved deaths—which had been underreported—upward and incorporated nonfatal costs. The annual number of reported opioid-involved overdose deaths increased from 33,091 in 2015 to 47,600 in 2017, a 44 percent increase. Although the provisional data on overdose deaths in 2018 show encouraging signs (see box 1), the current costs of the opioid epidemic are likely higher than the CEA’s estimate for 2015.

In order to mitigate the large costs imposed by the opioid crisis through appropriate policy measures, it is crucial to understand the forces driving it. We separate our analysis into two sections: The first one analyzes the first wave of the epidemic, lasting through 2010, which was characterized by growth in prescription opioid-involved overdose deaths; and the second analyzes the period since 2010, which has been characterized by growth in illicit opioid-involved overdose deaths.²

During the first wave between 2001 and 2010, the annual population-based rate of overdose deaths involving prescription opioids increased by 182 percent. Throughout this period, opioid manufacturers aggressively promoted the safety and effectiveness of opioids, and guidelines

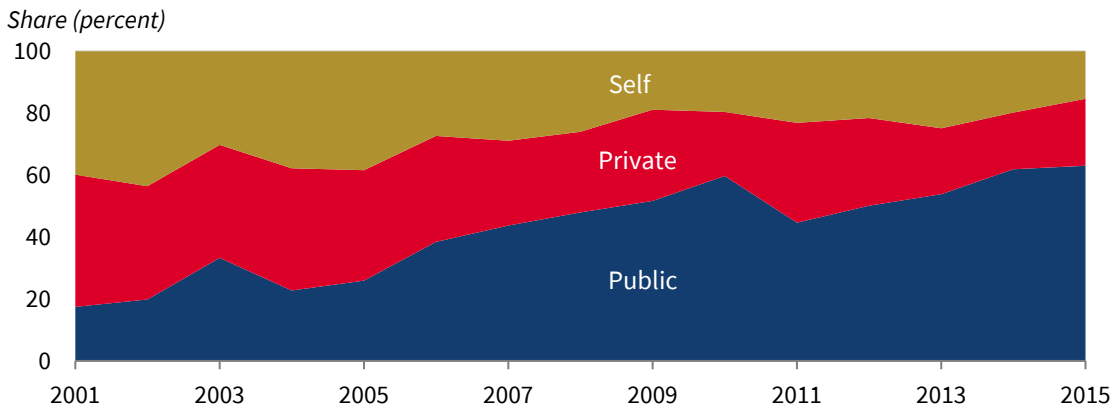
¹ We identify overdose deaths throughout the report using ICD–10 underlying cause-of-death codes: X40–X44, X60–X64, X85, and Y10–Y14. Deaths involving opioids are identified using ICD–10 multiple cause-of-death codes: T40.0–T40.4 and T40.6.

² We use “illicit opioids” throughout the report to refer to illicitly produced opioids such as heroin and fentanyl, which excludes the misuse of prescription opioids such as OxyContin. It is important to note that data on overdose deaths do not distinguish between illicitly manufactured synthetic opioids, such as illicitly manufactured fentanyl, and synthetic prescription opioids, such as prescription fentanyl. This analysis includes this broader category of synthetic opioids other than methadone in the illicit opioid category, given that illicitly manufactured fentanyl is commonly believed to have dominated this category in recent years, and that the category was much less important in the earlier years of the crisis.

for the treatment of pain were liberalized to encourage physicians to prescribe more opioids. Over the same period, we estimate that the out-of-pocket price of prescription opioids fell by 81 percent (see also Zhou, Florence, and Dowell 2016). We argue that the falling out-of-pocket price translated not only into a lower price of misuse for those who obtain prescriptions in the primary market, but also for the majority of misusers who obtain prescription opioids from the secondary (black) market.

The decline in out-of-pocket prices between 2001 and 2010 occurred in conjunction with a rising share of generic opioids in the market as well as increased public subsidies. Though we do not attempt to apportion their respective roles, these two factors may have contributed significantly to the out-of-pocket price decline. With regard to a rising generic share in the prescription opioid market, we note that supply prices paid to pharmacies fell by 45 percent between 2001 and 2010, fueled by an increase in the cheaper generic opioid share from 53 percent to 81 percent.

Figure 1. Share of Potency-Adjusted Prescription Opioids, by Primary Payer, 2001–15



Sources: Medical Expenditure Panel Survey; National Drug Code database; CEA calculations.

Note: The primary payer is defined as the third-party payer with the highest payment for a given prescription. In addition to Medicare, Medicaid, and private insurers, the other possible primary payers include veterans benefits, workers compensation, other Federal government insurance, other State or local government insurance, or other public insurance. All prescriptions are converted into morphine gram equivalents based on the quantity of pills prescribed and their potency using the National Drug Code database.

In addition, we document a large increase in the share of prescription opioids funded by public programs. As shown in figure 1, the share of prescribed opioids purchased with public subsidies increased from 17 percent in 2001 to 60 percent in 2010, rising further to 63 percent in 2015. Public programs accounted for three-fourths of the growth in total prescription opioids between 2001 and 2010 (data from the Medical Expenditure Panel Survey, MEPS). The introduction of the Medicare Part D prescription drug benefit in January 2006 coincided with a growing share of prescriptions reimbursed by the program, including opioid prescriptions. Also, Social Security Disability Insurance (SSDI) enrollment has rapidly increased since the 1990s (see figure 13 below). More than half of SSDI recipients received drug coverage before

the 2006 start of Medicare Part D through Medicaid and other programs (Briesacher et al. 2002; HHS 2011). After 2006, SSDI recipients, along with the general Medicare population, were for the most part eligible for prescription drug coverage through Medicare Part D.

Expansions in insurance coverage that reduce out-of-pocket prices can make misused prescription opioids more affordable, consumed either by the patients for whom they are prescribed or when supplied via the secondary market. Before generics were as widely available, it was very costly for the average American to afford maintaining an opioid use disorder, if not subsidized through insurance. In 2007, Americans could buy 1 gram of OxyContin—one of the most common brand name opiates prescribed—for an average of \$144 without health insurance. Some individuals on opioids may require up to a gram or more per day of OxyContin for pain relief (Schneider, Anderson, and Tennant 2009). Without insurance, someone with an opioid use disorder consuming between 0.5 grams and 1 gram of OxyContin every day for a year would have to spend between \$26,280 and \$52,560 in 2007—which could be more than the median household income of about \$50,000 in 2007 (in 2007 dollars) (Fontenot, Semega, and Kollar 2018).³ To put this in perspective, a person on Medicare would only pay \$9.78 per gram, or between \$1,785 and \$3,570 per year (in 2007 dollars), to fund an opioid addiction in the same year.

Given the role the government played in subsidizing the purchase of prescription opioids through the expansion of health insurance, we examine the possible roles of specific public programs. We find that the number of potency-adjusted opioids per capita subsidized by Medicare increased by 2,400 percent between 2001 and 2010, the largest increase among all third-party payers. SSDI rolls also expanded over this period. We estimate that SSDI recipients, who are generally eligible for Medicare (including prescription coverage in Part D starting in 2006), were prescribed a disproportionate share of 26 to 30 percent of total potency-adjusted opioids in 2011 across all payer types (while representing under 3 percent of the U.S. population). Of course, any role of SSDI expansion in the opioid crisis would be attributable to the design of the program rather than program recipients. SSDI recipients generally have debilitating conditions that prevent work, conditions that are often associated with high levels of pain. These conditions are the primary reason SSDI recipients are prescribed a disproportionate share of opioids; indeed, SSDI benefits in conjunction with Medicare coverage provide vital protection for these disabled workers. The majority of SSDI recipients prescribed opioids use them appropriately and do not contribute to opioid misuse directly or indirectly. Any role of SSDI expansion in the opioid crisis likely was a result of insufficient

³ Due to heightened risk to patients, the CDC recommends that physicians avoid prescriptions at or above 90 morphine milligram equivalents per day, equivalent to 60 milligrams of oxycodone or 0.06 grams, or carefully justify a decision to titrate dosage to 90 or more milligram equivalents per day (CDC n.d.). Schneider, Anderson, and Tennant (2009) observe that some chronic pain patients require doses that may range from 1,000 to 2,000 or more milligram equivalents per day. These doses would be equivalent to 667 to 1,333 milligrams (0.7 to 1.3 grams) of oxycodone per day.

protections against nonmedical use of prescription opioids, not the vital income and medical coverage that the SSDI program and Medicare provide to disabled workers.

As a calibration exercise, we take published estimates of the price elasticity of prescription-opioid sales to estimate the contribution of an 81 percent price decline to the increase in sales. This exercise suggests that, without the price decline, per capita opioid sales would have increased, by half as much, or less, than the actual increase between 2001 and 2010. In order to estimate the contribution of the price decline to the increase in the number of deaths involving prescription opioids, we assume that (1) secondary market prices are proportional to out-of-pocket prices in the primary market, and (2) the price elasticity of opioid use ranges from the elasticity of prescriptions at the low end to the own-price elasticity of heroin use at the high end. This second calibration exercise suggests that the observed decline in out-of-pocket prices for prescription opioids, which makes physician prescriptions more affordable for beneficiaries to fill, contributes to between 31 and 83 percent of the increase in overdose deaths involving prescription opioids between 2001 and 2010.

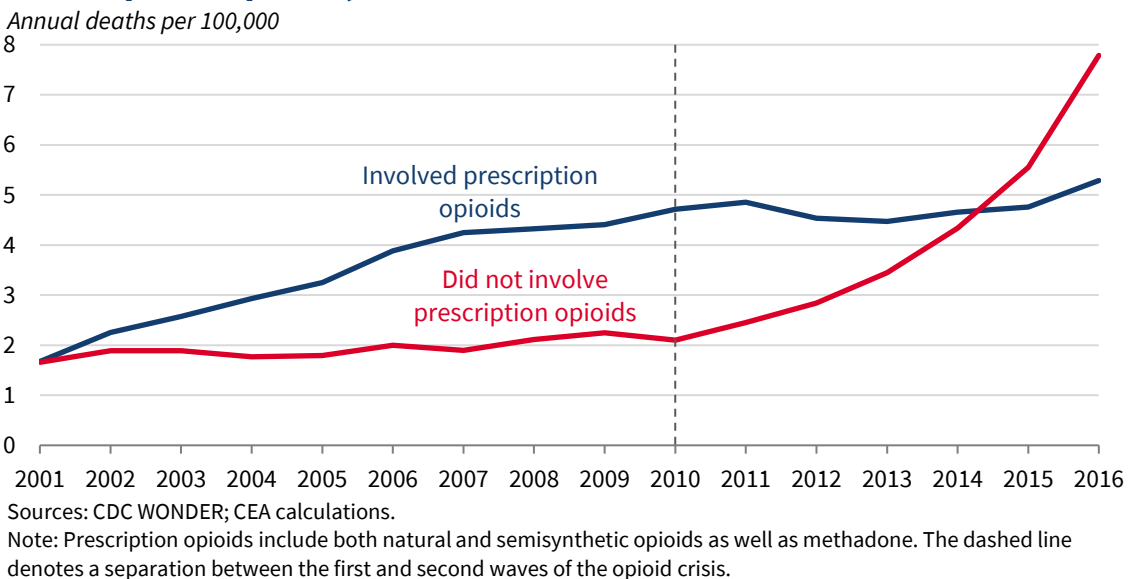
However, falling out-of-pocket prices could not have led to a major rise in opioid misuse and deaths without the increased availability of prescription opioids resulting from changes in pain management practice guidelines that encouraged liberalized dispensing practices by doctors, illicit “pill mills,” increased marketing and promotion efforts from industry, and inadequate monitoring or control against diversion. Without these factors, patients would have been unable to respond to lower prices by obtaining prescription opioids and diverting them to the secondary market. In other words, the change in the environment for obtaining prescription opioids was a precondition for the effect of falling out-of-pocket prices on opioid misuse. In addition, it is important to emphasize that the falling price of the *medical* use of opioids—due to expanded insurance coverage and generic entry—benefited patients because they could access needed drugs at a lower out-of-pocket cost. By contrast, the falling price of the *nonmedical* use of opioids, enabled by a lax prescribing environment in conjunction with lower out-of-pocket prices, may have played an important role in fueling the opioid crisis.

More generally, these findings of increased opioid misuse associated with the growth of public programs do not imply that these programs lack social value but rather the importance of safeguards to ensure appropriate prescribing, opioid use, and measures to reduce any impact on opioid misuse.⁴ Government policy for other addictive products, such as cigarettes, deliberately discourages consumption by raising prices through sales taxes and placing restrictions on purchase and sales; most analysts agree that such policies successfully reduced cigarette use and made new addiction cases less likely (HHS 2014). Unlike cigarettes, which are not safe or beneficial for anyone in any quantity, opioids have legitimate medical uses. The challenge of prescription opioids is balancing the goal of subsidizing opioids when they are prescribed for appropriate use with the need to discourage overprescription and misuse.

⁴ See HHS (2016) for further discussion.

Next, we analyze the second wave of the opioid epidemic, which was characterized by the growth in illicit opioid-involved overdose deaths between 2010 and 2016. In this case, demand-side expansions due to efforts to curtail prescription opioid use disorder along with supply-side expansions appear to have been important. Most notably on the demand side, an abuse-deterrent formulation of the widely abused prescription opioid OxyContin was released in 2010, and the original formulation was removed from the market. Research has found that although the reformulation stemmed the rise of overdose deaths involving prescription opioids, it led opioid misusers to substitute toward cheaper, more available heroin, resulting in increased heroin-involved deaths (Alpert, Powell, and Pacula 2018; Evans, Lieber, and Power 2019). Thus, the buildup of a pool of people with addictions to prescription opioids during the first wave ultimately facilitated the increase in demand for illicit opioids in the second wave. This large pool of new demand created additional profit opportunities for illegal sellers entering the market. Supply increased as Mexican heroin traffickers increased shipments to the United States in response to shrinking markets for cocaine, and other foreign manufacturers (especially in China) introduced cheaper and more potent synthetic opioids like fentanyl. Figure 2 illustrates how overdose deaths involving prescription opioids leveled off after 2010, while other opioid deaths (those only involving illicit opioids and possibly nonopioid drugs) escalated rapidly.

Figure 2. Opioid-Involved Overdose Death Rate by Presence of Prescription Opioids, 2001–16



In an attempt to assess the relative importance of demand and supply expansions in driving the second wave of the opioid crisis, we estimate the price of illicit opioids over time. Though subject to a number of highly imperfect assumptions, we find that the price of illicit opioids was roughly constant between 2010 and 2013, before falling by about half by 2016, due to the increased supply of illicit fentanyl (figure 14 below) starting in about 2013 (increasingly

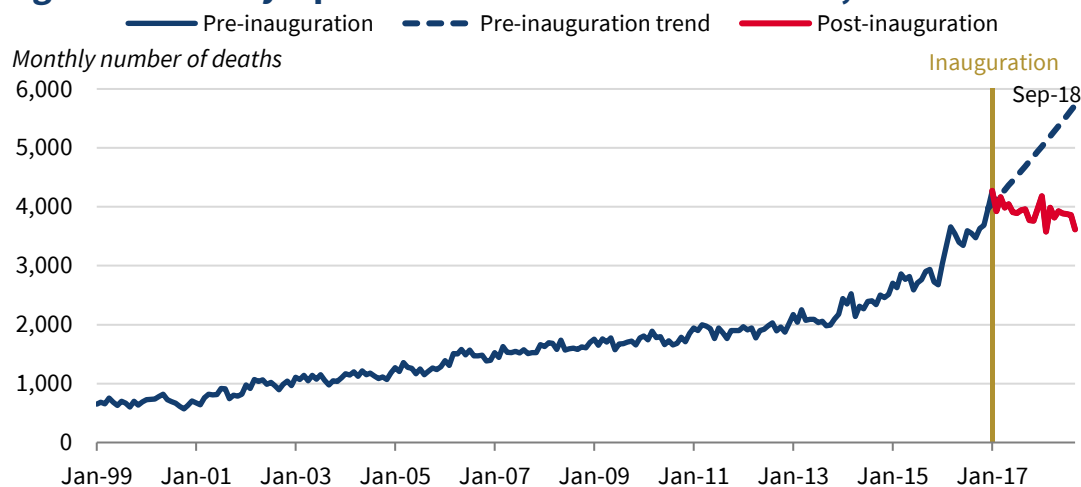
available via shipment from China and from other foreign sources). Given the extreme potency and low cost of fentanyl, it dramatically reduced the “cost of a high” for users. It is notable that even though demand for illicit opioids increased beginning in 2010, the price of illicit opioids remained constant until about 2013, implying that in these first years of the illicit wave, the heroin supply must have also expanded to keep prices steady; if supply had remained constant, prices would have risen. Falling prices between 2013 and 2016 imply that supply expansions of illicit opioids were more important in these later years.

Due to constraints on data availability for prices of both prescription and illicit opioids, this report focuses on the period ending in 2016. However, official mortality data are available for 2017 and provisional data are available for part of 2018. Box 1 describes how overdose deaths involving opioids peaked in January 2017, before growth then stopped and reversed. It also describes policies undertaken by the Trump Administration that may have contributed to this trend.

Box 1. The Slowing of the Opioid Epidemic under the Trump Administration

When President Trump took office in January 2017, monthly overdose deaths involving opioids had reached an all-time recorded high, a 21 percent increase from the average number of monthly deaths in 2016. The total number of opioid deaths grew again in 2017 (47,600) compared to the previous year (42,249 in 2016). Fortunately, the growth in opioid deaths may have finally begun to reverse. The rising overdose death toll through September 2018, the latest month for which provisional data is available, has flattened compared to previous trends (see figure i). The opioid epidemic remains at crisis levels, but the dramatic growth of the epidemic seems to be slowing down.

Figure i. Monthly Opioid-Involved Overdose Deaths, 1999–2018



Sources: Centers for Disease Control and Prevention; Ahmad et al. (2019); CEA calculations.

Note: Data from before January 2018 are compiled from the CDC WONDER database, and monthly data beginning in January 2018 are calculated using the provisional reported number of deaths from the CDC which is available through September 2018 as of April 25th, 2019. Pre-inauguration trend is calculated for the compound annual growth rate on a sample period from January 1999 through January 2017, with forecasted levels reconstructed from projected rates.

The Trump Administration has prioritized addressing the opioid crisis. In October 2017, President Trump declared a national Public Health Emergency to invest more resources to combat opioid use disorder. President Trump later established his Initiative to Stop Opioid Abuse and Reduce Drug Supply and Demand in March 2018 (White House 2018). These and other measures taken by the government aim to address the opioid crisis by reducing the supply of opioids, reducing new demand for opioids, and treating those with current opioid addictions.

To restrict the supply of illicitly produced opioids, increased efforts are being made to prevent the flow of illicit drugs into the U.S. through ports of entry and international shipments. The President also signed into law the International Narcotics Trafficking Emergency Response by Detecting Incoming Contraband with Technology (INTERDICT) Act, which funds U.S. Customs and Border Protection (CBP) to expand on technologies to help interdict illicit substances including opioids. These efforts have seen success—during fiscal year 2018, CBP seized 1,976 pounds of fentanyl and 5,770 pounds of heroin (CBP 2018). The administration has also increased enforcement against illicit drug producers and traffickers. In 2018, the Department of Justice (DOJ) indicted two Chinese nationals accused of manufacturing and shipping fentanyl analogues, synthetic opioids, and 250 other drugs to at least 37 U.S. States and 25 other countries (DOJ 2018).

Alongside reducing the supply of opioids, Federal and State governments are also playing a key role in curtailing the demand for prescription and illicit opioids. Prescription drug monitoring programs that track controlled substance prescriptions are operational in all 50 States, and they can provide timely information about prescribing and patient behaviors that contribute to the crisis and enable response (CRS 2018). In 2017, the number of high-dose opioid prescriptions dispensed monthly declined by over 16 percent, and the prescribing rate of opioids fell to its lowest rate in over 10 years. In addition to reducing opioid prescriptions to decrease the demand for opioids, the Administration has launched information campaigns to create awareness and inform the public about opioid use disorder to prevent drug abuse among new users. In June 2018, the White House’s Office of National Drug Control Policy, the Ad Council, and the Truth Initiative announced a public education campaign over digital platforms, social media, and television targeting youth and young adults.

Finally, the Administration is also focusing on treating and saving the lives of those currently struggling with opioid addictions by expanding access to the life-saving drug naloxone and other evidence-based treatments, such as addiction recovery services. In October 2018, President Trump signed into law the bipartisan Substance Use Disorder Prevention That Promotes Opioid Recovery and Treatment (SUPPORT) for Patients and Communities Act, which includes provisions improving substance use disorder treatments for Medicaid patients and expanding Medicare coverage of opioid use disorder treatment services. Additionally, in FY 2018, \$1.5 billion was appropriated for States to fund opioid addiction prevention and treatment. Many States—including West Virginia, Indiana, Wyoming, Tennessee, Florida, and Virginia—have implemented legislation to expand the availability of naloxone, and inpatient and outpatient use of the life-saving treatment is increasing (ASTHO 2018).

Many of the measures taken by the Trump Administration to cut the supply of opioids, prevent new demand, and save the lives of those currently struggling with opioid use disorders may have contributed to the reversal of overdose deaths involving opioids. It is important for future research to

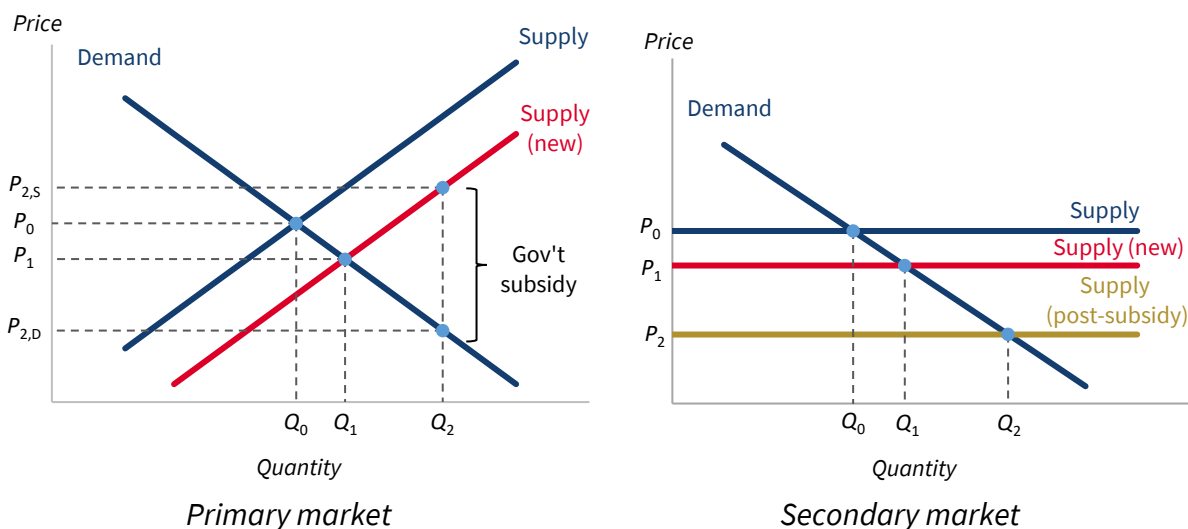
attempt to identify which policy levers have been most effective so that it can expand these evidence-based policies and save more lives.

The rest of the report proceeds as follows: The first section presents our basic methodology in assessing how demand, supply, and government policies can affect quantities and prices of opioids. The next section analyzes the first wave of the epidemic based on prescription opioids, and the following section analyzes the substantial growth in public subsidies for opioids that took place during this period. The last section turns to the second wave, which spawned the rise of illicit opioids.

The Supply-and-Demand Framework

While we cannot quantify the extent to which government subsidized drugs are diverted and resold for non-medical use, a simple supply-and-demand framework can provide powerful insights into how changing prices and quantities reflect the underlying forces driving the opioid crisis. Figure 3 considers the case of prescription opioids, showing how market dynamics and government subsidies in the primary market ultimately affect market prices and quantities in the secondary market. First, a supply expansion (e.g., due to generic entry) in the primary market for patients obtaining opioids via prescription reduces the price of prescription opioids (from P_0 to P_1) and increases the quantity prescribed (from Q_0 to Q_1), assuming of course that prescribers are willing to provide additional pills to patients as their demand rises. This expansion has the effect of reducing the price of prescription opioids in the secondary market as individuals purchasing prescription opioids in the primary market now face a lower acquisition cost if pills are diverted to family members, friends, and/or others. On top of a supply expansion, the introduction of a government subsidy for prescription opioids in the primary market drives a wedge between the price consumers pay (the demand price, $P_{2,D}$) and the price prescription drug suppliers receive (the supply price, $P_{2,S}$), with the difference made up by the amount of the subsidy. The demand price is lower than the price paid by patients before the introduction of the subsidy (P_1), which further reduces the price of prescription opioids in the secondary market. Thus, both supply expansions and government subsidies in the primary market for prescription opioids decrease the price and increase the quantity of opioid misuse in the secondary market, especially in an environment where there is overprescribing. As noted above, however, whether secondary market prices can actually respond to changes in the primary market depends on an environment in which obtaining prescriptions is relatively easy.

Figure 3. Effect of Supply Expansions and Government Subsidies on the Price and Quantity of Prescription Opioid Misuse



Note: The left panel illustrates the primary market for prescription opioids, i.e., those who obtain drugs via prescription from their physician. At the initial equilibrium, patients pay the price P_0 and the market quantity is Q_0 . An expansion of supply (potentially due to generic entry or other market forces) reduces the equilibrium price and increases the equilibrium quantity. On top of that, a government subsidy for prescription opioids drives a wedge between what the patient pays (the demand price) and what the drug supplier receives (the supply price). Ultimately, both the supply expansion and government subsidy reduce the price patients pay and increase the quantity of opioids prescribed. The right panel illustrates the corresponding impact on the secondary market for prescription opioids—for those who obtain the drugs from family, friends, or others for misuse. The supply expansion reduces price and increases the quantity of misuse, and the government subsidy magnifies these effects further. We assume that the demand price in the primary market determines the price in the secondary market, because lower acquisition costs reduce the cost of supplying prescription opioids on the secondary market. Also, because only a minority of pills are diverted, we assume the supply of prescription opioids to the secondary market is perfectly elastic.

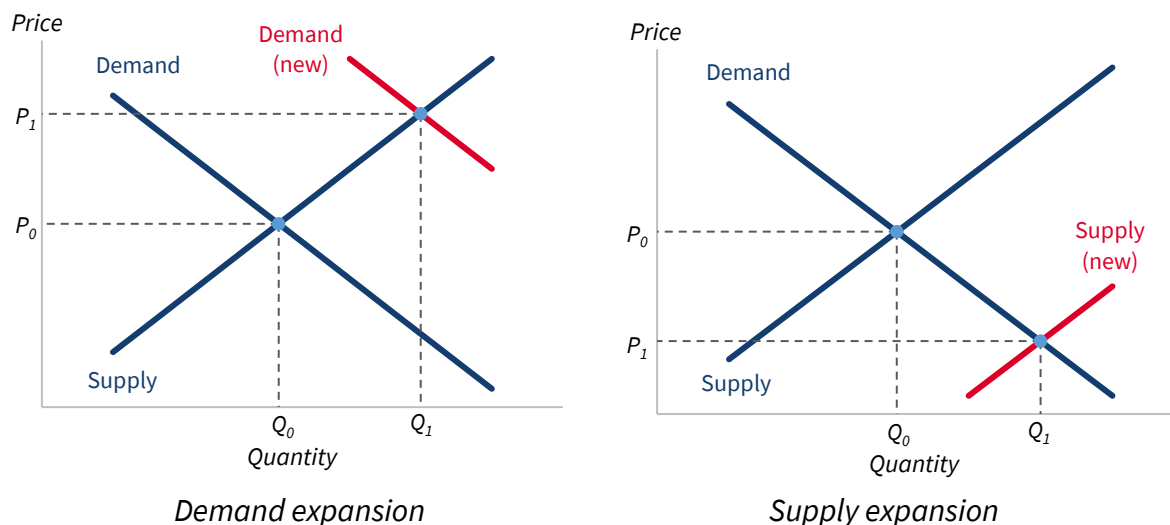
Figure 4 considers the case of illicit opioids (i.e., heroin and illicitly manufactured fentanyl), for which a legal market does not exist. Because the quantity of illicit opioid use increased substantially between 2010 and 2016, it stands to reason that demand or supply expanded, or both did. However, whether it was demand or supply that drove the increase in illicit opioid misuse has a testable implication. If demand expansions dominate, then the price of illicit opioids must rise, whereas if supply expansions dominate, then the price must fall.⁵ In fact, we find that illicit opioid prices were relatively stable between 2010 and 2013, suggesting that both demand—itsself fueled in part by efforts to curtail the prescription opioid wave of the epidemic—and supply expansions were important during this period. Then, between 2013 and 2016, the price of illicit opioids fell markedly with the influx of illicitly manufactured fentanyl, suggesting that supply expansions were most important during this later period.

Our findings suggest that subsidies and supply expansions in combination with changes in prescribing behavior can account for much of the rise in opioid overdose deaths. Some have argued that demand-side factors, such as economic stagnation in past years, was an important

⁵ The relative price elasticities of demand and supply also affect which expansion dominates.

driver of increasing mortality from drug use and other causes (Stiglitz 2015). However, there is direct evidence that demand growth due to worsening economic conditions was not the primary factor driving the growth of the opioid epidemic.

Figure 4. Effect of Demand and Supply Expansions on the Quantity and Price of Illicit Opioids



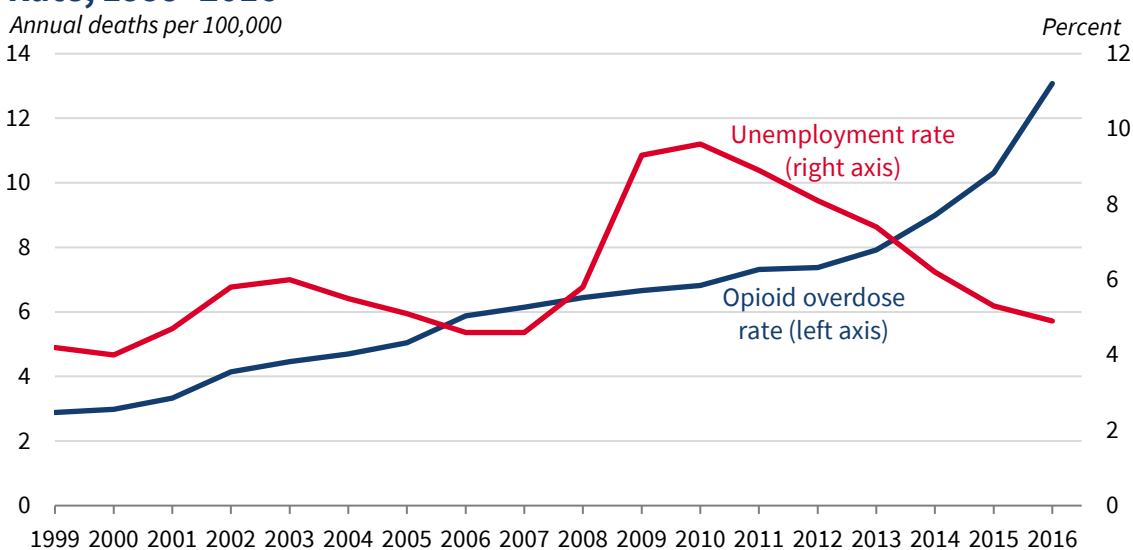
Note: The left panel shows the impact of demand shifting outward while the supply curve remains in place; in this case, the price must rise. The right panel shows the impact of supply shifting outward while the demand curve remains in place; in this case, the price must fall. Note that if the price falls while quantity increases, then supply must have expanded.

First, the hypothesis that lower incomes raise demand does not explain the aggregate time series within the United States. If worse economic conditions increase demand, then one would expect that the Great Recession would have fueled a substantial increase in opioid-involved overdose fatalities. However, figure 5 suggests that the growth rate of opioid-involved overdose deaths was unaffected by the Great Recession. The epidemic grew at roughly the same pace straight through one of the greatest recessions experienced in the last century, and in fact picked up growth well after the recession ended. More important, two of the four lowest growth rates in opioid deaths occurred between 2008 and 2010, in the midst of the Great Recession. It was not until 2014, 2015, and 2016 that growth rates again rose significantly—but that was in a period of lower unemployment, the opposite prediction of demand growth of opioids being fueled by lower incomes unless effects are lagged by several years.

Despite this lack of association between aggregate economic conditions and opioid deaths, Hollingsworth, Ruhm, and Simon (2017) do report a positive association between county-level unemployment and opioid-involved overdose deaths—a 1-percentage-point increase in a county’s unemployment rate is associated with a 0.19-person increase in the rate of opioid-involved overdose deaths per 100,000. However, this association does not appear quantitatively large enough to be a primary driver of the massive growth in opioid deaths. It

would take a 54-percentage-point increase in the unemployment rate between 1999 and 2016 to explain the 10.2-person increase in the rate of opioid-involved overdose deaths during this period. However, the unemployment rate increased by a net 0.7 percentage point (from 4.2 to 4.9 percent) between 1999 and 2016.

Figure 5. Opioid-Involved Overdose Death and Unemployment Rate, 1999–2016



Sources: CDC WONDER; Bureau of Labor Statistics; CEA calculations.

In addition, Ruhm (2019) formally tests whether a number of demand-side factors that reflect changing economic conditions can explain the growing epidemic during this period. He finds that very little of the rise in opioid overdose deaths during this period can be explained by economic conditions. Instead, he points to changes in the drug environment, reflective of supply conditions, as being central. Consistent with Ruhm’s findings, Currie, Yin, and Schnell (2018) find no clear evidence of a substantial overall effect of the employment-to-population ratio on the amount of opioids prescribed in a county.

The First Wave of the Epidemic: Prescription Opioids

The opioid crisis unfolded in two waves. The first wave, beginning around 2001 and lasting until about 2010, was characterized by rising misuse of prescription opioids.⁶ The second wave began around 2010, when prescription opioids were made more difficult to abuse and illicit opioids including heroin and, more recently, illicitly manufactured fentanyl, grew in the

⁶ We focus on the 2001–10 period throughout the report, due to the unavailability of consistent overdose data before 1999, the unavailability of illicit drug seizure data before 2001 used for estimating the illicit opioid price series, and the substantial volatility in the out-of-pocket price series before 2001.

market. This and the next sections focus on the first wave, and the following section focuses on the second wave.

Between 2001 and 2010, the rate of overdose deaths involving prescription opioids (which we define as natural and semisynthetic opioids and methadone) increased by 182 percent, while other opioid-involved deaths grew much more slowly (figure 2 above).⁷ In order to analyze the potential roles of expanded supply of prescription opioids, especially as a result of the pharmaceutical industry’s marketing efforts and changes in physicians’ prescribing norms, we first estimate the out-of-pocket price of prescription opioids. We then conduct a calibration exercise in which we assume that secondary market prices for prescription opioids are proportional to out-of-pocket prices, and that prescription opioid misusers respond to these prices of misuse in the same way that heroin users respond to heroin prices. We also assume that prescription opioid deaths are proportional to prescription opioid misuse. If falling prices suggest a large quantity response relative to the magnitude of the observed increase in prescription opioid-involved overdose deaths, then this would suggest that these price declines, when combined with other factors, may have played a role in the first wave of the opioid crisis.

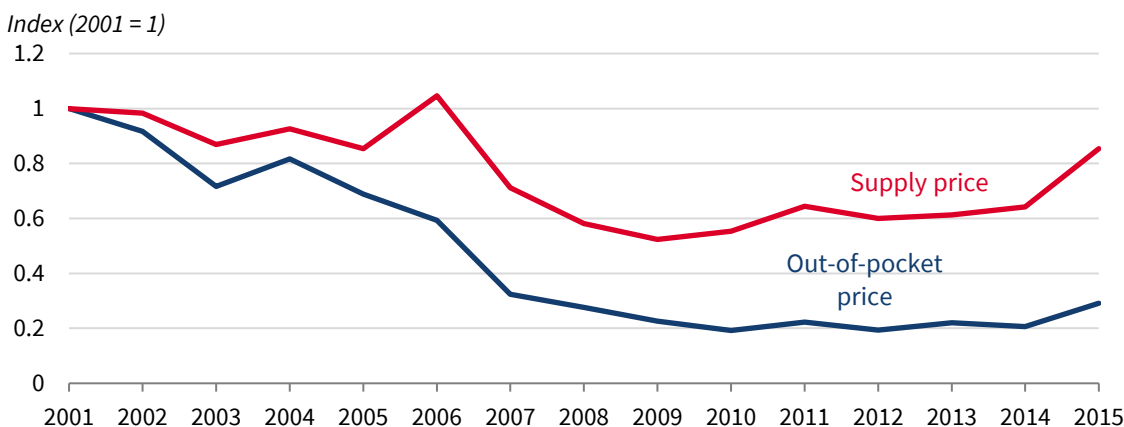
An environment in which opioid prescriptions were easier to obtain and fill is a necessary precondition for falling out-of-pocket prices to have played a substantial role—otherwise, it is unlikely that secondary market prices could have responded to falling out-of-pocket prices. This environment was created by a campaign to persuade doctors that pain was being undertreated and that opioids were the solution. Patient advocacy groups and professional medical societies urged physicians to treat pain more aggressively (Max et al. 1995). Pain was labeled “the 5th Vital Sign,” which should be regularly assessed and treated (VA 2000). Starting in 2001, the Joint Commission, an accrediting body for hospitals and other health facilities, instituted new standards requiring facilities to establish procedures to assess the existence and intensity of pain and to treat it with “effective pain medicines.” At the same time, multiple medical societies promoted opioids as a safe and effective treatment for chronic, noncancer pain (DuPont, Bezaitis, and Ross 2015). This coincided with aggressive marketing efforts by opioid manufacturers starting in the late 1990s to assure physicians that their products were safe with little abuse potential (Van Zee 2009; President’s Commission 2017). This report does not provide a comprehensive review of either the change in medical guidance regarding the appropriate use of opioids or the marketing and promotion efforts by opioid manufacturers.

We use the Medical Expenditure Panel Survey (MEPS) to construct a time series of the out-of-pocket price per potency-adjusted unit of prescription opioids. The MEPS asks respondents to

⁷ Some opioid-involved deaths include both prescription and other opioids. Figure 2 distinguishes between opioid-involved overdose deaths with prescription opioids present versus those without prescription opioids present. Similarly, figure 15 below distinguishes between opioid-involved overdose deaths with illicit opioids present versus those without illicit opioids present.

report all prescription drugs they obtain and how much they pay out of pocket for each drug. Opioid prescriptions are converted into morphine gram equivalents (MGEs), and then prices are estimated by dividing expenditures by the total number of MGEs. We use the terms MGEs and potency-adjusted units interchangeably throughout. Prices are converted into real dollars, and then a real price index is shown. Figure 6 shows the real supply and out-of-pocket price index for prescription opioids. The supply price is calculated as the ratio of total expenditures to total MGEs, and the out-of-pocket price is calculated as the ratio of self (out-of-pocket) expenditures to total MGEs. Note that out-of-pocket expenditures include individual payments made for prescriptions without third-party coverage as well as individual co-payments made for prescriptions that are only partially covered by third parties.

Figure 6. Real Supply Price and Real Out-of-Pocket Price Index of Potency-Adjusted Prescription Opioids, 2001–15



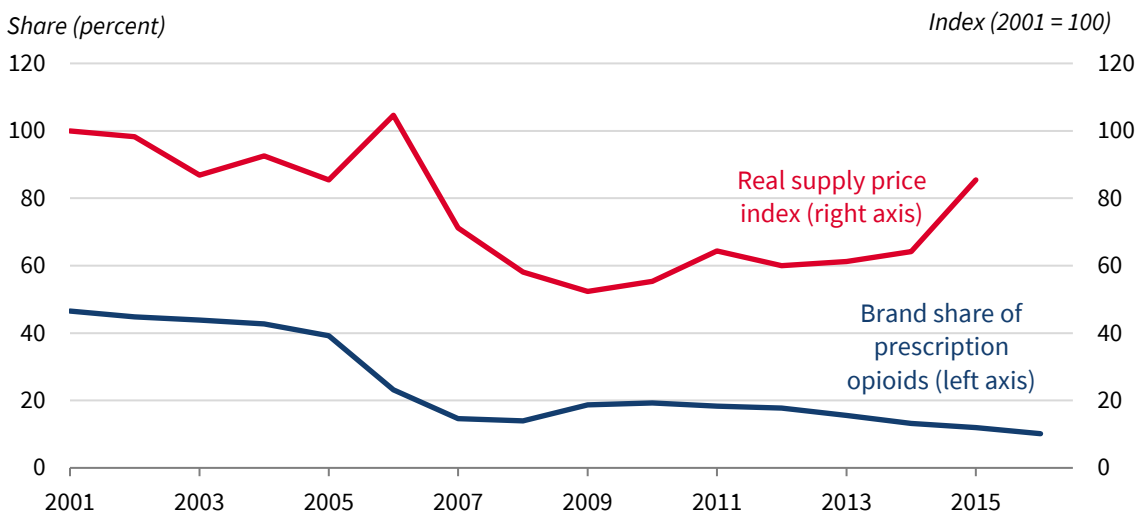
Sources: Medical Expenditure Panel Survey; National Drug Code database; Bureau of Labor Statistics; CEA calculations.

Note: Prices are calculated by dividing real total spending in a given year by the total number of morphine gram equivalents prescribed in that year. All prescriptions are converted into morphine gram equivalents based on the quantity of pills prescribed and their potency using the National Drug Code database.

Between 2001 and 2010, the out-of-pocket price fell by 81 percent before stabilizing. One potential factor in this decline, which is analyzed in depth in the next section, was the inception of Medicare Part D in 2006, which introduced subsidies for prescription drugs, including opioids, and lowered the out-of-pocket price for enrolled consumers. Box 2 discusses the need for reform in the Medicare Part D program. Another potential factor was the rapid expansion of disability (SSDI) enrollment, which before 2006 provided drug coverage for many enrollees through Medicaid or other programs, and after 2006 provided coverage through Medicare Part D (Briesacher et al. 2002; HHS 2011). Finally, between 2001 and 2010, supply prices fell by 45 percent in conjunction with the expansion of generic opioids. Recent analysis by the Food and Drug Administration (FDA) similarly finds that potency-adjusted opioid acquisition prices for pharmacies fell by about 28 percent during this same period, although they also find that prices substantially increased during the 1990s before the epidemic took off (FDA 2018a). Figure 7

shows the decline in the brand market share of potency-adjusted opioids as the generic market share rose from about 53 to 81 percent between 2001 and 2010 (FDA 2018a).

Figure 7. Brand Share of Potency-Adjusted Prescription Opioids and Supply Price, 2001–16



Sources: Food and Drug Administration (2018a); Medical Expenditure Panel Survey; CEA calculations.
 Note: Price data is only available up to 2015. Brand share data is provided through 2016.

Box 2. The Need for Reform of Reinsurance in the Medicare Part D Program

When a Medicare Part D beneficiary’s drug costs exceed about \$5,000 for the year, additional drug costs are financed 80 percent by Medicare, 15 percent by his or her insurance plan, and 5 percent out of pocket (KFF 2018). With Medicare paying so much, this creates a strong financial incentive for pharmaceutical manufacturers to encourage a high volume of prescriptions. Insurance plans may also profit due to the rebates they receive from the pharmaceutical manufacturer.

The President’s budget proposes to reform this reinsurance system, and the reforms would remove the joint profit to manufacturers and insurers from the distribution of high volumes of prescription opioids. Plans would be required to pay 80 percent of drug costs in the reinsurance phase, thereby giving them better incentives to manage the drug benefit.

The law of demand says that, all else the same, consumers engage in more of an activity when the activity becomes cheaper. However, the law by itself does not tell us the magnitude of the effect of an 81 percent reduction in the potency-adjusted price of prescription opioids on either the quantity of prescriptions or the number of deaths involving prescription opioids. Previous econometric studies that have related opioid prescriptions and other prescriptions to out-of-pocket prices suggest a range of likely quantitative effects of the price changes shown in figure 6 on the number of opioid prescriptions. Predicting the effect on the number of deaths requires additional information because the deaths derive from misuse. Only a fraction of opioid

prescriptions is given to people with opioid misuse disorder, and their price sensitivity of demand may differ from the sensitivity of average consumers.

We begin with the effect of reduced prescription opioid prices on the number of opioid prescriptions. A number of studies look at the effects of drug prices and insurance coverage on the sales of all prescription drugs as well as the sales of opioid prescriptions specifically. The more responsive drug users are to prices, the more they consume as prices decline. This price responsiveness is typically measured by the price elasticity of demand—the percentage change in quantity demanded when the price increases by 1 percent.⁸ Because the elasticity studies typically make cross-sectional comparisons, they are holding constant physician prescribing norms and marketing efforts by sellers that are changing over time. In other words, the effects of changing prescribing norms and marketing efforts need to be added to the price effects measured by the cross-sectional studies of the price elasticity of demand.

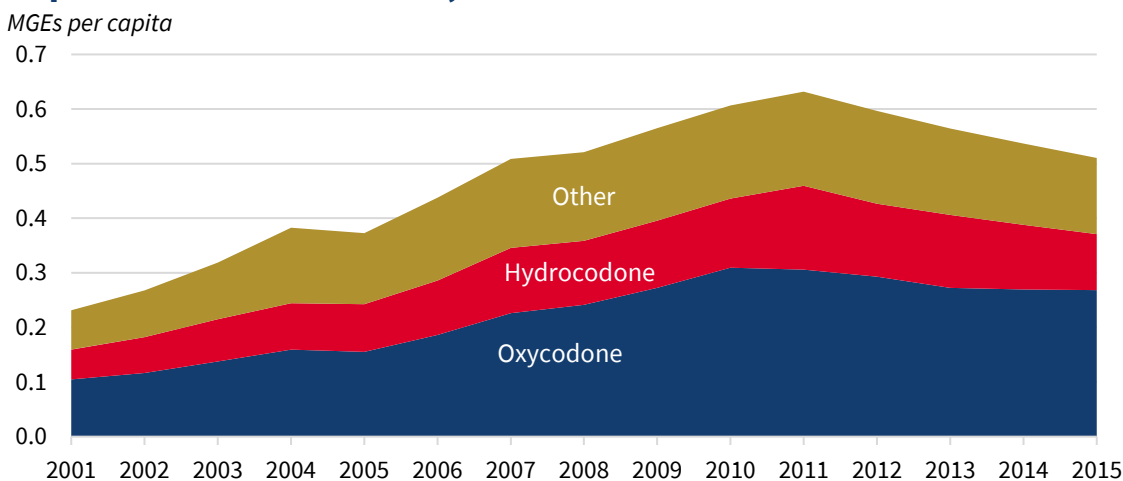
Soni (2018) found that the introduction of Medicare Part D increased opioid prescriptions for the population aged 65 to 74 (relative to the population aged 55 to 64 and not on Medicare) over a four-year period by a factor of 1.5. At the same time and for the same population, Soni (2018) found that the out-of-pocket price was reduced by a factor of 0.44 from the introduction of Part D, which is less than the price change for the entire U.S. population from 2001 to 2010 shown in figure 6. These estimated effects of Part D are economically significant and do not support the hypothesis that the changes shown in figure 6 have a minimal effect on the number of prescriptions. Indeed, they show an arc elasticity (calculated with the natural logarithm) of -0.49, which suggests that the price change in figure 6 would increase potency-adjusted prescriptions per capita by a factor of 2.3 between 2001 and 2010. A factor of 2.3 is close to the actual change as estimated with data from the Automation of Reports and Consolidated Orders System (ARCOS) and shown in figure 8 (DOJ n.d.).

Insurance plans should have coinsurance rates varying across drugs to the extent that the sensitivity of consumer demand to the out-of-pocket price varies across drugs (Feldstein 1973; Besley 1988). Health insurance plans behave that way in practice (Einav, Finkelstein, and Polyakova 2018). Coinsurance rates for opioids (43 percent) are higher than for other common therapeutic classes (39 percent). Similarly, coinsurance rates for hydrocodone (50 percent) are higher than for other common nonopioid drugs (40 percent). The observed coinsurance rates thus suggest that opioid prescriptions are not less price sensitive than the average prescription drug over the annual time frame (or longer) that is of interest to the sponsors of insurance

⁸ When sales effects are estimated from small price changes, the result is sometimes called a “point elasticity.” An “arc elasticity” refers to an estimate from large price changes and typically uses midpoints for calculating percentage changes or uses logarithm changes so that the same elasticity can be applied to price increases as to price decreases.

plans.⁹ If Einav, Finkelstein, and Polyakova (2018)'s one-month arc elasticity of -0.27 for therapeutic drug classes were applied to the price change from 2001 to 2010 shown in figure 6, it suggests that opioid prescriptions would have increased by a factor of 1.6 due to price changes alone.¹⁰

Figure 8. Potency-Adjusted Quantity of Prescription Opioids per Capita in the United States, 2001–15



Sources: Automation of Reports and Consolidated Orders System; National Drug Code database; CEA calculations.
 Note: Quantities are converted into morphine gram equivalents (MGEs) and divided by the total U.S. population in a given year to calculate MGEs per capita.

A factor of 1.6 is economically significant, but is still only a minority of the actual change in opioid prescriptions between 2001 and 2010. The discrepancy between the findings of Soni (2018) and Einav, Finkelstein, and Polyakova (2018) could be that behavior is more sensitive to a price change that lasts more than one month, or applies to a larger population of people.¹¹ But the discrepancy may also reflect the imprecision of estimating price effects, which is why our data are consistent with the view that the increase in prescriptions cannot be explained by price reductions alone but also reflect changes in physicians' prescribing norms and marketing efforts by opioid sellers.

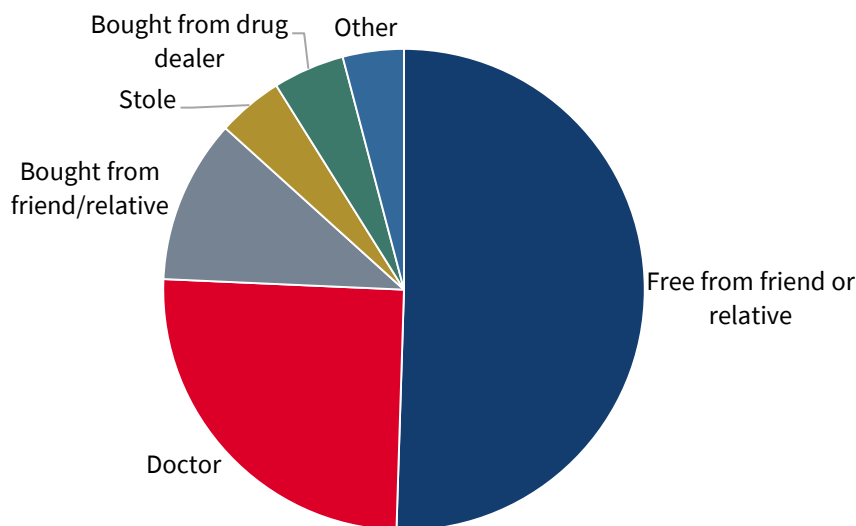
⁹ The coinsurance rates are inferred from the estimates by Einav, Finkelstein, and Polyakova (2018) and are for Part D participants who have not yet reached the "donut hole."

¹⁰ Einav, Finkelstein, and Polyakova (2018) report a point elasticity for a linear demand curve, but their reports of price and quantity changes are sufficient for their readers to calculate the corresponding arc elasticity. We also note that the authors' elasticity is estimated for a select group of Part D participants who have high drug costs.

¹¹ The demand for habit-forming products responds more to price changes that last longer (Pollak 1970; Becker and Murphy 1988; Gallet 2014), which is why it would be especially problematic to apply Einav, Finkelstein, and Polyakova (2018)'s approach specifically to opioids because it refers to price changes lasting only a month. Einav, Finkelstein, and Polyakova (2018)'s estimates also exclude "social multiplier" price effects that may occur when the entire population experiences a price change rather than a select few who are at a special spot in their prescription-benefit formula (Glaeser, Sacerdote, and Scheinkman 2003).

One reason that falling opioid prices may increase opioid deaths at a different rate than they increase opioid prescriptions is that opioid prices for medical purposes might follow a different trend than the prices paid by opioid misusers. In fact, only 25 percent of people who misuse prescription opioids most recently obtained the drugs from a doctor, while the remaining 75 percent obtained them from friends or relatives, via theft, from a drug dealer, or some other source (figure 9). But even when the drugs are obtained on the secondary market, the price is likely positively correlated with the out-of-pocket price. A lower out-of-pocket price decreases the acquisition cost for those selling the drugs in the secondary market. It also should decrease the implicit price for those giving the drugs away for free in terms of expected reciprocal gifts, and it should reduce the precautions taken by individuals to safeguard their drugs against theft.¹² Of course, the out-of-pocket price is only one component of the total price of obtaining prescription opioids for misuse. The ease of finding a doctor to prescribe the opioids and a pharmacy that receives a supply and is willing to fill the prescription is also important.

Figure 9. Proportion of Users Obtaining Misused Prescription Opioids by Most Recent Source, 2013–14



Source: Lipari and Hughes (2017).

As a calibration exercise for contextualizing whether falling out-of-pocket prices could have played a role in the first wave of the opioid crisis, we assume that the price of prescription opioid misuse is proportional to the out-of-pocket price. For example, a 10 percent decline in the out-of-pocket price of prescription opioids is assumed to reduce the price of pills in the secondary market (and for misusers obtaining pills in the primary market) by 10 percent. This

¹² This does not mean that the amount of theft varies with the price because thieves can be expected to put more effort toward stealing more valuable items. We only assume that thieves experience greater cost of theft for high priced items, due to owners' precautions.

assumption is clearly reasonable for the 25 percent of prescription opioid misusers who obtain their pills directly from physicians in the primary market because they only face the out-of-pocket price.

We may also expect the secondary market price to be proportional to the out-of-pocket price. Consider, first, the misusers who purchase their pills in the secondary market (as opposed to those receiving them for free). The sellers of these pills seek to maximize their profits, which are equal to the price of each pill P minus the cost of obtaining each pill in the primary market C (the out-of-pocket price), multiplied by the number of pills sold, Q :

$$\pi = (P - C)Q$$

In a competitive market, profits are competed down to zero for all sellers, so that the price charged on the secondary market is equal to the out-of-pocket price. In a noncompetitive market, each seller has the power to influence the secondary market price based on how many pills it sells. In terms of the above equation, this means that the price is a function of quantity. It can be shown that a necessary condition for maximizing profits is

$$P = \frac{1}{1 + r} C$$

where r is the responsiveness, in percentage terms, of the market price to the quantity of pills provided by a particular seller. Thus, an increase in the cost (or out-of-pocket price) C leads to a proportional increase in the secondary market price P , assuming that r remains constant.

As shown in figure 9, however, a large fraction of people who misuse prescription opioids do not purchase their pills from secondary market sellers, instead obtaining them for free from relatives or friends. In this case, there is still some “implicit price” for the misuser who obtains the pills; for example, an individual may provide pills to his or her spouse, who then is more likely to provide material or nonmaterial support in their relationship. In this setting, the implicit price may still be set according to the above formulas, so that it is either equal or at least proportional to the out-of-pocket price, depending on the potential sources from which misusers can obtain their drugs. It is less clear exactly how the implicit price of stealing pills from others would relate to the out-of-pocket price, although a falling out-of-pocket price would likely lead individuals obtaining their pills on the primary market to take fewer precautions in securing their pills against theft, suggesting that theft would be easier when the out-of-pocket price is lower.

Assuming that the share of prescription opioids obtained via various segments of the secondary market with different markups remains constant over time, the average secondary market price across all segments would change proportionally with changes in the out-of-pocket price. It is important to emphasize that this assumption would be plausible only if

suppliers to the secondary market face relatively low transaction costs for obtaining prescriptions from doctors and filling prescriptions from pharmacies. For this reason, changes in prescribing guidelines and practices, a greater emphasis on pain management, and the expansion of “pill mills” and supplies to pharmacies are preconditions for falling prices to have a potentially significant effect on opioid misuse.

Another reason that falling opioid prices can increase opioid deaths at a different rate than they increase opioid prescriptions is that most of the opioid prescriptions are likely used for medical purposes, and those who misuse opioids may have a different sensitivity to prices. One point of view is that medical users are less price sensitive because they are just following their physicians’ orders, whereas misusers are necessarily price sensitive to the extent that most of their income is exhausted by purchasing opioids.¹³ Another perspective is that those who misuse opioids are less price sensitive because they are less interested in saving money on their drug acquisitions.

Unfortunately, we are not aware of studies estimating price elasticities for the misuse of prescription opioids distinctly from price elasticities for the overall number of prescription opioids (regardless of their use). Thus, we use estimates of the price elasticity of heroin, a substitute for prescription opioids, for which a large body of academic literature is available. Olmstead and others (2015) provide an extensive review of the literature and categorize studies based on the methods used—table 1 summarizes their work. Although the literature contains a broad range of estimates, studies generally find that higher prices reduce demand. For our calibration exercise, we rely on a meta-analysis of the literature on illicit drug price elasticities by Gallet (2014), who synthesizes 462 price elasticities from 42 studies, mostly based on U.S. data. He finds that the price elasticity of heroin falls in the range of (negative) 0.47 to 0.56, which coincides with the arc elasticity of (negative) 0.49 calculated from Soni’s (2018) results for prescription opioids but is further from zero than the short-run estimates for all prescription drugs reported by Einav, Finkelstein, and Polyakova (2018).¹⁴

Because previous studies show a range of price elasticities, we can only provide a range of estimates of the contribution of price changes to the growth in opioid misuse and the number of deaths involving prescription opioids. As a low value, we take one interpretation of the Einav, Finkelstein, and Polyakova (2018) short-run findings for all prescription drugs, namely that the price elasticity of demand is constant and equal to -0.27. As a middle value, we take the other

¹³ People who misuse opioids who, for example, spend all disposable income on opioids, have a price elasticity of negative 1 because the quantity purchased is the ratio of disposable income to price. See Becker (1962) for a more general analysis.

¹⁴ Gallet (2014) finds that demand for drugs is (a) more responsive to price at the extensive margin (in decisions about whether to use drugs) than at the intensive margin (how much of the drug to use) and (b) more responsive in the long run than in the short run.

interpretation of their results: that the demand curve is linear in price.¹⁵ As a high value, we take Gallet’s high-end elasticity of -0.56. The corresponding results for predicted deaths are shown in figure 10 as “Low constant elasticity,” “Low linear demand,” and “High constant elasticity,” respectively.¹⁶ For reference, figure 10 also shows the actual rate of overdose deaths involving prescription opioids. Price changes would be capable of explaining between 31 and 83 percent of the growth between 2001 and 2010 in the death rate involving prescription opioids, assuming that the rise in overdose deaths is proportional to the rise in misuse. In other words, without the price changes, the estimates suggest that there would have been between 11,500 and 22,800 fewer deaths involving prescription opioids during those years.¹⁷

Table 1. Estimates of the Price Elasticity of Demand for Heroin

Studies	Study type / outcomes	Elasticity estimates
Silverman and Spruill (1977); Caulkins (1995); Dave (2008); Olmstead et al. (2015)	Outcomes related to heroin use (crime, emergency room visits, etc.)	-0.27; -1.50; -0.10; -0.80
Saffer and Chaloupka (1999)	National household surveys	-0.94
van Ours (1995); Liu et al. (1999)	Government historical records	[-0.7 to -1.0]; [-0.48 to -1.38]
Bretteville-Jensen and Biorn (2003); Bretteville-Jensen (2006); Roddy and Greenwald (2009)	Interviews with heroin users	[-0.71 to -0.91]; [-0.33 to -0.77]; -0.64
Petry and Bickel (1998); Jofre-Bonet and Petry (2008); Chalmers et al. (2010)	Laboratory studies	[-0.87 to -1.3]; [-0.82 to -0.92]; [-1.54 to -1.73]

Source: Olmstead et al. (2015).

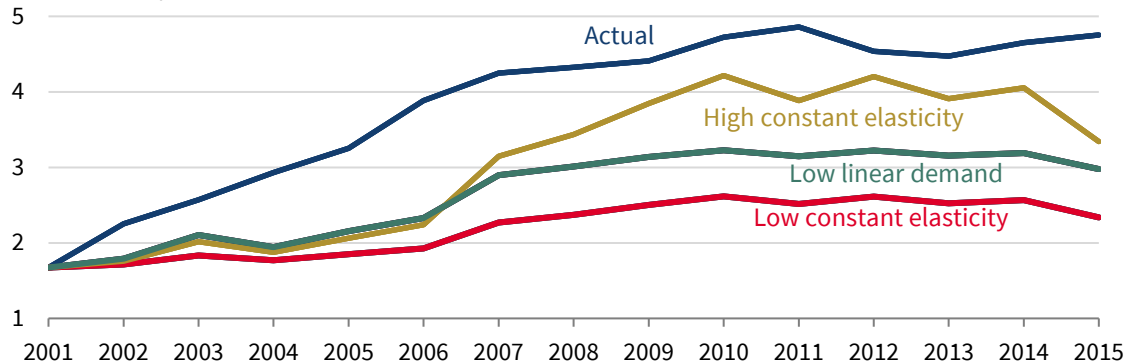
¹⁵ Einav, Finkelstein, and Polyakova (2018) calculate an elasticity of -0.15 based on percentage changes from the low price to the high price, which is a valid point elasticity only if the demand curve is linear in price, with a point elasticity of -0.15 at the average out-of-pocket price paid by low-cost Medicare Part D recipients between 2007 and 2011. It is a valid arc elasticity only if converted to -0.27 so that it can be applied to price increases as well as decreases.

¹⁶ For the constant elasticity predictions, we use a demand function of the form $Q_D = AP^\epsilon$, where A is a parameter and determined based on the initial quantity and price as of 2001, Q_D is the quantity demanded, P is the price, and $\epsilon < 0$ is the constant elasticity of demand with respect to the price.

¹⁷ Powell, Pacula, and Taylor (2017, 1) directly link the introduction of Medicare Part D—a source of some of the price reduction between 2001 and 2010—to deaths involving prescription opioids, including “deaths among the Medicare-ineligible population, suggesting substantial diversion from medical markets.”

Figure 10. Actual and Predicted Rates of Overdose Deaths Involving Prescription Opioids, by Price Elasticity of Demand for Misuse, 2001–15

Annual deaths per 100,000



Source: CDC WONDER; Bureau of Labor Statistics; Medical Expenditure Panel Survey; National Drug Code database; CEA calculations.

Note: Predicted deaths are calculated by holding the demand curve constant, and moving down the demand curve based on the amount of the price decrease. The functional form of the demand function is provided in the text. The low elasticity is 0.27 in magnitude, the linear demand assumes linearity in price, and the high elasticity is 0.56.

Figure 10 suggests that a greater fraction of the increase in actual overdose deaths are explained with constant elasticity models (red and gold) in 2010 than in earlier years such as 2005. This pattern occurs because our price measure shows proportionally less price declines in the early years than in the later ones and likely reflects the substantial influences of nonprice factors (e.g., prescribing norms and marketing efforts) in addition to price factors. However, the linear demand specification shows a time pattern of predicted deaths (as opposed to a total increase) that is closer to actual deaths, which suggests that constant elasticity might not be the correct model of the effects of price changes.¹⁸

Again, it is important to emphasize that the potential role of prices in explaining the rise of overdose deaths depends on the ability of consumers in the primary market to obtain more pills as prices decline. This was facilitated by an environment in which physicians were encouraged and even required to aggressively treat pain with opioids (President’s Commission 2017).¹⁹ As a result, physicians wrote more opioid prescriptions for more patients, lowering the time and effort needed to acquire the drugs. The rise of pill mills further increased the convenience of acquiring these drugs by combining prescription writing with dispensing.

¹⁸ Given that the research of price effects on drug sales finds most of them to be on the “extensive margin,” the market demand curve largely reflects the inverse distribution of consumer heterogeneity. Distribution functions can generate convex demand functions like the constant-elasticity function, concave demand functions, or a combination of both such as with the normal distribution.

¹⁹ In technical terms, prescribing norms affect both the number of prescriptions at a given price and the sensitivity of that number to price changes.

We further note that the death rate involving prescription opioids increased by a factor of 2.8 between 2001 and 2010 (figure 10) at the same time that per capita quantity of prescription opioids increased by a factor of 2.6 (figure 8). This suggests that whatever factor was increasing prescriptions over this period was also increasing opioid misuse, with only somewhat greater proportional effects on misuse. One possible explanation for this result is that the price elasticity of misuse is similar to—but somewhat further from zero than—the price elasticity of medical use so that price declines increase both types of use but proportionally somewhat more for misuse.

Public Subsidies for Opioids

A potentially relevant factor for the 81 percent decline in out-of-pocket prices for prescription opioids between 2001 and 2010 is the expansion of public health insurance programs that subsidize access to and purchase of prescription drugs, including opioids. These subsidies lower out-of-pocket prices in the legal market, thereby lowering prices directly for the 25 percent of prescription opioid misusers who obtain their drugs from a physician and indirectly for the 75 percent of misusers (see figure 9) who receive them on the secondary market from friends, family, and dealers who first obtained the drugs in the primary market.²⁰

The share of potency-adjusted prescription opioids funded by government programs grew from 17 percent in 2001 to 60 percent in 2010 (see figure 11). However, this may understate the share of diverted opioids that were obtained with the assistance of funding from public programs. The diversion of opioids to the secondary market is more profitable when out-of-pocket prices are lower, and drugs purchased with government subsidies cost less on average than drugs purchased out of pocket or with private insurance (MEPS). Thus, government subsidies that cut out-of-pocket prices the most may lead to opioids obtained with the assistance of funding from these programs to be the most likely to be diverted. In fact, government programs funded 74 percent of all opioids that were covered at least in part by a third-party payer in 2010 (MEPS).

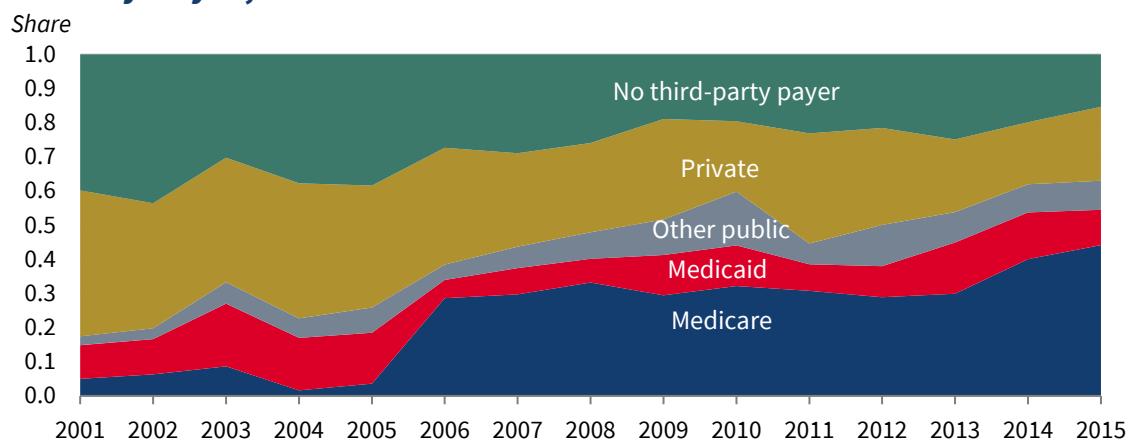
Figure 11 shows the share of potency-adjusted opioids covered by public programs, private insurers, and no third-party payer. Public programs have become much more important sources for funding opioids over time, and Medicare coverage expansions appear to have largely driven this growth. The share of opioids covered by Medicare spiked in 2006, coinciding with the implementation that year of Medicare Part D, which offered prescription drug benefits to Medicare beneficiaries.²¹ It is important to note that the vast majority of Medicare Part D

²⁰ See Schnell (2017), who analyzes the linkages between the primary and secondary markets.

²¹ In a similar calculation, Zhou, Florence, and Dowell (2016) find that the share of expenditures on prescription opioids accounted for by Medicare increased from 3 percent in 2001 to 26 percent in 2012. As shown in figure 11, we find that the number of prescriptions for which Medicare was the primary payer increased from 5 percent in

enrollees prescribed opioids do not misuse them. Carey, Jena, and Barnett (2018) studied a sample of over 600,000 Medicare beneficiaries who had an opioid prescription. Using several alternative measures, only 0.6 percent to 8.5 percent of the beneficiaries fulfilled a misuse measure.

Figure 11. Share of Potency-Adjusted Prescription Opioids, by Primary Payer, 2001–15



Sources: Medical Expenditure Panel Survey; National Drug Code database; CEA calculations.
 Note: The primary payer is defined as the third-party payer with the highest payment for a given prescription. In addition to Medicare, Medicaid, and private insurers, the other possible primary payers include veterans benefits, workers compensation, other Federal government insurance, other State or local government insurance, or other public insurance. All prescriptions are converted into morphine gram equivalents based on the quantity of pills prescribed and their potency using the National Drug Code database.

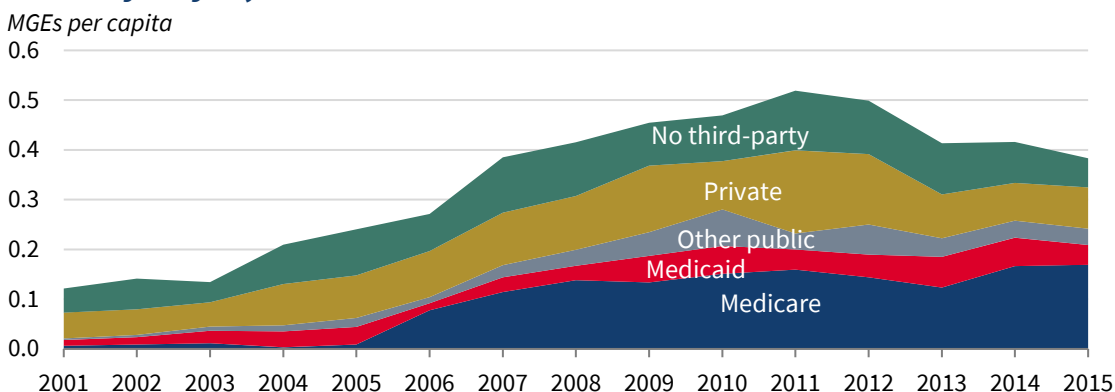
The implementation of Medicare Part D and the resulting growth in the share of opioids funded by Medicare does not appear to have simply displaced opioids covered by other sources. Figure 12 shows the quantity of opioids per capita funded by each source. Though the number of potency-adjusted opioids covered by Medicaid fell between 2005 and 2006, the increase in the number of opioids covered by Medicare was over three times larger than this decline.²² The number of potency-adjusted opioids covered by private insurance also increased between 2005 and 2006. Furthermore, between 2005 and 2008, the MEPS data suggest that the total

2001 to 29 percent in 2012. The slight differences may be because the Medicare share of expenditures (as reported by Zhou, Florence, and Dowell 2016) does not include out-of-pocket copayments made by Medicare enrollees for prescriptions where Medicare was the primary payer (figure 11).

²² An estimated 6.2 million Medicaid beneficiaries became eligible for Medicare Part D prescription drug coverage on January 1, 2006 (KFF 2006). These “full dual eligibles” included low-income seniors and low-income disabled individuals under age 65. Nonelderly disabled dual eligibles, including both full and partial, made up about one-third of all duals (2.5 million out of almost 7.5 million, per Holahan and Ghosh 2005, 3). Applying this one-third ratio to 6.2 million means that about 2.0 to 2.1 million nonelderly disabled Medicaid participants transitioned from Medicaid to Medicare prescription drug coverage in 2006. For comparison, the SSDI rolls grew from 6.5 million to 6.8 million individuals between 2005 and 2006.

quantity of potency-adjusted opioids dispensed increased by 73 percent, with almost three-fourths of this growth coming from opioids paid for by Medicare.²³

Figure 12. Potency-Adjusted Prescription Opioids per Capita, by Primary Payer, 2001–15



Sources: MEPS; National Drug Code database; CEA calculations.

Note: The primary payer is defined as the third-party payer with the highest payment for a given prescription. In addition to Medicare, Medicaid, and private insurers, the other possible primary payers include veterans benefits, workers compensation, other Federal government insurance, other State or local government insurance, or other public insurance. All prescriptions are converted into morphine gram equivalents (MGEs) based on the quantity of pills prescribed and their potency using the National Drug Code database.

Between 2001 and 2010, Medicare-covered opioids increased by over 2,400 percent, Medicaid-covered opioids increased by over 360 percent, and total publicly covered opioids increased by over 1,200 percent (MEPS). Given that Medicare covers the elderly and SSDI recipients who tend to have greater needs related to pain relief, it is not surprising that Medicare is the largest payer of prescription drugs as well as the largest public payer of prescription opioids.

Previous research has studied the implications of the rise in public funding for opioids fueling the opioid crisis, and in particular, for diversion of pills to the secondary market. Powell, Pacula, and Taylor (2017) found that a Medicare Part D–driven 10 percent increase in opioid prescriptions results in 7.4 percent more opioid-involved overdose deaths among the Medicare-ineligible population. The authors use the fact that Medicare Part D was plausibly more important in driving prescription drug benefits in States with a greater share of the population over age 65 to estimate the impact of drug benefits on opioid-involved overdose deaths.

²³ As shown in a comparison of figures 9 and 13, the MEPS undercounts the total number of prescription opioids. See also Hill, Zuvekas, and Zodet (2011, 242), which looks more systematically at the propensity of MEPS respondents “to underreport the number of different drugs taken.” MEPS underreporting presents greater challenges for measuring total quantities rather than average prices, which is why this report measures the former from ARCOS and the latter from MEPS.

Moreover, because the elderly—the major population that is eligible for Medicare benefits—are rarely reported to die of drug overdoses, these results suggest that the impact of Medicare expansion on opioid-involved death rates may have been due to an increased supply of prescription opioids in the secondary market. Others have examined opioid prescriptions in Medicaid. In a recent report, the Senate Committee on Homeland Security and Governmental Affairs notes numerous examples of Medicaid fraud that fuel abuse of prescription opioids—for example, with drug dealers paying Medicaid recipients to obtain taxpayer-funded pills (Senate Committee on Homeland Security and Governmental Affairs 2018). Eberstadt (2017) similarly suggests that Medicaid has helped finance increasing nonwork by prime-age adults by subsidizing prescription opioids that could be sold on the secondary market. Goodman-Bacon and Sandoe (2017), Venkataramani and Chatterjee (2019), and Cher, Morden and Meara (2019) however, find little evidence for Medicaid expansion fueling the opioid crisis. These findings are not necessarily inconsistent with other evidence that public programs worsened the opioid crisis. It is possible that Medicaid expansion did not increase opioid misuse because the expansion population is less likely to be prescribed opioids. Prior to State expansions, Medicaid already covered all disabled adults receiving Supplemental Security Income (SSI), as well as elderly adults not eligible for Medicare. Medicaid expansion only covered nondisabled, nonelderly adults with low incomes, a population less likely to be prescribed opioids. In fact, figure 12 above shows that the per capita quantity of opioids covered by Medicaid decreased between 2013 and 2015, despite the fact that Medicaid enrollment grew from 60 million to 70 million people over this same period, as the majority of States expanded Medicaid coverage. In addition, the Medicaid expansions studied by Goodman-Bacon and Sandoe (2017) occurred in 2014, after measures had been taken to reduce the ability of people to misuse prescription opioids (such as the reformulation of OxyContin in 2010 and the implementation of prescription drug-monitoring programs).

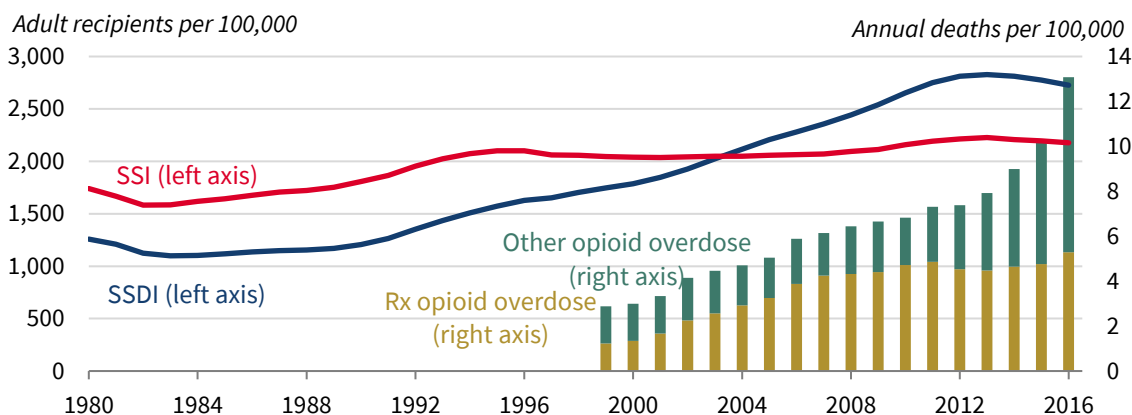
Public subsidies for prescription opioids have also been fueled by the growing number of Americans claiming disability insurance. SSDI is a Federal disability assistance program that offers a maximum possible benefit of \$2,687 a month, with an average monthly benefit of \$1,173. Only adults who have significant work experience are eligible to receive SSDI, and the amount of benefits is higher for those who had higher lifetime earnings before becoming disabled.²⁴

SSDI disabled workers are generally eligible for Medicare after 24 months of enrollment in the program. SSDI rolls have increased dramatically since 1990. The growth in SSDI rolls can be attributed to several factors, including aging of the population, the increased labor force participation of women, and more lenient disability determinations (Autor 2015). Another disability program, Supplemental Security Income (SSI), provides more modest benefits to

²⁴ Qualification for SSDI requires a sufficient number of work credits that were earned recently enough. Up to four credits can be earned in one year and are accrued based on sufficient annual earnings. Applicants generally require 40 credits to qualify for SSDI, although standards are different for younger workers.

Americans without sufficient work experience to qualify for SSDI, and provides automatic eligibility for Medicaid in most States. Figure 13 shows the rise in SSDI and SSI rolls per 100,000 people over time. Notably, SSDI rolls and opioid overdose deaths, especially those involving prescription opioids, have risen in tandem. It is also important to note SSDI growth occurred over the same period as increased treatment of pain conditions with opioids.

Figure 13. Adults Receiving Social Security Disability Insurance and Supplemental Security Income, and Opioid-Involved Drug Overdose Deaths, per 100,000 people, 1980–2016



Sources: Social Security Administration; CDC WONDER; CEA calculations.

Note: SSDI = Social Security Disability Insurance. SSI = Supplemental Security Income. Prescription opioids include natural and semisynthetic opioids as well as methadone. Consistent data for opioid overdose deaths accessed in CDC WONDER begin in 1999.

The 8.6 million SSDI disabled workers in 2011 represent less than 3 percent of the total U.S. population, and thus are overrepresented as a source of prescription opioids given disabilities (increasingly related to pain) that lead to a greater use of prescription opioids. The CEA estimates the total market share of SSDI recipients in two ways, each suggesting that SSDI recipients make up about 26 to 30 percent of the prescription opioid market. First, we use data from Morden and others (2014), who estimate the average potency-adjusted opioid prescriptions for SSDI recipients across the United States in 2011 (6.9 MGEs per SSDI recipient). We multiply this average rate by the total number of SSDI recipients in 2011 (8.6 million recipients). And finally, we divide the total opioids prescribed to SSDI recipients (59.2 million MGEs) by the total opioids distributed in the United States according to ARCOS data (196.9 million MGEs). The result is that 30 percent of potency-adjusted opioid prescriptions in the U.S. are filled by SSDI recipients, which is over 10 times their proportion of the U.S. population.

Second, the CEA uses MEPS data that report opioid prescriptions for a random sample of Americans each year. We identify SSDI recipients as individuals between age 18 and 64 who receive Medicare. This may slightly overstate the SSDI population, given that a small number of non-SSDI recipients under age 65 are eligible for Medicare as well, including people with end-

stage renal disease and amyotrophic lateral sclerosis.²⁵ Nonetheless, dividing the potency-adjusted opioids prescribed to these recipients by the total in the population results in an estimated SSDI market share of 26 percent in the period 2010–12.²⁶ The somewhat lower share estimated using MEPS data may be due to the exclusion of SSDI recipients who have been on the program for less than two years.²⁷ These SSDI recipients would not yet be eligible for Medicare and may instead receive coverage via Medicaid or other programs.²⁸

It is important to emphasize that the disproportionate market share of SSDI recipients receiving prescription opioids is a result of their higher levels of pain associated with the conditions that prevent them from working. SSDI benefit payments in conjunction with Medicare coverage provide a vital means of support for disabled workers with major healthcare needs. Thus, reforms that seek to reduce nonmedical use of opioids should be careful to preserve access to needed pain relief through the medical use of opioids for SSDI recipients.

The Second Wave of the Epidemic: Illicit Opioids

The second wave of the opioid crisis began in about 2010, when prescription opioids became more difficult to access due to efforts to rein in abuse. However, the buildup of a pool of people misusing prescription opioids that they could no longer access provided a large pool of new demand and a profit opportunity for sellers entering the illicit opioid market. Because legal and illicit opioids are substitutes for people suffering from addiction, raising the price (in terms of both money and time) of legal opioids raises the demand for illicit ones.

The reformulation of OxyContin in 2010 made it more physically difficult to abuse. States have implemented prescription drug monitoring programs that required doctors to consult patient prescription histories before prescribing opioids (Dowell et al. 2016; Buchmueller and Carey 2018; Dave, Grecu, and Saffer 2018). Professional societies and accrediting organizations have reconsidered their pain treatment guidelines. These changes have reduced the overall quantity of prescription opioids distributed, with potency-adjusted quantities of opioids peaking in 2011 (DOJ n.d.). Unfortunately, recent research has shown that overdose deaths averted from

²⁵ There were just under 273,000 Medicare recipients under age 65 with end-stage renal disease in 2013 (HHS 2014). The prevalence of amyotrophic lateral sclerosis is just five per 100,000, implying that in 2013, there were just under 16,000 Americans with the disease (Stanford Medicine n.d.).

²⁶ Based on a five-year average centered around 2011, we similarly estimate a market share of 26 percent.

²⁷ MEPS excludes the institutionalized population, so if SSDI recipients are overrepresented in this population, then this could further affect our estimate.

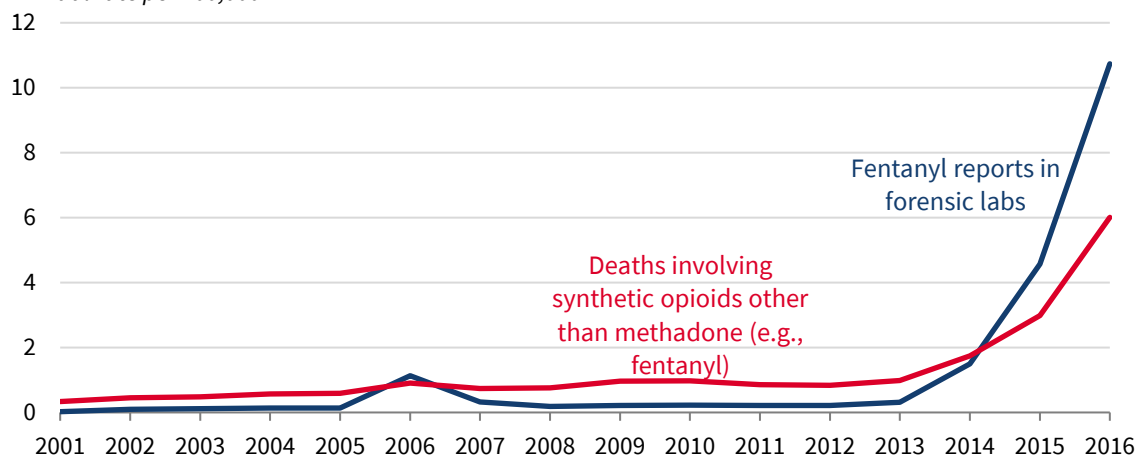
²⁸ We note that Finkelstein and others (2018) estimate that SSDI recipients account for about 13 percent of opioid prescriptions. However, they do not appear to analyze potency-adjusted opioids as we do. Indeed, when we use the MEPS data to estimate the market share of nonpotency adjusted opioid prescriptions for the same 2006 to 2014 period that Finkelstein and others (2018) appear to consider, we estimate a similar 15.5 percent market share.

prescription opioid overdoses, at least those resulting from the reformulation of OxyContin, have been replaced by overdose deaths from heroin (Alpert, Powell, and Pacula 2018; Evans, Lieber, and Power 2019).

As users have substituted to heroin, it has increasingly been made even more potent—suppliers and drug dealers now frequently lace heroin with illicitly manufactured fentanyl. Fentanyl is 30 to 50 times more potent in its analgesic properties than heroin, so even small amounts can vastly increase the potency of the drugs with which it is mixed. Illicitly manufactured fentanyl can also be obtained independently of heroin. Figure 14 documents the rise of fentanyl, showing both the rate of overdose deaths involving synthetic opioids other than methadone (a category dominated by fentanyl, although whether the product is illicit or prescription is not determinable), and the rate of fentanyl reports in forensic labs acquired by law enforcement during drug seizures.

Figure 14. Rate of Overdose Deaths Involving Synthetic Opioids Other Than Methadone, and Fentanyl Reports in Forensic Labs, per 100,000 Population, 2001–16

Annual rate per 100,000

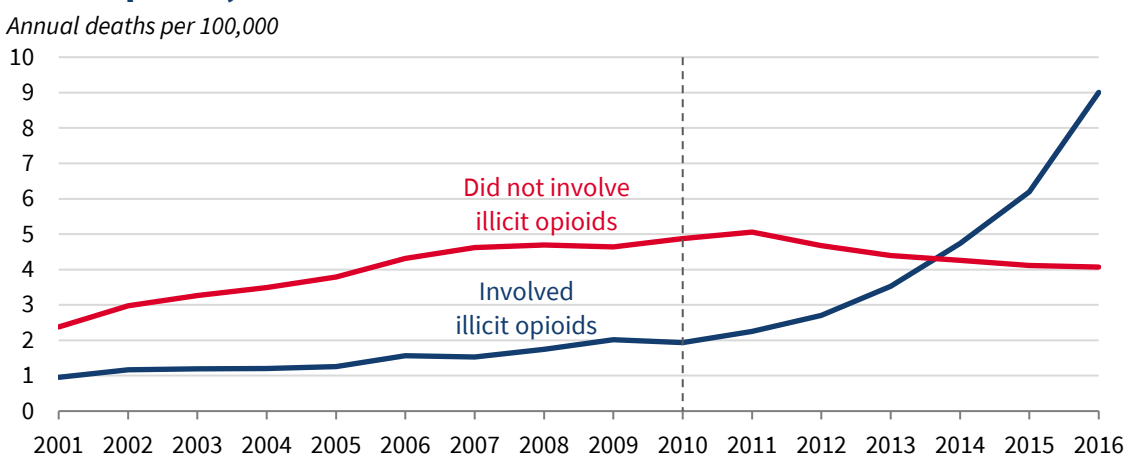


Sources: NFLIS via DOJ and DEA (2017b); CDC WONDER; CEA calculations.

Figure 15 shows the rise in overdose deaths involving heroin and fully synthetic opioids (mostly fentanyl), along with opioid deaths not involving heroin and synthetic opioids. As a reminder, we refer to overdose-related opioid deaths from heroin and fentanyl as “illicit deaths,” even though fentanyl can also be prescribed. From 2010 through 2016, the rate of illicit opioid deaths has increased by 364 percent, while the rate of opioid deaths not involving illicit opioids has fallen by 17 percent. Importantly, fentanyl also tends to be combined with nonopioids, and deaths for which fentanyl and nonopioids are factors are included in the illicit opioid series in figure 15.

Given their illegal nature, the price of illicit opioids is more difficult to measure than the price of prescription opioids. Accurate data cannot be reliably obtained from dealers or users who may fear criminal sanctions for truthful reporting. In recent years, complicating matters is the influx of cheap but highly potent fentanyl from Mexico and China, which can vastly increase the potency of drugs with which it is mixed (Department of State n.d.). Market quantities of heroin and fentanyl also cannot be directly observed, so the extent to which added fentanyl reduces the price per potency-adjusted unit of opioids is difficult to determine. Subject to these limitations, the CEA assembles data from several sources to create a time series of the price of illicit opioids.

Figure 15. Opioid-Involved Overdose Death Rate by Presence of Illicit Opioids, 2001–16



Sources: CDC WONDER; CEA calculations.

Note: Illicit opioids include both heroin and the category “synthetic opioids other than methadone” in the CDC data, which is primarily composed of illicitly produced fentanyl. The dashed line denotes a separation between the first and second waves of the opioid crisis.

The DEA’s System to Retrieve Information from Drug Evidence (STRIDE) and STARLIMS databases collect heroin price data. Heroin prices in these data sets are obtained by government agents, who pay informants to purchase heroin on the street. The price is recorded, and the heroin sample is analyzed in a laboratory to determine its potency so that prices can be quality adjusted. Between 2010 and 2016, the potency-adjusted real price of heroin increased by 10 percent.

However, any fentanyl contained within heroin is not considered when determining the price per pure gram of heroin in the DEA data. Thus, the true price per potency-adjusted unit of heroin purchases has likely increased by less than 10 percent or even declined. In addition, fentanyl can be consumed on its own outside heroin, which, if cheaper on a potency-adjusted basis, would lead overall illicit opioid prices to fall even more. Moreover, increased heroin purity and product modifications have increasingly allowed for heroin use by means other than injection. These changes lower the nonmonetary costs of using heroin, and although

nonmonetary costs are not estimated here, these changes would have further reduced the cost of illicit opioid use.

The CEA uses data from several sources to estimate the quantity of fentanyl mixed with heroin and available on its own, along with the potency-adjusted price of heroin (including the fentanyl with which it is mixed) and the potency-adjusted price of fentanyl when consumed alone or with other drugs. Quantity data are based on seizures of heroin and fentanyl recorded in the National Seizure System, along with exhibits of each drug recorded in the National Forensic Laboratory Information System (NFLIS). Price data are based on the DEA heroin price series and on DEA reports on the cost of fentanyl relative to heroin, along with the quantity data in order to adjust heroin prices based on fentanyl with which it is mixed. A detailed methodology for estimating illicit opioid prices is provided as an appendix to this report. We acknowledge that seizure data are a highly imperfect proxy of the relative presence of heroin and fentanyl. Seized products reflect a combination of market shares and law enforcement priorities rather than market shares alone. Still, absent an alternative data source, and without a clear direction for the bias in this proxy for market shares, we use the seizure data as reported.

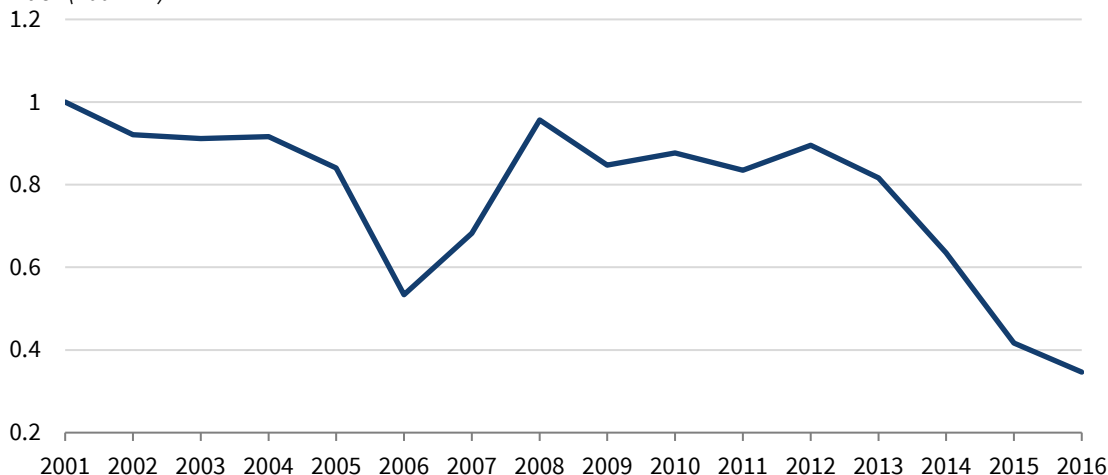
Figure 16 shows a real price index for illicit opioids between 2001 and 2016, which, given the data limitations involved, should be used only to draw qualitative conclusions. The price of illicit opioids is relatively stable before falling temporarily in 2006, and then quickly recovering, and then falls by over half (58 percent) between 2013 and 2016. Each of these declines is due to surges in fentanyl that is either mixed with heroin or sold on its own or with other drugs. The 2006 price decline was due to a laboratory in Mexico that dramatically increased the supply of fentanyl to the United States but was quickly shut down through cooperative action between the United States and Mexico. The price decline between 2013 and 2016 is attributed to the widely documented influx of fentanyl into the United States, including from China and Mexico (NIDA 2017). The price series shown in figure 16 is the outcome of a series of assumptions documented more completely in the appendix and is necessarily only a highly imperfect estimate of the real price from which only qualitative conclusions should be drawn. If data on the illicit opioid market in this period improve, revisions to this series may be possible.

It is clear from figure 16 that supply expansions were important for driving the growth in overdose deaths involving illicit opioids. Between 2010 and 2013, the price of illicit opioids was relatively stable. This implies that both supply and demand expansions were important during the first three years of the illicit wave of the opioid crisis. If only demand had expanded, then prices would have increased; and if only supply had expanded, then prices would have decreased. Demand expansions can likely be traced at least in part to efforts to clamp down on abuse that grew during the first wave of the epidemic. Expanded supply is likely due to increased supply from source countries, including Mexico and Colombia, and it may reflect substitution of drug production from marijuana (which has been legalized or decriminalized in some U.S. States) to heroin (ONDCP 2019). Meanwhile, supply expansions are likely more important than demand expansions for the 2013–16 period, given that the price of illicit opioids

fell by more than half during these three years. The shift towards fentanyl produced in China and distributed through the mail have increased the potency of drugs without significantly increasing their prices, and may have increased competition in the illicit opioid market, thereby also putting downward pressure on the price of heroin.

Figure 16. Real Price Index of Potency-Adjusted Illicit Opioids, 2001–16

Index (2001 = 1)



Sources: DEA; ONDCP (2017); BLS; NFLIS via DOJ and DEA (2017a, 2017b); National Seizure System via ONDCP (2017) and DOJ and DEA (2017a); CEA calculations.

Note: See the appendix to this report for details of the calculations.

To the extent that monetary price declines have been accompanied by increased ease of obtaining illicit opioids (given the proliferation of drug dealers in more locations and the increased availability of online markets), supply expansions may have been even more important than the falling illicit price series suggests. For instance, Quinones (2015) notes that Mexican heroin dealers who illegally cross the border have become much more efficient in delivering heroin to users rather than forcing users to find them. These drug dealers communicate with users via cell phones to establish a place to meet, at which point the user enters the dealer’s car to receive their heroin.

Conclusion

Many factors have exacerbated the opioid crisis. In this report, the CEA presents evidence that falling prices may have played a role in increasing opioid misuse and opioid-involved overdose deaths.

During the first wave of the opioid crisis, which was characterized by growing overdose deaths involving prescription opioids between 2001 and 2010, the out-of-pocket price of prescription opioids fell by 81 percent. This likely reduced the price of prescription opioids in the secondary

market, from which most people who misuse prescription opioids obtain their drugs. Using the proportional price assumption and given elasticities from the academic literature, we find the decline in observed out-of-pocket prices is capable of explaining between 31 and 83 percent of the growth in the number of overdose deaths involving prescription opioids between 2001 and 2010. At the same time that out-of-pocket prices were falling, government subsidies and the market share of generic opioids were expanding. We estimate that the share of prescribed opioids funded by government programs increased from 17 percent in 2001 to 60 percent in 2010 (and to 63 percent in 2015). The share of publicly funded opioids diverted to the secondary market may be even higher, given the relatively low acquisition cost for suppliers of diverted opioids.

Falling prices could not elicit a change in the quantity of opioids misused and resulting opioid deaths unless physicians were willing and able to prescribe the opioids, and pharmacies were willing and able to fill those prescriptions. We describe the change in environment resulting from changing pain management guidelines and aggressive marketing that reduced barriers to obtaining larger quantities of opioids.

The CEA finds that the second wave of the opioid epidemic—characterized by growing deaths from illicit opioids between 2010 and 2016—was driven by a combination of supply and demand expansions. Efforts to restrict the supply and misuse of prescription opioids led an increased number of users from the first wave to substitute illicit opioids in place of prescription opioids. At the same time, the supply of illicit opioids expanded, and this substitution drove down quality-adjusted prices to reduce the “cost of a high.” Despite the importance of demand through a substitution effect in the initial years of the second wave, the CEA finds that the evidence supports the idea that overall, supply expansions have been more important.

The Trump Administration has prioritized addressing the opioid crisis. In October 2017, President Trump declared a national Public Health Emergency to invest more resources to combat opioid use disorder. President Trump later established his Initiative to Stop Opioid Abuse and Reduce Drug Supply in March 2018, and since then, the Administration has also worked with Congress to pass legislation fighting the epidemic. In addition, the Trump Administration is identifying opportunities for health research and development to strengthen the response to the opioid crisis. These and other measures taken by the government aim to address the opioid crisis by reducing the supply of opioids, reducing new demand for opioids, and treating those currently suffering from addictions. These measures may be paying off as the growth in opioid deaths may have finally begun to reverse.

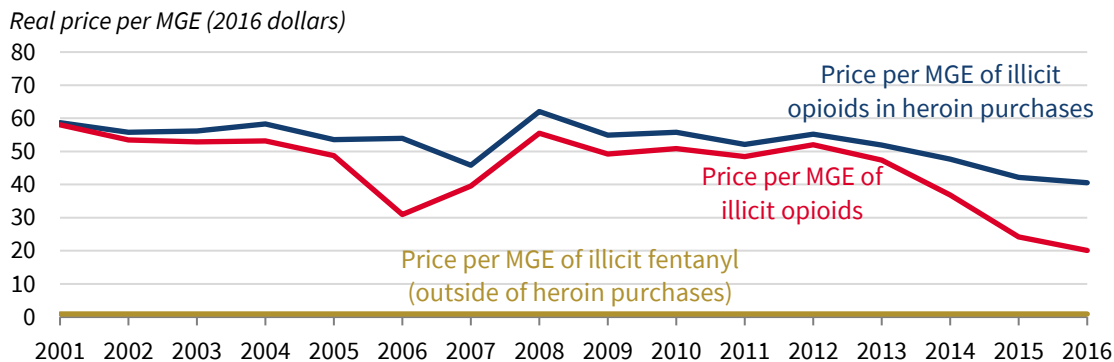
Appendix: Methodology for Estimating Illicit Opioid Prices

There are two main types of illicit opioids—heroin, and illicitly manufactured fentanyl. Fentanyl can be consumed on its own, but it is also increasingly mixed into the heroin supply. We estimate the average price of potency adjusted illicit opioids, $P_{illicit}$, in terms of morphine gram equivalents, or MGEs, by taking a weighted average of the price of an MGE in heroin purchases, P_{heroin} , which sometimes also include fentanyl, and an MGE of fentanyl on its own, $P_{fentanyl (alone)}$. The weights are the market shares w_j for each drug in the illicit opioid market. We denote the quantity of MGEs of illicit opioids in heroin purchases as Q_{heroin} (including the fentanyl contained in it), and the quantity of MGEs in fentanyl outside of heroin purchases as $Q_{fentanyl (alone)}$.

$$P_{illicit} = w_{heroin} \times P_{heroin} + w_{fentanyl (alone)} \times P_{fentanyl (alone)}$$

$$w_j = \frac{Q_j}{Q_{heroin} + Q_{fentanyl (alone)}}, j \in \{heroin, fentanyl (alone)\}$$

Figure A1. Real Price per Morphine Gram Equivalent (MGE) of Illicit Opioids, Illicit Opioids in Heroin Purchases, and Illicit Opioids in Fentanyl Purchases Outside of Heroin Purchases, 2001–16



Sources: DEA; ONDCP (2017); BLS; NFLIS via DOJ and DEA (2017a, 2017b); National Seizure System via ONDCP (2017) and DOJ and DEA (2017a); CEA calculations.

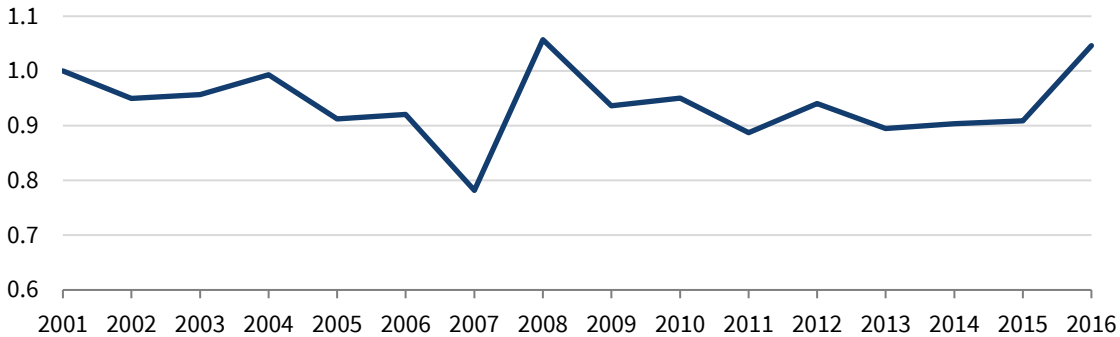
Note: The average price per MGE of illicit opioids is the weighted average of the price per MGE of illicit opioids in heroin purchases and the price per MGE of illicit fentanyl (outside of heroin purchases). The weights are the market shares in terms of MGEs for each drug. Further details of the calculations for prices and quantities are provided in the following text and figures.

Figure A1 shows the price of illicit opioids along with the price of illicit opioids in heroin purchases and the price of illicit opioids in illicit fentanyl outside of heroin purchases. Unfortunately, market prices and quantities are not observed for these drugs. Thus, we are forced to rely on a number of data sources to construct estimates. Given the difficulty in observing characteristics of illegal markets, these estimates rely on a number of untestable assumptions. The following sections describe how the prices and quantities of each drug are estimated.

The Price per MGE of Illicit Opioids in Heroin Purchases

Figure A2. Price per Morphine Gram Equivalent of Pure Heroin in Heroin Purchases, Ignoring Fentanyl, 2001–16

Real price index (2001 = 1)



Sources: 2006–16: DEA; 2001–5: ONDCP (2017); BLS; CEA calculations.

Note: Prices per pure gram of heroin are divided by 5 to be converted into prices per MGE, as heroin is roughly 5 times as potent as morphine, although this varies based on the purity of a given form of heroin (e.g., white powder versus black tar heroin). DEA prices (2006–16) are based on all DEA purchases. ONDCP prices (2001–5) are based on DEA purchases of 10 grams or less, as an overall average price is not provided. All ONDCP prices are anchored to the DEA price in 2006 by multiplying the ONDCP price in any given year by the ratio of the DEA price in 2006 to the ONDCP price in 2006.

Developing a price series based on heroin purchases requires two main steps. First, we obtain data on actual heroin prices, and then we adjust this series to reflect the presence of cheap but powerful fentanyl, which effectively lowers the price per MGE of illicit opioids consumed via heroin. For actual heroin prices, the CEA relies on data compiled by the Drug Enforcement Administration (DEA), which collects data on heroin prices through street purchases. The DEA calculates a price per pure gram of heroin by dividing the purchase price of a bag of heroin by the number of pure grams of heroin detected in the heroin purchase based on a laboratory analysis. The national average price per pure gram of heroin, $P_{heroin (pure)}$, for each year is shown in figure A2.

However, the DEA does not measure the amount of pure fentanyl in these heroin purchases, $Q_{fentanyl (in heroin)}$. As a result, these prices overstate the price per pure gram of opioid in heroin purchases. We address this issue by estimating the amount of MGEs of fentanyl in heroin purchases, and then calculating the price per MGE of all opioids contained in heroin purchases, as shown in the formula below. Specifically, we divide the price per MGE of pure heroin in heroin purchases by the sum of MGEs of pure heroin (1) and the number of MGEs of fentanyl in heroin per 1 MGE of pure heroin:

$$P_{heroin} = \frac{P_{heroin (pure)}}{1 + \frac{Q_{fentanyl (in heroin)}}{Q_{heroin (pure)}}}$$

For example, suppose there was no fentanyl in the heroin supply; then this adjusted price would simply equal the original price of pure heroin. Alternatively, suppose that the ratio of fentanyl to heroin quantities equaled 1 (2); then the adjusted price would be $\frac{1}{2}$ ($\frac{1}{3}$) the original pure price of heroin. In a nutshell, the fentanyl-adjusted heroin price is scaled by the relative importance of fentanyl MGEs in the total supply of heroin MGEs.

In order to estimate the amount of fentanyl in heroin purchases, we need to know how often fentanyl is actually found together with heroin, as opposed to on its own. We use data from the National Forensic Laboratory Information System (NFLIS), which conducts laboratory tests of illicit drugs seized by law enforcement. For each year, it reports the number of times fentanyl was found alone, along with how often it was found mixed with other drugs (figure A3). We assume that, conditional on being found, the number of MGEs of fentanyl when found on its own is equal to the number of MGEs of fentanyl when combined with other drugs.

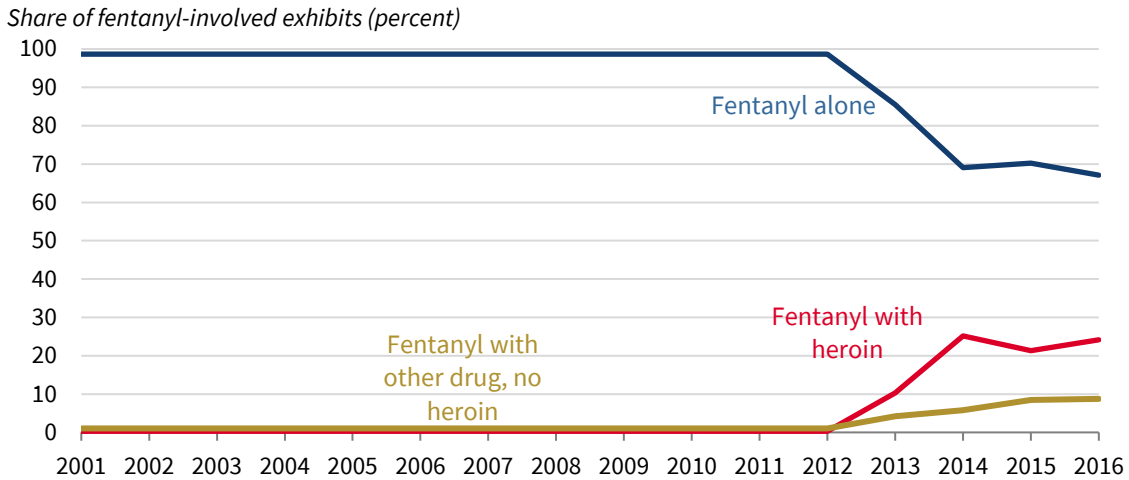
In order to apportion fentanyl MGEs to heroin purchases, we also must know how many pure fentanyl MGEs there are relative to pure heroin MGEs. To this end, we use data from the National Seizure System, which tracks the number of kilograms of various drugs seized by (primarily Federal) law enforcement. We assume that the ratio of market quantities of pure heroin and pure fentanyl is equal to the ratio of seizures of heroin and fentanyl.²⁹ However, the raw numbers of kilograms of each drug must be adjusted in two ways in order to be made comparable. First, fentanyl is often combined with heroin and other drugs, so seizures in which the identifying drug is fentanyl will understate the amount of total MGEs of heroin.³⁰ Thus, we adjust fentanyl seizures upward based on the share of the times it is found alone, as opposed to with other drugs, in the NFLIS data. Second, fentanyl is 30 to 50 times more potent than heroin, so we multiply the number of kilograms of fentanyl by 40, the midpoint of this range. Figure A4 shows the kilograms of heroin and potency-adjusted fentanyl seizures over time.

We next obtain the ratio of MGEs of fentanyl contained in heroin to the number of MGEs of pure heroin. To do so, we multiply the percentage of pure fentanyl MGEs that are found in combination with heroin by the ratio of market MGEs of pure fentanyl to market MGEs of pure heroin. The price per MGE of illicit opioids in heroin purchases is then calculated as the heroin purchase price divided by 1 plus the ratio of MGEs of fentanyl contained in heroin to the number of MGEs of pure heroin (figure A5). As discussed in the example given above, if there were as many MGEs of fentanyl in heroin purchases as there was pure heroin, then the price per illicit opioid in heroin purchases would be half the price of an MGE of pure heroin when ignoring the fentanyl contained in it.

²⁹ This assumption is imperfect, given that seizures reflect law enforcement effort and priorities that do not necessarily align with market quantities. Moreover, fentanyl quantities are likely understated, given that interdicting packages in the mail system is highly difficult.

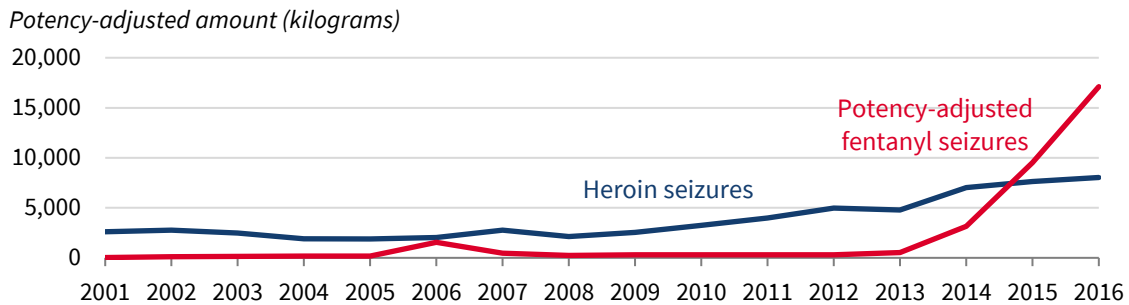
³⁰ We assume that when fentanyl and heroin are found together, heroin is the identifying drug in the National Seizure System, given that fentanyl is 30 to 50 times more potent and thus likely to have a much smaller physical presence. Also, heroin is not assumed to be in seizures in which another drug is the identified drug.

Figure A3. Share of Fentanyl Exhibits Alone and with Heroin, Other Drugs, 2001–16



Sources: NFLIS via DOJ and DEA (2017a); CEA calculations.
 Note: Data are available only from 2012 through 2016; thus, shares preceding 2012 are assumed equal to their shares in 2012.

Figure A4. Kilograms of Heroin and Estimated Potency-Adjusted Fentanyl Seizures



Sources: National Seizure System via ONDCP (2017), and DOJ and DEA (2017a); NFLIS via DOJ and DEA (2017a, 2017b); CEA calculations.

Note: Potency-adjusted fentanyl seizures are made comparable to heroin seizures by multiplying fentanyl seizures by 40, as fentanyl is 30 to 50 times more potent than heroin. Also, fentanyl seizures are divided by the share of fentanyl exhibits involving only fentanyl to reflect that there is also fentanyl in other drugs (especially heroin). It is assumed that heroin is not contained in other seizures in which another drug is the identified drug. Kilograms of fentanyl seizures are available starting in 2015. Thus, the ratio of seized kilograms of fentanyl to fentanyl NFLIS exhibits is assumed to be constant over time, and NFLIS exhibits in years before 2015 are multiplied by the ratio of seized kilograms of fentanyl in 2015 to NFLIS exhibits in 2015.

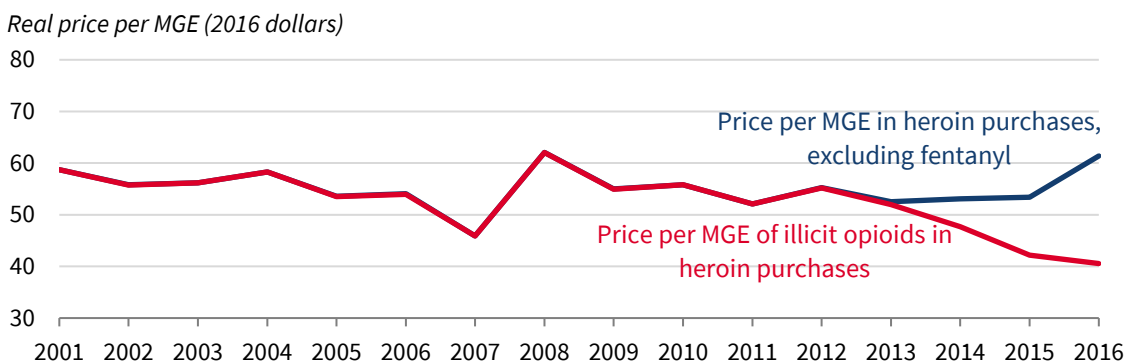
The Price per MGE of Illicit Fentanyl—Outside of Heroin Purchases

Although fentanyl is often found in heroin, it is also sold on its own—or, less commonly, with other drugs such as cocaine. We lack sufficient data to create a time series of fentanyl prices

when found alone, so instead, we assume a constant price over time. Given that potency-adjusted quantities of fentanyl were quite low compared with heroin until 2014, the price of fentanyl in earlier years would in any case have little effect on the total price of illicit opioids.

To estimate the price of illicitly manufactured fentanyl, we use a DEA report that notes that the cost for drug trafficking organizations to obtain a kilogram of heroin ranges from \$5,000 to \$7,000 (from Colombia), and 99 percent pure fentanyl costs between \$3,300 and \$5,000 (from China) (DOJ and DEA 2017a). We multiply the midpoint cost of the heroin cost range (\$6,000) by the average purity of Colombian heroin (77 percent), for a potency-adjusted cost of \$4,620. Also, we multiply the midpoint of the fentanyl cost range (\$4,150) by its purity (99 percent) and then divide by 40 to reflect that fentanyl is 30 to 50 times more potent than heroin, for a potency-adjusted cost of \$103. The ratio of the potency-adjusted cost of fentanyl to heroin is thus 0.022. Finally, we assume the ratio of costs to obtain these drugs is equal to the ratio of retail prices, so we multiply the cost ratio (0.022) by the price of an MGE of illicit opioids in heroin purchases in 2015 (\$43). The resulting price of an MGE of illicit fentanyl (outside of fentanyl) is \$0.95. See table A1 for a summary of these calculations.

Figure A5. Price per Morphine Gram Equivalent of Heroin Purchases, Excluding and Including Fentanyl, 2001–16



Sources: DEA; ONDCP (2017); BLS; NFLIS via DOJ and DEA (2017a, 2017b); National Seizure System via ONDCP (2017) and DOJ and DEA (2017a); CEA calculations.

Note: For each year, the price per MGE of illicit opioids in heroin purchases is calculated by dividing the price per MGE of pure heroin (ignoring fentanyl) by 1 plus the ratio of MGEs of pure fentanyl in heroin purchases to MGEs of pure heroin in heroin purchases. The ratio of MGEs of pure fentanyl in heroin purchases to MGEs of pure heroin in heroin purchases is calculated as the share of MGEs of fentanyl contained in heroin purchases multiplied by the ratio of MGEs of market-wide fentanyl to MGEs of pure heroin. For other details of calculations, see the notes in the preceding

The Quantities of Illicit Opioids in Heroin Purchases and Fentanyl—Outside of Heroin Purchases

We assume that the market quantities of each drug are proportional to seizures. The number of MGEs of illicit opioids in heroin purchases is equal to the sum of seized MGEs of pure grams of heroin and seized MGEs of fentanyl contained in heroin purchases. The number of seized MGEs of fentanyl contained in heroin purchases is equal to the percentage of fentanyl exhibits

found with heroin multiplied by total potency-adjusted fentanyl seizures, as described above. Finally, the number of MGEs in fentanyl outside of heroin purchases is assumed to be equal to the percentage of fentanyl exhibits not found with heroin multiplied by total potency-adjusted fentanyl seizures.

Table A1. Estimating the Price per Morphine Gram Equivalent of Fentanyl (when Outside of Heroin Purchases)

Substance	Cost per kilogram	Purity	Cost per purity-adjusted	Potency adjustment	Cost per potency-adjusted	Price ratio with heroin	Price per MGE
Heroin	\$6,000	77%	\$4,620	1	\$4,620	1	\$42
Fentanyl	\$4,150	99%	\$4,109	40	\$103	0.022	\$0.94

Sources: DEA; ONDCP (2017); BLS; NFLIS via DOJ and DEA (2017a, 2017b); National Seizure System via ONDCP (2017) and DOJ and DEA (2017a); CEA calculations.

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